

Environmental Audit Committee

Oral evidence: UK export finance, HC 1804

Tuesday 5 February 2019

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Members present: Mary Creagh (Chair); Mr Philip Dunne; Zac Goldsmith; Caroline Lucas; John McNally; Kerry McCarthy; Alex Sobel.

Questions 1-38

Witnesses

I: Professor Kevin Anderson, Professor of Energy and Climate Change, University of Manchester, and Deputy Director of the Tyndall Centre for Climate Change Research, Navraj Ghaleigh, Senior Lecturer in Climate Law, University of Edinburgh, and Professor Jim Skea, Chair in Sustainable Energy, Imperial College London, and Co-Chair of Working Group III of the IPCC.

Written evidence from witnesses:

- [Navraj Ghaleigh - written evidence](#) | [PDF version](#) ( 118 KB)

Examination of witnesses

Witnesses: Professor Kevin Anderson, Navraj Ghaleigh and Professor Jim Skea.

Chair: I welcome our panel to start our first hearing in the Committee's inquiry into UK Export Finance. I welcome our three very distinguished guests. Please introduce yourselves, from my left.

Navraj Ghaleigh: I am Navraj Singh Ghaleigh, Edinburgh Law School, University of Edinburgh.

Professor Skea: I am Jim Skea, professor of sustainable energy at Imperial College and co-chair of IPCC Working Group III. I should also mention that I have recently been appointed to chair the Scottish Government's Just Transition Commission, which touches on this topic.

Professor Anderson: I am Kevin Anderson, a professor at the University of Manchester and at Uppsala University in Sweden. I was previously director of the Tyndall Centre for Climate Change Research.

Q1 **Chair:** Brilliant. Thank you all very much indeed for coming. Can we start off by big-picture scene setting? Can you tell us how much of the world's reserves of fossil fuels we can afford to exploit if we are going stay either in a 1.5° C world or a 2° C world? Does anybody know?

Professor Skea: Maybe I can come in on that. There was a paper done by colleagues at UCL about this about three years ago, where they certainly defined that a large chunk of fossil fuel reserves were unburnable if you were going to achieve the Paris targets. They used 2° warming as their target. In the recent IPCC report on global warming of 1.5° C, we did not identify specifically the level of unburnable reserves. What we did do was look at markets for fossil fuel, the volumes of fossil fuels that might still be used in different scenarios—1.5° C, well below 2° C. We also looked—though it is a little bit more shaky—at evidence on the amount of investment needed in the future on fossil fuel extraction.

Q2 **Chair:** Can you talk us through some of that—those markets and the different scenarios, and the amount of investment needed? Was it the £23 trillion?

Professor Skea: Let me say this right at the beginning: IPCC attaches confidence levels to all its conclusions, and all the conclusions around investment were medium confidence rather than high confidence. The investment side of it in fact relied really on only one study—one paper—which compared six different models. I have to say there was quite a lot of variability between the results of the different models if you poke into it. Broadly speaking—I have the extraction of fossil fuels numbers in front of me at the moment—if the nationally determined contributions are fulfilled, investment would stay roughly at the same levels up to 2030, but might perhaps double by 2050. This is under the nationally determined contributions. If we were looking at a scenario which was about well below



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2° C warming, there is maybe a 20% decline in investment by about 2030, and a little bit more by 2050. In the case of a 1.5° C warming scenario, on average, between the models, you are perhaps looking at about a reduction of a third in investment in the extraction of fossil fuels by 2030.

Q3 **Chair:** That is very helpful. Who did that paper? You said there was one paper.

Professor Skea: This paper was by a gentleman based at IIASA, the International Institute for Applied Systems Analysis, called David McCollum, and it was in *Nature Energy* last year.

Professor Anderson: Can I just revisit the paper you mentioned earlier, about the proportion that you can omit? The paper that I think Jim was referring to was the one by Christophe McGlade and Paul Ekins. I think it was over three years ago—that shows how time passes. That paper was aimed at a 50% chance of 2° C—so a low chance, if you were thinking 2° C was serious. It also embedded within it, if you looked at the accompanying spreadsheets, about 360 billion tonnes of carbon dioxide removal from the atmosphere. That is, about 10 years of current global emissions were assumed within the paper; they were not written about in the paper. I asked Christophe McGlade, who is a colleague, for the accompanying spreadsheets. That paper had somewhere between—depending on how you looked at the resources around the globe—60%-plus of global emissions could not be burned for a 50% chance of 2° C, if you believed in highly speculative negative emissions at a level that is 10 times current global emissions. In other words, you have to hold a belief that a technology that does not exist at any sort of scale will work in the future to remove huge quantities of carbon dioxide from the atmosphere. Even when you do that for a 50% chance of 2° C, you still can't burn 60% to 70% of current known fossil fuel reserves at that time, which is quite a few years ago now.

If you then go to a better chance of 2° C—well below 2°, like the Paris agreement, or 1.5°—the budgets get considerably smaller. The amount of CO₂ you can emit is considerably smaller. So, without doing the calculations within the paper, the work that we have been doing and that we use is that probably somewhere between 80% to 90% of current reserves could not be combusted if you were to hold to 1.5° C, based on the carbon budgets in the IPCC report AR5 for 1.5, and if you were not reliant on negative emission technologies. Any number you ever get, always remember to ask, "Are negative emission technologies assumed?" because they almost always are.

Q4 **Zac Goldsmith:** Does that include forests?

Professor Anderson: That 360 billion wasn't. It was mostly through NETs. There is an argument that you could remove more through forests.

Q5 **Chair:** And the soil. What about the four parts per 1,000 each year improvement? That is one of the targets our Government has signed up to, but there is no road map to actually achieve it.



Professor Anderson: There is a lot of uncertainty on this. Others may know much more about it than me. There are some interesting papers out on soil, and as an engineer you start realising how complicated biology and ecology is, because the error bars are just enormous. On soils, there are lots of issues about what the emissions might look like under different scenarios, and I think it is fair to say that there is a lot of uncertainty, other than that, overall, the way we are going at the moment is making the situation much worse. There were two papers of that nature a while ago that said you could roughly halve our carbon budget by 2° C from emissions from soils.

