

PARLIAMENTARY DEBATES

HOUSE OF COMMONS
OFFICIAL REPORT
GENERAL COMMITTEES

Public Bill Committee

ADVANCED RESEARCH AND INVENTION AGENCY BILL

First Sitting

Wednesday 14 April 2021

(Morning)

CONTENTS

Programme motion agreed to.
Written evidence (Reporting to the House) motion agreed to.
Motion to sit in private agreed to.
Examination of witnesses.
Adjourned till this day at Two o'clock.

No proofs can be supplied. Corrections that Members suggest for the final version of the report should be clearly marked in a copy of the report—not telephoned—and must be received in the Editor’s Room, House of Commons,

not later than

Sunday 18 April 2021

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The Committee consisted of the following Members:

Chairs: JUDITH CUMMINS, MR PHILIP HOLLOBONE, † ESTHER McVEY, DEREK TWIGG

† Baker, Duncan (<i>North Norfolk</i>) (Con)	† Onwurah, Chi (<i>Newcastle upon Tyne Central</i>) (Lab)
† Bell, Aaron (<i>Newcastle-under-Lyme</i>) (Con)	† Owen, Sarah (<i>Luton North</i>) (Lab)
Blackman, Kirsty (<i>Aberdeen North</i>) (SNP)	Richardson, Angela (<i>Guildford</i>) (Con)
† Butler, Dawn (<i>Brent Central</i>) (Lab)	† Solloway, Amanda (<i>Parliamentary Under-Secretary of State for Business, Energy and Industrial Strategy</i>)
† Crosbie, Virginia (<i>Ynys Môn</i>) (Con)	† Tomlinson, Michael (<i>Lord Commissioner of Her Majesty's Treasury</i>)
† Fletcher, Mark (<i>Bolsover</i>) (Con)	† Zeichner, Daniel (<i>Cambridge</i>) (Lab)
† Flynn, Stephen (<i>Aberdeen South</i>) (SNP)	
† Furniss, Gill (<i>Sheffield, Brightside and Hillsborough</i>) (Lab)	Sarah Ioannou, Seb Newman, <i>Committee Clerks</i>
† Hunt, Jane (<i>Loughborough</i>) (Con)	
† Mayhew, Jerome (<i>Broadland</i>) (Con)	
† Metcalfe, Stephen (<i>South Basildon and East Thurrock</i>) (Con)	† attended the Committee

Witnesses

Tris Dyson, Managing Director, Nesta Challenges

Professor Dame Ottoline Leyser, CEO, UK Research and Innovation

Professor James Wilsdon, Digital Science Professor of Research Policy, University of Sheffield

Professor Mariana Mazzucato, Professor in the Economics of Innovation and Public Value, University College London

Professor Philip Bond, Professor of Creativity and Innovation, University of Manchester

Public Bill Committee

Wednesday 14 April 2021

(Morning)

[ESTHER McVEY *in the Chair*]

Advanced Research and Invention Agency Bill

9.25 am

The Chair: Before we begin, I have a few preliminary announcements. Hon. Members will understand the need to respect social distancing guidance. In line with the House of Commons Commission decision, face coverings should be worn in Committee unless Members are speaking or medically exempt. *Hansard* colleagues would be grateful if Members emailed their speaking notes to hansardnotes@parliament.uk. Please switch electronic devices to silent mode. Tea and coffee are not allowed during sittings.

Today, we will first consider the programme motion on the amendment paper. We will then consider a motion to enable the reporting of written evidence for publication and a motion to allow us to deliberate in private about our questions before the oral evidence sessions. In view of the time available, I hope that we can take these matters formally, without debate. The programme motion was discussed yesterday by the Programming Sub-Committee for the Bill.

Ordered,

That—

(1) the Committee shall (in addition to its first meeting at 9.25 am on Wednesday 14 April) meet—

- (a) at 2.00 pm on Wednesday 14 April;
- (b) at 9.25 am and 2.00 pm on Tuesday 20 April;
- (c) at 11.30 am and 2.00 pm on Thursday 22 April;
- (d) at 9.25 am and 2.00 pm on Tuesday 27 April;

(2) the Committee shall hear oral evidence in accordance with the following Table;

TABLE

<i>Date</i>	<i>Time</i>	<i>Witness</i>
Wednesday 14 April	Until no later than 10.25 am	Nesta; UK Research and Innovation
Wednesday 14 April	Until no later than 11.25 am	Professor Philip Bond, University of Manchester; Professor Mariana Mazzucato, University College London; Professor James Wilsdon, University of Sheffield
Wednesday 14 April	Until no later than 3.00 pm	Defense Advanced Research Projects Agency; Wellcome Leap; Professor Pierre Azoulay, MIT

TABLE

<i>Date</i>	<i>Time</i>	<i>Witness</i>
Wednesday 14 April	Until no later than 3.45 pm	Professor Dame Anne Glover, Royal Society of Edinburgh (formerly); Tabitha Goldstaub, CognitionX
Wednesday 14 April	Until no later than 4.30 pm	The Royal Society; Royal Academy of Engineering; Confederation of British Industry
Wednesday 14 April	Until no later than 5.00 pm	David Cleevely, Focal Point Positioning Ltd and the Cambridge Science Centre; Campaign for Science and Engineering

(3) proceedings on consideration of the Bill in Committee shall be taken in the following order: Clause 1; Schedule 1; Clauses 2 to 7; Schedule 2; Clauses 8 and 9; Schedule 3; Clauses 10 to 15; new Clauses; new Schedules; remaining proceedings on the Bill;

(4) the proceedings shall (so far as not previously concluded) be brought to a conclusion at 5.00 pm on Tuesday 27 April.—*(Amanda Solloway.)*

The Chair: The deadline for amendments to be considered at the first two line-by-line sittings of the Committee, on Tuesday 20 April, is the rise of the House tomorrow.

Resolved,

That, subject to the discretion of the Chair, any written evidence received by the Committee shall be reported to the House for publication.—*(Amanda Solloway.)*

The Chair: Copies of written evidence that the Committee receives will be made available in the Committee Room and circulated to Members by email.

Resolved,

That, at this and any subsequent meeting at which oral evidence is to be heard, the Committee shall sit in private until the witnesses are admitted.—*(Amanda Solloway.)*

9.28 am

The Committee deliberated in private.

Examination of Witnesses

Tris Dyson and Professor Dame Ottoline Leyser gave evidence.

