



HOUSE OF LORDS

Science and Technology Committee

Corrected oral evidence: Government Chief Scientific Adviser

Tuesday 22 October 2024

10.15 am

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Members present: Baroness Brown of Cambridge (Chair); Lord Berkeley; Lord Borwick; Lord Drayson; Lord Lucas; Baroness Neuberger; Baroness Neville-Jones; Baroness Northover; Lord Rees of Ludlow; Viscount Stansgate; Lord Wei; Baroness Willis of Summertown; Baroness Young of Old Scone.

Evidence Session No. 12

Heard in Public

Questions 1 - 31

Witness

I: Professor Dame Angela McLean DBE FRS, Government Chief Scientific Adviser, Government Office for Science, Department for Science, Innovation and Technology.

USE OF THE TRANSCRIPT

1. This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witness

Professor Dame Angela McLean.

Q1 The Chair: I welcome the Government Chief Scientific Adviser, Dame Angela McLean, to the committee's evidence session on the Chief Scientific Adviser's responsibilities in general, and questions for our inquiry into engineering biology.

The session is being broadcast on parliamentlive.tv and a full transcript will be made available to you shortly after the meeting for any potential, hopefully minor, changes, so that you can make any corrections if necessary. If you think of anything that might be useful to us by way of publications or further evidence, we would be delighted to receive that as formal evidence after the session.

You were very much part of the inspiration for us to do this inquiry into engineering biology, and now that we are coming towards the end of our inquiry it would be really interesting to hear your perspectives on the opportunities and challenges for the engineering biology sector. Why do you think this should be a priority for the UK now, and how do you think we can fit it into the industrial strategy?

Professor Dame Angela McLean: I still definitely think that engineering biology is a great opportunity for us as a country. It is clearly a platform technology, something that sits underneath all sorts of different applications. We can use it to solve quite a lot of our existing problems—we can use it to address some of the grand challenges like net zero, plastic pollution and health challenges—and there are fantastic growth opportunities in companies that use engineering biology as a technology.

So on the one hand it is a super-useful way to drive prosperity, and on the other hand we are good at it. Remember, we are the country where the structure of DNA was discovered. We could go further back. We were good at genetic engineering when it was called that, and at synthetic biology when it was called that, and we are still good at it under its current name—engineering biology. We have good evidence about the ways in which we rank highly in engineering biology. We might want to talk later about whether there are places where we ought to intervene in order to make sure that we stay at the forefront of this technology.

Those are the first two reasons why it is super-interesting: it is one of the bits of technology with very wide applications, and it is something that we are already comparatively good at by any international comparison.

We have lots of promising start-up companies, which brings me to the handbag I have brought in. I visited one last week; it is based here, just down the Northern Line, if you care to go. It is called Modern Synthesis; Baroness Willis will know why that is a joke. The handbag I am holding is made from a product quite like nata de coco, which is a pudding. I will hand this around. The solid stuff in there is the substrate, which is processed to make this leather substitute. That is interesting, because neither a cow nor a barrel of petrol had to be accessed in order to make this. That is a current prototype of this leather substitute.

You should see when you look at that that the material folds very beautifully and that you can use it to make a high-end product, which the start-up has done. You should also know that it is inherently recyclable, it is a very low-carbon product, and no animals were involved. So it solves a lot of issues that are of importance to us.

The Chair: Can we buy it at the cost of a current designer handbag, which runs at about £1,000 these days?

Professor Dame Angela McLean: Next year, yes. I do not yet have any information about the price. I have been lent that one specifically to show to you today. It is important to understand that these things are here now. We are not talking about science fiction coming; we are talking about real products.

Q2 **Baroness Young of Old Scone:** How is the feedstock grown, where is it grown, what will it substitute?

Professor Dame Angela McLean: That stuff is grown from coconut milk and a bacterium called *K. rhaeticus*, which produces something called bio nanocellulose. The jelly in there is lumps of bio nanocellulose, which are produced by that bacterium in great vats. It is a food product. One of the beauties of this product is that there is already an industry that produces the starting product, and the company's IP is processing that jelly stuff into something that can be made into that coating to create leather substitutes.

The company's engineers will tell you much better than I can that one of their other strengths is that here in the UK we still have some of our great strengths in textiles. They take the stuff that comes out of bioreactors that are making food, process it into something that will make a leather substitute that is better than plastic, and pass it on to somebody who is used to coating with plastics but now coats with this engineering biology product.

Baroness Young of Old Scone: Does that mean that we have to plant more coconut?

Professor Dame Angela McLean: You put your finger straight on one of the big questions for what we think of as the engineering revolution: what are the feedstocks going to be? I cannot be the first person who has said this to you, but as we move away from using oil and coal as the source of base material we have to address the issue of what we will use instead.

The big thing we would hope for from engineering biology is a big role in the circular economy, so a big role in recycling, because obviously the dream is that, for some of these things, not necessarily for feedstock, the fundamental material would be waste plastics, because we would love something really useful to do with waste plastic. I have a fantasy that plastic is so valuable that you cannot find it any more; it has all been scavenged up and sold to be made into useful, valuable products.

The Chair: We will ask you about waste valorisation a bit later. I certainly think that your point about access to feedstocks is key for our inquiry and one we have touched upon at various points.

Professor Dame Angela McLean: I am sure you have. Product two is this packet. I will not pass round the egg that was the starting product for this, because I thought that was too high-risk. This is also not for sale yet, but it has passed its regulations and should be for sale next year. It is an animal feed—cat food, I think—grown from a single cell from a chicken's egg to make chicken meat. It is not meat; it is chicken cells that apparently to cats and dogs tastes like meat. It says very firmly, "Not for use or consumption", on the bag, but it is the same issue: there is no need to raise livestock, so it has a much lower carbon impact than raising animals, and without the associated welfare issues. That is also a UK product that is also coming to market next year.

The point I wish to make with both these things is that these things are frequently here, and many more of them are coming, so the questions about feedstocks will become big questions soon. I am delighted that you focused on them all, because this is a now issue.

Q3 **The Chair:** You flagged up the textile industry and animal feed, and potentially human food after that, as areas. What would your priority be for the Government in making the national vision for engineering biology a success? If, as the Government, you were going to invest right now, what would your priority be for that?