On forestry, we have to be very cautious about this. A lot of the forestry that is assumed in the models is just afforestation—in other words, planting forests, almost regardless of where they are. Where you plant them impacts the soils dramatically. If you have forest restoration—existing forests, and you improve the management within the forest—you get good carbon sequestration. If you have reforestation, which means a forest that was chopped down relatively recently, where the soils are appropriate for growing forests, and you grow forests on those, that also gives you good soil containment of emissions and good carbon sequestration.

If you go for afforestation—in other words, planting areas that were not recently planted with trees—you can actually have more warming impacts from the impact on the soil than the carbon sequestered in the trees, so we have to be very careful about understanding the details of these things. Often the devil is in the detail.

Chair: That is why you are here. *[Laughter.]*

Professor Anderson: This is not my area, I hasten to add.

- Q6 **Zac Goldsmith:** Can I jump in? Professor Anderson, can you explain the last point you made? Why would planting on areas that have not recently been forested have a negative impact?

Professor Anderson: Because of what happens to the soils themselves. When you plant on areas that were not planted, the types of soils are different and they are not necessarily suitable, or they will have emission implications when the tree is first growing, and during the planting phase. I can point you towards people who work in detail—

- Q7 **Chair:** What is recent—500 years, 2,000 years, 50 years or 10? What are we talking about?

Professor Anderson: I say this advisedly, because it is not my area, but I think it is more in the 100-year timeframe. It is not in the thousands, but it is in the 100-year timeframe, and it depends on exactly what has happened to the soil in between. All I am saying is be very cautious when people just talk about forestry in the blanket sense, because the detail is really important.

Chair: That is very interesting.



Professor Skea: Can I just try to turn this into a fairly high-level point? The computer models that IPCC assessors assess operate by assuming a menu of different mitigation options, and the models choose from them. It is becoming quite clear that the models are making quite heroic assumptions about some options, particularly bioenergy with carbon capture and storage, and do not include in their menu some more so-called nature-based solutions that would involve managing land differently.

For that reason, the IPCC is currently preparing a special report on climate change and land, due to be launched in August, that will get deeper into these issues. Just to echo the point that Kevin Anderson made, those of us who are coming more from the engineering, renewable energy side are devastated by the complexity of land and forest. It is really difficult stuff.

Chair: Welcome to our world. This is why we cross over all Departments, and this is where the really interesting stuff happens, in my view.

Q8 **Mr Dunne:** Thank you very much for coming. We appreciate the effort you have made to talk to us. You have been talking about the investment required to extract fossil fuels at a lower level in order to keep within the climate change targets. Have you done any work on the investment required in alternative energy sources to manage the amount of energy that the world will consume, which we assume will continue to grow, from sustainable sources?

Professor Skea: The paper I referred to from David McCollum, which was assessed in the IPCC 1.5° C report, had quite a large overview of all the energy-related investments that would be required in 1.5° C pathways. Basically, the overall conclusion is that the aggregate level of investment in the energy sector would need to be higher in the 1.5° C scenarios, because low-carbon generation, for example, tends to be more capital intensive than generation relying on fossil fuels.

The key point within the different pathways and different levels of ambition is the more ambitious you are, the less you invest in fossil fuel extraction and, say, coal-fired power stations, and the more you need to invest in renewable energy, especially wind and solar, and demand-side measures—so improving energy efficiency. That is a very robust conclusion from the modelling. All the models agree on that.

Navraj Ghaleigh: There is a huge range of opinion in terms of the recent studies about the level of investment required for 1.5° warming. Pollin, for example, says that you are talking about 1.5% of global GDP, which is roughly 1 trillion per annum, globally.

Q9 **Chair:** Pounds or dollars?

Navraj Ghaleigh: Dollars—those days have passed.

Chair: We are going to have a new 50p commemorative coin—I bet you are excited about that.



Navraj Ghaleigh: The New Climate Economy puts it much lower: they say it is 0.35% of global GDP. There is a very wide variation, but within that, additional to what Jim said, you are talking about the need for huge shifts in the locus of that investment, with dramatic reductions in unabated fossil fuels—the figure that the New Climate Economy gives is a reduction of 300 billion per annum. It also means huge increases in renewables—typically 60% per annum—tenfold increases in CCS and sevenfold increases in energy efficiency. It is very much about shifting the pattern of investment within a much expanded overall envelope. According to Pollin, we are currently at about a third of the required sum.

Q10 Mr Dunne: Our inquiry is into the activities of UK Export Finance, a relatively small player in UK public sector spending, and the proportion of projects within it that account for energy. We have heard from our advisers about the 20% funding that it puts out each year, but less than 1% goes into renewable energy rather than fossil fuel projects internationally. What we want to get a sense of from you is whether that is an appropriate allocation. If not, what do you think it should be? If part of UK Export Finance's objective is to help UK exporters to finance projects internationally, should its remit change?

Navraj Ghaleigh: Jim is probably the expert here, but if we are going to hit 1.5° or anything close to it, all the pathways say that we need very rapid decarbonisation, demand-side mitigation, electrification and emissions reductions now—meaning the decade from 2020 to 2030—as well as carbon dioxide removals. If that is correct, and if it is what we want to do, the current pattern of UK export finance is simply flatly inconsistent with it.

It is important to note that the pattern of UK export finance that practically everybody who has given written evidence to the Committee has laid out is not global. Other export finance agencies have a rather different pattern of export support. The most radically different one that I have identified is Export Development Canada; in 2017, which I think is the last year that it has reported on, it supported 1.5 billion of renewables. I do not know the exact number, but I suspect that that must be two or three orders of magnitude greater than what UKEF managed. That is from a jurisdiction that, it must be said, does not have nearly as good a story to tell about climate action as the UK.

Professor Anderson: I second the point that it is completely incompatible to be investing in fossil fuels elsewhere in the world if we are going to meet our Paris commitments. We need to be very clear about this: when we invest in fossil fuels, we are locking in high-carbon infrastructure for decades to come, sometimes in poorer countries, along with all the other accompanying air pollution issues.

If we are not to rely on these negative emission technologies, which we have to be very cautious about because they are everywhere in this scenario, and if we think that they are sufficiently speculative that we should research them but not assume that they will work, we need to get to zero-carbon energy—not electricity, but energy—by about 2035-40 for



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the OECD countries and by about 15 years later for the non-OECD countries, on average. Any investment in fossil fuels will play against that; as David MacKay pointed out many years ago, we should not be investing in energy from fossil fuels.