9.29 am

Q1 The Chair: Before we start hearing from the witnesses, do any Members wish to make declarations of interest in connection with the Bill? Nobody has given notice that they would like to do that. We will now hear oral evidence from Tris Dyson, managing director at Nesta Challenges, and Professor Dame Ottoline Leyser, chief executive officer of UK Research and Innovation. Before calling the first Member to ask a question, I remind all Members that questions should be limited to matters within the scope of the Bill and that we should stick to the timings in the programme order agreed by

the Committee. We have until 10.25 am for the first witness session. Tris Dyson, please introduce yourself for the record.

Tris Dyson: Good morning. My name is Tris Dyson. I am the founder and managing director of Nesta Challenges, which was set up in 2013 by the UK Government in partnership with the innovation foundation Nesta. Its explicit purpose is to develop UK expertise in challenge prizes as a funding model for frontier innovation. We have grown significantly over that period of time and are now something of an export; we design and develop challenge prizes for Governments around the world in North America, Europe, Africa and so on, and for companies and foundations. Essentially, the model looks at where you can stimulate innovation and new activity to create new markets, new opportunities and to solve important societal problems.

Q2 The Chair: Thank you. Professor Dame Ottoline Leyser, please introduce yourself for the record.

Professor Leyser: Thank you. My name is Ottoline Leyser and I am the CEO of UK Research and Innovation, which is an arm's length body of the Business, Energy and Industrial Strategy Department. We are the major public sector funder of research and innovation for the UK. We fund right across the disciplines and sectors that conduct research and innovation.

Q3 Chi Onwurah (Newcastle upon Tyne Central) (Lab): Given that this is my first contribution, may I say what a pleasure it is to serve under your chairship, Ms McVey? I look forward to working with all members of the Committee on the Bill, which is important for our future research and prosperity.

I welcome our two witnesses. I have one general question for both of you, given your broad range of experience in research and development: what is the problem that the Advanced Research and Invention Agency is fixing? Professor Dame Ottoline, do you have a clear understanding of the proposed working relationship between ARIA and UK Research and Innovation, and should that be put on a formal footing to provide clarity? Mr Dyson, Nesta Challenges is based on challenges, so what is the role of challenges and missions with regard to the work of ARIA in driving high-risk, high-reward research?

Professor Leyser: I do not actually see ARIA as being about fixing a problem; I see it as adding something new and extra to an already very high-quality research and innovation system. As I have said, UKRI is the major public funder for research and innovation. We invest £8 billion of public money every year in research innovation, and we have a major responsibility to act as stewards for the whole system in the UK to ensure that it has the right capabilities and capacity to conduct the research and innovation that we need for the kind of inclusive and sustainable knowledge economy that is so important for our country.

As CEO of UKRI, I have to think about all parts of the system. I have to think about the people—do we have the right kinds of people in the system, the right mix, the right diversity, the right set of skills, and the right career trajectories and pathways through the system? I have to think about infrastructures—do we have the right balance of institutes, universities, catapults and national facilities, as well as high-quality equipment

within institutions and universities, for example? Are we funding the right mix of ideas, starting from the really high-risk, high-gain research, which will be the focus of ARIA? It is also our responsibility to fund the really important work that perhaps does not fall into that transformative, high-risk, high-reward category, but without which the benefits of that high-risk, high-reward research will not be realised and the foundations for the next transformative ideas will not be built. I also have to think about the connectivity in the system, how to join it up and make it all work effectively. Then I have to think about how we can take that and focus it on particular challenges that we face in the country. The work that UKRI does seeks to balance all of those needs and support all of them to create a really high-functioning system for the UK.

I hope that ARIA will do what you might call an extreme or particularly transformative, visionary version of that focus activity, so it will work in a different way from the way in which we typically work. Because of our incredibly broad responsibility for the system, we tend to work in a way that asks the system, in a very broad and open way, how it can best deliver the things that we think need to happen, whereas ARIA will work on the programme manager model, so it will identify a small cadre of visionary leaders who will have extraordinary ideas, we hope, to drive forward the edge of the edge, transformative, visionary ideas, and they will hopefully be empowered to work in very different, agile ways to take forward those kinds of ideas. That is quite experimental. They should be able to experiment with different ways of funding research, including, for example, the challenge model, which Tris is such an expert on. There is a whole range of opportunities. That is how I see it working. It is a small, agile agency that will bring together these visionary individuals to add something on top of a very high-functioning system. It is not about fixing a problem; it is about adding something new at the edge of the edge to push forward those frontiers.

I absolutely agree that it is very important that activity is properly rooted in the research base for which I and UKRI are responsible, because it will depend totally on that research base. The people employed at ARIA will absolutely need to understand deeply what UKRI is doing and what the opportunities are across that research base in order to deliver their vision. I would expect a very close working relationship with ARIA to allow that to happen.

Tris Dyson: I would agree with quite a bit of that. Nesta Challenges produced a report in the summer called “The Great Innovation Challenge”, which we should share with you. We looked at the funding ecosystem. The current funding ecosystem is pretty good and our main funding mechanisms work quite well. It is not wasted. It includes direct financial support through bodies such as UKRI and also the Small Business Research Initiative. It also includes research and development tax credits and the effect that has.

There has, however, as I think the Government have recognised, been an overall need to increase funding in research and development, which is why the target of 2.4% and the promised increases in Government funding are so welcome. In that context, we think that there is an opportunity to explore new avenues and do things slightly differently. Some of the opportunities that that presents, both through ARIA and more generally, is

around boosting the diversity of people involved in frontier technology and innovation and improving geographical reach. If we do have a long-standing problem in the UK, it is perhaps with that feed-in to commercialisation and the connection between university R&D and patenting and things that get picked up by the private sector, so that might be something to look at. We do not think that there is a problem, but I guess that this does present, as Ottoline has said, an opportunity for a new, smaller, dynamic agency to add to the current ecosystem.

We think the advantage of ARIA would be that, because it is smaller, it might be able to generate a culture that is a bit more nimble and a bit more agile, take some more risks, look at things about diversity of innovators, and engage with types of innovation and types of innovation funding that ordinarily might be perhaps a little too high risk. It can also be a little more focused and entrepreneurial, but—to consider the second part of the question—it can also look beyond just grants and R&D tax credits, which are overwhelmingly the main way of funding innovation in the UK.