Professor Dame Angela McLean: I am very pleased that the Government, through DSIT, have established the Regulatory Innovation Office—RIO, we call it—because one thing that comes

across very clearly when you talk to engineering biology companies is that the regulation landscape is very complicated for them.

The Chair: If you are going to talk about investment in the regulatory landscape, can we hold that for now, because a question is coming up specifically on that and I do not want to pinch somebody else's question? So regulation is one area.

Professor Dame Angela McLean: Another is scale-up.

The Chair: Scaling up what? Where do you see the real focus opportunities for the UK?

Professor Dame Angela McLean: There is a gap in the scale-up of the non-pharmaceutical end. We have massive pharmaceutical industries that are good at this and know how to do scale-up, and I would worry less about them. It is the very new sorts of products that need to go through the steps from pilot through scale-up to industrial production that we are not properly delivering scale-up facilities for in this country at the minute. What Belgium has done—you may have visited the facility in Ghent already—has had a big impact on the success of engineering biology companies particularly in Belgium, so particularly locally, not least, I believe, because some have chosen to set up close to that facility.

We are in the process right now of consulting with those companies on what exactly they need. So rather than me saying, "I think you need this, this and this", this sits with DSIT—I think you spoke to it last week—with help from various committees of specialists and government sat together, in the process of figuring out what kind of scale-up our engineering biology start-up companies need in order to grow into the companies we would wish them to be.

Q4 **The Chair:** How would you like to see an industrial strategy flagging up a platform technology like engineering biology as an opportunity? Does it fit into the categories, or do we somehow have to make sure that our industrial strategy can cope with things that run across several sectors?

Professor Dame Angela McLean: As you know, the eight growth sectors for the industrial strategy were listed last week. It clearly sits in life sciences, although that tends to be more at the medical end. It clearly sits with digital technologies, because the five critical technologies are still with us while DSIT decides exactly what to do. Engineering biology was one of the five critical technologies under the science and technology framework. It ought to be part of advanced materials. Do I mean advanced materials, or do I mean advanced manufacturing?

The Chair: Advanced manufacturing, I think.

Professor Dame Angela McLean: It could go into advanced manufacturing as well. For the moment, I think the best place for us still to push for it is in digital technologies, which is one of the eight sectors, not least because there is an expert team there in DSIT. Eventually—the point you are getting at—it ought to be widespread across all sorts of different sectors. I do not think we are quite there yet. It is too early to say, “Here you go, everybody, do engineering biology”.

The history that we should look at is the history of chemical engineering. Think about how chemical engineering completely transformed all sorts of products that were fantastically expensive rather niche products into the things that everybody could have. We can learn on the positive side from that. There are also things we might learn from chemical engineering about the way we used to treat the environment, and think, “We’re not going to do that this time”. That is an interesting history for us to look at.

Q5 **Viscount Stansgate:** Thanks for bringing the exhibits. It is amazing what engineering biology will be able to achieve. I am sure of that. Nevertheless, do you have some concerns about what you might call the dual-use nature and biosecurity implications of engineering biology? If so, how best do you think the Government can address those concerns, because there is no doubt that, as with all major new technologies, they could be used for good and ill.

Professor Dame Angela McLean: You are absolutely right: there are risks associated with any emerging technology, and indeed with existing technologies. A large part of government work is to make wise balancing decisions between the risks and the opportunities.

There is a good example in the gene synthesis screening guidance that has just come out. It was published on 8 October and is a set of guidance about how to have our gene printing companies screen what they are asked to print. That is a normal part of any of this industry. You tend to send off to get it done as a service. We need to make sure that places that are printing strings of DNA are careful both about who they provide such a service to and about what sequences they are providing.

That piece of guidance is pointing to areas of further work. It has already reached out to input from academia and industry and is already thinking ahead about how to shape the ongoing interventions that we can see coming our way.

Q6 **Viscount Stansgate:** Do you think that these can be read across

to the emerging new field of engineering biology.

Professor Dame Angela McLean: Yes, I do. That is a good model for how to think about what we should do. We should consult with the people who are producing this stuff and with the public about what the risks are, what we should be looking for, and how we can regulate these industries in a way that gives clarity and proportionality and can be done fast enough that we do not hamper these growth industries. That is something that government needs to do in the end, but in the process of developing it it should consult widely.

Viscount Stansgate: Thank you.

The Chair: We move on to Baroness Young and the regulatory issues.

Q7 **Baroness Young of Old Scone:** Yes, now is your moment. You said that you see investment in the regulatory process being really important. There is quite a lot of change afoot at the moment, and it would be good to hear how you think your recommendations in the pro-innovation review of regulations for the life sciences are working through, particularly the role of the new Regulatory Innovation Office and how that is beginning to work through. There are other things as well, but that gets us off to a good start.

Professor Dame Angela McLean: The Regulatory Innovation Office, which was also announced on 8 October, is led by DSIT. Remember: I am in DSIT for pay and rations, but GO-Science, my organisation, is independent of DSIT. We do science advice for policy; DSIT does policy advice for science. That is how we manage the handovers. RIO is there to improve the existing regulatory ecosystems, and engineering biology is one of its four areas of focus. It has asked the Regulatory Horizons Council to give it suggestions on the regulation of engineering biology in order to support those efforts.

Baroness Young of Old Scone: So the horizons council marches on alongside the Regulatory Innovation Office.

Professor Dame Angela McLean: That is what it says, yes.

Baroness Young of Old Scone: Just so I have got this right, we have the Regulatory Innovation Office, the horizons council and the Engineering Biology Regulators' Network. Are there any other bits of kit around?

Professor Dame Angela McLean: There is the Engineering Biology Steering Group, which is a bunch of government, academia

and industry people who are there to offer advice about getting the balance right on regulation that is properly focused and proportionate, but they are not regulators. The EB steering group is a very specialist set of advisers.

Q8 Baroness Young of Old Scone: You say that you would like to see investment in regulation. What would that look like?

Professor Dame Angela McLean: About this time a year ago, the recommendations that were being made were thinking about a skills pipeline for regulators. These things move fast, and we all have to be working all the time on keeping our skills up to date. We have talked already about the EB regulatory network.

One thing we suggested that is now up and running is having regulatory sandboxes. For a long time I did not really understand what a regulatory sandbox was. They were best explained to me as, effectively, experimental regulation—places where you deliberately set out to try regulations before you put them into law to see how they work.

The first of those sandboxes has been set up. It is with the Food Standards Agency and it was regulating meat that comes from growing cells rather than animals.