The other thing to bear in mind from an investment point of view is that, at a global level, but also particularly for the industrialised countries, about 20% of the final energy demand that we can assume is electricity; 80% is not electricity. If you go to France, even with all its nuclear, or Sweden with its nuclear and hydro, still only 30% is electricity and 70% is not. So when we talk about these technologies, the ones we talk about at the moment are always to do with electricity: renewables, CCS, even nuclear. All these things are supposedly low carbon. I would argue that CCS is not, but that's a different issue. They are all to do with electricity, so this investment requires us to convert the other 80% of the world's energy sectors to become basically something very near approaching electrical.

We could say we could use hydrogen, but you will probably make that using electrolysis or thermal decomposition—in other words, using electrical power stations—so it is very hard to imagine zero-carbon energy options that do not have some significant electrical dimensions. Bear that in mind. We are not just trying to convert the electricity system to a low-carbon future; we are trying to convert the energy system, and that is a much more challenging issue than when we just think about the electrical part itself.

Professor Skea: Could I just add to this a slightly different perspective and say, with my IPCC hat on, we are enjoined to be policy relevant, but not policy prescriptive, so I should not answer questions with the word “should” in them, because that falls out of it. The evidence from the IPCC 1.5 report is important, but it would not be a clinching factor in any policy decision. What this shows is that there will be continued investment in oil and gas, perhaps not in coal, in the 1.5 scenarios. The McGlade and Ekins paper, which Kevin Anderson mentioned, has continued investment in reserves growth from existing fields, like tight oil in the US and some Arctic work as well, falling into it. So the investment in fossil fuels will fall, but it doesn't vanish. That poses a policy question. It is a policy choice for the UK as to whether it wants to be involved in these kinds of investments at the moment, because somebody somewhere will still be doing them even in a 1.5 world.

Professor Anderson: I do think, though, that if you look at the scenarios in the IPCC that fit that, without exception they rely on significant negative emissions. If you take the negative emissions out, you end up with quite a different conclusion. Again, you have to hold the view that technologies that do not exist will work in the future at between one and four times the size of the current fossil fuel industry to remove the carbon dioxide from the atmosphere. The levels assumed in most of the models range from, not uncommonly, 300 billion tonnes—so very approximately 10 times current total global emissions—up to about a trillion tonnes. These are



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absolutely heroic assumptions that are almost ubiquitous in the scenarios submitted to the IPCC. They are for 2° C and for 1.5. In some of the scenarios submitted for 3° C, they still are very common. So the negative emissions have completely skewed, in my view, the arguments that we make. If you hold to the view that it is reasonable to assume they will work, you can perhaps follow some of those conclusions. If you think we should not assume they work, you come up with very different conclusions.

Q11 Chair: Can I just ask, then, why are they included? If that is not too political a question for Professor Skea to answer.

Professor Skea: The IPCC's job is to assess the literature, and that is what is in the literature. In the 1.5 °C report, in one of the chapters we increasingly point out the challenges that such scenarios pose for sustainability and food security, which will absolutely be part of the special report on climate change and land, which is due to be launched in August. I do not disagree with Kevin. There are some very heroic assumptions embodied in these scenarios. That is what is in the literature at the moment, and we need to look very carefully at the feasibility of these scenarios in a wider context.

Q12 Chair: I am genuinely interested. Why does the literature assume things that haven't been invented yet? Is it political with a small "p"?

Professor Anderson: Partly it is political. In fact, if you look back at the history of how these scenarios develop, they have always had this dimension in there. Quite a lot of the earlier scenarios assumed that you had a time machine and that emissions peaked in the past, including the Stern report, interestingly enough, which was out by about six years in terms of emissions. It is important to see why these things emerge in virtually all models. Remember, all these models—there are only a handful around the world, probably six or seven, that are very large—these are not climate models; these are integrated assessment models. There is a very clear distinction between the two. They have a very strong economic approach. They all basically use a neoclassical growth model—a general equilibrium model, in a sense, or something very near that. They apply discount rate of around about 5%.

So what you have are technologies in the future—almost all of the scenarios assume that the major negative emissions occur after 2050. So when I will be retired in Tuscany, our next generation will be removing the CO₂ from the atmosphere using the technologies that we don't have. By doing that, you have a 5% discount rate, so everything after 2050 is virtually free. Now you have an option in your model—most of them are cost-optimised or cost-effective models. What they do is, they say, which is the cheapest route—technology today, which costs you money, or a technology that does not exist, with estimated costs for 2050 and beyond, that we then discount at 5% in virtually every single model?

Even when you ask them what their sensitivity analysis is, it is only very small—around the 5%. So inevitably, these models will say that it is more



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cost-effective to wait for the future, rather than putting these other technologies in place today to reduce emissions, or changing behaviour today or to changing demand today. That is why all the models give a very similar output—because of the 5% discount rate that is in them and the assumptions about the costs of these technologies that do not exist.

What is nice about them is that they give a politically palatable outcome. You can make the judgment as to whether that influences us when we try to go for funding or not, but I think there is a question to be asked about systemic bias of the modelling, in this case towards these negative emissions. You may want to think about that in the Committee when you are looking at investment in fossil fuels.

- Q13 **Chair:** I think it is interesting that the mitigation and the future invention of things does not come across when you just read about it in the papers. We are quite a specialist Committee and I think most of us were unaware of it.

Professor Skea: This is a comment on modellers rather than models. Ten years ago, the people who ran these integrated assessment models were in the back of their laboratories, running computer models, without the policy world paying very much attention to them, so they have perhaps put some quite artificial constraints and methods into the models. With the Paris agreement, they have been pulled into the daylight and the spotlight is now on them. Now the challenge for them is really to think more about the reality and the serious constraints and issues that some of the model runs are actually raising.

In the next full IPCC assessment report, which is due in 2021, we have deliberately designed the structure of the report to put some challenges to the integrated assessment modellers, by thinking about nearer-term issues and what is practical.

Chair: That's fantastic. Great—sign me up for the class.

- Q14 **Alex Sobel:** I am trying to overcome my deep depression now. I will start domestically and then we'll move out globally. Perhaps Kevin could start us off on the first one.

How can a move to net zero emissions align with a prosperous UK? How can we keep our economy going? Is the green new deal that is about to be laid in Congress in the United States by a range of new Representatives and Senators something that we would model here?