On the role of challenge prizes, challenges get used quite loosely to mean a lot of things, but what we mean by them is outcome-based funding, where you use the combination of technology foresight and insight with some creativity and understanding of how markets evolve and develop, and what opportunities might exist in the future, in order to identify quite specific problems, where there is a real ability to push things forward in innovation but where it is unclear where the most promising innovation is going to come from. For ARIA, I think that this might be quite a useful tool, because, comparatively speaking, you are dealing with relatively small amounts of money, and outcome-based challenge funding gives you a degree of focus but also allows a degree of payment on results. So, you have milestone payments on the basis of ability to solve problem A, B or C, or of demonstrating some traction in the market.

They have other benefits as well, which go beyond the non-financial. You can use relatively smaller amounts of money in a challenge prize model because you might be building up a deal flow for investors, customers and other people who you want to crowd in and bring in additional funding. They are also quite high-profile because of the nature of the competition or the race towards solving x. That means that the publicity and the promotional opportunities for innovators can be quite significant, above and beyond just the financial reward.

Q4 Chi Onwurah: Thank you very much for those responses. It is great to hear such support for our existing science base. A lot of the discussion around the Bill has been critical of the bureaucracy associated with current research, which has served us so well, particularly in this pandemic.

Both of your responses referred to the role of ARIA in looking at new areas, particularly having new areas of focus that may have been missed and addressing them in different ways. The document of intent that the Secretary of State published leaves the choice of areas of research or the overall mission to the programme managers rather than the chief executive of ARIA, whoever that might be. How will that address our country's research needs, and do you think that the Secretary of State should have responsibility for identifying the overarching missions that ARIA looks at?

Dame Ottoline, there has been controversy with you over exempting ARIA from meeting freedom of information requests. UKRI meets freedom of information requests. Do you find them to be burdensome in going about your objectives, and what proportion of your budget is taken up by them? I will go to Tris first this time, if that is okay.

Tris Dyson: I think that the question about leaving it up to the team that is put together at ARIA is a very good one. When you ask people about the US Defense Advanced Research Projects Agency, the US Advanced Research Projects Agency and so on, you get quite different answers as to what they do—that is probably because they do so much—but one of the common responses is that they have very empowered programme managers who understand and know their fields and are able to pursue agendas with a degree of freedom.

I think that has got to be a model that an agency like this—if it is going to be higher risk-taking and a bit more agile, and is going to look at funding innovation that you might ordinarily overlook—needs to be able to pursue, but it does mean that you need to get the right team in place and empower them appropriately. That means that you need a combination of, obviously, people who understand frontier science and technology; but then you also need a degree of creativity and insight as to what the opportunities might be. You need people also who understand the strengths and abilities within the UK, in order to build on that. So, yes, we are significant advocates of the idea that you would have a small, dynamic, empowered team; but they will also need to be relatively ruthless to stop funding things that do not work quite early on, and stick with things that do. That will have to be a mindset, or a regimen, that is baked in from the start.

Professor Leyser: I absolutely agree with what Tris has said. I think it is widely acknowledged that the success of ARIA—and in many ways the rate-limiting factor—is going to be finding those people. The whole ability of this organisation to operate in this edge-of-the-edge really visionary way that we are all very excited about is critically dependent on those people; and they are in very short supply. So I think the idea of leaving it open to that team of people to decide their focus, to pick the projects that are at the edge of the edge, as it is described, is a really important element.

I also view the notion of this small, agile additional agency as having that freedom in a very positive way. The needs of the country—the priorities that the Government and Ministers set to solve particular challenges for the nation—fall very much within the UKRI remit, and indeed we have very successful programmes doing exactly that, including in a challenge-led model. Those programmes tend to operate on a slightly different basis in the more traditional open call route that Tris describes with grant applications and so on. Again, I would see ARIA as an additional small, agile, free agency that can creatively identify and capture those transformative opportunities that, indeed, are not necessarily thought about in the broader system, and reach parts of the system that our current system does not as successfully reach. It needs to be very experimental and I suppose from that point of view it is not the place where you invest the responsibility for delivering major national priorities.

We are very committed to our freedom of information responsibilities. We get about 30 requests a month and we have a team who deal with those requests and also the other data access requests, and so on, that are part of our responsibility. I am happy to be able to do that. I think that is important for public money, and there is a judgment call about the burden of administration of that, relative to the benefits in transparent use of public funding.

Chi Onwurah: I will stop there, because I know many Members have questions.

The Chair: I will go to the Minister, and then to Stephen. Can I have an indication—will Members put their hands up—of how many there are? That is four. If you want to ask another question, do you want to ask it now, or come back a little bit later?

Chi Onwurah: I will come back later, if that is okay.

Q5 The Parliamentary Under-Secretary of State for Business, Energy and Industrial Strategy (Amanda Solloway): May I say what a pleasure it is to be here under your chairmanship to discuss such an important subject, Ms McVey? I have two separate questions for both the witnesses. The first question, for Tris Dyson, is about funding mechanisms and how they support the R&D system. Do you have some examples of how a range of funding mechanisms support the R&D system?

Tris Dyson: We put together a document in the summer, which we can share with you, that has examples both from Nesta Challenges and particularly from the United States of outcome-based challenge prize funding. That is obviously mainly the space that we occupy. There were some great examples of where it stimulates and creates whole new industries and sectors. There were also some examples of where there can be quite big mistakes, because you go off down the wrong course.

I know there has been quite a lot of inspiration from DARPA and from the US. One example would be the driverless car in the early 2000s. DARPA ran a series of challenge prizes in the desert around the development of driverless cars. It was literally an annual race where teams from universities would compete to develop vehicles that would outperform one another, and there was prize funding associated at the end of it. That is more or less where driverless cars began. The teams that came out of those universities and the individuals have now been picked up by Google, Uber, Apple and everybody else. It is why a lot of that frontier technology is now being developed on the west coast and the rest of the world is playing catch-up.

Another example would be the Ansari X prize, which was about building a privately funded spaceship that would carry two passengers. It had a very specific target about how high a sub-orbit it needed to reach within a two-week period. That created an enormous race for people to build privately funded spaceships, again in the early 2000s. You can see now what has happened in the private space flight industry in the US. The team that won that is now Virgin Galactic and we see every day in our newspapers what has happened to them.

We are a bit newer to this in the UK, but we also have some examples. We concluded a challenge prize just before Christmas that was looking at lower-limb paralysis. It was essentially saying that there have been dramatic improvements in the fields of artificial intelligence, robotics

and sensory technology but why has the wheelchair not changed very much in the last 100 years, except for electrification? That was a global challenge in partnership with Toyota that resulted in some amazing breakthrough systems and products for people with lower-limb paralysis all around the world. A Scottish team called Phoenix Instinct won. They developed a wheelchair that moves with the user, anticipates movement using AI and sensory technology, and has a very lightweight alloy frame that is quite revolutionary from the perspective of a wheelchair user. Those are some examples.