Baroness Young of Old Scone: Is there any result yet from the sandbox, or is it not the sort of thing that will produce any ongoing utterances?

Professor Dame Angela McLean: The first one, the Food Standards Agency one, is awarded and will start work in February. The final recommendation was that our regulators need to be properly resourced. We are looking forward to more on that.

Baroness Young of Old Scone: It is interesting that you said that chemical engineering made great progress. When I was running the Environment Agency it was the chemical engineering regulators who were the best paid and the most highly skilled.

Professor Dame Angela McLean: That is interesting. I did not know that.

Q9 Baroness Young of Old Scone: Yes, it is quite interesting. The Engineering Biology Regulators' Network was going to create a taxonomy of who was going to do what, which regulator would be a lead on which products, and how the others would combine together and get road maps going. We have not seen many signs of anything coming out yet—it is too early—and we could not even find a website for the network.

Professor Dame Angela McLean: It was set up in 2023 and brings together 13 regulators and policy teams from across government. There will be announcement of who those 13 are. Even I do not know. Watch this space. That is a work in progress.

Baroness Young of Old Scone: I think we got some intelligence from the department—

Professor Dame Angela McLean: From DSIT? Good.

Baroness Young of Old Scone: —about who was on it. I was intrigued to see that there was nobody there who would have an eye to the feedstock issue, so no Natural England, and nobody from Defra who looks at land use, for example.

Professor Dame Angela McLean: That is very interesting. You are ahead of me, but thank you.

The Chair: It was an area that the regulators' network and WHO regulates and which every company we saw said was confusing. So the taxonomy that you recommended is urgent.

Professor Dame Angela McLean: I agree. That is why the first word I would use is "clarity", so that it is clear what you have to do in order to achieve the regulations that allow you to market your product.

Baroness Young of Old Scone: Will the announcement simply be about the members of the Engineering Biology Regulators' Network, or will it also talk about its work programme?

Professor Dame Angela McLean: It gives the regulators, their contact details and their role as part of the EBRN.

Baroness Young of Old Scone: So it is not a work programme, a taxonomy or a road map.

The Chair: Not yet, by the sound of it.

Professor Dame Angela McLean: Not from what I have been told. I am talking about colleagues and DSIT's work here.

Q10 **Baroness Young of Old Scone:** You may not want to answer this question, but do you think this Government are putting enough welly behind the regulation of engineering biology?

Professor Dame Angela McLean: With the Minister for Science that we have, that is not a worry that I have, actually. Somebody cornered me at a drinks party at a university and said, "Is EB going to survive?" The answer I gave was, "The previous GCSA was very keen on engineering biology and is now the Minister for Science,

and I'm very keen on engineering biology and I'm not going anywhere just at the minute". That is as much as I can say at the moment.

Lord Borwick: With the cat food example you showed us a moment ago, did the manufacturer choose to make it into cat food rather than into human food because of regulation? Is the regulation of animal food easier?

Professor Dame Angela McLean: I think that is correct: regulating feed is less work than regulating food. But you would have to ask them that rather than me.

Lord Borwick: Of course.

Professor Dame Angela McLean: Let me put it this way. If you were to ask them and they said yes, I would not be surprised. I have not asked them that specific question.

Q11 **Baroness Northover:** This question follows on from the earlier discussion and is about regulation as promoting innovation. Some Governments in the past have come in saying that they will have a bonfire of regulation, and the sense is that regulation is always a barrier to innovation that has to be overcome. However, we have certainly heard that regulation can spur innovation, and witnesses have borne this out. So can you say, in perhaps a wider way, how you feel regulation could spur that kind of innovation in this area?

Professor Dame Angela McLean: I would agree with that hypothesis. Regulation that can be clear, proportionate, and as speedy as possible but not hasty is a driver for innovation—and, in fact, can bring people to our shores. We know that our best regulators are trusted worldwide, so surely we would want to be a country that innovative companies come to because we have such great regulators.

It is the kind of thing that we are well placed to do, because we have the intellectual hinterland in our fantastic science and technology to do it. For a long time we were world-leading at the regulation of medicines, and we should be thoughtful about which areas we are going to do this in and about being the world-leading place to come and get your first approvals, and work very hard at it.

May I put standards into the same bucket, because there is another thing there about international standards? This is a side product of what you might call the tech diaspora. As a lot of new technology has moved out of enormous companies into tiny companies, it has

become much more difficult for our experts in those companies to take the time to be part of the standards bodies.

Going way back, imagine being ICI. You would have had people whose job it was to sit on standards bodies to make sure that they did things sensibly. We all know, I think, from having sat on grant panels or whatever the equivalent is in your world that you get to see really good practice and to learn how a field is shaped—all those sorts of things. Now that much more of our very high-tech is happening in tiny companies, where there might be three or four what I would call grown-ups and a few others, they cannot spare somebody to do all that work. We should also be thinking about how we can support that, because it is a real source of competitive advantage for a country.

Baroness Northover: Do you see other opportunities? Take another example: the regulation on not selling diesel cars or petrol cars and so the focus on electric cars is stimulating innovation in that area. In this area, can you see regulation elsewhere promoting innovation in this area?

Professor Dame Angela McLean: There is a nice example in the US, a programme called BioPreferred. Perhaps you have come across it. If you are the US Government, the assumption is that you would buy the biological product if it is available. That is a very good, rather specific, example of using public procurement to drive innovation. The US is quite pleased with it.

The Chair: That is a perfect point at which to move to Lord Drayson.

Q12 **Lord Drayson:** Successive Governments have talked about, and used, public procurement as a tool to bring through new innovations. Could you tell us a bit about how you as Chief Scientific Adviser, and your colleagues, are empowering the departments to understand the opportunities and to champion the use of procurement. If you have some specific examples of where this is taking place, that would be helpful.

Professor Dame Angela McLean: I can give you a specific example from my last job. I used to be the chief scientific adviser for the Ministry of Defence. This was in the days when we were building the S&T framework and we were all being told that government procurement should be a driver for innovation, so we bought a quantum computer. I will be honest with you; it is not tremendously useful yet. But we bought so that our scientists have their own quantum computer that they can use to find out what it

is good at and not so good at, and to be at the cutting edge of that technology.