Professor Anderson: I think you can take things from my understanding of the prospective green new deal, but academics are always awkward people; they want to unpick every word—"What do you mean by prosperity? Have we seen prosperity since 2008?" For a lot of people in the UK, certainly no. So it depends what you are defining and what you are trying to genuinely achieve.

I personally think that in the wealthier parts of the world—basically the OECD countries—you cannot reconcile 1.5°C or even 2°C with continuing growing economies, if you measure economies as we measure them



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today. We can measure things differently—we can measure job security, we can measure river quality, we can measure female literacy; we can measure those things—but if you convert them into pound or dollar signs, then I don't think you can reconcile growing economies with the rates of reduction that are required, unless you rely on negative-emission technologies. They will rear their heads everywhere. Well, they won't rear their heads, because they are hidden behind the scenes, but they are there, everywhere.

We are in a very difficult position and I think that most of the time, including in the academic community, we are still with our heads in the 19th century or, if we are really lucky, we might be in the 20th century. We are not in the 21st century. We are still trying to solve the problems and the mindsets of the last century. We still talk about base-load. We still talk about the electricity system that we had then, not the one that we will require that needs to be at least three to five times bigger in a very short period of time, with all the different variations that that would bring.

We haven't really focused on demand. We haven't really started to look at what we can do on the demand side. It is really good that Jim and his co-chair in the IPCC Working Group III that look at mitigation are driving a different agenda there. We are going to get some really new insights, hopefully, in the new IPCC report. Historically, though, we have been really poor at looking at demand. It has been almost an exogenous issue.

Finally, beyond that, it comes back to the prosperity issue. We don't look at where the emissions come from. There was a wonderful report by Lucas Chancel and Thomas Piketty in 2015, just before Paris, on carbon inequality. 50% of global emissions come from 10% of the global population; 70% of global emissions come from 20% of the global population. So when we talk about prosperity, are we talking about prosperity for that group? Or are we talking about prosperity for the other huge swathe of people who hardly emit any carbon dioxide? I personally would like to see their emissions going up, including the people in fuel poverty in the UK—10% to 15% of all households—but that means that people like professors, and probably most of us here, would have to see dramatic reductions in our emissions.

Prosperity is a question that needs to be unpicked if we are to solve, or respond to, the scale of the challenge that is laid out in the Paris agreement. Thus far, the academic community, the NGO community and the policy community have fundamentally failed to appreciate that.

Q15 Alex Sobel: But if we implement a new green deal with a just transition, does that not create a lot of new jobs and opportunities? Hydrogen production, electric vehicle manufacture, all the infrastructure that needs to go with that, the transformation of the grid—for a period, which should start now, will all that not generate economic growth in the traditional sense?

Professor Anderson: That is an argument I regularly hear. We have to go back, really—Roosevelt is a good example: "You don't make cars any



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more; you make tanks.” We are not going to be making tanks, but perhaps we should not be making cars; we should be making trams or wind turbine blades. Maybe we would make some electrical cars.

Just because you have all that activity, it is not in addition to what we do today. The labour resources, the material resources and the energy resources that we use today to furnish the luxuries of the 20% will need to be used—this is not a socialist argument, but a mathematical argument—to make the rapid shifts in our infrastructure to become zero carbon. It is not on top of other things.

Maybe we will have growth, but that is why I prefer a post-growth view of the world that does not look at economic growth, which has virtually never had any relevance anyway. You look at the components that are desirable and maybe you measure those, if you want to measure it in some way. But I don’t think that you can necessarily say, just because you are going to have all these activities—which we will have, of course—that that will necessarily see economic growth.

I would also go one layer back to, for instance, when you said, “We must have electric cars.” This is where we have to question the way we think about this. Is it still reasonable that I might get in an electric car that is powered by renewable power? I am 83 kg and the car is 2,000 kg, so am I going to drive 6 km in 2,000 kg of metal to pick up 10 kg of groceries? I think in 2019, we can come up with different ways of framing the problem. If we are going to frame the problem like it was the 1950s or the 1990s, then we are going to fail on climate change anyway. So it is not just about the kit; it is about how we do what we do—particularly for those of us in that top 20%.

Alex Sobel: We could open up a whole really interesting thing about cultural change and how people need to live their lives differently, but I think that might be for another session.

Chair: There are 23 kg electric bicycles.

- Q16 **Alex Sobel:** Or you don’t have a car and should people have autonomous vehicles and share them; but they would still need somebody to make all these things. In terms of the last point, before we got on to that, is there not a point here about the environmental and social justice of the transformation? You are talking about the 20% consuming less, but even in our advanced economy we still have the 80%—the people in fuel poverty and all the rest—that we need to pull out. This could provide a solution to those social problems as well as the environmental problems that we face.

Professor Anderson: Certainly, we have 25 million households in the UK, of which probably 24 million are rubbish. Probably about 17 million to 20 million of those will be here in 2050. They need to be retrofitted if we are going to reduce heating demand. Remember: domestic heating demand in the UK is roughly the same as total electricity demand in the UK. Industrial heating demand in the UK is also roughly the same as total electricity

demand, so industrial and domestic heating are roughly twice the size of current electricity demand in terms of terawatt hours.

We are going to have to retrofit our houses if we are going to start responding to climate change. As you say, that has lots of social repercussions and lots of benefits in terms of jobs. A very high proportion of GDP will have to be spent on it, so there are lots of challenges around those issues, but it is not as if we don't know what we need to be doing to make these sorts of shifts.

You mentioned the cultural element earlier. Remember: the technologies and the cultures are not separate things; they are entwined. I would be remiss if I did not bring up what my social science colleagues always tell me, which is that we should view these things as what they call socio-technical regimes. That is an awful expression, but you cannot see technology and society as separate things. They intertwine. If you change certain things in society, other forms of technologies may be more appropriate. That combination is important.

Q17 Alex Sobel: Is there a view that there are potential risks or downsides to moving to a net zero economy?

Professor Anderson: Undoubtedly. I worked in the oil industry for quite a lot of years, and many of my colleagues and friends out there, and the people who served those sorts of industries, will suffer significant repercussions if we don't very carefully think through what a just transition looks like. I do not mean just an umbrella policy, but the details. People pay mortgages every month. They can't wait for three months to pay their mortgage. The actual details of how you move people from one highly polluting industry to using their wonderful skillsets for renewable or low-carbon infrastructures is really important. So it is great that Jim Skea is involved in that in Scotland. We need to ensure that we have those committees available.

