

# Science and Technology Committee

## Oral evidence: Technologies for meeting clean growth emissions reduction targets, HC 1454

Tuesday 23 April 2019

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Watch the meeting

Members present: Norman Lamb (Chair); Vicky Ford; Bill Grant; Darren Jones; Stephen Metcalfe; Carol Monaghan; Graham Stringer.

Questions 357 - 504

### Witnesses

**I:** Professor Jim Skea, Chair in Sustainable Energy, Imperial College London; Professor Gideon Henderson, Professor of Earth Sciences, representing the Royal Society; Dr Naomi Vaughan, Tyndall Centre for Climate Change Research; and Professor Jonathan Gibbins, Centre Director, UK Carbon Capture and Storage Research Centre.

**II:** Rt Hon Claire Perry MP, Minister for Energy and Clean Growth, Department for Business, Energy and Industrial Strategy; Tim Lord, Director, Clean Growth, Department for Business, Energy and Industrial Strategy; and Damitha Adikaari, Acting Director, Science and Innovation for Climate and Energy, Department for Business, Energy and Industrial Strategy.

Written evidence from witnesses:

– [Add names of witnesses and hyperlink to submissions]

## Examination of witnesses

Witnesses: Professor Jim Skea, Professor Gideon Henderson, Dr Naomi Vaughan and Professor Jonathan Gibbins.

Q357 **Chair:** Welcome, all of you. It is very good to see you. Thank you for coming in today. Can I reinforce the need for succinct answers? There are four of you. We have to be quite tight on time. We have the Minister coming at 2, and I want to make sure that we finish on time. Don't feel that you need to repeat what others have said. Keep your answers succinct, if you can. May we do quick introductions, starting with Naomi?

**Dr Vaughan:** Hi. I am Dr Naomi Vaughan from the Tyndall Centre for Climate Change Research at the University of East Anglia.

Q358 **Chair:** It is very good to see you—and good to see that you are from Norwich as well.

**Professor Gibbins:** I am Jon Gibbins, professor of carbon capture and storage at the University of Sheffield and director of the UK Carbon Capture and Storage Research Centre.

**Professor Henderson:** I am Gideon Henderson. I am based at the University of Oxford, but I am here representing the Royal Society and the Royal Academy of Engineering. I chaired their recent report on greenhouse gas removal, published last year.

**Professor Skea:** I am Jim Skea from Imperial College. I am co-chair of IPCC working group III.

Q359 **Chair:** If you feel that you have any financial interests that you want to declare, please do so now.

How likely is the UK to need greenhouse gas removal technologies to meet the current emissions reduction target?

**Professor Henderson:** To some extent, it depends on how you define greenhouse gas removal technologies. I would consider reforestation or afforestation to be one form of greenhouse gas removal technology. We are already utilising that in our planning for the 2050 targets under the Climate Change Act. We are using some of that already; it is built into plans. I will leave my comments there.

**Professor Gibbins:** I think that more engineered solutions are very likely to be used.

Q360 **Chair:** And to be needed.

**Professor Gibbins:** If you have unlimited amounts of money, there is usually a way around, although it is very hard to offset certain emissions. These solutions are certainly likely to be cheaper than a number of other solutions that you would need to remove, for example, widely distributed sources of emissions, infrequent sources of emissions, some transport emissions and some land-use emissions.



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**Professor Skea:** Maybe I can recall the Committee on Climate Change's report on the fifth carbon budget, which I was involved in. Greenhouse gas removal was certainly involved in the scenarios for 2050, because they effectively were least-cost scenarios. Greenhouse gas removal turned out to be one of the cost-effective solutions at that level of ambition.

**Professor Gibbins:** I want to add a point on the scale. The scale of those studies was of the order of 50 million tonnes a year of removal, wasn't it, Jim?

Q361 **Chair:** A question was being asked of you, Professor Skea.

**Professor Gibbins:** According to the Committee on Climate Change, the amount was of the order of 50 million tonnes a year, I believe.

**Professor Skea:** It was a long time ago, Jon.

**Professor Gibbins:** Okay. Just to put it in context, I think that that was roughly the amount, give or take a factor of two.

Q362 **Chair:** What impact would a net-zero emissions target have on the likely scale of greenhouse gas removal technologies required?

**Professor Henderson:** We looked at this very explicitly in the Royal Society and Royal Academy report. We took as a starting point the Committee on Climate Change's look at a stringent emissions reduction, which takes us down to something like 130 million tonnes of CO<sub>2</sub> per year in 2050. The committee considered that we could not get below that value.

In the report, we looked at how you can manufacture that level of greenhouse gas removal, to get from 130 million tonnes to net zero. We considered that it is possible for the UK to achieve that.

That gives you some assessment of the scale. About 130 million tonnes is an achievable number and, possibly, what we will need, even with very stringent emissions reductions.

**Dr Vaughan:** One thing that is key in going from 80% to net zero is the difficult-to-cut emissions sectors—things like agriculture, in terms of their non-CO<sub>2</sub> emissions, but also things like aviation and some other sectors of industry. To achieve the step change from an 80% reduction to net zero, the role of greenhouse gas removal—which, as was said earlier, was in the original 80% reduction—is even more necessary, to help to deal with those difficult-to-deal-with, leftover emissions.

Q363 **Chair:** To offset the fact that you simply cannot remove carbon from some sectors that easily.

**Dr Vaughan:** Yes, or that some of the technological options available are longer term. It is to deal with the fact that, on that timeframe—by 2050—what you need to do at that point is to remove the CO<sub>2</sub>.



Q364 **Chair:** The talk is often of net-zero emissions being a target from the middle of the century—from 2050. When would greenhouse gas removal technologies need to start to be deployed at scale to assist in achieving net zero by, say, 2050?

**Dr Vaughan:** Afforestation and things that we can do around peatland restoration and land management practices can start now. We can do more—

Q365 **Chair:** That in itself could have a significant impact.

**Dr Vaughan:** In the first decade, it can definitely contribute. The larger-scale options are the ones that require work on the CCS bit—biomass energy with CCS or direct air capture with CCS.

Q366 **Chair:** When do you think that they would need to be deployed if they were to contribute to net zero by 2050?

**Dr Vaughan:** I think that the numbers suggest the 2030s. Does anyone want to correct me?

Q367 **Chair:** That is achievable, in terms of the technology.

**Professor Henderson:** Again, I will refer to the Royal Society and Royal Academy report. We classified the technologies in three ways. First, there are those that Naomi has already mentioned—things that we can roll out right now and that would still be useful and important by 2050, such as reforestation.

In the second category are things that have potential, although we do not yet know how workable they are. There is an urgent need to do research and development of those technologies. That would take some time, in order for us then to be able to roll them out to achieve net zero in 2050.

In the third category are technologies that rely entirely on the ability to store the carbon that you remove. As Naomi has mentioned, those are BECCS and DACCS. The speed at which we can deploy them depends on building CCS infrastructure at a sufficient scale to deploy it.

**Professor Gibbins:** I will come in on that. You actually want to start deployment at scale very quickly. You need to build up the infrastructure, which takes time. You also need to increase the maturity of the technology, to reduce costs. That also takes time—and it takes examples. You cannot just do it.

Q368 **Chair:** Big-scale demonstrators, as it were.

**Professor Gibbins:** Demonstrators, or first-of-a-kind units, or just getting started. It is just the way in which technologies get developed. The classic term is “learning by doing”. Unless you are actually doing it, you do not make the technologies more commercially mature.

Q369 **Chair:** Sure. Can we be clear about the technology readiness of the different removal technologies, so that we understand the order of



readiness? Who can help us on that?

**Professor Skea:** I will comment at the global level, rather than the UK level, as that is what I am most familiar with at the moment. The technology that features most in the global projections is bioenergy with carbon capture and storage. In the global scenarios, that is starting to take off from about 2030. It will really begin to scale up during the 2030s. What I would flag up is that it would need to be preceded by carbon capture and storage on fossil-fuel systems, which would happen a little earlier. Some of the technologies we are talking about are not individual, single pieces of kit; they are actually systems with different elements. The different elements may need to be progressed on different timescales. The carbon capture part and transport would probably need to be done earlier. The storage, and connecting it with bioenergy to get negative emissions, would perhaps come later.

**Professor Henderson:** The technology readiness of some of these methods is mature. Growing forests is not difficult. Others are proven technologies. You could probably put bioenergy with carbon capture and storage into that category. Increasingly, you could put DACCS into that category, but they have not really been done at the scale that we would need to see. To support Jon's comment, you would need to see a scaling up and a testing of the technologies.

**Professor Gibbins:** I will make a point on the technology now. BECCS is not one particular technology. You are taking biomass, generating CO<sub>2</sub>—

Q370 **Chair:** For the benefit of anyone else listening and watching, will you explain what BECCS is?

**Professor Gibbins:** BECCS is biomass energy with carbon capture and storage. If you do not mind, Chair, we will use it as a shorthand, but I am happy to keep on repeating what it is.

People are talking about two main ways of converting the biomass into CO<sub>2</sub>. One is combustion, which is well proven and is taking place at the necessary scale at this very moment.

Q371 **Vicky Ford:** That is wood burners.

**Professor Gibbins:** Wood burning at Drax, for example, is at the multimillion-tonne scale. The other technology that is talked about is gasification, to produce hydrogen. That technology has been tried a number of times. I tried it when I was in my early 20s. It is still not really working. There are technical reasons why it might not work.

Q372 **Chair:** It might never work.

**Professor Gibbins:** It might not be easily workable. It is to do with the maximum temperature that you can obtain with biomass. There are workarounds, but it is not easy.



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It is quite important, if the UK is considering BECCS, to think about whether it is going to be combustion—which, basically, will produce heat and, ultimately, electricity—or gasification, which could produce hydrogen. As I have said, that technology would need to be assessed and, certainly, demonstrated before it was reliable.

The significance is that, if you are going to go down the biomass route, 50 million tonnes is about 5 GW of continuous power. You want to leave space in the electricity system for that, if that is the route that you are going to use. If it is gasification, people say, “We can use, essentially, unlimited amounts of hydrogen,” but that may not be an option.

We are definitely at technology readiness level 9—mature technology—for combustion, with post-combustion capture. The technology needs to increase its commercial maturity, which we are looking to do. I am working with various places, including China, to develop an open-access route to post-combustion capture development.

As I have said, if we decide that we need to go down the route of biomass gasification, because we do not want to do it in electricity, that needs looking at urgently.

**Professor Henderson:** Chair, you may be planning to come on to this subject separately, but one issue with dealing only with technology readiness is that it does not necessarily consider other issues to do with deploying these approaches. For instance, the environmental consequences also need to be looked at. There are other components, independently of whether the technologies work from an engineering point of view.

Q373 **Chair:** That is understood.

**Professor Gibbins:** With all these technologies, once they get into the field at scale, you are better off using something called the commercial readiness index, which is used to assess how technologies go from being the first example to being totally bankable, mature technologies. I can send you something on that, if it would be useful.

Q374 **Chair:** Thank you. Is there a risk that pursuing these negative emission technologies could reduce our progress in just reducing emissions? Is there a risk that it takes the eye off the ball of the importance of reducing emissions?

**Professor Henderson:** There is always a risk of that happening, but it is a risk that people working in this game work very hard to try to minimise—for good reason, as the cost and difficulty of taking carbon dioxide back out of the atmosphere is significantly larger than that of not putting it there in the first place. Emissions reductions are clearly the most sensible thing to focus our major attention on—only then should we use greenhouse gas removal to scrub up the last bit of emissions that is impossible to remove in other ways. I think that we as a broad



community are repeating that message often enough to ensure that the risk is not very substantial.

**Chair:** Good.

Q375 **Vicky Ford:** My question is about incentivising and means to incentivise greenhouse gas removals. How might the deployment of greenhouse gas removals or other geoengineering technologies be incentivised or rewarded in the future? For example, if the UK were to stay in the EU emissions trading system or to have a similar system, would that provide the revenues for the technology?

**Professor Gibbins:** Obviously, the carbon price for removal, if it is a more expensive option, will not immediately fund that activity. It is important to improve the maturity of the technology by deployment, so you would need a special measure. In that situation, I do not think that it is geoengineering, because all that you are doing is taking out of the air CO<sub>2</sub> that has gone into it. To call carbon dioxide removal—somebody paying to take CO<sub>2</sub> they have emitted out of the air—geoengineering is to misrepresent it, if you see what I mean.

That brings me on to this point. It is probably feasible to have people pay for carbon dioxide removal technologies for niche applications that do not necessarily make sense. At the moment, for example, people are apparently prepared to pay for them to make low-carbon fuels, which is just wrong in terms of economics, but none the less seems to happen. In other areas, if you tell people that if they want to do something that is basically frivolous, like flying for non-essential reasons, they have to offset it using a rigorous carbon dioxide removal, perhaps it will happen. There may be some incentives there, as well as Government actually supporting the development of the technology.

Q376 **Vicky Ford:** I am sorry. Perhaps I am being really thick, but can you go through and explain that again? I am not sure that I got it.