We bought a UK one, and a byproduct of that purchase was that it was an important sale for the quite small company that was making them. I was told at the time that a purchase is worth 10 times a grant. It was not until I saw on that company's website how thrilled it was that it had sold one of its quantum computers to the MoD that I realised the truth of that.

The very fact that we were all told that this is an excellent co-benefit of purchases that we might make was helpful. So there is messaging right across government, often particularly the more science-y bits of government, because they will often be the bits that need something that is very cutting-edge.

Lord Drayson: That is happening, with some examples, in engineering biology, is it?

Professor Dame Angela McLean: Do I know of any examples in engineering biology? I would have to get back to you.

Q13 **Lord Drayson:** It would be helpful if you could. Related to the procurement issue, as well as the general opportunity of using procurement to signpost the opportunities through using innovative technologies, the Government are making choices about which procurements should have some form of sovereign capability understanding involved in those decisions,—particularly given the geopolitical context.

How is that going? How would you assess the sophistication or otherwise of the public procurement framework, particularly given that there is now an industrial strategy, to take into account a realistic assessment of the UK's true competitive advantage? In other words, is it viable to use this area of public procurement to develop a sovereign capability which the UK has a chance of growing such that it moves the dial on economic growth, which is the Government's number one priority?

Professor Dame Angela McLean: I think it is realistic that we can do this. I will tell you about the work that we are doing. The procurement strand of the S&T framework sits with the Cabinet Office. One of the bits of work that we do with it is to bring ideas about how to access small companies to a wider audience, so I can talk about that.

Another thing we do is to drill much further down into sectors in order to think about where our real competitive advantage is. For me to sit here and say, "We're good at engineering biology", is a

bit meaningless. On the one hand, we want to know exactly which bits we are good at, and, on the other, we want to know where our risks really lie.

That is happening in GO-Science, and we are doing that for EB. You may have already come across this, but, for example, there are bits of the supply chain for engineering biology where we are very exposed to supplies from other countries. That ought to be addressed if we want to have a sovereign capability.

Lord Drayson: Is that the responsibility of you and GO-Science, not the Cabinet Office, to identify those?

Professor Dame Angela McLean: The responsibility for us is to generate the advice about where the vulnerabilities lie, but not to write or enforce the laws about who does what procurement and where.

Lord Drayson: Do you publish that, because that would be really useful to signpost as a way of encouraging investment and innovation?

Professor Dame Angela McLean: We publish it internally, not necessarily always externally.

Q14 **Lord Drayson:** Finally, on procurement, we have heard evidence in this inquiry that civil servants have developed a sort of risk-averseness in making decisions in this area, caused by the overall political environment and so forth. Would you agree that that is a problem? If it is, what is being done about it?

Professor Dame Angela McLean: Yes, I think it is. Let me give you an example of managing that process. Civil servants do not like having to manage the fallout of failed procurements, and one response to that is to be risk-averse. There is an excellent example in the National Security Strategic Investment Fund. This was set up by the then Chief Scientific Adviser for National Security, Anthony Finkelstein. One thing it is doing is making procurements in baskets, so that if four of them fail but one is a great success, you can take the whole basket to whoever is trying to tell you off and say, "I knew they were high-risk. I knew many of them would fail. I need to make some high-risk procurement decisions, because I really need to get ahead of the curve here. I am working with adversaries who have pretty much zero risk aversion".

That has been very successful. It uses a public-facing set-up to do procurement for defence and security at the high-risk end.

Lord Drayson: Is that basket—or portfolio—management

approach accepted by the National Audit Office as a reasonable principle?

Professor Dame Angela McLean: I have not seen them tested, but that is the idea—that when challenged, the answer would be, “Yes, we needed to make some high-risk investments. We know that when they go wrong people get cross, so we have explicitly put them into a basket so that we can tell you a fair and reasonable story. We knew it wouldn’t all succeed, and we didn’t know which ones would succeed”.

Lord Drayson: So civil servants are being encouraged to develop their understanding of the management of our portfolio laws.

Professor Dame Angela McLean: Yes. My organisation, GO-Science, ran a whole day in February with that model to show to some other departments and say, “This is actually a good thing. Why don’t some of you also try to take the same approach for packaging up your high-risk investments?” It is not just the packaging up into a basket; it is also having some people whose job it is to be out there looking for the very cutting-edge things that might be just over our horizon, so searching as well as accumulating.

The Chair: Are you feeding into ARIA, for example, on some of these things?

Professor Dame Angela McLean: Let me think. NSSIF is things you can buy. ARIA, I would say, is even further over. ARIA is midnight. NSSIF is more like dawn, not even first light. For NSSIF there basically needs to be a product. You might need to do a bit more development of the product, but there needs to be a product. ARIA is way before that. So yes, absolutely, but a different bit of the landscape, I would say.

Lord Drayson: What about the Treasury? The Treasury Green Book would not allow that, as it stands at the moment. So what is being done in the discussions with the Treasury to enable such a positive and sophisticated approach to the management of technology innovation? Are you talking to the Treasury about that?

Professor Dame Angela McLean: I would have to take note of that question. I am happy to go away and find out what conversation NSSIF and the Treasury have about risk appetite and baskets of investment.

The Chair: It would be very helpful if you could let us have any information of that sort. Thank you.

Q15 Baroness Willis of Summertown: You gave some fantastic examples of waste valorisation in that handbag—I have my eye on that now—but there are many others.

Professor Dame Angela McLean: Maybe we can share one, because I think it is going to be very expensive.

Baroness Willis of Summertown: To me, that is a classic example of raw innovation that is also dealing with other issues such as waste residual, climate and so on. That is one of the recommendations to the Government: that they should do more to encourage waste valorisation. What did you feel about their response? Their response to the point you made was, first, “We already have a waste hierarchy” and, secondly, “We deal with waste in the Environment Act”.

My perspective from the things we are hearing is very much that waste is still seen as a domestic issue that sits firmly within the Defra bucket. I would be very interested to hear your views on that. Maybe things have moved on in waste, but it does not seem like that.

Professor Dame Angela McLean: I told you my fantasy about every scrap of plastic on the beach being fought over in order to go back in to make a new feedstock. Progress towards that is moving on, and it will be great when it moves faster.

Baroness Willis of Summertown: Do you think, though, that waste valorisation ought to move out of Defra and there is another department where it sits? I do not know. I just feel that innovation is getting lost in that department.