Q18 Alex Sobel: So there are some places, particular geographic locations, where it might be a particular risk. I am thinking of places such as Aberdeen and Immingham, whose economic base is entirely the oil and gas industry.

Professor Anderson: The oil and gas industry is at risk, undoubtedly. It will probably be true for some other things, such as refineries and other industries related to high-carbon heavy industries. We will still have to continue using many of the heavy industries, such as steel, aluminium, cement and so forth, but probably with carbon capture and storage.

Navraj Ghaleigh: The idea of just transitions goes across all industry sectors. I think it would be a mistake to think that this is siloed to oil and gas, or heavy industry. It goes across all industries, including the built environment. Think about the way that buildings are currently built. If you want to build zero-carbon houses, there is absolutely no way you can do it with the culture of the building industry as it currently is. In agriculture there are much the same problems.



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Just transitions involves retraining, relocation, and guaranteeing pensions for individuals and communities in the fossil fuel industries. You would need new forms of industrial ownership. This is far broader than just skilling people up, which is where a lot of the discussion is, so far. Climate Strategies has done some work on exactly this problem in six coal-dependent countries. We are seeing that this just transition is already happening, and it is affordable and feasible. Communities want to be appropriately informed about doing this stuff. The countries were China, India, Brazil, the US—I can't remember the other two. There are models that can be adopted from countries—Poland is another one—which are in a far stickier situation when it comes to coal than we are.

- Q19 **Alex Sobel:** None of you mentioned stranded assets. All of our pensions—I imagine we are all in US\$—are dependent on quite a lot of investment into companies that will have a large amount of stranded assets, we all hope sooner rather than later. We are cutting our noses off to spite our faces in some ways.

Navraj Ghaleigh: The stranded assets argument is tricky. There is a reason why this argument, which has been knocking around for 10 years, has not dented the finance community. They don't believe it. Now, they might be wrong—they have been wrong in the past—but it is not axiomatic that that argument is correct. Obviously, morally, from our perspective, it is. But it doesn't follow that if you hold positions, for nanoseconds in many cases, or weeks or months, which is what most fund managers do, you are going to be rendering your beneficiaries vulnerable by so doing.

Alex Sobel: Because the movement of money is quick even though the assets are stranded.

Navraj Ghaleigh: Yes. The other issue, of course, is that the vast majority of these assets are not held by listed companies: 90% of reserves are held by SOEs—80% of global production likewise.

- Q20 **Alex Sobel:** That is really interesting. Globally—obviously, we are talking about UK Export Finance—how can a move to net zero emissions support the UK in achieving its other national and international commitments, most fundamentally the sustainable development goals, but also the OECD common approaches, and the G7, G20 and EU commitments that we all have?

Navraj Ghaleigh: In terms of the SDGs and the trifecta of social progress, economic growth and environmental protection that the SDGs seek to promote—obviously, SDG 12 is probably the most relevant one for our purposes—there is a risk, which I don't know whether the UNDP is aware of, that the SDGs become more paper than practice. Actually, they have just started—well, it was over the last year or so—a new process called MAPS, which stands for mainstreaming, acceleration and policy support. I think that is a potentially practical way in which policy and industry that the UK wants to export can be leveraged in a way that is SDG-compliant. You pick your activity that has multiple SDG benefits; renewable energy is the obvious one, in terms of domestic production and



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green growth. You lock in low-carbon growth, lock out high-carbon growth, reduce emissions and so on. And then there is your policy support, which goes back to what we were talking about—just transitions.

In terms of the common approaches, the OECD's annual meeting for the officials who work on this stuff is tomorrow and the day after in Paris, and it will be very interesting to hear what policy innovations are coming out of that meeting, but one thing that is self-evidently the case with the OECD common approaches is that they are very much lowest common denominator approaches. If the ambition of the United Kingdom is merely to comply with the global lowest common denominator, we may as well not bother. There must be a higher standard, and we do see higher standards around the world. Domestically, the UK has a very good story to tell. What we are doing extraterritorially with export credits is just odd. We are making enormous efforts to decarbonise domestically—you can argue about how enormous those efforts are and how enormous they should be—but making significant contributions to the problem through our exporting activities. That is a classic case of policy misalignment.

Q21 Alex Sobel: Obviously, a number of Departments are involved in this policy area. We will have them sat where you are sat. What would you ask them on this question? When the Ministers come, what would you ask them?

Navraj Ghaleigh: In terms of our export finance, it is relatively straightforward. The mandate of UK Export Finance is basically a standard growth model—the traditional 1980s or 1990s growth model. It has no environmental considerations within it, so what would be required would be to generate a climate change policy that requires UK Export Finance to measure and monitor the CO₂ intensity of its lending portfolio; assess the risk of its climate-related investments; implement recommendations of the financial stability task force, which go back to what you were saying about stranded assets; and integrate climate change-related considerations into its lending practices.

Q22 Alex Sobel: Should we ask for this to be bolted on, or to reset the whole framework?

Navraj Ghaleigh: No, I don't think you need to reset; I don't think you need primary legislation. I think the 1991 Act is fine as it is. What you need is a new policy, which must be considered in the process of the variety of export finance products.

Professor Skea: Before I was approached by the Committee, I knew next to nothing about export finance and how it was done, so maybe that plays into the question that has just been asked. I did a little bit of reading, and there are questions I would ask as well. For example, what is the profile of applications for support coming from business? That is a little bit different from the question of what money is actually awarded. One observation is that countries that do relatively well in export markets usually have a good home market to start from, in terms of achieving export performance, and the UK has historically, whether we like it or not, been



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very good at oil and gas and the skills and competences needed to extract it. For that reason, I wouldn't be that surprised if a lot of the applications were coming from that sector. The UK has not so far exploited all the opportunities associated with renewable energy such as wind and solar, because although we have a lot of deployment of wind energy, the turbines themselves come from Vestas, Siemens and so on. That for me is the area that I would be poking. I don't think we can do well in export markets unless we have a home market to build from. That consideration of what people are applying and the condition of the home market seems quite critical, in addition to the criteria that Navraj mentioned.

Alex Sobel: I have engaged with the solar industry, and it feels frozen out. That is something for us to take up in another session—the fact that those renewable energies feel locked out of the export finance.