**Professor Gibbins:** I am sorry if I am taking too long. Very quickly, what I am saying is that Governments need to support it to develop the commercial maturity. That is one area. We are also seeing—it is somewhat surprising, but it happens—that people are prepared to pay for carbon dioxide removal to offset emissions in niche applications. We may see some of that happening. Calling it geoengineering, particularly for people paying to offset their emissions, just does not seem to be the right way of representing it. It is just people cleaning up the mess that they have made.

**Professor Skea:** Could I make the very basic point that people need to be rewarded, especially if carbon dioxide is going to end up in geological storage? Transmitting a carbon price in some form is absolutely essential.

One point that I would flag up is that many greenhouse gas removal approaches involve land, agriculture or forestry. At the moment, bioenergy, for example, is accounted for in national inventories in the





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agriculture, forestry and land use sector, not in the energy sector. Frankly, to reduce something, you need to be able to measure it, so that you can reward it properly. One of the prerequisites would be better measurement and estimate of emissions, so that farmers and people who own the land can be properly rewarded for the changes in techniques that they might apply. That is not uniformly the case at the moment. I have had many complaints from the National Farmers Union that farmers are punished for their livestock emissions, but not rewarded for the way in which they manage the land and the soil.

**Q377 Chair:** Presumably there is an opportunity, as we redesign our payment systems in agriculture post Brexit, to get the payment system right to incentivise.

**Professor Skea:** I am not an agriculture expert, but it seems to me that there is eminently an opportunity to do that.

**Professor Henderson:** I think that that potential is recognised in the 25-year environment plan. It will probably be recognised in the Environment Bill.

**Q378 Vicky Ford:** What I am getting at is that the EU emissions trading scheme covers emissions, but does not cover demissions, as it were.

**Professor Skea:** Yes.

**Q379 Vicky Ford:** We need to have a similar mechanism to measure and reward the removing of emissions. Naomi, do you have anything to add?

**Dr Vaughan:** I agree. It has to be valued. The fact that you are removing the carbon has to have a value.

**Q380 Vicky Ford:** Have you thought about how it could be valued?

**Dr Vaughan:** Not in specific detail.

**Professor Henderson:** There is work commissioned by BEIS to look at how you would incentivise greenhouse gas removal. It has not yet reported on that work. It does not have to be payment. You can place a requirement on emitters of CO<sub>2</sub> to remove some CO<sub>2</sub> or to do greenhouse gas removal. You can also do it by tax credits or by direct payments. There is a range of measures.

**Q381 Vicky Ford:** Jon, was your point that just taking a whole load of CO<sub>2</sub> and pumping it under the ground is not as value added as properly removing CO<sub>2</sub> for good? Is that what you were trying to say with your geoengineering complaint?

**Professor Gibbins:** No. What I was saying was that I do not think that addressing CO<sub>2</sub> emissions by emitting CO<sub>2</sub> to the air and then the polluter paying to remove it from the air is geoengineering. It is just as good as not emitting the CO<sub>2</sub> in the first place. If it is the cheapest way of getting carbon neutrality for that activity, it is probably quite worth doing.





Q382 **Vicky Ford:** Are there any greenhouse gas removal techniques that are a cost-effective way of reducing emissions?

**Professor Henderson:** Could you define the terms of “cost-effective”?

Q383 **Vicky Ford:** I think that that is why we are asking you the questions. Is that the problem—that you cannot define it?

**Professor Henderson:** It is possible to do only a very small amount of greenhouse gas removal in a way that would make you money. It is not profitable in all but a very small number of cases.

Some approaches are quite cheap to pursue. Normally, the way in which we judge whether they are worth while is to look at what you might call the social cost of carbon. You work out how much you think a tonne of CO<sub>2</sub> in the atmosphere is doing damage to the planet and societies, value that and then work out whether the cost of your technologies to remove the carbon dioxide is lower than that social cost of carbon.

The Stern-Stiglitz report, for instance, values the social cost of carbon currently at something like US\$30 per tonne of CO<sub>2</sub>, with that escalating into the future. It rapidly gets to \$50 and \$100.

The cost of greenhouse gas removal technologies includes things like forestation, some of which can be done for single-digit dollars per tonne and much of which can be done for \$30 per tonne of CO<sub>2</sub>. Many of these technologies are cost-effective against a social cost of carbon remit.

**Dr Vaughan:** I want to reiterate that point. I agree that these are not things that are going to make you money right now, but you can broaden your frame of cost, particularly around some of the things that we can do right now and are not doing as much as we aspire to do them. We are missing our targets on afforestation rates. There are things that we could do around peatland restoration or coastal habitat restoration. Those things have lots of other benefits—I am thinking about biodiversity, for example—that are costed not in terms of whether this is going to make you money, but in terms of society and wellbeing.

Q384 **Vicky Ford:** When you talked about peatland restoration and deforestation, you said “we”. Is that global “we” or we in the UK?

**Dr Vaughan:** That is the UK. I have just finished rereading the Committee on Climate Change’s report on land use change. It deals with this quite well, looking at actions such as peatland restoration and afforestation. Those actions offer the mitigation of emissions reduction. They also help with adaptation, improved biodiversity and things such as access to woodland for recreation, which might help around mental health or physical wellbeing. When I said “we”, I was thinking of that UK piece of analysis by the Committee on Climate Change.

Q385 **Chair:** We will take a very quick comment from Professor Gibbins.



**Professor Gibbins:** A better measure of cost is what it would cost to get carbon neutrality by other means. Carbon neutrality is what is required. It is no use paying a carbon tax, whatever the value is—you need to get carbon neutrality. If you want to assess the cost of greenhouse gas removals, look at what else you have to do. For many actions, it is hundreds of pounds per tonne of CO<sub>2</sub>. That is in the region where greenhouse gas removal technologies would be competitive.

Q386 **Vicky Ford:** Are there any viable options, other than your grant to plant trees, to support the deployment of different greenhouse gas removal technologies now?

**Professor Gibbins:** Do you mean in the UK?

Q387 **Vicky Ford:** In the UK or globally.

**Professor Gibbins:** Globally, California has a clean fuel standard that, together with some of the other incentives for CCS, might make greenhouse gas removal to make liquid fuels attractive. That is the only example that we have.

**Professor Skea:** Can I come back very briefly on the question of greenhouse gas removal techniques that would pay for themselves, without payments? I have seen some examples, perhaps on a small scale, related to conservation agriculture. This happened to be in Spain, rather than the UK. By changing the tillage techniques and planting different species between the growing seasons, you could actually retain and build up carbon in the soil. That should lead to increased yields of the plants, which would allow the farmers to get a return.

There are tricky issues, because climate change affects the predictability of the yields. The climate variability is very difficult, so farmers find it difficult to borrow money from banks to pay for the extra equipment that they would need to get their return. There is a general point that, as soon as you get to the land area, the question of institutions and mechanisms for getting payments to people and rewarding them is much more difficult than it is in the energy sector.

Q388 **Vicky Ford:** Are there viable options to support the deployment of technologies now? Somebody mentioned the Californian system. Is there anything in the UK?

**Professor Gibbins:** Not that I am aware of. You need to think about the scale for different technologies. Take BECCS, for example. We could do combustion with post-combustion capture tomorrow, basically, and you could have perhaps as much as 10 million tonnes per year quite quickly.

Direct air capture is at an earlier stage. It could be developed in much smaller units, of the order of perhaps 100,000 tonnes per year. Some of the land use changes are at the scale of millions or tens of millions of tonnes a year, I guess. You need to differentiate developing technology to reduce the cost and gain familiarity from deploying technology to get



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an actual effect—basically, just rolling out multiple examples of the same technology to get an effect. They have different purposes.

**Professor Henderson:** Although I do not have full expertise in this, my understanding is that currently there are very few, if any, approaches in the UK that financially incentivise removal of CO<sub>2</sub>. In fact, many of the greenhouse gas removal technologies are not formally factored into global carbon accounting at the moment. Forestation is an exception. Most other technologies are not factored in.

Q389 **Chair:** We would need to develop the market mechanisms to result in deployment of these technologies.

**Professor Henderson:** We certainly would. Presumably, that would need to be incentivised at national level, but it would also involve some international agreement, so that you could effectively give benefit to countries that were doing a good job.

**Professor Gibbins:** However, you may want to develop the technologies in advance of a market. If you just say, “We want a market,” you will get a lot of the cheapest option, but it may be that you want to develop other technologies. For example, DACCS is a long-term backstop technology. It is good to develop it, but you may not want to deploy it in unlimited quantities straightaway.

**Chair:** I am conscious of the fact that we are running behind schedule, so everyone needs to be terribly disciplined. Over to you, Darren.

Q390 **Darren Jones:** I want to focus specifically on the development of technologies to get us to net-zero or negative emissions. When we have these conversations, it feels to me that we are at a very early stage in this process. Nobody comes to me and says, “This is the technology that will do this. This is the technology that will do this. This is the technology that will do this.” It therefore feels as if the Government need to try to speed this up, in order to meet the urgency and to play an active role in the development. Is the Government strategy that we have today doing that? If not, why not?

**Professor Henderson:** There are some positive moves by the current Government. For instance, there is a funding programme to the research councils—I think that it is the first of its type internationally—of in the order of £9 million that is looking at greenhouse gas removal technologies. The need for greenhouse gas removal was reflected in the green growth strategy and is continuing to be reflected in documents.

There is an urgent need for more. One area that has been touched on in comments already is the urgent need for demonstrator-scale, field-scale trials of some of these technologies, to move beyond what is effectively paper or laboratory scale to real deployment scale. In the UK, there is a need for funding for that sort of endeavour.



There is also an urgent need to look at the life-cycle assessment. We must think not only about whether something is taking carbon out of the atmosphere, but about what the net carbon removal is, what the net cost is and what the impact on the environment is, looking at the whole system. That is not yet being supported at an adequate level. As we have heard mentioned before, there is also a need to develop the monitoring, reporting and verification of whether these technologies work or not. Without that, we cannot report on them adequately and give credit where it is due.

**Dr Vaughan:** It helps to think about these groups of technologies in the way in which Gideon and the Royal Society report did. There is a basket of things that we can do now, which is generally land-based stuff. Afforestation—the aspiration for a certain amount of planting—has been there, and the Government have not met that target. I think that they are at about half of their target. That is the ballpark they are currently in. There is that basket of stuff, which has the other co-benefits I have talked about.

The way in which you might incentivise and get those things moving is different from what you might do for large-scale technologies such as BECCS and DACCS—the ones that involve CCS and infrastructure. Those are really a collection of industries, whereas thousands of people, like landowners and farmers, make choices about land use.

I find them very different, in their characters and in how you might incentivise them, where the issues are, where the other benefits might be and where it is just about a pricing mechanism. It is about big industry versus something where there are many more people involved and that may be harder to do, in some ways. Does that make sense? If you say “technologies”, I often think of the big infrastructure ones. But when you say “technologies and practices”, like afforestation, I think of this group here. This group is the ones that we can do, and do more of, right now. I think that that helps.

**Professor Skea:** Many greenhouse gas removal technologies are in fact greenhouse gas removal systems with many technological elements. Many of the technological elements have already been demonstrated and are operating effectively. For example, there are now 20 to 25 carbon capture projects running around the world. We might have hoped for more a few years ago, but that has been demonstrated. What we are lacking is demonstration of the end-to-end system in some of the technologies. To echo Gideon, what is needed is a real demonstration to the commercial sector.

Q391 **Darren Jones:** How do we do that? We have taken advice before on this Committee from the Catapults, for example. They made a similar point. How would the Government make the demonstrations work?

**Professor Gibbins:** In the UK it is clearly important—we have mentioned this point before—that we get some carbon dioxide transport and offshore



storage infrastructure in place and do other things, and that specifically in terms of greenhouse gas removal once we get that transport and storage infrastructure in place there is some measure of development work done on technologies such as BECCS, gasification—if you want to do biomass gasification—and direct air capture, which may be a bit beyond what you would do if you are saying that you will go for the lowest-cost option every time and will not develop anything else until you get there. You deliberately encourage some measured amount of technologies in advance of them being needed, as we did with renewables. Renewables were supported for a long time before they became strictly viable.

Q392 **Darren Jones:** We are not doing that today, so that is what you would recommend.

**Professor Gibbins:** I would recommend that we keep going with the quite good work that has been done by BEIS, under the leadership of Claire Perry, to push CCS forward and make sure that translates into some real infrastructure and that the opportunity that provides to do other technologies is supported as well as the basic research. Even in our research centre in Sheffield with the PACT facilities we are looking at developing direct air capture and storage applications to get started. A lot of work can be done.

**Professor Henderson:** Can I come in on some of the technologies that do not involve carbon capture and storage, which are largely the land-based ones? Significant research questions remain unanswered, like the benefits of biochar, which remains quite controversial—for example, whether it is really beneficial as a carbon capture system—or the density with which you can plant trees in the UK. The northern forest is a large area but it is not capturing very much carbon. There are land-use issues where research needs to be done in the field to see what happens in the UK context if you put biochar on your soil, and what happens if you try to grow a very dense forest.

There needs to be Government funding in those sorts of areas to make sure we do that research and work out the viability of it.