Professor Dame Angela McLean: I definitely would not take it out of Defra, because of its profound expertise in waste and environment in general.

Baroness Willis of Summertown: Really?

Professor Dame Angela McLean: We perhaps need to keep on nudging to help Defra see that this is a very important growth area, both from the point of view of managing waste and because growth and prosperity plays there too.

Q16 Baroness Willis of Summertown: Do you think there are different sorts of waste? Maybe it is the term “waste” that is the problem here.

Professor Dame Angela McLean: Yes. I was reading about aniline dyes this morning, again because of my small obsession with chemical engineering. Coal tar was a waste product. That was

all made from stuff that was a waste product.

So yes, I think you are right. There is a value shift in coming to see that what we are treating as waste stuff that is actually very valuable. I think we will live to see the move away from refining petrol all the time, all this other stuff comes in, it is cheap, we use it once and then throw it away. We have to grow a lot more coconut trees and then make the absolute base product, not just stick a hole in the ground and get it out.

I think we will be much more thoughtful about these things. Obviously, you would not throw that bag out; you would keep it for ever. Presumably that will be the case when we have shoes that are made from artificial leathers. It has to be something that you would never consider putting in landfill. I would not put any of my jewellery in landfill; it is a ridiculous idea. So you make a good point. We will move to a proper circular economy. I am trying to think of an equivalent, something that we would never throw away and would always re-use. It is not coming to me instantly.

It ties into the feedstock issue. As feedstock becomes rare and valuable, many things that we currently put in the bin will become valuable too and we will not think of them as waste; we will think of them as going back into the circular economy.

The Chair: Should we have a waste-first or a circular-first approach to government procurement, like the bio-first approach in the US? Is that something we need?

Professor Dame Angela McLean: As part of the transition away from hydrocarbons, time is ticking. So yes, maybe.

Q17 **The Chair:** We are about to move on to the general science policy questions, but just before we leave engineering biology, are there any messages you might want to give us for our report?

Professor Dame Angela McLean: I think you being clear and thoughtful about the balance between opportunity and risk would be tremendously helpful. Your leadership there would be tremendously valuable. That would be at the top of my shortlist.

The Chair: Thank you. We move on to the general science policy questions, kicking off with a question from Lord Lucas.

Q18 **Lord Lucas:** Could you give your perspective on the priorities for science advice and the science advisory network under the new Government? At this early stage, are there any promising stories of science advisers making progress or of departmental working showing that it might actually happen?

Professor Dame Angela McLean: Yes. As everybody knows, this Government are focused on their five missions, and I am pleased to tell you that each of the five missions has one or two of my chief scientific advisers embedded right there on the mission board. Their job is to make sure that science advice is always at the head of every decision the mission board is making, and to convene the other science advisers.

As I spend more and more time in government, I have come to see that the network of science advisers, which is quite a tight network of individuals from across every department, is a great strength, and at the moment I am optimistic that that strength is being played into the missions well. So there is an optimistic story for you.

The kind of things they will be doing will be making sure that good metrics and targets get chosen to measure whether the mission is making progress, looking at the evidence of what works—if you want to change a measure, what do we know about what works already?—looking for gaps in the data in the evidence, and pushing the agenda that a valuation should be built in from the very start of the missions. Those are the four starting areas where that has been kicked off, and, I am glad to say, it has been accepted straightway by all the SROs.

Another place where science across government is working very well at the moment is in preparations for the next round of the spending review. As you probably know, the next round of the spending review has to be handed in pretty soon, and, using the missions' frameworks, we have been having a very interesting set of meetings with CSAs about the R&D in their department relevant to that mission.

The missions' way of working has given us a terrific platform for having detailed discussions between departments about what R&D they are doing and how it feeds into the management and delivery of those missions. As you can imagine, they are very different and very varied—some missions are enormous, some missions are not quite so big—but I must admit that they are some of the most enjoyable science discussions I have had with my CSAs, because they have allowed us to get down to some real nitty-gritty.

What else can I tell you that we are up to? I could tell you about the response to the Covid inquiry. Module 1 of the Covid inquiry came out. It gives us a good homework list for thinking, for example, about what we could have done better to be prepared for that emergency. That is very helpful to us, and we are using it. We are particularly interested in the recommendation about red

teaming during peacetime for the plans we have for the risks that we have already thought about.

- Q19 **Baroness Neuberger:** You have answered part of this question. During Covid, the role of scientific advice and the presence of the scientific advisers talking to the public was dramatic. You have already said that the Covid inquiry is beginning to help you to think about the future, but what horizon-scanning can you do to look at and consider future risks, and to get ready for something else that might come along when that kind of advice might be needed?

Professor Dame Angela McLean: I think we view that as one of our core skills at GO-Science. Undertaking foresight projects and helping all of government to do futures thinking is something that GO-Science does well. I am very proud of the work that our futures team has done to put a set of tools online so that anybody in government can run their own futures events.

What do I mean by events? It is basically a set of tools to let people sit down and do some formal thinking about the future. You will know better than I do that this is not about predicting the future; it is about thinking in a structured way about some of the possibilities and, when I have got those, how I can compare the policy options I am looking at against the various futures that might unfold, and how they then perform. We do that ourselves, but we are also very keen on disseminating that set of skills widely across government.

We are also proud of our ability to do foresight projects. Those are topics of long-term strategic importance where we would tend to do quite a long piece of work synthesising what we think the future possibilities are, challenging current perceptions, and deepening understanding. That is another part of our work on preparing for potential future crises.

Turning to our work on chronic risks, we have, as I am sure you know, a national risk register, a public-facing document that lists the very large number of things that could go wrong. They are all acute risks; they are things that would unfold on timescales of weeks or months. We now have something that is new for government. It is a similar set of considerations; a piece of work that we have done over the last couple of years with the Cabinet Office on chronic risks.

Those are obvious things like climate change and demographic change, but there are also things like skills shortages and mismatches—a chronic risk for this country. Our aim with that is to help drive a culture across all of government that also considers

the things I might think of as the long-term grinding risks. They are always here, but that does not mean that you can forget about them. We would like to drive a culture that gives them the weight they deserve.

Baroness Neuberger: That is very helpful. Picking up on the skills example, you could be looking at something that is an emergency—Covid being an example—and you have the chronic risk of, say, a skills shortage. Are you thinking about the two, such that if there was a particular emergency, you would come back to the chronic risk of skills. Is there some way of marrying the two?