Whether you do a challenge prize or not, I think you would need to do the same thing with ARIA, which has got to focus on areas where there is the most opportunity and where you have a decent hypothesis that technology pathways can be developed in order to solve that problem and encourage activity around that singular thing. That is the whole premise of missions or challenge prizes.

Q6 Amanda Solloway: Thank you, that is really helpful. My next question is to Dame Ottoline. We acknowledge that there is clearly a role for ARIA, but I think it is important that it does not just fund the usual suspects. What are your thoughts on this? How will ARIA be able to target people and ideas that are not picked up through the current system, for example that UKRI is able to target?

Professor Leysler: Absolutely. I think that the kinds of examples that Tris has just talked about are quite illustrative from that point of view. Typically, the way the current system works is that we would put out a call for applications in a variety of contexts. It might be a completely open call; right across UKRI we run these so-called response-paid funding competitions where people with ideas about what they want to do can apply for funding to do them, whatever they might be. On the whole, those kinds of applications are the sort of bread and butter of really established research organisations: universities, institutes and, through Innovate UK, businesses. A lot of them are also collaborative with industry. It is that kind of grant application process that then goes through peer review, and we try to pick the projects that, as an overall portfolio, will best deliver what the UK needs, both in the short term and, absolutely, in the longer term, building that capacity and capability.

It tends to be established organisations that know the system and how to apply for those kinds of projects, and which have the structures available in their organisations to do that. With ARIA, however, I think there is the opportunity to test a much wider range of models, such as those kinds of competition-type prize approaches that Tris described—he is an expert in those. There is also a fairly well-established system called Kaggle for coding competitions, for example. That potentially reaches a much wider range of people. You do not have to apply; you do not have to have a system that can support that kind of application process. The funding flow is very different: it is a response to the results; it is the winner of the competition. As a result, it may be possible to reach a much wider range of people. In that coding space, for example, there are really extraordinary people working in their homes as freelance coders who would find it very difficult to access the classical UKRI and most of the funders that there are currently.

I very much hope that we would be able to tap into some of the talent right across the UK that is not in the more established places. That would be one really exciting

outcome from this with that prize model. Where you have a really clear objective—so it is really clear who has won the money, so to speak—it is possible to do that in a way that does not automatically engage the kind of financial management systems that we have to use. For example, are we sure that this money is being spent on what the applicant said it would be spent on? If you are giving somebody the money for having done the research or having delivered the outcome—the car that goes across the desert—you are in a very different situation.

I do think there is a very interesting possibility for ARIA to reach those people who are talented and can contribute in ways that it is much harder to with the standard systems. I hope that we would learn from that and be able to import some of that expertise into the standard system when it was established and really clear that it was providing good value for money in a robust way.

Q7 Stephen Flynn (Aberdeen South) (SNP): Thank you Dame Ottoline and Mr Dyson for your answers so far, which have been incredibly informative and helpful. I want to pick up on a couple of things that you have said. You have both mentioned the benefits of a small, agile agency. I guess that raises the question of whether £800 million is a sufficient budget for that small, agile agency. To pick on something that you said, Mr Dyson, about ARIA being quite ruthless in terms of stopping the funding of things quite early on, what would you expect the failure level to be, and how do you expect us all to measure in a reasonable way the success or otherwise of ARIA?

Tris Dyson: Well, more money is better. I think this money needs to be deployed intelligently, so being quite clear on the missions and the focuses is really important. It is even more important with a still significant amount of money but relatively smaller sums. Getting those areas right is really important. The examples that were just given about Kaggle and databased approaches are potentially a useful avenue for some of this, because the R&D investments and sunk costs are relatively low as opposed to building spaceships or something like that. That would be the sort of calculation you might need to make.

You can also use leverage. One of the areas that the UK has been pioneering is around regulatory sandboxes, for example, through the regulators' pioneer fund, which is administered through UKRI. But some regulators, off their own backs, have also been setting up and developing sandboxes that allow innovators to play with datasets in an environment where the regulator is giving them a little bit more permission than they might have had otherwise. That in itself is an incentive, particularly when you are playing around with datasets.

You can think of examples where we have got significant strengths. One of the things we have talked about a lot during the pandemic—more recently, at least—is the UK's strengths in genomics research. That means we have got an enormous range of data that could be made available to people through the likes of Genomics England, which in itself is an inducement or an encouragement above and beyond the financial. So being clever—boxing clever—with the money is important.

In terms of ruthlessness, part of this comes to the culture. The ARIA team will have to establish a culture where they trial things out, set targets and objectives and have constant reviews where they get together and

decide whether to kill things off. That is clearer when you have defined missions or objectives that you are working towards. It is much harder when you are fostering lots and lots of different things—it is hard to compare X with Y.

Professor Leyser: From my point of view, the question I would ask is not so much how much money should ARIA have but what proportion of the public sector R&D spend should go into this way-out-there, high-risk, transformative research-type project and, of that, how much should be in ARIA. It is a proportionality question and, as Tris said at the beginning, at a time when there is an aim to drive up UK investment in R&D to 2.4%—hopefully beyond that, because 2.4% is the OECD average and I think we should aim to be considerably better than average—that is quite a stretch target for us. We do incredibly well—the quality and amount of research and innovation in this country is extraordinary—given that we currently invest only 1.7% of our GDP. So I think the opportunities to build that really high-quality inclusive knowledge economy, given how well we perform in the R&D sector with such a small proportion of R&D, are incredibly high.

On that rising trajectory, with us aiming for that 2.4% and beyond, I think spending a small proportion of that on this edge-of-the-edge research capacity and capability is the right thing to do. I would look at the budget in that context as a percentage of the overall R&D spend. People have been comparing the current ARIA budget with the budget of organisations such as DARPA, but if you look at it as a percentage, you get a very different number because, obviously, the US spends a much higher proportion of their—anyway—bigger budget on R&D than we do. That is the important question from that point of view.

How will we know that it has succeeded, and what would one expect the percentage failure to be? I agree with Tris that it is incredible difficult to predict. There is also serendipity and other things to factor in. If you set yourself a fantastic target of solving a particular problem or producing a particular new product and you fail to do that, none the less, along the way you might discover something extraordinary that you can apply in another field.