In other areas that have a more technological focus—this drifts towards Jonathan’s answer—we will need to see a close relationship between Government and research funding and industry development, and a real partnership to bring those technologies to maturity.

Q393 **Darren Jones:** I am conscious that everyone here is in the research space, but what does Government need to do on commercialisation of the R&D space and getting companies to integrate these systems? Is there an institutional requirement? Is there an R&D tax credit requirement? What do we need to do to get it out of the labs and demonstrators and into the real world?

**Professor Gibbins:** One of the things you can do, particularly in the early stages, is to have a halfway stage between full commercial and



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demonstration/research. For example, in post-combustion capture, which is a useful technology for fossil fuel and biomass, with China I am developing an initiative to look at open access development of the technology. When you are developing a few plants globally, that is a very important way of building up commercial readiness and expertise more quickly than would normally happen.

You can look at doing similar things in the space of direct air capture with larger-scale deployment. If Government funding is going in, there is a measure of shared activity which, very importantly, gets communicated between different parts of the supply chain, including small companies that can provide useful components, and the wider research space. A very important part of all this development is getting the questions and knowing what is going on.

A lot of the CCS projects Jim has referred to are basically black boxes, and the companies doing them know as much as they need to know to get them done, but they are not interacting with other CCS initiatives, like Mission Innovation, by saying what the problems are.

**Q394 Darren Jones:** A lot of the conversation today has been on the basis of capturing carbon from combustion, whether that is wood, biomass or fossil fuels. What is the balance between carbon capture and burning stuff in the first place versus renewable energy technologies so we are not having to burn wood or fossil fuels? We have not really spoken about the latter very much. Is that a more advanced level of deployment in terms of technologies, or not?

**Professor Henderson:** By “renewables”, do you mean things like wind and solar?

**Q395 Darren Jones:** Wind, solar, tidal.

**Professor Henderson:** Those technologies are extremely useful in reducing our emissions; they do not affect greenhouse gas removal. We still need to get rid of the residual emissions that happen from other sectors to reach net zero. We will need both of the approaches you mention. We need continued expansion of our renewable base and some technologies that take out the residual emissions of greenhouse gases.

**Q396 Graham Stringer:** The Government have provided two significant wedges of money for carbon capture and storage. Both of those projects failed. Why?

**Professor Gibbins:** The first initiative was linked to a proposed plan for the UK to deploy about 10 GW of new coal plant. It was accompanied by protests very similar to the ones we are seeing now around coal-fired power plants. It was all ready to go. We had the Energy Act 2010 with a CCS levy, which, as some of you may remember, was worth about £10 billion. We immediately had the recession and no new coal plants were built and electricity demand went. After the recession, shale gas





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came in and reduced the need to build new coal plants. Therefore, there were no new coal plants and no new programmes to fit CCS on coal.

We have recently followed on fairly quickly from that with two demonstration projects, as it ended up: one at Peterhead and one at White Rose. The White Rose project was for coal. By the time it came to be looked at it was not the preferred option economically because shale gas was bringing down global gas prices.

The one in Scotland—I had quite an involvement in starting it up—was on a power plant that had three gas turbines. It was looking at fitting just one gas turbine because the amount of money available was limited. Whereas originally we considered converting the whole power plant to get reduced cost, by the time that project started it made sense to retrofit only one of the turbines because the generation mix in Scotland had changed with a lot of renewables and you could not justify a lot of fossil energy.

Therefore, that site was basically sub-economic in scale and looked to be an expensive project, and there was no immediate follow-on. The real problem is that, first, we went for coal and that proved inappropriate; secondly, we went for very small units and they ended up not being useful projects in useful places.

**Q397 Stephen Metcalfe:** This morning we have already talked a lot about some of the greenhouse gas removal technologies and systems that are available. There are others we have not touched upon. Each on its own has associated with it a varying degree of environmental impact. Can you expand on what some of those environmental impacts might be across different technologies, and what we should do to mitigate that impact?

**Dr Vaughan:** The main one is around bioenergy. It is essential that your bioenergy is sustainably sourced. You could have biomass energy with carbon capture with storage of a megaton of CO<sub>2</sub> underground, but the net effect is not to remove anything if you get wrong how you get that bioenergy. If you deforest a primary rain forest or interfere with a high-carbon ecosystem, you can make all that effort but the planet will see no benefit.

**Q398 Chair:** You achieve nothing.

**Dr Vaughan:** Yes. It is really important with any of the ones involving biomass that you get the sourcing of that biomass right. You can think about using agricultural residues, as long as enough is kept in the farmland that is needed for the soil; you can think about using forestry residues; you can think about what is possible in terms of bioenergy crops domestically, making sure that your governance is stringent enough in terms of what is imported. You need governance and regulation around bioenergy. It is possible to have bioenergy with CCT, but it is also possible to do it really badly. The difference is not technological but regulation and governance.





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Q399 **Stephen Metcalfe:** How effective do you think our regulation and framework are at the moment?

**Dr Vaughan:** I think the CCC highlighted three areas, which I cannot remember off the top of my head right now, where we still have room for improvement. I think that domestically we can be much more assured than when we look at the global scale, as Jim has mentioned. You see that most of the projections of where bioenergy is going to come are related to tropical regions. Then you start to get into problems of which countries you are importing from and whether you can be sure of the governance and regulation in those countries. You have to look at the risk in terms of from where you are bringing in that bioenergy.

Q400 **Stephen Metcalfe:** If the UK wanted to do this at scale, where would we get the majority of this from at the moment? Do you think we should create it internally?

**Dr Vaughan:** I think the CCC is looking at about two thirds being produced domestically, and that is a mix of miscanthus and short-rotation coppice; that is, dedicated energy crops on lower-grade agricultural land, because obviously you need to protect food production. It is messy and complicated when it comes to land use.

Then you have residue streams. You are looking at other waste residue streams as well. These are things that at the moment we just chuck into landfill but could divert. There are a lot of options and work being done at quite a detailed level at a UK scale about where those possibilities are. I think the headline it is working on is about two thirds domestic.

Q401 **Stephen Metcalfe:** What about other technologies and the environmental impact?

**Professor Henderson:** If I could make a broad statement about environmental impact rather than looking at one particular technology, in many cases we do not really know the environmental impact. This is another reason why doing things at field scale and demonstrating them is really important to see how the impact plays out.

Those impacts fall into two categories, one of which is that there are often environmental impacts which themselves change climate. If you restore peatlands or some agricultural practices, you will change the emissions of other greenhouse gases. This is partly reiterating Naomi's point that you need to think about the whole life cycle of the environmental consequences of other greenhouse gases, or perhaps the reflectivity of the planet in what you are doing.

The other category of environmental changes concerns things like affecting biodiversity or changing the cycle of toxic metals in the environment. Those really need to be looked at in terms of their potential benefits, occasionally, but generally their potential harms.



**Professor Skea:** Looking at the global level, apart from biodiversity, the question of food security is quite important. I emphasise that it depends on the scale of deployment of the different greenhouse gas removal technologies. There is nothing wrong with any individual technology; it is the scale and the cumulative effects that would be the challenge.

**Professor Gibbins:** When you have greenhouse gas removal technologies, it is quite important to realise that it is the only way you can go to net carbon negative. We have spoken about getting to net zero, but in a lot of scenarios the world as a whole is going negative. The UK by 2050 might be at net zero, but we might need to be on a trajectory to go even further. When you think about things that asymptote to zero with renewables, you can always get close to zero but you may need to go well below it to achieve what you need to achieve.

Q402 **Stephen Metcalfe:** Jim, you said it was to do with the scale of a particular use. Are there any effective technologies or systems where the impact at scale would be too great and we should just avoid using them altogether?

**Professor Skea:** I would not necessarily reach that conclusion. As we have said, many of the elements of the technologies are quite mature already and have been demonstrated. You can probably find locations at particular times where almost all the techniques could be applied at least at demonstration scale. The point Naomi is making is that we need to feel our way forward on this where there are knowledge gaps. We do not need to go to gigatons-worth of CO<sub>2</sub> removal immediately; we can work up towards it a bit.

**Professor Henderson:** In response to that, I should say that the Royal Society and Royal Academy report did suggest we should not pursue fertilisation of the ocean. There are a number of reasons for that, but perhaps in the interests of time I will not expand on them.

Q403 **Carol Monaghan:** The Government have recently produced a carbon capture and storage action plan. To what extent does this plan make large-scale deployment more viable?

**Professor Gibbins:** If it is carried through, I think it makes it eminently viable. The only thing I would say is that the plan talks about doing at least one cluster, a cluster being a group of CO<sub>2</sub> sources serviced by a shared transport infrastructure. It is important that the Government aim to develop a number of these clusters. We recently had a meeting in Cardiff where five UK clusters came together and talked about what they could do, because if you aim to do one it is very easy to end up doing nothing. If you get ready to do several, at least one will happen first and, since we need the others anyway, they will follow on. Just be realistic about what you need to start to get the result you want in the end.

Q404 **Carol Monaghan:** Do you think it provides the urgency and shift in momentum that we are looking for in this?



**Professor Gibbins:** I think Claire Perry has done an awful lot to accelerate it and make it clear that things need to happen. If that sort of impetus carries on, we will be in good shape. The main thing is to make sure that the money is there to make it happen. These are big impact projects. That means they also come with a fairly big price tag, but it is a good investment. It could be an excellent way of getting a post-Brexit or whatever stimulus to invest money in CCS. All I am saying is that things need to happen. Talking about it will not make it happen. We need to develop a number of options and make sure that one of them goes through very quickly and the others follow.

Q405 **Carol Monaghan:** You talked about five clusters. Where are they?

**Professor Gibbins:** They are Scotland, the north-east, Yorkshire and Humberside, and Thames, which is a good cluster. There is a lot of CO<sub>2</sub> from round here, and I am seeing the Mayor's climate representative soon. South Wales has a very important cluster for jobs, and the north-west, again going into the Irish sea, has a cluster. We are also quite closely related economically to potential clusters in the south of Ireland and in the Netherlands.

Q406 **Carol Monaghan:** Does the action plan include sufficient consideration of the potential future use of CCUS with greenhouse gas removal technologies?

**Professor Gibbins:** It talks about it, but I do not think it has got to the point of having suitable mechanisms to make sure that an appropriate scale of development happens. We do not have any mechanism to reward negative emissions, as you were saying, and I do not think we have quite got our head around getting things like direct air capture pursued on a sufficiently large scale to be useful for development, but it could come if it is supported quickly. You have to have the basic transport and storage infrastructure for that.

Q407 **Graham Stringer:** One of the technologies that always seems to be 30 years in the future is fusion. If fusion works, it would be great. Do you think that in the balance of investment, given the overall money spent on alternative technologies, fusion is getting enough money given its potential?

**Professor Henderson:** I am not going to answer the direct question because I do not know what the balance of spending is. I know how difficult fusion is, but it is worth being clear about one thing: even with a viable fusion technology to make a lot of our energy, it would not involve our getting rid of fossil fuel emissions completely. There are some ways in which we completely rely on technologies that release greenhouse gases. Two of those examples are aviation—we cannot fly planes with batteries yet—and agriculture, where it is very hard to limit greenhouse gas emissions from that sector. Therefore, even a ready supply of energy would not change the concern we have about greenhouse gas emissions or their potential removal.



Q408 **Graham Stringer:** But if the investment was greater it might rebalance what else was happening. I accept that it is not a complete panacea.

**Professor Skea:** The UK is quite different from some other countries in the way it approaches fusion technology. We have always tended to see it through the lens of a commercialisable technology, and many other countries invest in fusion as a kind of scientific curiosity. It is much more on the science side of the budget; you are advancing fundamental science.

If you go back 30 or 40 years, fusion had the promise of coming through with clean power at a low cost. The problem is that, while fusion has stayed 30 or 40 years in the future, other things like nuclear fission and renewable energy have achieved that kind of goal in the shorter term; they are with us now. It makes it a much bigger challenge for fusion to come through in the future if we have already achieved effectively zero-carbon electricity. That is another challenge for consideration.

**Professor Gibbins:** If you want to get a benefit from tackling climate change, you need to get the rest of the world to go to net zero. Obviously, you will not get the benefit if the UK does it. One of the things that ultimately has to be considered is how effective technology developments and investments in deployment in the UK are in influencing global outcomes. In that context, because net zero is now the challenge, technologies that convince other countries they can go to net zero are quite valuable. It is probably true that, if you have £10 billion to spend on something and you spend it on low-cost electricity generation, whether it is from fusion, nuclear, intermittent renewables, or any renewables, it would not be as impressive as spending it on carbon capture and storage and greenhouse gas removals, just because there are other technologies there that will do it, whereas having technologies that allow you to get to net zero, which people think is essentially impossible, is a real deal maker in getting the world to agree to a global budget and to commit to that process, and then for the UK to get the value of all the good work it has done in getting itself on a very cost-effective emissions reduction trajectory.

Q409 **Graham Stringer:** Do you think there is much potential in solar radiation management technologies, and how significant are they alongside other technologies for removing greenhouse gases?