Professor Dame Angela McLean: We certainly think about the pair-wise combinations, and they can go either way—chronic-by-chronic, acute-by-acute, chronic-by-acute. Sadly, the world might go through more than two of them at once, and one can often create others. Yes, we think about those situations.

At the moment, we have just got to the stage of working with the Cabinet Office for two years to be very clear about 26 big chronic risks. There are two things: interactions, and cascading risks where one thing goes wrong that triggers another thing that goes wrong. We also need to go beyond beautiful lists to, "But what would we do about it?"

Lord Lucas: Would you be able to share your futures-thinking tools with us?

Professor Dame Angela McLean: Let me check what we are allowed to share.

Q20 **Lord Lucas:** What are the big underlying challenges for science that need addressing at this moment? I am looking at things like the quality of science, whether the publication system works, and whether we are allocating to consensus science or challenging science. What do you see as the big challenges?

Professor Dame Angela McLean: I would put public trust first. We were talking about this the other day. I am not sure we are even terribly good at measuring public trust, and if we cannot measure it we cannot tell whether it is getting better or worse. So I would put that very high up as a challenge. That opens up a set of questions that are tremendously close to my heart about listening to the public and asking, "What have we done that you don't trust us?" There is also something about what is going on in schools. How could anybody come out of school and not be completely in love with science? Something is not right. How long a list would you like? That would be my number one thing.

We must never take our brilliant universities for granted. The fact that we have several world-class universities is not an accident, and that is where the golden eggs come from. In my opinion, that we can make the claim that we are really good at science is to do with that baseline of education, and space and time for people to think.

Q21 The Chair: Do you think we have a public trust issue with engineering biology that we should be concerned about?

Professor Dame Angela McLean: We should think very carefully about that. Sciencewise has two documents on that, which are very useful. I am sure you have come across them. Sciencewise has done that work, and the answer is yes. We should probably, collectively among ourselves and with Sciencewise, figure out what we will do about that.

The Chair: We will all be carrying Frankenstein handbags.

Professor Dame Angela McLean: It is not a Frankenstein handbag. It is a nata de coco handbag, a sort of coconut jelly handbag.

Q22 Baroness Willis of Summertown: How much of it do you think is also a communication issue? The problem with engineering biology is that lots of people still put it into the GM food bucket.

Professor Dame Angela McLean: There was no genetic modification in that handbag. Nothing has been genetically modified, and it is made from something that is a foodstuff that large parts of the world have eaten for a very long time I think we should go back to brewing. This is an old technology.

Baroness Willis of Summertown: I do not know where within the Government we need to move that conversation on and move it away from GM, but that is where it is getting bogged down, and I suspect a lot of the public mistrust is still in that area.

Professor Dame Angela McLean: Yes. I will turn that back into a question: is government the right voice, or is there somebody else we should be providing with what we think is true and then standing back and saying, "Please would you consider talking about this?"

In my day, it would have been, "Could we get 'Blue Peter' to do some stuff about fantastic engineering?" I do not think kids would care about handbags, but they might be interested in cat food for which no animal had to die. So absolutely. It is quite a wide discussion, and you will know as well as I do that we need to move

on from the information deficit model to something that is quite a lot more interesting: listening to concerns, being clear in our own minds that we have done the right job of balancing the risks and opportunities.

I do think there is something about saying, "Hold on a minute. What's new here?" The new thing is the post-processing of the coconut jelly. Coconut jelly is an old, old process, and taking something that is a bit like a plastic and turning it into a lovely material is a pretty old too. That is one of the things I would try to impart to people: have a laser-like focus on the new thing. Once you have convinced yourself that this is something we have been doing for a very long time, you can probably guess that most of the things that have gone wrong have already gone wrong and we have figured out how to deal with them.

Viscount Stansgate: If I might say, it might still involve questions of land use.

Professor Dame Angela McLean: Yes, absolutely. That is probably quite a good thing.

Q23 **Lord Borwick:** We have spoken before about AI in government. How has the deployment of AI in government progressed since we last discussed it? What about the watchdog or monitoring systems?

Professor Dame Angela McLean: We already had the generative AI framework for HMG, although it is now widely used, so we had a list of things that we should do to be sensible. That is widely known. People know what to do with it. I hope that if you picked a civil servant at random and said, "Are you going to use AI and, if you are, are you going to put official, sensitive material into it?", they would say, "No, I'm not". So there is that.

Last time I saw the committee we had just started what we now call our work in progress group. It is one of my favourite panels that I go to. It is not even a board, thank goodness. I do that with Steve Riley from UKHSA, who I knew from our previous lives in academia. We get people together from across government whose job it is to roll out generative AI tools to share how they are getting on and to be very honest with each about how difficult it is.

I am genuinely hopeful that, with DSIT being given the job of being the digital centre for government, a lot of the things that are difficult will be confronted. The things that are difficult are nothing sexy. It is that we all have different IT systems, and our IT estate is pretty old and crumbly—probably things that you will recognise. It is pretty sad, because it means that when one set of people

solves the problem, they cannot just port it over to another set of people.

As I say, we have made progress in that some problems have been solved. Some really useful bits of very modern AI are being used in a thoughtful and careful way in government. That is deep innovation. It is not infectious innovation in that it cannot spread from one bit of government to another, for reasons to do with what I could call our IT estate. So yes, progress is being made, but progress as fast as one would fantasise about? Definitely not.

The work in progress meeting is very precious to me, and I would like to roll it out more widely across government. Actually, I would like more work in progress meetings where other people who are trying to solve similar problems get to learn from each other.

Q24 Lord Borwick: If you asked a lot of citizens about their view of government, they would say that it is the amount of time it takes to get things done. Will the presence of AI merely increase the number of options that are available to people, or will it speed up the choosing of which option?

Professor Dame Angela McLean: I am sure you know enough about government to know that there is a lot of sensible automation that we can do before we get to AI. I hope most of us have had the experience that DVLA is now functioning well and that getting a new passport is now straightforward. Those are bits of sensible automation. It would be very difficult to do that without at least a sufficient set of data to run your sensible automation over. Once you have that and you do sensible things to learn about the patterns in our service to the public, you start to build a database that will let you do even wiser automation of those projects, sometimes using AI.

So there is progress, and I reiterate that nominating a department to be the digital centre for government is a big step forward.