That high-risk appetite feeds into the question, again, of how much money or what proportion of the overall R&D portfolio should be invested in that way. One has to think about risk in R&D in that portfolio way. It is considered generally in investment markets that really high-performing investment portfolios are a portfolio. You invest in stuff that you know will deliver in an incremental sort of way, and then you invest in the really high-risk crash or multiply parts of the system. That is very much how one has to think about ARIA.

In that domain, where you have a very high probability of failure—that is what high risk means—but also an extraordinary probability of amazing levels of transformative success, it is a dice roll. The total number of projects will be relatively small, so it is very hard to predict an absolute number or proportion that one would expect, and one should not need to—that is what high risk, high reward means.

The Chair: Thank you, Dame Ottoline. We have just under 20 minutes. Members need to be around the horseshoe to ask a question—there is a microphone on the corner. I will tell you the order in which I will ask

questions, so those who are not in the horseshoe can get there. I will go to Daniel Zeichner first, Stephen Metcalfe second, Dawn Butler third, Aaron Bell fourth, Virginia Crosbie fifth and Chi Onwurah at the end. If anyone else would like to ask a question, please indicate.

Q8 Daniel Zeichner (Cambridge) (Lab): Thank you, Chair. It is a pleasure to be on this Committee. I will be brief. Good morning, Dame Ottoline. I would like to pursue the funding question. Governments have long had aspirations to raise the level of R&D, but it proves incredibly difficult to do under pressure of circumstances. Things seem to have changed, in the sense that over the last few months we have seen considerable pressures on UKRI budgets and ongoing uncertainty about the cost of being part of the Horizon programme. Given that there is lots of uncertainty, if you had £800 million to spend in the coming period, would you spend it on this?

Professor Leyser: That is an excellent question. Clearly, the economic circumstances of the pandemic have made the choices the Government have to make about where to spend the money extremely challenging. Having said that, the opportunity thrown up by the pandemic and the instabilities put into the system as a result of the extraordinary circumstances make now an extremely good time to invest in that R&D-led recovery and to build that inclusive knowledge economy that I have mentioned several times, which creates long-term, sustainable, high-quality jobs right across the country for everybody.

In terms of taking that chance to invest in R&D—to reach 2.4% and beyond—and having the £22 billion public sector investment that has been discussed, now is the moment to do that. That is a really sound investment for the future. It is a lot of money, but it is how we are going to re-establish that stable, more productive economy that we need to fuel and to fund all the kinds of underlying public services, and so on, on which the country depends, so I think it would be a really wise investment.

I am avoiding the question, because I would rather focus on driving up that investment in R&D than work on the pessimistic assumption that it is not going to happen and therefore that we are going to have to be more conservative in our approach to R&D investment than is optimal for building that overall high-quality system that we need for the UK.

Daniel Zeichner: Splendidly diplomatic answer. I will pass you over to colleagues.

Q9 Stephen Metcalfe (South Basildon and East Thurrock) (Con): It is a pleasure to serve under your leadership, Ms McVey. Good morning to both of you, and thank you for your presentations. I truly believe that ARIA will significantly add to the research and innovation landscape, in an area where we perhaps have not done that before. That does beg the question of where those visionary ideas would have gone up until this point.

The question that I would like to ask is, what role do you believe that ARIA and UKRI have in ensuring that ARIA-funded research becomes a tangible service or product and actually supports the UK economy? If we are investing £800 million, we need to make sure that there is a benefit. I fully accept the high-risk, high-reward model—I think that is an important part of it—but we

need to make sure that we support that innovation and that research along the technology-readiness scale to make sure that it turns into something tangible that adds to our overall wealth. How do you see that role playing out?

Professor Leyser: To me, a key question in our R&D system altogether is connectivity. We have a spectacular international reputation for the quality of our R&D base right across the disciplines and in both the public and the private sectors, and we have some fantastic innovative companies creating extraordinary products and services for the UK. However, there is an acknowledged weakness in our system in the middle, so to speak, which is sometimes referred to as the valley of death. There is a lot of analysis as to what is going on there. It is partly to do with getting the right pathway of funding that supports activity across that gap.

I personally think that a bigger problem is our relatively balkanised R&D system. I think that we need to focus very hard on building much higher-quality connectivity and networking, right across the system and across that gap. We tend to think of this as a very linear, translational process, and it does not work that way. It is about joining up all the parts in a way that information, ideas, skills, know-how and, crucially, people—all those things are carried best by people—flow to and fro across that system.

One of the major priorities for UKRI is to consider the dynamic career pathways that people need to follow to connect that system up better and to support researchers in different parts of the system moving to other parts of the system—so from academia into industry and, crucially, from industry back into academia, which our current incentive structures in academia do not adequately support.

I think that that “bridging the valley of death” part is a key role for UKRI. That is exactly what we can do, because we bridge all the sectors and we have some levers on a lot of those incentives that are currently driving balkanisation. If we add ARIA into that properly connected system, then the ideas and innovation that emerge from ARIA will feed into that system in an entirely productive and creative way.

It is not ARIA’s job to think about the system and to build bridges across the valley of death; its job is to push those transformative ideas to try to drive step changes in particular areas and technologies where the experts in ARIA think the best opportunities lie. If those seeds are sown on fertile ground, they will transform into that knowledge economy that I keep talking about. My job is to make sure that the ground is fertile.

Q10 Dawn Butler (Brent Central) (Lab): Dame Ottoline, you said earlier that you expect a close working relationship with ARIA. What does that actually look like? Legislatively, what should that look like?

Professor Leyser: It is an interesting question as to the extent to which that needs to be written into legislation. In my experience, the kinds of relationship that one wants to have with key players across the system are not things for which you necessarily legislate. They are about maintaining open lines of communication and building high-quality personal relationships with different actors in the system. There are a lot of players in the R&D system. I spend a lot of my time talking to people who run other agencies—for example, in the charity sector and those who run R&D activities in businesses—

connecting them up, understanding what people's needs are, what the opportunities are and building the joined-up system I have talked of about before.

So I think the personal relationships are going to be almost as important as anything that one can write into legislation. None the less, possible tools for connection, such as seats on each other's boards, are certainly worth considering, as is observer-type status, rather than formal status, given that high-quality boards tend to be small. Our board worked really well where people were not representative but bringing their skills and expertise round the table. One does not want to bog down the governance structures for a light, agile and out-there organisation with representative requirements. As I have said before, active and engaged communication is going to be essential for ARIA, because it needs to understand the breadth of opportunity in the system to work well. It will be in everybody's interest for those activities to work well. Because of that, they will happen naturally, in the same way that I spend a lot of time talking with other funders of research and innovation already in the public and private sectors.