**Dr Vaughan:** Solar radiation management techniques are doing a completely different thing from greenhouse gas removal. They are not removing any of the greenhouse gases, so you still have a problem. They will lower the temperature of the planet, but only for as long as you are maintaining that intervention. The moment you stop it, the temperature of the planet will go back to being what it was: because you have not dealt with the greenhouse gases, they are still there. They have a very different character in terms of what leverage they give you in dealing with climate change. They are not giving you clean fuel and not taking greenhouse gas emissions out of the atmosphere. Modelling studies have



shown that some technologies could lower the temperature, but you still have not dealt with the actual problem, so it is important not to blur the two; they are doing very different things.

**Professor Henderson:** I would agree with what Naomi has said, especially on what is called the termination shock. If you start doing this and then stop, it leaps up very quickly. Therefore, you are locked into having to continue to blanket the planet with particles.

In addition, the fact is that you do not solve the problem of causation and things like ocean acidification would continue, even though you have cooled the planet somewhat. The cooling is also not uniform, so radiation management would not lead to the same cooling level across the world; you would get patchiness and, therefore, different countries would benefit differently. There are a number of very significant disadvantages of solar radiation management. To reiterate Naomi's first point, it is a very different beast from greenhouse gas removal.

**Professor Gibbins:** Solar radiation management is a very dangerous thing to do, but globally there would be a strong incentive to do it if it seemed like the alternatives were worse—for example, destabilisation of the Greenland ice cap or uncontrolled release of methane from thawing permafrost.

Given the present global trajectory of CO<sub>2</sub> emissions, it has to be considered that things will get bad if dangerous climate change is a reality. The world will be facing it and people will actively consider using solar radiation management to try to avoid some of the worst effects.

It is terrible that I have heard people say to me it would damage their professional careers if they were seen to be taking an interest in solar radiation management research. I put it to the Committee that it is very much in the UK's interest to research solar radiation management to show how dangerous it is and all the effects you will get. It does not reverse CO<sub>2</sub> emissions, but, bearing in mind that we may face suggestions to use it even within our lifetime, we need to be prepared. Wilfully closing our eyes to studying it because it is very unattractive and dangerous is not a responsible attitude.

Q410 **Chair:** Do you all agree with that?

**Professor Henderson:** I would agree we should definitely not stigmatise people who think it is a good idea to research it. There are some thoughtful and clever people who are researching it, and that is to the benefit of the UK and the globe.

Q411 **Chair:** It is one thing not to stigmatise; it is another thing to invest in it if it is potentially something we have to deploy.

**Professor Henderson:** This is clearly a matter of opinion. My personal opinion is that the dominant research spending should be on greenhouse gas removal in these two branches of technology. If we can develop and



deploy those effectively, we will not need solar radiation management, and that would be a better route to follow than investing a substantial portfolio in solar radiation management.

**Professor Gibbins:** I agree you should not invest substantially in solar radiation management and you should not consider it as your prime option for tackling dangerous climate change, but it is difficult to be sure that, even if the UK introduced greenhouse gas removal as quickly as it could, we could get the rest of the world to follow suit. We can try, but it is not within our control. There is a distinct chance that we would not be successful in reducing emissions and we would need to go for a period of solar radiation management, coupled with net negative, to draw back the CO<sub>2</sub> that is in the atmosphere.

Q412 **Bill Grant:** What would be the top dog in solar radiation management? What would it look like? How do you manage solar radiation?

**Professor Henderson:** You do it by squirting stuff into the atmosphere so it reflects some of the sunlight away. If you are referring to how you govern it, that is a whole can of worms.

**Professor Skea:** A very large proportion of the scientific articles about solar radiation management are about the legal and ethical aspects rather than the physics and chemistry of it. My personal view is that it would be worth while doing desk studies of solar radiation management. I would be far less convinced of the case for doing demonstration, which is clearly needed for greenhouse gas removal.

Q413 **Chair:** On that somewhat contentious note, we need to end this session. Thank you all very much indeed. We appreciate your time.

## Examination of witnesses

Witnesses: Claire Perry MP, Tim Lord and Damitha Adikaari.

Q414 **Chair:** Minister, welcome. May we make very quick introductions and then we can start? I am conscious that you, Minister, want to leave at quarter to, and I understand why. We will slightly reorder the questions and ask some of them of the officials once you have left. We may want to come back to you on further points, but that is the way we will try to do it.

**Damitha Adikaari:** I am acting director for science and innovation for climate and energy at BEIS.

**Claire Perry:** I am Minister for Energy and Clean Growth.

**Tim Lord:** I am director for clean growth in BEIS.

Q415 **Chair:** The Committee on Climate Change has said that current Government policies do not put the UK on track to meet its carbon budgets. By when do you think you will fill the policy gaps for the fourth and fifth carbon budgets?





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**Claire Perry:** First, thank you very much for your indulgence. As I said in my letter of the 10th, I was really looking forward to giving a full evidence session. I appreciate the flexibility. We have an extraordinary urgent question and statement on climate today, so it is a good day to be discussing this.

Perhaps I may set out a couple of things. As to the carbon budgets, it is important to say that we are one of the few countries in the world that has statutory numbers against which politicians have to deliver over political cycles. When we put together the clean growth strategy, we went through 50 policies and procedures that we could calculate, of which about two thirds could calculate some carbon emission reductions and the other third were not fully developed. Based on those numbers, we are at 95% of the way to meeting CB4 and 93% of the way to meeting CB5. My sense is that that gap is small.

Since then, a couple of things have happened. First, we have had the IPCC report and we have asked for advice from the CCC. Although we have explicitly asked for the current budget profile not to be included, clearly there was a trajectory question there.

Secondly, the Committee will have seen things like the spring statement and the announcement that we want all new homes from 2025 to be built without fossil fuel heating, which is an example of a policy for which we have costed no carbon reduction at all.

What I have seen since we did this budgeting exercise is an acceleration of focus and policy delivery and a further reduction in cost. I am confident that we will meet these budgets within the timeframes we are given, and that we will be well on the way towards thinking about that zero-carbon future that we would like to consider.

Q416 **Chair:** Do you have a timescale for when you are going to achieve the closure of these policy gaps? The Committee on Climate Change has raised the fact that there is quite a lot of uncertainty in some of the steps you will take—whether or not it will deliver.

**Claire Perry:** The short answer is no. Tim is my expert on the actual budgets. I do not sit there and say that we are going to hit the middle of a particular budget. As you all know, macro-impacts happen. One of the reasons we have so massively overachieved on CB2 is the fact that the recession lasted longer than we thought. Macro-impacts come into play, but, based on the work I have seen and the acceleration of our focus on this, I am confident that we are well within those budgets.

Tim, would you like to comment further?

**Tim Lord:** I think you have covered it. Those budgets cover the years 2023 to 2027 and 2028 to 2032. Every year, we publish updated projections of our emissions, as we have done recently, that you are rightly referring to. As the Minister says, we do not put everything that





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we have said we are going to do into those policies until they are fully quantified. As we move towards those budget periods, you would expect those policies to be fully quantified and reflected in those numbers.

Q417 **Chair:** Are you aiming to get to policies that will deliver 100%, or to go further, given that you may well need to mitigate the risk of some approaches not delivering what you anticipated?

**Claire Perry:** Yes, exactly. It is always a balancing act. When I was fortunate enough to be given this portfolio, one of the things I did was to try to understand the correlation between cost and impact. People always talk about policies like retrofitting homes, which is clearly an important part of the process, but in 2016 homes were only 15% of our emissions in the UK, whereas business and industry was 25%. We almost never talked about what you would have to do to reduce emissions from intensive industries; we just dealt with that with an offsetting process to try to keep down energy costs. With the real progress we have made on carbon capture and storage, the focus we have given, particularly in the power sector, where we feel confident we will obtain at least 70%, and possibly more, from low-carbon sources by 2030, and an understanding of what more we need to do, particularly in the transport sector, we feel confident.

We are one of the few countries in the world that is spending substantial amounts of money on carbon recovery technology. It is not just things like carbon capture from biomass, but direct air capture, which are very expensive but equally could be something the whole world will have to think about.

Q418 **Chair:** You made the point that homes account for only 15%. None the less, the Government abandoned the zero-carbon home standard. Why did they do that given the sense that this is an urgent priority? Is that not a massive own goal?

**Claire Perry:** I was not the Minister at the time.

Q419 **Chair:** So you can be open and honest about it. Do you disagree? Do you think it should have happened?

**Claire Perry:** When I looked at it—I will ask Tim to comment—it looked like a rather expensive policy combination of zero-carbon renewable energy provision and improvements in energy efficiency. Both those things need to be done, but at the time, given what we have seen with cost reductions, particularly in renewable technologies like solar, I think it would have been very expensive.

Q420 **Chair:** Lord Deben makes the point that we are continuing to build homes to a low standard that will cost a fortune to rectify.

**Claire Perry:** I very rarely disagree with anything Lord Deben says, but I would take issue perhaps with some of that language. In the past nine years the average energy performance standard for new homes has



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improved by 30%. You will have seen that I took legislation through the House last year that targeted the least energy-efficient part of the private rented sector.

I think we are making progress. The particular win for us is that, given that the pace of home building has accelerated, saying basically that there will be no fossil fuel heating in new build by the middle of the next decade will be real progress.

Tim, you were in place then. Could you comment any further on zero homes?

Q421 **Chair:** It was your fault, Tim.

**Claire Perry:** It is the official response, as you know.

**Tim Lord:** I could not claim that. As the Minister says, in the home sector the key thing is around improving energy efficiency and decarbonising the heating supply. What the Chancellor set out in his spring statement is that we are going to set a clear trajectory for how we do that so that the industry can get on and invest in doing that.

We have made progress over recent years. There is a lot more to make in new build and retrofitting the existing housing stock. I think the plans the Minister referred to will enable us to do that, and crucially enable the supply chain to step up, invest and get the right training and skills in place to make sure we can secure the economic benefits that go with that.

Q422 **Graham Stringer:** You mentioned the reduction in emissions of whatever it is—30%-odd—but when John Gummer was here I asked him whether that was a poor measure, because, if you are exporting industry elsewhere and shipping manufactured goods back, by putting up the cost of energy and changing regulations you may be increasing the amount of carbon dioxide. I did not think his answer on that was very satisfactory. He said we could measure our own emissions, which is true, but if it is not actually doing what you want to do, which is to reduce the amount of carbon dioxide, what is the point?

**Claire Perry:** There are two parts to that question. The first is: are we capturing the territorial emissions versus consumption emissions? The argument often made to me is that you are just exporting your emissions. Our emissions on a consumption basis are down by 21% between 2007 and 2016; consumption of raw materials is down by a third since 2000. We are becoming both more resource efficient and reducing our emissions, including territorial emissions.

Q423 **Chair:** The figures that we have are that consumption emissions fell by just 4% between 1997 and 2015.

**Tim Lord:** We recently published an update. I do not know that they are the absolutely latest numbers. I think it was last week. I will have to



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check the date when we published an update. There is a range around those statistics, inevitably, because it is very challenging to quantify emissions that occur internationally, but the latest numbers are 6% between 2015 and 2016, and 21% since the peak in 2007 and 2016.

While we would absolutely accept the importance of international action on climate change, which is the best way of addressing this, the way we quantify our territorial emissions reductions is in line with the best international protocols. We are doing that and seeing some progress in reducing the emissions and the products we use in consuming them.

**Claire Perry:** To answer the second part of the question, which also goes to the cost point, you want to ensure that you are working with industry in a way that makes it cost competitive. I would particularly point the Committee towards the £170 million I secured for the industrial strategy challenge fund to develop the UK's first net-zero industrial cluster. What we want to do is recognise that some industries will continue to emit and they should not be penalised for that on a cost basis; it is just too expensive to re-engineer there, but we want to ensure that we are capturing that carbon and working on a cluster basis.

The other thing I would point to is that we also do not capture the emission reductions that we deliver through our international climate finance spending, which is another part of this corollary. We spend £6 billion over this Parliament, but we do not capture any of that benefit in our own CO<sub>2</sub> terrestrial numbers.

Q424 **Graham Stringer:** We had a debate in Westminster Hall, Minister, about Dieter Helm's report. He was scathing about the energy policy, saying that people were paying 20% more in their bills than was necessary to reach the same reduction in emissions, and that by 2030 we will have spent £100 billion. When you put those huge figures, both to individual consumers and the Exchequer, against 4% or 16% or 1% of total global emissions, it is a huge cost for very little, is it not?

**Claire Perry:** I would take issue with two points. One is that energy bills per household have gone down since 2010 because appliances have become much more efficient.

Q425 **Graham Stringer:** But Dieter Helm's point was that they were 20% more than they should be.

**Claire Perry:** Hindsight can be helpful. The other point I would make is that none of us, over successive Governments, has picked up the economic opportunity from being a first mover in technology globally. If we take the offshore wind sector, where we now have the world's biggest offshore wind market and the most well-structured and transparent forward look for that market, the opportunity to lead the world and create economic value for UK Plc from exporting that technology and systems know-how is absolutely huge. I very rarely quibble with Dieter, but what we have done, as we often do with R&D, is invest experimentally in



various technologies, and we have some absolute winners that will be paying back for decades to come.