- Q23 **John McNally:** I would like to move on to the consequences of failing to meet the global warming targets in the first place, and basically to understand the consequences of missing the 1.5° to 2° targets on the world and the UK. Could you give us your ideas about how it would affect things globally? Some of the things we read are pretty scary.

Professor Skea: My expertise is not in climate change impact, but I have been working alongside colleagues who have worked on that area and on the 1.5° report. I think we understood climate impacts at 2° warming before the Paris agreement, and the scientific community has had to get itself together to look at 1.5° warming and what it would mean. The headline conclusion is that the IPCC report found very distinctive differences between 1.5° and 2° warming in terms of climate impacts overall. The area that got the highest attention involved warm water corals—perhaps not relevant to the UK—which would effectively completely disappear with 2° warming. We might be able to retain about a quarter of them if we keep warming to 1.5°. The other thing was Arctic sea ice, where with 2° warming you would get an ice-free Arctic every 10 years, and with 1.5° warming it would be once every 100 years. Coastal flooding is probably the area most relevant to the UK. It is not such a dramatic difference, but there is a difference. The frequency and intensity of storm events would be the other area where you can see a discernible difference if you look at the literature that the IPCC assessed in the last report. So absolutely there is a difference between 1.5° and 2° warming.

Chair: The whole of the coral reefs? That is terrible.

Professor Skea: Yes.

Professor Anderson: I think the report is excellent on the impact. I am really pleased that the 1.5° report was completed—even though I was very sceptical about it to start off with—because of the impact that Jim just touched on. It is also worth bearing in mind that, correctly and quite rightly, by definition science in aggregate is a conservative process, and that is exactly how it should be. People who use the outputs from science, the discerning user, must be aware that that is how science is developed. It is fair to say that there are very good eminent scientists who have been



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doing work that would suggest that the impact of a 1.5° or 2° rise would still be well above those outlined here. They may be wrong or they may be right. It is hard to tell.

On these issues—it is incredibly complex—science has quite a wide spread. You will see people who suggest much higher levels of sea level rise—probably still not much more than a metre and a half by the end of the century, but at 1.5° you are locking in a whole suite of other things that other people think will occur nearer a rise of 2°. Just be aware that when you see claims that this or that will occur, there is a risk to mention, and a confidence related to that. That doesn't mean that those people who say things could be much worse are necessarily wrong—they could be correct. Of course there are some people, although generally it is not the case, who think things will not be as bad as suggested. It is important for other people who are using scientific work to have that understanding of how the process develops and evolves. It is not that it is incorrect, but it is incumbent on the user to use that information appropriately.

- Q24 John Mc Nally:** Let me follow on from that, and the point about the UK market and where we currently live—how global warming between 1.5° and 2° will affect the UK was touched on earlier on. We are all seeing the effects of global warming in the extreme weather we are having at this particular moment. You don't need to go very far to see horrific things such as freshwater crocodiles coming up rivers. I don't think that is likely to happen here immediately, but you never know. Down to reality and practicalities, is there a danger that property and enterprises in the UK could become uninsurable? Is that a definite risk that we will face? The Chair and I visited Leeds some time ago. Flooding had caused considerable problems to businesses, which would affect jobs. How would that affect us in a practical manner?

Professor Skea: Just to say that the IPCC report did not go down to the level of specific countries. You just couldn't do it in the time available—assessing what was a completely new literature. There is a definite conclusion that every increment of global warming makes a difference. That is a very clear conclusion of the report and a message that we wanted to emphasise from it. Every little bit that we don't do in terms of mitigation will make it a little bit worse in terms of the impacts. I am not an expert, so I don't recognise the numbers about the uninsurability of property: I haven't seen them before. But having had previous engagement with the insurance industry in this area, it is certainly an issue that some properties may become uninsurable unless the Government twist the insurance industry's arm to make sure that the properties are insured—which may have happened in the past.

- Q25 John Mc Nally:** But you would think there would be some form of legal obligation that makes sure that, if the Government have not acted, these places were insured.

Professor Skea: The other point is the question of where you actually build houses in the first place. One of the implications of uninsurability is that it sends a very clear signal that building on flood plains is not a very



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good idea—especially if you are thinking about the risks being exacerbated by climate change.

Navraj Ghaleigh: Two things. One is that the Government would of course argue that they are making best efforts—very considerable efforts—in this direction. If they were sitting on their hands, I think that the argument might be stronger; but that would be the argument being made. The other point, which is relatively trivial but not unimportant, is about ordnance survey maps not marking flood plains any more, which took place at some point in the 1970s under ferocious lobbying from the housebuilding industry.

Q26 **John Mc Nally:** That is a very good point, because we know from previous evidence that some of the ordnance survey maps were being used by insurance companies to raise the premiums. So there is a very practical impact on local communities.

Professor Anderson: I think in terms of insurance—and, indeed, with all these issues—you have to be aware of the equity dimension. Many people can't insure their houses today. Insurance may be available if you are wealthy enough to be able to afford it. The issue then is, are there significant proportions of the community who are living in areas where they do not have sufficient income to be able to insure their houses, either today, in the current climate, or tomorrow, in whatever the climate may turn out to be? Like most of these things, there is a very important equity dimension that needs to be understood.

Q27 **John Mc Nally:** And the economic impact on communities.

Professor Anderson: Yes—again.

Navraj Ghaleigh: Presumably that builds into broader questions about poverty in coastal communities, which is certainly a live issue, although I am not sure whether the Committee has looked at that.

Q28 **Caroline Lucas:** As we know, the UK claims to be a climate leader, yet the figures we have seen for the UKCF, according to ODI, is that between 2010 and 2018, 97% of UKCF's support for energy was for the production and consumption of fossil fuels. As for who else does it better, I know that the panel has already mentioned a little about Canada, but are there any other positive precedents from other parts of the world that we could learn from in terms of the shift that needs to be made?

Navraj Ghaleigh: I think the Committee is to be applauded for finding a topic for which there is practically no academic research. I don't know if you have ever done this before, but you have really hit the bull's-eye here. There is nothing on this topic. This really is a pagina bianca—there is very little to go on. There is actually quite a lot going on in Canada, which I can pass to you off line. The other example that is potentially interesting is the German system of export finance and development banking, in which there is a series of sub-units within the main German development bank that address environmental and housing sectors specifically. That may be

an approach you may want to look at. France also has development banks that are sectoral in part.