Dawn Butler: I agree with you that there needs to be a close working relationship. I do not think we can count on it happening naturally. I have two quick questions, if I may, Ms McVey?

The Chair: Dawn, I am mindful of time. We have seven or eight minutes. I have another three questions and Chi Onwurah to come back. Is it a quick one?

Q11 Dawn Butler: It was a quick one on why UKRI cannot access the innovators of tomorrow—the people coding at home. I did not understand what was stopping UKRI doing that?

Professor Leysler: At the moment, most of our funding opportunities require people to apply for a research grant. People coding at home have a hard time applying for research grants, because it is a system with financial checks and so on. Applying for a research grant is a non-trivial activity, whereas winning a research prize, where there is no application process and you just get on with it, is doable. We are very interested in that wider range of funding mechanisms and in how we can learn from the work of Nesta, and, in the future, the work of ARIA to reach a wider range of people. But at the moment, we work on a largely open-call process; it is really effective because it is completely open, but it none the less creates barriers for people who do not have the infrastructure and administrative support to help them submit those kinds of grant applications.

Q12 Aaron Bell (Newcastle-under-Lyme) (Con): It is a pleasure to serve under your chairmanship, Ms McVey. I thank both witnesses for their time, and Dame Ottoline for her evidence to the Science and Technology Committee, on which Ms Butler and I also serve.

Following on from Dame Ottoline's answer to Ms Butler, obviously, the purpose is to expand ARIA to cover areas that are not already well covered, but it also seems to be to try to pick up the pace of research and innovation. We have seen that that is possible through crises such as coronavirus. Can you explain how the pace can be picked up by some of the things that you do at Nesta and whether that would carry across to what ARIA is going to do?

Tris Dyson: I think it helps to pick things, to say, "We want to achieve x within the next two or three years" and to give people a degree of certainty about what outcomes you are going to fund and why. It happens naturally, anyway. Coronavirus is a crisis that has created a rush for R&D. It has also shown, on the drug development or vaccine side, what a combination of funding and relatively agile thinking, including from regulators in conjunction, can do in order to improve outcomes and achieve things. A challenge prize creates that in a positive sense; it essentially says, "We are going to solve for x and award funding on that basis." That helps speed things up.

Related to the previous question, with a grant model approach, you are funding inputs and costs primarily. People put in a proposal for half a million pounds and say, "We are going to do x and this is what the associated costs are going to be." Inherently, your risk threshold is going to be different, because you are anticipating whether this an investment that means they are going to be able to spend that money well and achieve x. You are going to look at track records, their financial history and their institutional strengths. You are going to make a judgment on whether to fund A versus B. That lends itself more towards funding the usual suspects than an outcome-based model, where you say, "It is not important to us who solves for x as long as somebody does." In reality, you tend to blend these models. It is not like there is a pure challenge prize model that does not involve other types of funding mechanisms as well.

Aaron Bell: Understood, thank you. I had better hand on, as we are running out of time.

Q13 Virginia Crosbie (Ynys Môn) (Con): It is a pleasure to serve on this Committee, particularly as a scientist. Dame Ottoline said one of the challenges was finding the right people to lead ARIA and that they were in short supply. Tris said that ARIA was about identifying visionary leaders with extraordinary ideas. My question to both of you is, how much is the success of ARIA linked to finding the right people to lead it? Are you confident that we can find them?

The Chair: If you are both answering, you have about a minute each.

Professor Leysler: I think it is crucial for the success of ARIA—it is everything. We need to go into the search process with absolute resolve to wait until we find the right people, and not appoint people just because there is a vacancy.

Tris Dyson: I agree with that. I would also say that the primary thing would be the mindset and agility, rather than necessarily focusing on a private sector background, a science background or whatever. You need people with the right creative and entrepreneurial mindset.

The Chair: Those were both short answers so, Chi, we have time for you.

Q14 Chi Onwurah: There are two contradictions that I have spotted in what you are saying. Dame Ottoline, you talked about ARIA needing to deliver transformational research and outcomes, but at the same time you said that it is too small to be entrusted with society's great challenges. Should not the public interest determine

what that transformation is? Mr Dyson, you talked about ARIA having a new diversity of funders—regional as well—yet at the same time we hear that it has got to be people who know people and have lots of experience, and we do not have diversity in the base now. Twenty seconds each on those contradictions.

Professor Leyser: I did not say that it would be too small. My point is that if it is really working on the edge of the edge, it is about capturing the extraordinary opportunities that these people see in the system. Those cannot be straightforwardly dictated. They are not to do with those outside requirements; they are to do with what the opportunities are. The smallness of the agency is to do with what proportion of your R&D spend you put into that activity, given that we have major national priorities that need substantial investment, where the target is driven by those national priorities. It is an opportunity—

The Chair: Order. I am sorry, but I am going to have to stop you there. They had both been concise answers. I am sorry that we did not finally get to hear your further answer, Tris. Thank you both very much indeed for your time, Dame Ottoline and Tris Dyson.

Examination of Witnesses

Professor James Wilsdon, Professor Mariana Mazzucato and Professor Philip Bond gave evidence.

10.25 am

Q15 The Chair: We will now hear oral evidence from Professor James Wilsdon of the University of Sheffield, Professor Marianna Mazzucato from University College London, and Professor Philip Bond from the University of Manchester. We have until 11.25 am for this session. Could the witnesses please introduce themselves for the record? I call, first, Professor James Wilsdon—*[Interruption.]* James cannot hear at the moment, so we are just going to sort the sound. Can I move on to Professor Marianna Mazzucato?

Professor Mazzucato: I am a professor at University College London, where I am the founding director of the Institute for Innovation and Public Purpose.

Professor Bond: Good morning, everybody. I have very unstable internet, so if I vanish, that is why and I apologise. I am Professor Philip Bond and I work as a professional problem solver and inventor. I am the professor of creativity and innovation at the University of Manchester, and I have visiting professorships at the University of Bristol in the computer science department, and also in engineering and mathematics. I am also visiting professor in the applied mathematics department at the University of Oxford.

Professor Wilsdon: Good morning. I am James Wilsdon, and I am professor of research policy at the University of Sheffield, and also director of a thing called the Research on Research Institute, which is based at the Wellcome Trust and does research on research systems, cultures and decision making.