**Q426 Darren Jones:** As a general comment, in many ways it is great to see such a busy climate change Minister, but what that means for us parliamentarians is that often we get somewhere in the region of zero to three minutes to talk to you about these issues. Do you not think it is time to elevate you to a Secretary of State of a climate change department with Ministers to help you with the workload?

**Claire Perry:** I think you would get even less time if that was the case, based on my recollection.

First, we have a superb team of officials. Going around the world, I have been amazed at just how well regarded the UK effort is.

Secondly, my door is always open. I like talking about this stuff. I am very happy, as we have done, to have endless debates in Westminster Hall, which, by the way, if I was a Secretary of State you would not get, although you might get another Minister.

Part of the challenge is that this is now a whole-economy problem. Back in the day when it was just energy and climate change we would never have talked about industrial strategy; we would never have talked about transport or land use; we would not have had that joined-up approach across Government. Now we have to see this on a whole-economy basis.

**Q427 Chair:** Are you resistant to Darren's suggestion?

**Claire Perry:** I could not possibly comment on that. My sense is that restructuring Government creates more effort sometimes.

**Q428 Vicky Ford:** On your comment about investing and energy-efficient homes, do the Government have any plans to help those who are not vulnerable households, but who are in theory able-to-pay households, to invest in energy efficiency? That has decelerated a bit.

**Tim Lord:** I think you are right; it is one of the most challenging sectors. We have taken action in the private rental sector, fuel poverty, social housing and various other areas. Incentivising people in mortgaged homes or fully owned homes to pay is challenging. We carried out a call for evidence last year about how we can mobilise that market more effectively. We will be bringing forward our plans in response to that call for evidence and consultation later in the year.

One of the focuses of this Committee is innovation. One of the interesting things we are seeing is not so much necessarily technological innovation in this space, although there is plenty of that, but financial services innovation—for example, the provision of green mortgages. Barclays and others are bringing green mortgages to the market and enabling people to make investments that will pay back on their properties and add value to their properties.



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Q429 **Chair:** This is absolutely critical to it being financially worth while to do these things.

**Claire Perry:** Yes. You will remember the green deal. I sat on that Bill Committee through choice. We knew you could save money. This was a perfectly sensible thing to do, and you did not have to find the capital up front. There were questions about the financial structure and the golden rate, but it just did not persuade enough people, partly because there is no financial incentive, even though if you rent an energy-efficient flat you can save yourself thousands of pounds a year. The evidence is that people who are moving into energy-efficient homes are less likely to default on rental payments. There is economic value that we are working with the financial sector to try to deal with.

Q430 **Chair:** Where would you go here and now for advice if you wanted to improve the energy standard of your home?

**Claire Perry:** We have the simple energy advice service, which is a new, digitally-led energy efficiency application.

Q431 **Chair:** But is that really enough? I would say that people generally have no idea where they should go if they want to play their part in improving energy efficiency.

**Claire Perry:** The answer is that it is a really important challenge. You will know that we set out the buildings mission, which is to halve energy use of all new builds and to halve the cost of retrofit. My sense is that innovation in this sector has stymied. Essentially, when people think about energy efficiency they think about loft insulation and cavity wall insulation, which does not suit many of the homes in my constituency. When we reformed ECO to try to make it focused entirely on fuel poverty, we increased the innovation level of ECO spend, because we want the big energy service companies to be saying, "Why don't we use thermally efficient paint?", or, "Is there a more effective way of doing floor insulation?", for example. I think it is a very good challenge, particularly training boiler installers and heating engineers. Those are often the people you turn to when you are installing a new boiler. You do not think to go off and do these things.

Q432 **Chair:** Could you give a very brief overview of your strategy for three absolutely key issues: energy efficiency in buildings; decarbonising transport; and decarbonising homes? These are the key things that will make a difference, and we need to understand what is going to make a difference.

**Claire Perry:** There is a kind of tripartite approach to each of these things that I think Government should take. The first is to set ambition. We need to set a high ambition for each of those areas. You will see that in the clean growth strategy we set out the ambition of all homes being band C or better by 2035.

Q433 **Chair:** But you then need the mechanism to achieve it.



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**Claire Perry:** You need the regulatory mechanism underneath, and that is a combination of regulation and taxation incentives, just as we have done with the announcement on homes.

Then you need the power of government to convene and stimulate. Government is not a great communicator, but it is really good at convening. To give an example, when you go to rent a flat, nowhere does it say what the running cost is. It will tell you how much the rent is, but it will not tell you the cost per month of that particular property. It would be the simplest thing in the world, based on EPC data, to have estate agents display that alongside it so people can make an economic assessment. That triple approach of ambition, regulation and power of convention is how we bring all those together.

We talked a bit about building energy efficiency where we have set ambition; we have said we will legislate, and we are trying to use things like ECO and others as a convening power.

On electric vehicles, you will have seen the Road to Zero. People always say, "You are not ambitious enough with the 2040 phase-out." I can tell you that in the Council of Europe we are among the top three most ambitious countries in Europe. Others might talk a good game, but they are pushing for far less ambitious targets.

Q434 **Chair:** But other countries have set an earlier date.

**Claire Perry:** But they were not pushing for the package to be at the most ambitious level. I find it is very easy for politicians to set dates if there is no plan behind it, whereas if you have a plan that you have to deliver it is different.

Q435 **Chair:** Do you not need both?

**Claire Perry:** You need ambition and detail. We have been spending on EVs as well—£1.5 billion on the package of support for zero-emission vehicles. That is primarily going into charging infrastructure.

Q436 **Chair:** But emissions from cars are going up.

**Claire Perry:** Not on a per-mile driven basis.

Q437 **Chair:** On the basis of new cars sold, emissions are going up. Does that not indicate a complete absence of incentives to get the right model?

**Tim Lord:** The most recent statistics show emissions from transport going down slightly. You are right. Essentially, what has happened over the past 20 years or so is that the energy efficiency of vehicles has improved, but the volume of miles being travelled has increased.

Q438 **Chair:** Average new car emissions rose between 2016 and 2017.

**Tim Lord:** But, in terms of economy-wide emissions, transport emissions are now coming down.





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**Claire Perry:** Perhaps I may bring in Damitha. The value of innovation in this space as well is absolutely huge. What we have seen, working particularly with local authorities—you also asked me about the approach—is that for transport, in particular, the power of combined local authorities as a huge pull factor in saying, “We are going to have a zero-carbon transport city,” is driving change. We have been pumping some of the innovation funding into that space.

**Damitha Adikaari:** That is right. On the innovation discussion, we could talk about some of those. For example, if you take the industrial strategy challenge fund Prospering from the Energy Revolution, all four of the projects that have been announced in Oxfordshire, Oxford, Orkney and Sussex are looking at whole-systems management of decarbonising local areas. In those areas, all three aspects that you mention, Chair, are taken into consideration. Innovation demonstration aspects are pushed through.

What we have been doing up to now, when it comes to innovation and research, is building the capability and developing the technologies and options. We are now in a place where demonstration of those things on a bigger scale is quite necessary to push this agenda forward.

Some of those technologies have very high leverage—sometimes one to two—and local authorities, universities, tech suppliers and energy utilities are all involved in looking at some of these aspects and trying to come up with whole-system solutions.

Q439 **Carol Monaghan:** Minister, you are talking about electric vehicles as a possible way forward to clean up the transport sector. Unfortunately, unless we can guarantee that the electricity is being produced in a low-carbon way, that is not going to have an impact. Have you looked at how clean the electricity being produced is?

**Claire Perry:** It is a brilliant question, because other countries will trumpet their electric vehicle penetration and will be using coal. This has been an area of incredible success for the UK, and it is a real tribute to a very good policy framework and some very big investment. We are now at over 30% renewable energy. We have just had our longest coal-free streak over the Easter weekend; it is now at 70 hours. When I was elected in 2010, our energy supply was 40% coal based. It has been an absolute transformation. We will be zero coal by 2025.

I launched the offshore wind sector deal a few weeks ago. We have an incredible opportunity to exploit the North sea, which we exploited for oil and gas, for offshore wind. The combination of wind speed and basin depth is incredible. We will be at least at 70% zero-carbon power generation by 2030, and I think we could go faster than that. In March we were at 40% renewables as well. The combination of cleaner gas, a huge dash for renewables and a commitment to phase out coal based on policy decisions around emissions and a unilateral carbon tax is transforming our electricity system.





Q440 **Carol Monaghan:** The Committee on Climate Change has estimated that by 2030 the UK will need an additional 130 to 140 TWh of low-carbon energy. The support for offshore wind is, I think, debatable. What other technologies are the Government going to invest in to ensure that this energy target is met?

**Claire Perry:** I would slightly challenge your point about support for offshore wind. We have the biggest installed offshore wind base in the world and the best market for offshore wind investment going forward. We continue to invest in nuclear. I have stood on the Hinkley Point B reactor and lived to tell the tale. I am not glowing. That will be open and on stream.

Gas will continue to play an important part in the mix. There is a very interesting conversation about gas. Every scenario we have seen from the CCC suggests that we will need some thermal efficiency in the grid, and gas, which is the easiest possible fuel to decarbonise with carbon capture and storage, could play a very valuable role. I do not know whether Tim wants to comment on shortfall.

**Tim Lord:** I think you are absolutely right. On offshore wind, we have committed to 1 to 2 GW a year. Clearly, the cheaper it gets the more affordable offshore wind becomes. There has been incredible progress in that sector, and it is hugely important. With nuclear and Hinkley Point C, and potentially beyond that, there is the work we are doing with carbon capture and storage.

Q441 **Carol Monaghan:** I understand that the Anglesey and Moorside projects have been scrapped.

**Claire Perry:** No; I am sorry to interrupt, but that is not true. We would all agree that you have to spend taxpayers' money wisely. Given the precipitous decline, particularly in other renewable technologies, it became apparent that some of the financial proposals put forward for Wylfa in particular were just not good value for money, but those negotiations and conversations continue.

Q442 **Carol Monaghan:** You can see nuclear playing a significant part in the energy landscape in future.

**Claire Perry:** We should be proud of the fact we have a diverse energy supply, and we have made very strong commitments to it being low carbon and affordable. Nuclear has a part to play in the mix. I also think the level of systems flexibility is important, because we need to make sure that all the new draws we will have on the system, like electric vehicles, are well balanced. There will be a lot of investment not just in generation but in the transmission and storage network, which will be crucial as well. We should be pleased that we have a diverse energy mix, because it means we are not completely dependent on one resource.

Q443 **Carol Monaghan:** I am a physicist and I am fairly relaxed about nuclear power. However, there is no disputing the fact that it is extremely



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expensive. It is not affordable, and the investment is extremely expensive.

I want to move on. The 2017 Conservative manifesto stated that more large-scale onshore wind power was not “right for England”. What are the UK Government doing to support onshore wind power in other parts of the UK?

**Chair:** Incidentally, as part of your answer, do you agree with the manifesto commitment that it is not suitable for England?

**Claire Perry:** I do. Let me try to explain. I think it is partly because of what I have seen with offshore wind. If you want to do serious large-scale wind generation, you can build wind farms of 200 turbines taller than the Gherkin out in the North sea, and bring power on more effectively. It goes back to the point about the whole economy. There are now conversations about how you use wind to create hydrogen, for example, because that is another great opportunity to decarbonise our industry. It would be very hard to persuade constituents in our lovely, green parts of the world that they should have a hydrogen generation plant next to or near to the wind generation. Those are the sorts of things you can do in some coastal communities and more industrialised areas, but not all, I accept.

I have realised that, if we want to scale up wind generation, there will be sites suitable for onshore wind. Indeed, we already have 13.3 GW installed, and that number will go up. Fifteen projects won CFDs in 2015, and 10 of those are in Scotland. There will still be onshore wind; there will also be repowering of onshore wind, but if we want to scale up wind technology we do not have to go through some of the planning fights. I know that in certain devolved Administrations this has been incredibly challenging, with major protest marches, because people find these wind turbines to be very unsightly. Moreover, the power connections—it is not just the turbines but the grid connections—can be very unsightly.

This was a manifesto commitment; it was what I was elected on, so I am happy to support it, but I have realised that we could be generating all the wind power we need offshore with concomitant industrial benefits in a way we could never have imagined.

Q444 **Chair:** At a higher cost to the consumer.

**Claire Perry:** That is potentially true, but equally right now we have not invested sufficiently in things like offshore ring mains, which are now part of the conversation about how you deploy that energy more cost-effectively. I hope that answers the question.

**Carol Monaghan:** I just worry that we are at a tipping point in the planet’s future, but we are worrying about unsightly things around our coast. I think we need to be a bit more ambitious, but I will stop there.

Q445 **Stephen Metcalfe:** I want to talk briefly about decarbonising our



domestic heating system. The clean growth strategy states that “at present it is not certain which approaches or combination of them will work best at scale and offers the most cost-effective long-term answer”—to decarbonising domestic heating, presumably. What information will the Government need before making long-term decisions about our domestic heating systems?

**Claire Perry:** It is an excellent question. First, we have to recognise how gas-dependent we are. People always ask, “Why not just get rid of the gas network and go to 100% electrification?” My answer is: who is going to pay to rip that out and provide all the new electric appliances?