Lord Borwick: Sensible automation is very different from my ideas about the use of AI.

Professor Dame Angela McLean: I completely agree, but if we cannot walk, let us learn how to walk.

Lord Borwick: Absolutely. It is one step forward. But there is a danger of AI producing more and more options, and paralysis by analysis being the result.

Professor Dame Angela McLean: Yes. You have put your finger on something that would be unhelpful. You will remember that I am not a civil servant by birth, and I have to admit that I see a focus

among civil servants on service delivery to the public. I think it is more of an academic thing to say, "Let's try that. That would be interesting".

On the whole, I would say that in my experience people will be very interested in focusing down on how we deliver the things that we need to deliver. If anything, the danger is that we do that too much and just automate the current thing, or use AI to do the current thing, rather than stop and think, "Hang on a minute. Why were we ever doing this in the first place, and is there some better way of doing it?"

One wants to be thinking a bit about the options, because some of what we do is probably just automating the current thing, which is not the best solution. I cannot think of an example of that right now. I think there is a balance that is mostly towards public service delivery.

Q25 Lord Wei: Given that algorithms, including ones that are used in AI, can act as black boxes where accountability and interpretability can be difficult, has any progress been made on the right to an explanation when a decision is made or with the assistance of AI? How can we avoid repeats of scandals like Horizon or the algorithmic grading scandal in education, where it is hard to hold individuals responsible for the mistakes made by such algorithms?

Professor Dame Angela McLean: I agree. That is an extremely important area, and transparency in decision-making is essential. We were just talking about public trust in government. We have to provide that transparency, and we need to guard against bias and to make sure that standards are being met. This question in particular brings to the front of mind that this is a socio-technical challenge. So this is about how we use this technology, not just how good it is.

There is something called the Responsible Technology Adoption Unit in DSIT that leads on the developing the tools and techniques to enable the responsible adoption of AI. There is also something called the Algorithmic Transparency Recording Standard, which works with departments to help them to declare where and when algorithmic tools are being used to deliver services to the public. So there is a declaration of that.

You will know better than I do that explainable AI is a deep topic of research that is ongoing, and I would continue to stress the importance of having a proper scientific practice in this area, by which I mean that we make sure that results that we use in

government are transparent about how the evidence was gathered and that repeatability is a core value for us.

- Q26 **Lord Wei:** Horizon was obviously complicated, because it involved suspected fraud, but there was government guidance, I believe, that the algorithms used could not be questioned and were to be considered accurate. Do you think that needs to evolve? Also, as we go into the world of AI, how much confidence do you think we in government can ever place on some of the decisions made, and how do we avoid situations where you are fighting the AI in government, as it were, to get that overturned?

Professor Dame Angela McLean: There is quite a good Royal Society list about what we should ask for from explainability, and that is one of them. So interpretable is one, implying some sort of understanding of how the technology works. Explainable is another, in the sense that quite a wide range of users ought to be able to understand why or how that conclusion was reached. Then there is transparency, being justifiable, and being contestable, which is the one that underpins them all and is the point that you are raising. I guess the point you are making is that that was not there in the Horizon scandal; people were not allowed to contest the decision. You are right that we should learn from that.

- Q27 **Lord Lucas:** Looking at the Responsible Technology Adoption Unit and the Algorithmic Transparency Recording Standard Hub, are those things that you can share with the parliamentary committee working on AI? How do they get rolled out to companies that are using AI in, say, recruitment, in ways that are not obvious to people applying for jobs?

Professor Dame Angela McLean: I know that the algorithmic transparency one is for tools that are being used to deliver services for the public, so I would guess that that is public services. The short answer to your question is that I will have to go away and find out, if that is okay. I am happy to write back with those answers.

The Chair: That would be really helpful.

- Q28 **Baroness Neville-Jones:** My question is related to exactly what Lord Lucas just said. Are the units he mentioned part of the Civil Service or external? I ask, because in the intelligence world one of the things that has been done to increase public confidence in the internal honesty of the system—not cheating on the public, not doing things that we would subsequently be ashamed to have discovered—is monitoring not only what they are allowed to do but how they are allowed to do it. There are internal commissioners to whom they have to report on how they have done things, so that

during the execution of policy you get an externally accountable body that is knowledgeable about how that has been done.

My only thought is that in an area where trust can be very fragile—trust in whether what they are telling us about how they did it is actually true—it might be a useful technique to examine whether there is anything appropriate in that approach.

Professor Dame Angela McLean: If I have understood right, you think that the transparency recording standards and the responsible adoption unit should have some external challenge too.

Baroness Neville-Jones: There are many ways of doing it. That is one of them. Or that the unit reports to somebody external during the process of decision-making, so that there is confidence in each stage of decision-making being conducted in the fashion laid down by law or by whatever procedure the Civil Service has decided or thought of.

It strikes me that one of the very potent arguments from when we passed a lot of legislation on intelligence about 10 years ago is that this is one of the techniques that was used, and I think it has provided quite a lot of confidence in the ability of the system to keep itself honest.

Professor Dame Angela McLean: Thank you. That is a really interesting idea. If it is all right with you, I will take it to the Chief Scientific Adviser in DSIT, who is himself a computer scientist with long experience in safety-critical systems.

Baroness Neville-Jones: We are talking to MI5 about this.

Professor Dame Angela McLean: I think we can arrange that.

Q29 **Lord Wei:** Linking to what you have just discussed, the flipside to how we keep these units accountable is whether they have teeth. Lord Vallance told us that the discussion about AI has focused too much on safety and not enough on opportunities, and that you always have to balance the safety and transparency in all that alongside the opportunities.

There are two parts to my question. On one side, if these units have to intervene in the various sectors across government where greater transparency is needed, can they actually do something—get legislation changed and so on? On the other side, we have these catastrophic risks. We saw, dramatically, the boardroom fights that OpenAI has had in the States. When it comes down to it, do you think that the units, and those who care about safety, can put their foot down when things are going too far? Or do you think that, ultimately, we have great guidance, but we do not know

whether it will work until it comes to a head?

Professor Dame Angela McLean: On AI safety, I understand that there are discussions in flight as we speak about regulatory work. Regulations are not in place at the minute, and it would require new regulation. We are in a good place to discuss what form that should take with the safety institute that we have advising us from the inside.

On what teeth these units have, I will have to write back to you. As I say, they are in DSIT, not in GO-Science. I do not know what their precise mechanisms for toothiness are.