The Chair: Again, I will start with Chi Onwurah, move across to the Minister, and then go side to side between the parties. After I have been to Stephen Flynn, I will ask Members to indicate whether they want to ask a question. I think we will get through everybody, as we were quite successful last time.

Q16 Chi Onwurah: I thank our witnesses for taking the time to join us today and bringing us the benefit of your considerable expertise and experience. Professor Mazzucato, you wrote the groundbreaking book “The Entrepreneurial State” and the more recent “Mission Economy”—perhaps there is a clue in the title, in terms of the emphasis on the benefits that mission-orientated research can bring. Indeed, many thought that this new agency, ARIA, was based on some of your work, yet at the same time it does not seem to reflect some of the important context that you set out for it. Can you tell us whether it will achieve the benefits that you set out in your work? What needs to change? What should the Bill Committee look at changing in order to ensure that that can happen? Similarly, Professor Wilsdon and Professor Bond, based on your work on research and innovation systems—particularly in a UK context—what benefits will ARIA bring and what needs to change in order to improve it?

Professor Mazzucato: Thank you so much for the question and for inviting me to give evidence. Without going into the history of the DARPA model—I am sure you have done that already—I think the really important thing is to ask what it is about the UK system that an ARIA could give benefit to. We need to remember that the whole point of having a DARPA or ARIA-type institution is actually to provide that kind of purpose-driven approach to innovation. It is not a replacement for blue-sky research, funded in the United States by the National Science Foundation or in the UK by the research councils. It is precisely that kind of rare moment where you can do high-risk, high-bet research, very much linked between the basic and the applied; it is neither basic nor applied.

Fundamentally, where it has been successful—let us not forget that other countries have also tried this and it has not always been successful—is when it is on the back of a strong system. For example, DARPA in the US would have failed miserably had there not also been a strong military and defence system.

Secondly, it has to work across Government. DARPA in the US, for example, works with the small business innovation research programme, a procurement programme across all the different Departments, which set aside about 3% of their budgets to do purpose-driven research that brings in, for example, small and medium-sized enterprises. Again, that procurement side means that it is fundamentally linked to how Government works; it is not separate from Government.

Thirdly, it has always been linked with a vision or mission of what is to be done. Again, in the wartime scenario, it is clear that the DARPA model was mainly about military goals, but the Advanced Research Projects Agency – Energy, or ARPA-E, is about renewable energy and a green transition, and the Advanced Research Projects Agency – Health is about strengthening the health system and going after big health innovations.

What questions are we asking in the UK that an ARPA-H and ARPA-E or an ARIA would actually resolve? If we think of one of the biggest successes of DARPA, which is of course the internet, they did not obsess about the internet. They were not saying, “Oh, we need a technology.” They needed to solve a problem. The problem at the time was getting the satellites to communicate, and the internet was a solution for that. There were also many other experiments being done at

the time, some of which failed. It is about that kind of willingness to take risks, but those being purpose-driven and problem-oriented.

The first question we should be asking in the UK is: what are the big problems? What questions are we asking that would even require an ARIA? If we do not have enough of a national debate on that, and if we do not have enough of a rethink in Government on things like procurement—the everyday of what Government does—and if we do not have strong systems underlying an ARIA, such as health and energy systems and so on, it will be really hard for this agency to be successful.

Chi Onwurah: Thank you. Professor Wilsdon?

Professor Wilsdon: I agree with everything that Mariana has just said. The one thing that many of us have been calling for since this idea was floated as an option for the UK system is more clarity on its purpose—its mission, in Mariana’s language. It is regrettable, in a way, that it has reached the stage of a Bill without that question having yet been properly answered. There are multiple dimensions to why it is regrettable.

First, it is a recipe for confusion. When it does finally decide what it is for, it has to then negotiate and haggle for space in the wider system, as Mariana said. That is time-wasting and is a source of bureaucracy, which this thing is supposed to avoid. Secondly, the Bill and the debate around it sort of vests the choices about purpose and function in the leadership of ARIA. I agree with Mariana that the role of Government in setting up a new agency is surely to undertake and co-ordinate with the public and wider society a discussion of what this would be for—what big priorities we have as UK society to which a new agency can be directed.

I am fully in favour of a new agency. I think there are lots of arguments, as we have heard already from Ottoline Leyser and Tris Dyson, that in a system that is expanding and doubling its budget over a short period of time, there is definitely scope in the budget to do new things, and I would be wholly in favour of that. Without that clarity, we essentially run the risk of setting it up and then there being a delayed period before it actually does anything very effective.

The final point I would make is that in relying on appointing the leadership as the route to answering the question, all you do is move the source of the problem. If the Government have not been able to resolve the question of what it is for, how do we identify who the right leaders are? We have not yet decided what this thing is for and where it operates in terms of the scale of basic to applied. Does it have domain focuses? I don’t see how you can find the right people. If you do find people, how do you avoid it simply becoming a tool, a plaything, of their prior interests and priorities?

In today’s line-up of witnesses, you are going to hear a number of compelling visions from different people for what this thing could do. I do not have a particular vision to sell you, but those visions map on to the prize and the things that you would expect the CBI or the Royal Academy of Engineering to argue for. If you set something up without resolving that first, you are moving it to the site of the leadership. It is a recipe for capture by particular interests in the system, which I think would be regrettable and quite distorting of the role that this thing is supposed to play, which is to be added to existing things.

I worry generally about the process, as someone who is perfectly happy to support the idea. I don’t think it is being executed in an optimal way to achieve the outcomes that the Government wish to see.

Chi Onwurah: Thank you very much. Professor Bond?

Professor Bond: I thank the previous speakers. I think that the idea is about having radical innovation, which is different from grand missions and grand challenges. Certainly the budgets that have been talked about fit an agency doing radical innovation, rather than some very large-scale grand challenges. The discussion over the need for a directed mission is an interesting one. You can do it both ways. The original ARPA started off with the rather nebulous but powerful mission statement of, “Develop strategic advantage”. That is acceptable if you have a good director who understands what that means. DARPA, for example, or IARPA and so on, have somewhat narrower remits, but that does not necessarily make things easier. A really good director can overcome issues around narrowness of mission statement by using the opportunity to do things that span across many domains. In fact, I think it is a rather liberating thing. The fact that we have not at this point had utter clarity on things I regard as extraordinarily good, not bad.

A defining characteristic of all of the US ARPAs is that they have a strong focus on rotating people in and out—about 80% from industry and 20% from academia, or some balance like that—and they do a lot of work with both. I entirely agree with what was said about a link between applied and more fundamental research, but I want to strengthen that statement by saying that with the industry base there is a focus on getting things done as opposed to publishing papers, and it is important to remember that.