We are putting forward three areas. One is looking at the benefits of heat networks. I think we have about £320 million of available funding because there is evidence that heat networks can deliver lower costs and CO<sub>2</sub> if you change the generation mix, albeit with some questions around regulation, which we are also addressing.

The second is hydrogen. There is a huge amount of enthusiasm for hydrogen heating, but there is a question about public perception and how much you can blend, and currently we do not have hydrogen-powered appliances.

Lastly, how can we create those electrification networks cost-effectively? In a way, it is pushing forward on all fronts and recognising that not one solution will be right everywhere. You could imagine a totally mixed economy where you have heat networks in some dense urban areas, or rural areas, and you have hydrogen. I mentioned the ability to generate hydrogen cost-effectively using renewable energy. What we are doing essentially is not to have a one-size-fits-all consensus but pushing forward on various fronts.

I did not mention heat pumps. The hope is that through the regulatory changes we make we will kickstart a real cost reduction in some of these technologies that already exist but are not deployed at scale.

Q446 **Stephen Metcalfe:** You need answers to those questions.

**Claire Perry:** Yes.

Q447 **Stephen Metcalfe:** To get those answers, what actions are the Government taking? How big a demonstration scheme do you need to run? Who is going to fund it?

**Claire Perry:** I am going to ask Damitha to answer this. We have lots of R&D funding going into these areas.

**Damitha Adikaari:** All the main three areas the Minister highlighted can greatly benefit from innovation. The Government’s push at the moment is to provide sufficient funds to de-risk some of those unknown technologies towards the demonstration phase. For example, there is a hydrogen innovation project that the Department is running with private sector



participation. The fundamental aim of that is to de-risk the safety case around hydrogen used in people's homes and determine whether we can build appliances that people can use. We are also considering the impact of the commercial and industrial applications of those hydrogen appliances that we will be generating.

Similarly, you might want to consider bioenergy as a solution in certain areas, maybe on a different scale. There are various innovations we need to try to cost-trial in new advanced commercial technologies. Those innovation interventions are not small; they are quite significant.

I mentioned earlier that we have been focusing on developing technologies, but now we are focusing on more demonstration scale projects, pushing to demonstrate at scale how these technologies are viable.

**Q448 Stephen Metcalfe:** Can you give us any practical examples of a demonstration at scale, either planned or under way—how big they are, when they are taking place and when we will see the results—so we can bolt one of these things down, as opposed to keeping on saying we know what the question is?

**Claire Perry:** Again focusing on hydrogen, there is the Hy4Heat project, costing £25 million. That is looking at how to bring forward hydrogen appliances in occupied buildings. We have the £20 million industrial fuel-switching competition, which is trying to get intensive industries to invest in lower fuel heating. There is another £20 million project looking at large-scale innovative energy storage. We have energy system demonstrators trialling a heat pump configuration at the Oxford energy super-hub.

There is also a question about whether we do more to decarbonise gas by starting with what we have and looking at how we can take carbon out of the gas network. That is important work, because not retrofitting the entire transmission and storage system would be a potential cost saving, but there are live projects going on.

**Q449 Stephen Metcalfe:** Are there any involving large numbers of consumers yet? That is probably the most unpredictable factor.

**Damitha Adikaari:** That is a difficult area in which to make progress. A good example that explains how difficult some of these aspects are is the smart systems and heat project, the second phase of which we concluded a couple of months ago with the Energy Systems Catapult. The initial ambition was proving wider whole-system solutions involving thousands of consumers. We found out that it is really difficult to prove these whole-system solutions at one go. I think we ended up proving that heat as a service, which is the commercial model people are looking at seriously now, is viable using 100 homes. To prove that theory of change we had to assess 7,000 homes to get to a reasonable sample size.



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When people talk about large demonstrators, yes, they are necessary, but they are the most difficult. That is why we are systematically approaching those difficult questions.

**Claire Perry:** There are some really simple things. Officials have heard me on this. We used to pump into the grid town gas, which had 40% hydrogen; we are now down to single digits. Changing the regulations to allow us to introduce blended hydrogen into the system—you obviously need to produce hydrogen in a cost-effective and low-carbon way—would be a really easy thing to do.

There is a question of consumer perception and we need to work on that, but it seems to me there are some quick wins we could do at scale. I go back to the cost and scale challenge. What are the things you can do relatively easily that impact millions of people at a time, rather than trying to persuade every single homeowner that they should be investing in a hydrogen boiler, which is incredibly expensive to do and is difficult from a communication point of view?

One thing I have neglected to mention is the third part of this triple test. What is the competitive advantage for the UK? If we are exploring hydrogen heating seriously, we have excellent, world-class boiler manufacturers in the UK. How can we create an opportunity for the UK to be in the vanguard of that particular technology? That is now a really important angle for the investments we are making.

Q450 **Bill Grant:** I think we can all agree that the success of decarbonisation up to now has been on the generation side of the business. We are heading for the consumer-facing side. We have touched on that. We have looked at electric vehicles, heat pumps and so on. What are the Government doing to raise public awareness? We need to get the public on board to take this forward. If we do not bring them on board and do not make them aware, it will fail. What are we doing to bring them with us?

**Claire Perry:** It is an excellent question, because we have the protest going on outside. I admire the passion and commitment that is bringing people out on the streets. We are tending to ignore the fact that we have made progress, partly because it has been a niche conversation. Frankly, we have been worried about putting up costs and people not believing in climate change. We are now in a place where it is a much more mainstream conversation. I am keen for people to see that the progress we have made is a sign of hope that we can do it. We have cut our emissions by 42% since 1990. We have not challenged the energy supply. We have had some subsidies, but bills have gone down. This is not a kind of existential threat; we can tackle this, but we need to be talking about it and have it as a whole-of-Government approach.

Q451 **Bill Grant:** Does the protest tell us that we have failed to take the public with us and make them aware of the successes, or partial successes?



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**Claire Perry:** There is something in that. I think we have been shy in talking about this. I also think that, frankly, it has been a niche conversation rather than something people talk about when they pick up the Sunday papers.

Q452 **Bill Grant:** It was mentioned earlier that local government has a big role to play; it has an ambition to play this role. I think you yourself mentioned it. What is central Government doing to allow local authorities to realise their ambitions and help central Government to decarbonise?

**Claire Perry:** We have set our own ambitious energy reduction targets across the Government estate. I cannot remember the numbers, but Tim will help me. There is an excellent financing programme called Salix Finance, which is available to all local authorities and which offers them interest-free loans for energy efficiency measures. If your local authority wants to invest in LED street lamps or improve the energy efficiency of its estate, it can borrow that money.

I have been passed a note to remind me that we have committed £10 million to local energy hubs. We have found that, often, it is not a lack of will but a lack of knowledge and skill. We want local authorities to be able to access and hire the talent they need to deliver these plans.

UK100 is an excellent organisation that is trying to get the most ambitious local authorities working together. I spoke at one of its recent events. There is some amazing, incredible and innovative work being carried out by local authorities in places like Nottingham, Leeds, Oxford and Wandsworth.

Q453 **Bill Grant:** The Department is overcoming its shyness in pushing this out to the public to let them know what we are doing and that we need them to come with us to make it a success.

**Claire Perry:** Thank you. I will do my best.

Q454 **Darren Jones:** You rightly say we should congratulate ourselves on our successes, but many people outside protesting today are thinking not just about what more we need to do in the UK, but about what we need to do as a global community. The science is very clear. We are on a trajectory to fail to meet the target of 1.5° above pre-industrial levels. Minister, you must recognise that as a global community we are failing, and that is why people are protesting. What more can we be doing not just domestically in the UK but with our partners internationally to get us into the right place?

**Claire Perry:** It is a brilliant question. We are 3% of the world's land area and are ranked 17th in national CO<sub>2</sub> emissions. There are two points. One is that we were the first country in the world to pass a climate change Act. We started talking about budgets. I think I am one of a tiny handful of Ministers who ever has to talk about carbon budgets. We have a framework we can share with the world that does deliver reductions.





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We are also one of the most generous funders of international development assistance for climate change—over £6 billion has been spent. Crucially, this is doable; we can achieve this. That is why I am pitching for us to host the UN climate change talks next year. That will be a crucial event because it is where we have to show our homework and bring forward our nationally determined contributions. It is, if you like, the follow-on from Paris. Other countries are bidding, but I think it would be brilliant for the UK to host that and to be encouraging countries to embrace this as an opportunity, not something that is incredibly fearful.

**Q455 Chair:** Minister, clearly we can all see your commitment to this imperative, but in going through the brief for the session today I could not help but notice that there is a whole host of ways in which we are currently falling significantly short. The renewable heat incentive has not delivered what was planned for; the feed-in tariff has come to an end without its replacement already being in place; the zero-carbon home standard has been abandoned; and there is a delay in the consultation on building regs. I think we have been waiting for over a year for the Government's response to the consultations. There have been slowing improvements in energy efficiency; emissions in transport, if not rising, are certainly not falling, as we would hope.

Greta Thunberg is in Parliament today. Do you agree with her that this Government and those around the world need to be far more ambitious than we are at the moment, and that we face a crisis? She used the words "we need to panic". Do you agree that this is an emergency that needs to be met with a much higher degree of priority?

**Claire Perry:** I absolutely agree that we need to raise our ambition. The serious engagement around a net-zero carbon economy for the world's sixth largest economy and an industrialised country of 65 million people—we will receive advice on that and crucially try to understand how much it would cost—is absolutely enormous.

You raise some important questions. I will make no excuses for the feed-in tariff. That was really expensive. We spent £6 billion giving a lot of Government subsidy to people who could afford the capital to invest that.

**Q456 Chair:** I understand that, but you need a replacement.

**Claire Perry:** We will bring forward the smart export guarantee. I want to do that quickly to ensure that people are paid for their generation, but that it is not burdening often the poorest consumers with higher energy bills. The challenge is that it has to be a whole-Government and whole-economy approach. You are right. We have made great progress.

**Q457 Chair:** Do you think that means your ambition is not shared by others?

**Claire Perry:** I think the fact that I do attend Cabinet, that we have a clean growth cross-Government strategy, and that for the first time ever we saw a green-focused financial statement, should give the Committee reassurance that it is absolutely percolating across Government. The bid





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to host COP is a cross-Government commitment of several hundred million pounds, should we be lucky enough to succeed.

I accept that we need to accelerate and that we have been shy, but there is a very committed Government. It is very easy for me to sit here and say I want to legislate for zero carbon in 2050. I will not be here then; it will be on my children or grandchildren, but the point is that we need to have plans to deliver that. As I go around the world and compare this with the Plan Climat, which is like a pamphlet, I genuinely believe we have the most detailed plan for emissions reduction and that, if successive Governments just stuck to this, we would get to our targets. We need to go further, but you have to have a really detailed plan to do that.

**Chair:** Minister, you had better go.

**Claire Perry:** Thank you. I do apologise.

Q458 **Chair:** Thank you for your attendance. We will now focus our attention on your officials.

How much private sector funding do you expect the £2.5 billion for research and innovation announced in the clean growth strategy to draw in? How might this change the balance between early-stage research and technological demonstration?

**Damitha Adikaari:** The leverage depends on what type of innovation we are planning to push through. The £2.5 billion outlined in the clean growth strategy, at a high level, falls into three different camps: basic research, which we can call applied research as well; development of technologies and processes; and demonstrations.

Of the £2.5 billion across Government, if you look at it roughly, about £1 billion is planned to be spent by 2021 on basic and applied; about another £1 billion will be spent on development; and about £500 million will be spent on demonstration. In the next iteration of this effort, that is where the focus will be.

Depending on which area we are talking about, the leverage changes. One example I can give you is the 2010-2015 DECC energy innovation programme, of which we can make an evaluation given that it is three or four years since the completion of those projects. There, the private sector funding leverage is 5.4:1—£1 of public spending leverages £5.40. That is a mixed bag of innovation interventions and not so much on demonstration, but on development and basic research.

If you go towards demonstration-type innovation intervention, a good example is the four demonstrators I previously discussed under the industrial strategy challenge fund. Those projects are just starting on the ground, but the private sector leverage is already 2:1.

Q459 **Chair:** Are the Government doing anything to incentivise that private



investment in the demonstrators, or are you simply offering a sum of money and inviting matched funding, as it were?

**Damitha Adikaari:** It is a bit of both, depending on the commercial model we use to get this funding across to the actual people who innovate and develop these things. The leverage depends on that. At the same time, it is the participants' perception of what return they can make on some of these things. That is why demonstration-type activity in innovation attracts more private sector funding.

If I try to answer your second question about the right balance, beyond demonstration comes deployment. There is not a clear-cut rule on the right balance between R&D and demonstration and deployment. Again, it depends on a number of factors: not just the technology capability, but the timelines we are looking at for commercialisation of some of these technologies and processes.

I will explain that by using two examples. One project I was part of was energy storage technology development, which started in 2012 at DECC. Seven years later we now have a number of technologies that came from these processes. We invested about £20 million. Over seven years those technologies have to go through a chain of arduous innovation. Some of those technologies are now playing a big role in the Prospering from the Energy Revolution demonstration competition projects that I mentioned earlier. The innovation investment has been quite significant and has taken a long period of time.