Lord Wei: It seems at the moment as though it is advice. It is providing guidelines, it is giving us information, but we are not yet at the point where if somebody says that it is rolling out and could cause a problem because we have not yet figured out this part of how AI is going to operate in this part of government, we cannot right now say, "Stop". The current state of affairs is that we just have to talk to each other. Would you say that is true, given the absence of regulation?

Professor Dame Angela McLean: I think that is a question you should ask of DSIT, not of me.

The Chair: We have the Secretary of State for DSIT coming in two weeks' time. We will take that question away and challenge him with it. Thank you. We move on to our final question in this session.

Q30 **Lord Rees of Ludlow:** Your predecessor bemoaned the fact that in the general fast-stream Civil Service only 10% of the staff had a STEM-type degree, and he thought that this should be increased. What is your perspective, because having people with science degrees does not help if they are very geeky and specialised? How can you ensure that you and your CSAs in different departments have colleagues who can interact with them at a high level? They will need to have specialised knowledge, but they will also have to have breadth. Is it feasible to have such people in the fast-stream Civil Service, or do we need more secondments and things of that kind in order to provide expertise to back up what your CSAs are doing?

Professor Dame Angela McLean: That is a great question, and one that I expect is close to the heart of every CSA. There has been progress on hiring more people with a science background into the Cabinet Office fast stream, the main fast stream. There is also the science and engineering fast stream, which is run out of GO-Science and has grown steadily. There are about 140 fast-

streamers in that at the moment. They are all scientists and engineers. We do a lot of looking after them; I meet with them, and we work hard to make sure that they get good jobs when they leave that bit of the fast stream. So there are 140 now compared with 47 back in 2017, so it has grown.

There are secondment schemes, and they are pretty good, actually. We love the UKRI secondment scheme, and DSIT has something called an expert exchange programme. Those are very successful, but they bring people in temporarily. So I am interested in exploring whether there are people halfway through their career who we can persuade not only to try to join the Civil Service but to join it permanently, and that we can help them to make sure that they can get a job in the Civil Service, because the Civil Service appointments procedures have a certain language. Perhaps most importantly of all—we were talking about this the other day—is making sure that they get a great second job. They say that in a democracy the really important thing is the second election. The really important thing here is the second job for these people. So it is something that we are actively working on.

We have done some survey work mostly of people who have done secondments, and, to my delight, 555 people who have done secondments into the Civil Service were prepared to take the time to fill in our survey about whether there is an appetite for people to join permanently after a substantial science or engineering career. What I mean by that is that I want people who have run a research group, raised a grant, probably sat on a grant panel actually—all the things that are about shaping a field that you learn in the middle chunk of science career.

There is plenty of appetite both internally and externally to bring a stream in at that middle-career stage, and we are building our understanding of why it does not happen automatically. All Civil Service jobs are open. If there are people out there, why are they not coming in?

So we are actively working on it.

Q31 Lord Berkeley: That is very good news about more scientists coming into the Civil Service, but how many of them get frustrated, having been there for a few years, about the lack of promotion prospects, and are promotion prospects given too much to the generalist people and not enough to the people with some scientific background?

Professor Dame Angela McLean: You raise a question that is close to my heart. That is why I made the point that what really

matters is the second job. Another thing that matters is that, in the 10 or 15 years that my scientist has been a scientist, their mates who went off and became civil servants have been taught a whole load of stuff about the profession of being a civil servant, and we need to make that up. We need to teach people: "This is a complicated machine. How do you make things happen in the Civil Service? What does it mean to be in the private office of a Minister? What is a min Sub (Ministerial Submission)?"

There is a lot of stuff, but I imagine that we will get smart people—and the Civil Service is full of smart people—who I am pretty sure could help us to create a very fast training programme in what it is to be a senior civil servant and how you help somebody who has to make the very difficult trade-off decisions that we ask our politicians to make.

So I completely agree with you that there is no point doing this if we are going to end up with a bunch of people stuck in the job we brought them into. Perhaps I should be very clear that I am imagining people who will become generalists but with what I would call a scientific background. Once you have been a scientist for 15 years, it is in your bones.

People often ask me, "How could I help the Government? My science is so weird and specialised". A lot of it is things that you would all do naturally. All of you could look at an experimental design and say, "Hang on a minute. That experimental design's just wrong. It's missing a control", or, "It's completely unbalanced", or, "You're not going to be able to figure out the causality here"—that sort of thing. It is the sort of thing that all working scientists and engineers do automatically without thinking. I want these people to become generalists, because that is where the power lies.

Lord Berkeley: Is there a general wish, with the new Government and the Civil Service, to encourage you to do that?

Professor Dame Angela McLean: Yes. Some bits of the Civil Service think this is a great idea.

Lord Berkeley: Great. Wonderful.

The Chair: But not all of it.

Q32 **Baroness Willis of Summertown:** All of that is music to my ears, I have to say, but more of a shift is needed than just bringing in the scientists. My perception, having worked with fantastic civil servants who have no science background, particularly in nature, is that the go-to model is to go to consultants to bring in the data. What I am hearing from you is that you want generalists, but

generalists who know the right questions and are themselves able to understand the data or at least know where to get it from.

This is a very big question: how do you get a shift, because it is a culture shift as much as anything else?

Professor Dame Angela McLean: It is a massive culture shift. We talk a lot about evidence-based decision-making, and we work hard to try to do it. I share your reservation that sometimes not all of the Civil Service has in its bones what I would call the constructive cynicism of a scientist or an engineer who is trained throughout their life to say, "Well, they say that, don't they, but do I believe them?"

There are things we are doing to help to instil that more widely, or to persuade people to get some science help; get somebody who will come into the room and say, "Who says what on what evidence? Do I think that evidence is any good?" It is a style of critical thinking that it would be better to have internally, I agree. There are deep pockets of fantastic expertise, not least in our own public sector research establishments. We should use them more. I have seen that in various departments. That is one thing we could do more quickly: make sure that people are using the expertise that they already own. We should do more of that.

The Chair: Thank you. It has been a long and very interesting session, and I conclude it by thanking our witness, Professor Dame Angela McLean, the Government Chief Scientific Adviser. Dame Angela, you have offered to send us a number of things that would be valuable to us, so thank you for doing that, and we look forward to receiving that evidence.