The difficulty with that is that it is very different from the status quo. If you think you can start with a fresh piece of paper and redesign the entire system of flexible finance and domestic finance of public services, you may have some traction there. If you are looking in terms of incremental development, those ones are not particularly helpful.

What I am very interested in looking at in the short term, kicked off by this inquiry, are the models in the Commonwealth, where we share common language, legal systems, transfer of experience and a lot of sharing that goes on. In the very near future, I hope to have something more for you. There is just not a lot out there in terms of what is being done.

- Q29 Caroline Lucas:** You have touched on this a bit, but which areas of UK policy and legislation or practice do we need to develop to be truly world-leading in reducing climate change, if we really wanted to live up to our aspiration?

Navraj Ghaleigh: Let's start off with a positive. I think the Climate Change Act, the implementation and the institutions established, such as the Climate Change Committee, continue to be world-leading. They absolutely don't do everything that one would want them to do but, in comparison with practically anywhere else, they have made real, significant changes to the domestic emissions profile of the United Kingdom.

What they haven't done is change our consumption patterns, which of course are not accounted for if the goods and services are produced extraterritorially. As for UKEF, £5 billion per annum for building oil refineries in Saudi and coal infrastructure in Ghana and fleets of aircraft all over the world, those are locked-in emissions that will not be reversed. That is really significant and is a sharp indication of policy dissonance that needs to be addressed.

Professor Anderson: Just in terms of the UK position, I agree the Act is excellent. I still think it is the best piece of legislation that I have been aware of. I have been involved recently with the Swedish development of their climate change law and they keep telling me that the Act is the pinnacle of climate change legislation.

- Q30 Caroline Lucas:** Do you think the targets in it should be changed? Is it too big a risk to undo it in case it goes the wrong way?

Professor Anderson: No. The Act has what it needs in it. This is not the exact language, but the Act broadly talks about if there is material change in the science—remember the Act was out way before AR5, which has a carbon budget framework in line with the CCC approach—and if there is material change in the international policy regime. Well, of course there is, because we have the Paris agreement.



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I think there has been every requirement for us to go back and revisit that, certainly since Paris, if not since AR5. I am pleased that the Minister has asked for that, although I think her initial letter was unhelpful, in that it was trying to persuade the CCC not to consider the fourth and fifth carbon budget, which I think was inappropriate. That has fortunately now been changed.

Look at how the UK has succeeded. Remember that the climate does not care about relative emissions; it cares about absolute emissions. If you look at UK plc and say, "What have we delivered since 1990?", our reductions have been 10% for the operation of UK plc. If you include aviation and shipping, imports and exports, we are 10% lower—not the 38% or more that some people often try to tell us. That is a 0.4% per annum reduction since 1990.

We need to hold ourselves in a more appropriate perspective and context. When I was in Katowice this year, every national pavilion was telling me how wonderfully they were doing. What was surprising then was that when they looked at the emissions, they had gone up globally by 2.7%. I don't know who was responsible for that, because every country was doing remarkably well.

I think we have to step back from that and no longer pat ourselves on the back for things that we have not really done that well. I do not think the Act itself or the CCC secretariat are really the problem. Sitting next to Jim Skea, I say this very carefully, but I think that the commissioners have played too political a role in the CCC. I think it has not been an independent organisation, but a semi-independent organisation. I think it has been too near to what is required by the policy makers.

I can understand why they do that, because it is very easy to dismiss the CCC. They are a really important body, but I think the way that the system has emerged has meant that the CCC is too highly linked to what is necessary for Government, and hence they assume very high levels of negative emissions, for example. They do not look at a fair apportionment of the global carbon budget to the UK. They take a disproportionate share, as does every other wealthy country that has considered these issues.

I would rein back a little bit and say that the Act is excellent. Its implementation and the framing around it has not been as good as I think it should have been, for us to meet our commitments within Paris. I do not hold the committee solely responsible for that, but I hold very significantly the supine academic community, who have also been very scared to speak out about what would be necessary on this. I hear this repeatedly from other academics as well.

- Q31 **Chair:** Some bits of the Act have been repealed in the 2011 Bill; I had a look at it last night—as you do. The bits referring to waste and what local councils must do have been totally removed under the Localism Act. Some bits of it have been peeled away, which is quite interesting for us to be aware of as law makers, climate law makers and people who care about the climate. Jim, you wanted to come in?



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Professor Skea: Yes—I couldn't resist coming in, given that Kevin nudged me. I came off the CCC at the end of December, so I am signed up to every word in the annual reports to Parliament from recent years. The key message that has come out of that is that we have done incredibly well in electricity and renewables, but we have not done well in almost every other sector—heat transport, land—and we have much more to do.

Turning back to the way that reflects on the Act, given the circumstances we are now in—in my view, now that I have left the committee—the second and third carbon budgets are simply not ambitious enough. That is because they were set just at the time when the global economic crisis was coming out, so economic activity has been lower.

There are some painful accounting issues around the EU emissions trading scheme, which mean that budgets 2 and 3 are far too lax. That has allowed the Government to take their foot off the accelerator in terms of the practical mitigation actions. If you were looking at the Act again, I guess some more dynamism about the ambition would help to keep the feet to the fire, in terms of mitigation activity.

Q32 **Caroline Lucas:** Can you remind me of what would need to change if we were to try to account for our consumption emissions as well as our production emissions? Would the architecture of that Act need to change?

Navraj Ghaleigh: Yes, the architecture of the Act would need to change. The method of accounting, at the very least, would have to change entirely. We are not doing anything unusual. What we are doing in the Climate Change Act is the global standard, which is the IPPC standard of territorial emissions, but it is completely wrong-headed because it doesn't measure what is important or what we actually consume. Rather than ditching the status quo, an alternative approach would be to add to an obligation to account for consumption emissions. Then you would see the tension between the two things very clearly and your 42% would close up to more or less parity over the duration.

Q33 **Caroline Lucas:** How would you do that? If you were trying to introduce legislation to do it, would it be an amendment to something?

Navraj Ghaleigh: In addition to reporting as the Act requires, the Secretary of State is under an obligation to give an account of consumption emissions.

Q34 **Caroline Lucas:** Do you think that will be useful, were we to recommend—

Navraj Ghaleigh: I think it would put enormous pressure on the Minister, and thereby the Government. Prior to that, you would have to have all sorts of complicated debates and fights about how you account for consumption emissions, which is far from straightforward.