On the other hand, if you look at some of the information technology-related innovation, one example is flexibility markets. A couple of years ago we provided public sector funding of up to £1 million, I think. Already, within two years, that platform has been commercialised by all the distribution network operators to purchase flexibility services, and it can happen that quickly. When that happens, the innovation investment is quite small, and deployment happens very quickly where necessary.

Q460 **Chair:** Why is power generation allocated 25% of research and innovation spending when other sectors are responsible for a greater proportion of emissions?

**Damitha Adikaari:** That is a very good question.

Q461 **Chair:** What is the answer?

**Damitha Adikaari:** If you look at the power sector, a large amount of that funding is going into nuclear innovation. Historically, throughout the world innovation and R&D investment in nuclear has been quite significant; it is the nature of the technology sector, fundamentally driven by the safety case. That is why it looks perhaps disproportionate.

Q462 **Chair:** Are you saying, therefore, that that remains rational, or it is a historical result of the investment in safety features?



**Damitha Adikaari:** We believe that it remains rational. Nuclear is expected to play a significant part in the decarbonisation challenge, and for us to maintain the capability we need to maintain the R&D activity related to the nuclear sector. Therefore, it is right to invest those kinds of sums.

**Tim Lord:** Can I pick up a point that Mr Stringer made earlier? There is a really critical point about where the UK can have the most impact in innovation investment. Countries across the world are doing this. We are not going to be world leaders in every single element of the low-carbon transition, so part of it is about identifying within the industrial strategy the areas where the UK can have a real influence around cost reduction, export to other countries and, potentially, drive inward investment, job creation and so on, and focusing our efforts there.

It is absolutely the case that we want to secure the benefits where others are investing in other technologies and reducing the costs of those—we have seen that in everything from batteries to solar and many other things—but we must also make sure that we divide the pot of money on the basis not simply of UK emissions as they are now, but of where we can most effectively secure benefits. In your recent letter, you pointed out that the wider productivity benefits of this whole agenda are a really important component of it.

Q463 **Carol Monaghan:** When will the smart export guarantee scheme be in place?

**Tim Lord:** As the Minister said, and as you talked about earlier, the feed-in tariff has now ended. We ran the consultation on the smart export guarantee. That closed on 5 March. Obviously, it raises a complex range of issues. We are considering the responses and will provide a response as soon as we can. We will minimise any hiatus for the sector as part of that.

Q464 **Carol Monaghan:** You will respond as soon as you can. Are we talking months or years?

**Tim Lord:** I certainly would not expect it to be years. It is something we are looking at very actively. As the Minister said, it is a priority for her. She recognises the importance and urgency.

Q465 **Chair:** Will it be in place before the end of this year?

**Tim Lord:** I cannot give a date, I am afraid, but I will certainly go back to the Department and see whether I can provide you with a more specific date.

Q466 **Chair:** Do you agree that it is seriously suboptimal not to have any mechanism in place? We recognise the flaws in the original scheme—the feed-in tariff—but not having any scheme to take its place has potentially very serious negative consequences.



**Tim Lord:** We accept that there is a need to respond to the consultation quickly and to bring forward plans as quickly as we can. I would also say that we are seeing the market responding. That is not to abdicate our own responsibility to bring forward our proposals on the smart export guarantee, but we are seeing energy companies bringing forward export tariffs and so on to support continued deployment of microgeneration. We certainly support that, but we do not underestimate the urgency and importance of coming back on it.

Q467 **Carol Monaghan:** Do you share the concerns that have been expressed by many, including the Renewable Energy Association, that Ofgem's proposed network charging reforms run "contradictory to Government's ambition to decarbonise the energy system and create a market for flexibility"?

**Tim Lord:** I think that there is a real challenge in making sure that the energy system, the regulations and the cost allocation that goes on around that reflect the development of the system, which is very rapid. As you know, we are seeing more and more embedded generation, distributed generation and so on. It is incumbent on us and on Ofgem to make sure that what we are doing reflects that change and that we are allocating the costs as fairly as we possibly can across consumers. Although I do not want to pre-empt, to prejudge or to influence what Ofgem is rightly doing in its role of regulator, I know that there are discussions going on and that those concerns have been raised with Ofgem as well. We want to make sure that there is a regime in place—

Q468 **Carol Monaghan:** Do you share those concerns, then?

**Tim Lord:** I am not saying that I share those concerns, but I absolutely recognise the importance of cost-reflective allocation of costs and of making sure that we have a regulatory and policy framework that adapts to the fact that the system is changing very rapidly.

**Carol Monaghan:** You recognise them, but you are not willing to share them. That is fine.

Q469 **Vicky Ford:** I was going to ask questions about energy efficiency, but we dealt with quite a lot of them during the first run with the Minister. There is just one specific question. The Government say that they want all homes to reach the energy performance certificate bands B and C by 2035 where "practical, cost-effective and affordable". What proportion of homes do you expect to be able to be covered?

**Tim Lord:** That is one of the things we looked at with our call for evidence last year. As I said earlier, we will bring forward a response to that, with a kind of action plan for homes as part of it. I would not want to put a specific percentage number on what that might look like.

The critical thing, which we have talked about, is that there are some energy efficiency improvements that pay back very rapidly—in one, two, three or four years. There are others that pay back over longer periods.



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There are others that, because of the type or age of properties, are not cost-effective in the long term. Where it is not cost-effective to make those investments, we will look to decarbonise in other ways—for example, through the source of the heating for those properties.

The key thing for us is absolutely that we are ambitious—we recognise the challenge around retrofitting the existing building stock and the importance of that, as we move beyond the power sector, for our decarbonisation trajectory—but also that we make sure that we focus the policy efforts on securing the benefits that have the lowest cost of carbon, ultimately, for consumers and for the UK economy. We should not pursue a headline target at the expense of that.

Q470 **Vicky Ford:** Claire said that she wanted all new homes to meet those performance certificate bands, but my understanding is that there is then this caveat that says that they should do so where “practical, cost-effective and affordable”. Are we talking about the vast majority of homes being covered?

**Tim Lord:** First, I would make the distinction between new homes and retrofits. For new homes, as the Chancellor said, we are going to move to low-carbon forms of heating, to very high standards of energy efficiency. Obviously, there is not the retrofit challenge there, so that is absolutely something that we are going to do.

In retrofit, I would certainly expect to be able to improve cost-effectively a very significant majority of homes. I think that you can improve all homes in some ways. The question is, how far can you get cost-effectively in terms of EPC band C? I expect the majority—and a significant majority—of homes to be able to get there, but I also expect there to be a minority where that is more challenging, because of the nature or age of the property. In those cases, it might be more cost-effective to look elsewhere.

Q471 **Vicky Ford:** What is stopping the Government bringing in that zero-carbon home standard for new homes before 2025?

**Tim Lord:** What the 2025 date really enables us to do is to give a very clear signal to the sector that that is where we are going to get to. It is a very ambitious target to get no fossil fuel heating in new build. The rate of deployment of heat pumps, for example, is now about 20,000 a year, so you are talking about a really significant ramp-up over a relatively short period of time. We want to make sure that we are delivering those carbon savings, but also that we have in place the supply chain that can ramp up quickly, now that we have offered that certainty, to make sure that we can deliver them. I certainly do not expect that to be a flat line to 2025 that then moves up. I expect it to be a trajectory that we will move along over the coming years.

Q472 **Vicky Ford:** Carol has left now, but earlier we talked with the Minister about onshore wind. As I heard her statement, she was talking about the



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possibility of repowering existing onshore wind turbines in a much more positive tone than about new large-scale developments. Is there evidence that the existing onshore wind sites that you would be repowering tend to be in the windier—and, therefore, the most effective—places? Is there such a correlation?

**Tim Lord:** I do not think that one can talk in a blanket way. Wherever people have brought forward onshore wind projects, they have felt that they are able to be profitable, so you would expect them to have a significant wind resource. I think that the wider question around repowering of renewables projects will be on a project-by-project basis, certainly for project developers.

Q473 **Vicky Ford:** Are you looking at a route to market to facilitate that?

**Tim Lord:** Repowering is an issue that will arise increasingly as we move into the 2020s, as some of the early renewables obligation projects reach the end of their subsidy period under that mechanism. We are looking at how we can make sure that we are doing that in a way that is as cost-effective and sensible as possible, building on the existing resources that we have.

Q474 **Chair:** Before I bring Stephen in, may I ask about the energy companies obligation? The plan in 2017 was to upgrade around 1 million homes. It was then amended so that it had to be delivered only in low-income and vulnerable households. I understand completely that that is the priority, but the Government themselves acknowledged that the change “will result in lower carbon emissions reductions being achieved under the scheme”. Why did the Government do that?

**Tim Lord:** These things are always a bit of a balancing act, in the sense that if you pursue the cheapest carbon, while being blind, in effect, to the homes and their occupiers, you will end up with a different profile from what you end up with if you focus on fuel poverty. With the changes that we have made to ECO, we have done two things. One is to focus it more explicitly on the fuel poor and the least able to pay. That means that sometimes you can get a bit less carbon for the money, but that you are addressing both of the issues at once. The second, which was mentioned earlier, is around focusing more of it on innovation, so that it is not simply about rolling out existing technologies that do not have a significant cost-reduction potential, but about focusing some of the funding on technologies where there is really significant cost-reduction potential, beyond ECO and into the economy more broadly.

Q475 **Stephen Metcalfe:** Hopefully, this will be a brief question. In the session with the Minister, I talked about the long-term future of decarbonising our heating system. One way in which that was being tackled in the short term was through the renewable heat incentive, which, as I understand it, has now ended.

**Tim Lord:** Not yet.





Q476 **Stephen Metcalfe:** Not yet, but it is about to. It will end soon.

**Tim Lord:** In 2021.

Q477 **Stephen Metcalfe:** What is going to replace it?

**Tim Lord:** The first thing is that funding for the RHI is agreed out to 2021. It is going to save just under 140 megatonnes of CO<sub>2</sub> over its lifetime, with an estimated lifetime spend of £23 billion, so it is a very significant commitment on the Government's part.

At this stage, I cannot say what the successor to or the future for that scheme will be. As I said, it still has a couple of years of funding to run. However, we are looking at what the future for the scheme will look like and how we can continue to make sure that we are deploying low-carbon heating, aligned with the strategy that the Minister set out earlier around developing a range of different technologies, given the fact that there probably is not a single silver bullet to address the heating challenge in the UK.

Q478 **Stephen Metcalfe:** Is it viewed as a successful scheme?

**Tim Lord:** Obviously, it has delivered significant emission reductions. It has around 80,000 accredited installations. I think that it has delivered innovation and supported market development and cost reduction. But schemes like the RHI on their own will not deliver the levels of decarbonisation that we want to see. As we have mentioned, the Chancellor's announcement in the spring statement is another example of the policy mechanisms that we need to bring to bear to develop that market beyond just the RHI and into the wider economy.

Q479 **Chair:** It is also fair to say, surely, that the RHI has massively fallen short of what was anticipated. It was initially hoped that it would fund 513,000 installations by 2020, but it is on track to install 111,000. That is about a quarter.

**Tim Lord:** As you say, the delivery has been a bit lower than some of the earlier numbers that were done around the RHI. There are obviously challenges in rolling out a scheme of that kind. It has been successful in delivering emission reduction, developing markets and so on, but some of the numbers are lower than was anticipated.

Q480 **Chair:** Sixty thousand renewable heating systems have been installed, compared with 6.2 million gas boilers.

**Tim Lord:** You are still seeing gas boilers being installed—absolutely. As the Minister said, that is one of the really big challenges. The RHI has helped to address that, but it will not be the only solution to that challenge.

Q481 **Graham Stringer:** We have had mixed evidence, both written and verbal, about whether Drax is carbon neutral on an annual basis. What is the Department's view? I have met people from Drax, who say that they



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are carbon neutral. We have had written evidence saying, “Oh no, they are not. You have to wait 30 years, and they are not accounting properly for the time of growth and the carbon dioxide release from the soil.”

**Tim Lord:** Clearly, on the evidence of the conversations that you have had, it is a very complex area. We have supported significant biomass generation in the UK. We have some of the most stringent standards in the world around the fuel sources for that biomass and have continued to make sure that that is the case.

Earlier we talked about the importance of international action. There is a broader question that we and our international colleagues are going to have to address around the role of bioenergy, where that is most cost-effectively deployed and how we can make sure that we are deploying it in a way that minimises emissions, both from the supply chain and in terms of the crops and other activities that biofuels can potentially displace. That is one of the big challenges that we have as we move out towards 2050 targets and, potentially, net-zero worlds. That is clearly going to be a major challenge.

Q482 **Graham Stringer:** Is it producing more carbon dioxide or less?

**Tim Lord:** I am afraid that I cannot say more. My colleagues in the Department can provide you with more information. We have some of the most stringent biomass standards in the world. The embedded emissions within the supply chain are absolutely quantified as part of that.

Q483 **Graham Stringer:** At least it is helpful to know that we do not know.

I turn to my second question. When I asked the Minister about the cost, she pointed out that prices have fallen, which is a good thing if you are a consumer. But it is also a complete failure of policy, isn't it? Most of the policy since the time when Miliband was Energy Secretary has been based on the price of hydrocarbons going up, but it has not—it has fallen. I do not want you to contradict the Minister. I am not trying to trap you in any sense—I realise that you are an official—but the fact that prices have gone down actually undermines the policy direction over a 10 or 12-year period.

**Tim Lord:** I will offer a couple of thoughts. First, the point that the Minister was making was that the investments that we have made in energy efficiency essentially outweigh the additional cost of some of the subsidies that we have given to renewable energy to bring the cost down. Projecting forward is hard in any sector, but in the energy sector it is really challenging. There are plenty of charts that will show how projections of everything from fossil fuel prices to solar deployment have changed over time.

The one point that I would make is that something else has happened over that period, which is that the costs of renewables have come down far faster and far more than anyone predicted. When I started working in offshore wind, we were talking about £100 a megawatt-hour by 2020—



and we thought that that would be pretty good. What we are actually seeing is £57.50 in the most recent auction, with the next auction starting in May this year. Similarly, solar costs have fallen by 80% over the last six or seven years. Again, that far outweighs what people would have anticipated. You are seeing those cost reductions offsetting to some degree some of the effects you were talking about.

**Q484 Graham Stringer:** You said the costs of offshore wind were coming down. Do they include decommissioning costs, maintenance costs and connection costs?

**Tim Lord:** They do include costs such as connection—absolutely. We are not stripping that out. Other countries fund in different ways, but we include the cost of the connection requirements within the CfD. As far as possible, we are assessing like against like and enabling a level playing field.

**Q485 Graham Stringer:** What about decommissioning and maintenance?

**Tim Lord:** Decommissioning and maintenance are included in the overall cost.

**Q486 Graham Stringer:** The area that is doing poorly is transport. What is the Department's relationship with the Department for Transport like? What policy areas are you asking it to improve as regards carbon dioxide reduction?

**Tim Lord:** As you say, transport is one of the most challenging sectors that we have. It was the fourth largest emitting sector back in 1990, which we often use as the baseline. It is now the largest emitting sector. We are making progress. Transport emissions came down in the most recent provision of statistics for 2018, but we absolutely need to—

**Q487 Graham Stringer:** Does that include the manufacture of the cars?

**Tim Lord:** It is on a UK territorial emissions basis, so it does where that takes place in the UK.

**Q488 Graham Stringer:** If they are made in Germany, it does not.

**Tim Lord:** That is correct. We talked about the consumption emissions earlier.

We work very closely with the Department for Transport. We have two joint units between BEIS and the Department for Transport. One is the Office for Low Emission Vehicles, which is there to incentivise the roll-out of low emission vehicles. The second is the Centre for Connected and Autonomous Vehicles, which is a linked and very important technology. We are working very closely on a number of things: the route to market for low-carbon vehicles, in particular; the infrastructure charging network, as it is critical that over the coming years we make sure that we have a network people can rely on; and emissions in other sectors. Obviously, there is a challenge around cars. There is also a challenge



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around commercial and heavy goods vehicles. Similarly, there is a challenge around shipping, aviation and so on. We are working together very closely and have a range of cross-Government structures that enable that to take place.

**Q489 Graham Stringer:** The Committee on Climate Change does not think that the targets for ultra low emissions are sufficient to meet the UK's existing emissions targets. Do you agree, or are you responding to what the Committee on Climate Change is saying?

**Tim Lord:** The Minister addressed the 2040 target earlier. One of the key challenges on low emission vehicles is precisely the challenge that you have talked about with the energy sector more broadly, around projection, because the costs are changing very rapidly. The costs of batteries are coming down. A lot of that change will be market driven, rather than Government driven, because the costs of those vehicles will come down. We are working very closely with the DFT to make sure that we have the right set of policies in place to enable those costs to come down and, therefore, to enable us to meet our projections for the long term.

We will look very closely, as we always do, at what the CCC says and what it has recommended. We have subsidy in place for purchase of vehicles, particularly the most low-carbon vehicles. We are also taking very seriously what the CCC says about the importance of charging infrastructure, which I have mentioned, working with National Grid and others.

**Q490 Graham Stringer:** This is my final question. I sit on the Transport Committee as well as this Select Committee. We spend a lot of time looking at congestion and how one can get a more efficient use of vehicles. Does your Department get involved in that debate, whether it is about car sharing or about different ways of having more intelligent journeys by using apps on phones?

**Tim Lord:** We are very much involved in that discussion. Often there are co-benefits here. There are co-benefits from electric vehicles around air quality. As you say, technology deployment more broadly to reduce congestion can also help to reduce emissions.

As part of the industrial strategy, we have four grand challenges. One of those is clean growth, which reflects the priority that the Government put on this. Another is the future of mobility. Essentially, we understand that it is not a case of everyone using transportation in the same way as they do now, but just doing it in electric vehicles. Rather, it is a case of rethinking how we move around and making sure that we are doing that much more efficiently. We are working very closely with the Department for Transport on that and also, because of BEIS's relationship, with the auto sector and other manufacturing and services sectors in the economy.



Q491 **Vicky Ford:** I have a question about electric vehicle charging infrastructure. I get this at a local level quite a lot. Is there more that we could do to support and encourage local councils to invest in more charging points?

**Tim Lord:** We are doing a lot of that already. We have over 14,000 public charging points in place, but we are also looking at what we can do further, both on the strategic infrastructure, around motorways and so on, for people who are travelling long distances, and, as you say, in local areas, to make sure that we have the right infrastructure in place and that, right down to distribution network level, we have resilience in the network to enable people to continue not only to charge their vehicles but to do all the other things they want to use electricity for.

Q492 **Darren Jones:** I have a quick follow-on from one of Graham's questions. I will then come to my specific questions. It is on the biomass markets issue. There is one thing that I have never really understood with this argument. If you are creating a market for wood to burn, how does that align with our policy commitments on trying to stop deforestation in places around the world? How on earth can we regulate that? What is the Government's position on that point?

**Tim Lord:** Our biomass standards have requirements around what happens when you have chopped the tree down in order to burn it and making sure that that area is reforested, rather than left and used for something else. As you say, it is a really critical part of the bioenergy story that, where you are burning trees and other forms of bioenergy, which, ultimately, are carbon stores, you are reforesting or replacing those—and potentially, in the longer term, into the future, capturing the carbon where you burn it and turning that into negative emissions.

Q493 **Darren Jones:** How do we check where a tree comes from if it is chopped up?

**Tim Lord:** For use in power generation, for example, there are requirements around the verification of supply chains and so on that ensure that people who are burning wood can demonstrate where they have got it from and what the forest management and so on that lies behind it is.

Q494 **Darren Jones:** I will go on to my specific questions. We have taken evidence on the capacity market, which you spoke about earlier in relation to the innovation space. In the past, when there is peak demand, there has been a requirement to pay for diesel generators, coal or quick mechanisms to get power on to the grid. Clearly, if we want to get towards net-zero or negative emissions, we want to move away from that. What more are the Government going to do in the capacity market to make it easier for renewables to be able to provide that peak-demand energy?

**Tim Lord:** I agree with what the Minister said earlier about a diversity of sources of generation being incredibly important. Obviously, things like



diesel generation are potentially very problematic if they are running all the time. If they are running for one half-hour or two half-hours a year, providing relatively low-cost power precisely at the point at which you need it, that is not necessarily quite as problematic.

The capacity market is intended to be technology-neutral. What we care about is security of supply, not necessarily the technologies that bring it forward. One of the challenges with that is making sure that it is designed in a way that enables lots of different technologies to come forward in the most effective mix. We are consulting at the moment about that approach and making sure that, for all technologies, the capacity market is providing appropriate and fair treatment, so that their contribution to security of supply is properly reflected.

Q495 **Darren Jones:** One of the answers, is it not, is that if we had better storage and the ability to move flexible generation from renewable sources, we would not need someone to burn some diesel in a can?

**Tim Lord:** I think that that is right. I mentioned earlier that one of the challenges in the energy sector from a policymaker's and regulator's point of view is the fact that new technologies are coming forward that behave differently from old technologies. Storage is a great example of that. Both we and Ofgem are doing a range of things across the market to make sure that storage providers can bring their products and services to market in a way that enables them to compete fairly with the more traditional forms of generation.

**Darren Jones:** This debate has been going on for quite a few years. I should probably declare my interest. I met my wife at a debate on this issue a number of years ago.

**Bill Grant:** Thanks for sharing.

**Darren Jones:** Exactly. People who were storing energy, because they were taking it from non-generation sources, were not able to bid for capacity market funding and then to put it back on. That was because they were not generating brand-new power, but just moving it around.

**Chair:** Reith sounds very romantic.

Q496 **Darren Jones:** It was. If there are any single people listening, I can recommend the lecture series.

One of the bits of evidence that we have had is about the need to legislate for energy storage. Do you know what the Minister's plans are to bring forward legislation on energy storage?

**Tim Lord:** We have already taken a range of steps to enable storage to participate more fairly in the market. As you say, there were issues around the fact that storage was paying to be a generator, but also paying to be a consumer of energy, for example, which was challenging. I am not sure about any specifics on further legislation that people are





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seeking or require, but I am sure that we would be happy to provide more information.

Q497 **Darren Jones:** Because of time, maybe we will come back to that.

This is my last question. I do not know whether you were here for the previous panel, but there was a quick question on the EU emissions trading system. If we were building our own system from a blank piece of paper—I declare my interest in wanting to stop Brexit, so maybe we will not have the opportunity—how would we upgrade what the EU emissions trading system offers, certainly around the de-emissions, as opposed to the emissions? I cannot remember the language that Vicky used—is that right? Did you hear that bit?

**Tim Lord:** I did not, I am afraid. I was outside for that part of the session.

Q498 **Darren Jones:** Do we have any plans to extend the EU emissions trading system, or are we happy with the way it is?

**Tim Lord:** The EU emissions trading system is still the largest trading system in the world. It is an incredible achievement, when you think about the range of emissions that it captures, the range of countries that it captures and the way in which it has helped to bring emissions down. I am sure that you will understand that I am not able to speculate on what a longer-term, post-Brexit trading system might look like. Certainly, we are looking at a range of options, including linking to the EU ETS or a more independent scheme. As part of that, we would want to make sure that we were optimising for cost-effective emission reduction.

Q499 **Darren Jones:** Has the Minister said anything publicly on this, or is it just something you guys are still working on?

**Tim Lord:** The Minister has not taken a decision as yet about what our future relationship with the EU ETS should be.

Q500 **Chair:** Do you know whether the EU Commission is itself working on whether the trading scheme can be adapted to incentivise greenhouse gas removal, as well as reductions in emissions?

**Tim Lord:** By incentivising greenhouse gas removal technologies, do you mean things like direct air capture?

**Chair:** Yes.

**Tim Lord:** I am not aware of any such activity at the moment. Certainly, one of the things the EU is looking at is the long-term, 2050 pathways for the EU as a whole, in much the same way as we are looking at them for the UK. Greenhouse gas removals have an important role to play in that, potentially. I am sure that, as that work develops, the EU will be looking, as we will, at how existing policy mechanisms are best adapted.

Q501 **Bill Grant:** We have an increasingly diverse and yet interdependent energy system, with sources such as onshore and offshore wind, solar,



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nuclear, hydro, gas, biomass and, possibly, tidal. You then have three partners beside that: storage, intermittency, which is a risk, and capacity. How are the Government co-ordinating decisions across the various sectors? Who pulls it all together?

**Tim Lord:** We in the Department do, I guess. For example, last year the Secretary of State made a speech on energy strategy, in which he set out some of the principles that we are following. We have said that we will publish a White Paper later in the year, which will do some of the things you are talking about in setting out the vision for what the future looks like, as some of the technologies you have referred to evolve and as the way in which the system works changes.

Q502 **Bill Grant:** So it is wholly your Department. Do you reach out to other Departments?

**Tim Lord:** Yes. We work together incredibly closely. We work very closely with the Treasury, for example. We work very closely with the Ministry of Housing, Communities and Local Government on issues around planning. We work very closely with DFT on transport, which obviously has very strong links into the power and energy system more widely. There is a huge amount of cross-Government collaboration on all those issues.

Q503 **Bill Grant:** With the aim of matching supply and demand and, at the same time, decarbonising the system.

**Tim Lord:** Absolutely. One of the benefits that we have in the UK is that we have the carbon budgets framework, which is legislated for. Those are legally binding targets, so we know what we need to achieve in that respect. We know that we need to maintain security of supply. We know that we need to make sure that we have a system that is fit not just for now, but for the future, and that we are keeping costs down. We work with colleagues across Government to make sure that we are achieving that.

Q504 **Chair:** Brilliant. I think that you have to be in the Box for the urgent question, so you had better go.

**Tim Lord:** I do, I am afraid. I have an easy job.

**Chair:** Thank you, Tim and Damitha, for your time. It is very much appreciated. Thank you for performing without the Minister next to you.