Chair: We are doing an inquiry into fashion, which immediately gets you into consumption emissions, which are all offshore.



- Q35 **Caroline Lucas:** Really quickly, on that particular bit about consumption emissions, looking at the big picture, is it a battle worth having—yes or no?

Professor Anderson: Yes, as a complement to territorial. They are completely different policy realms or responses, so I think you need both. You need territorial emissions, which are robust and accurate. Consumption-based emissions give you a very clear guideline. They need to complement the territorial ones, and there is a lot more uncertainty in the input-output analysis around the consumption-based emissions, but they are important as a complement.

Professor Skea: I think there are big analytical difficulties. You cannot calculate consumption-based emissions unless you have first calculated the territorial emissions, plus consumption-based emissions have to be modelled rather than measured. There are some interesting, challenging issues, and people could do all sorts of game-playing around the analytical approaches.

Chair: We are back to organic cotton versus polyester.

- Q36 **Kerry McCarthy:** In your answer to Alex, I think you touched a little bit on whether there would be investment opportunities—climate-smart investments in emerging markets—that the UK could reasonably exploit. You said that we would need to develop our own expertise in that before we could look at doing it overseas, but could you say a little bit more about what we would need to do? I think there was a report that identified \$23 trillion worth of climate-smart investments available in emerging markets by 2030. How can we take advantage of that, rather than continuing to subsidise the sorts of things we already do?

Navraj Ghaleigh: Briefly, one way of framing this is that in January 2017, a subset of the US Trade Department did an analysis of the value added to the labour market of renewable jobs versus fossil fuel jobs, and 6.67 jobs were created for each gigawatt of added capacity of renewables, compared with 0.07 for coal. Of course, there are all sorts of legacy issues there about the structure of the industry, but renewables now employ more Americans than coal. There are huge opportunities: you generate enormous numbers of jobs, which are in median terms more or less equivalent to the fossil fuel industry, so there is a real scope to generate large numbers of well-paying jobs.

- Q37 **Kerry McCarthy:** At the moment, the UK is good at the research side of renewables, but once you get beyond that—the high-tech manufacturing skills—we do not do very much at all.

Navraj Ghaleigh: Yes, this is an industrial policy problem.

Professor Skea: Having done work on this for the research councils, I completely agree: our research base largely performs better than the industrial base, and that is something we need to deal with. However, I think we can look carefully at what the UK is good at within this low-carbon agenda. The UK is the lead global market for offshore wind at the

moment: it may be that the kit is coming from Vestas, Siemens or whatever, but there are a lot of skills around project management and operations—how you manage the maintenance regimes and so on—which the UK has got good at. Perhaps those other, more service-related activities could be exported.

You would need to go through it in an incredible amount of detail, but issues around smart grid and the convergence between information communications technology and energy is another area in which the UK could perhaps demonstrate some excellence. I really think that there is no glib answer: you need to go through the list of possibilities, looking with a very cool head at what the UK is good at and what it is not so good at. I do think that there are opportunities in there if you can do that more detailed horizon scanning.

Professor Anderson: I would add two things to that. I completely agree, but, first, do not just focus on supply. We have spent the last 150 years focusing only on supply. Demand is also hugely important. If we are looking at doing things in a timely manner, you cannot make transformations in the supply in the timeframe that we have to address the Paris commitments. They are a prerequisite, but they are not sufficient, so in the very near term we have to reduce our emissions. We know that the only way to do that is through policies that change our behaviours, our practices and our norms. When I say “our”, I particularly mean the high emitters in our society.

That will make your immediate to short-term changes. I am not saying that any of these are easy, but they are viable. You cannot put wind turbines up that quickly, or nuclear power stations, or anything else for that matter. The demand side gives you very fast returns as well. Whether it is a toaster, a computer or car, all these things are replaced usually in under eight years. About 60% to 70% of all the vehicle kilometres of cars travelled are travelled in cars that are under eight years old. If you change the legislation, in eight years you can pretty much change all the UK fleet. So the demand side on everything efficiency-wise can be improved dramatically. Then, of course, you have the supply as well.

The other thing in all this is the infrastructure. The infrastructure part is massively important as well. What is the infrastructure going to look like? What are our cities going to look like? Do we restructure them so they do not have car parks, roads and lots of tin boxes? Do you reframe how those cities operate? Do you think about where people live relative to their work? We are not really addressing that set of infrastructure concerns; we are looking at renewables or fossil fuels as supply options, almost like plug and play. That is not what the future is going to be like; it will be radically different from where we are now if we are going to solve climate change, and, if not, it is going to be radically different because of climate change.

Let's not try to rewrite the last century. Let's think what we need to do for this century. That is not just about supply; it is about infrastructure, behaviour and efficiency of demand products.



Q38 Kerry McCarthy: But in terms of emerging markets and developing countries, which is really what I was asking about, the Department for International Development is not geared up to have that sort of approach at all. It is very much a sticking-plaster approach; it is not really about commercial opportunities, et cetera.

How do we do that? When we cannot get the industrial strategy and sustainability right in our own country, are we almost just relying on them? I know there is little piecemeal stuff like where we are trying to get solar into little African villages or whatever, but is there a gap there?

Professor Anderson: I think you answered your own question. If we cannot sort our own infrastructure out, and our own transition, is it appropriate for us to go to other parts of the world and tell them how to do it? It may be that we have to step back from that and say, "Before we do anything else, should we really rethink where we are? Let's not just carry on assuming that what we did before was necessarily good."

It may well be that there are piecemeal components that we can make some really useful contribution to. As Jim Skea commented, from a research community point of view we have a very solid base in the UK, and a long history of experience in that. I work in Sweden 50% of the time and I am really surprised at how advanced the UK is thinking academically on climate change—way ahead of Sweden. There is plenty of academic base to use to think about, at a system level, what that transformation looks like. How you then convert that into something that is commercially appropriate to take around the world I am uncertain at the moment.

Chair: We are going to have to end the session there, I am afraid. We may have a quick chat with you offline. May I thank you all very warmly indeed for coming to talk to us? I think the phrase is "mind-blowing". I hope the fact that nobody was sitting in the Gallery does not mean that it has not been watched at home.

We really do appreciate you all taking the time out of your busy lives to come and push our thinking a little further on this. On this Committee we are always trying to think about what is next, and you have certainly helped us to do that today. Thank you very much indeed.