On risk tolerance, a lot has been said about DARPA and taking a lot of risk. I personally think that talking about taking a lot of risk is a poor framing of what they do. What they aim to do is have a significant multiplicative effect on what they achieve. In other words, radical innovation simply says, “We want step change. We want to do things that would create a tremendous impact were they to be done.” What DARPA—all the ARPAs probably, but let’s talk about DARPA in America—has always been good at is managing that risk tremendously well. A large part of the reason they have succeeded is their extraordinarily good management of risk.

In terms of deciding what it is for and whether one should necessarily have a public engagement with that, for some things that is very valuable. For others, opacity is surprisingly effective. Most of the US agencies have some degree of opacity, partly because they work on defence and security, but partly because you are going to ask people to stick their neck out and try to do things that they start out by viewing as probably impossible. Step 1 for an ARPA mission specialist or programme manager is to try to get some evidence that it is not impossible and might be possible. If you are asking people to work like that, shining a spotlight on them is more or less placing them under pressure to step back from that plate and become more conservative. I do not think that is a good thing.

Q17 Chi Onwurah: Thank you very much. Professor Mazzucato, you were very clear that it is helpful not to consider this as a replacement institution. We have

already heard some confusion as to whether it is cutting edge or transactional. You were also clear about the need for a strong research base, engagement on procurement, and a vision. What should that vision or mission be, in your view? We have heard from Professor Bond that there might be a trade-off between transparency and risk taking. How would you respond to that?

Professor Mazzucato: I just want to clarify what I understand in terms of challenge orientation, because I think there is also a bit of confusion there. Challenges globally are the sustainable development goals. Every country is actually signed up to them, including the UK, so we should hear a bit more about the SDGs in the UK national debate.

Let us just bring it back to the DARPA or NASA kind of model. Broadly defined, DARPA is, of course, challenge-oriented. The key thing is how it can translate those challenges into missions. Take the moon landing, which I wrote about in my recent book. I talked about both what to copy and what not to copy from it—most of it was what not to copy. The challenge was the space race, the cold war, Sputnik—NASA did not have much to do without that. They transformed that into a mission, which was to get to the moon and back again in one generation, so it would be wrong to say that DARPA and NASA are not challenge-oriented.

The point is that how they are structured is much more specific than that. Those are problems that need solving. They did not just say, “Oh, let’s go and compete in space with the Russians.” Again, it was very specific: getting to the moon and back in one generation. You can actually answer the question, “Did you get there: yes or no?” Lots of different sectors got involved; it was not just one big isolated project—that is the whole picking winners problem. It required innovation in nutrition, textiles, materials, electronics, and the whole software industry can, in some ways, be seen as an output of that. Again, how did they organise the thinking and the purposefulness of the organisation? One of the first things they did was change their own internal structure to be much more horizontal, with project managers, precisely to be purpose-oriented.

I just think there is a bit of a false dichotomy between whether you need a challenge or whether it is about a big radical innovation. DARPA has always been challenge-oriented, and that is why they needed those radical innovations to actually confront those challenges. The questions they were asking were much more specific and were framed in a targeted way, so you could actually answer the question, “Did we achieve it or not?”

In terms of the risk, I absolutely agree that it is not about risk for the sake of risk. In a conference I organised back in 2014, called “Mission Oriented Innovation”, I invited Cheryl Martin, who back then was the second director of ARPA-E, and she said that they actually structured ARPA-E in such a way as to welcome as much high-risk thinking, and that the whole point was to matter in the economy. They would actually measure their success both on whether they took those risks, because if they were going for easy things, they were not doing their job, and on whether their successes, of which there would only be a few—they accepted that there would be lots of failures—would have a big impact in the economy. For example, they ended up being very important for battery storage.

ARPA-E is very different from DARPA. It has a tiny budget of about only \$300 million a year. One of its problems—it is also really important for the UK to learn about the problems—is that it has been too wedded to industry. It has focused too much on asking industry what it needs and then it ends up almost being this massive technology office, compared with DARPA, which had a very clear Government customer—basically, the Department of Defence. It is important to ask again who the obvious customer for ARIA is and how that is linked to different Departments, so it does not just become a matter of bringing geeks into government—the line Dominic Cummings mentioned. Yes, you want experts in government, but geeks in and of themselves are not what you want to strive for; you want to solve problems that different Departments of a democratically elected Government put out there.

We should also make sure that those problems are not told to Government by experts like ourselves on this Zoom call, or other Zoom calls, as James rightly said, when everyone will just put forward their own pet project. We need to think about the democratic forums and the different types of the debate that are needed in a country, precisely so that the problems and purpose are shared as widely as possible. That includes winning the war, back in the cold war days.

Q18 Chi Onwurah: What do you think ARIA’s mission should be? I will put that same question to the other witnesses.

Professor Mazzucato: I am holding the 2017 industrial strategy, which Greg Clark’s team put together. We were very much advised on that and one of my roles was to say stop just making lists of sectors. You will remember that under David Cameron’s team there were five sectors: automotive, aerospace, life sciences, finance/financial services and the creative sector. I said not to make a list of random sectors, which can easily get captured by those sectors with the loudest voice, but to think about what their problems were. They solved that in the industrial strategy—they listened, and I was very happy—and decided on four challenges, namely, healthy ageing, clean growth, the future of mobility and the opportunities that AI and the data economy provide to us.

In terms of identifying the missions underneath those, I set up a commission co-chaired with Lord David Willetts entitled the Commission for Mission Oriented Innovation and Industrial Strategy. We worked very closely with the different challenge teams in BEIS precisely to answer your question. It is definitely not the role of an economist, academic or business person to tell you what the missions are. That must be co-created within Departments alongside different stakeholders, but surely the first answer is that those missions must be those that respond to those four challenges.

On clean growth, the answer must be carbon-neutral cities all over the UK; or take a global challenge such as clean oceans—sustainable development goal 13—and getting the plastic out of the ocean. What is the UK’s contribution to that? What about the digital divide, under the challenge of AI and the data economy? Just think back to when the BBC had a mission. Back in the 1980s, it wanted to get every kid to code, before it was sexy—today it is very sexy to talk about coding. The BBC was doing that back then, and its own procurement strategy helped to deliver that by producing the BBC

Micro computer. The BBC did that not because it was obsessed by technology but because it needed it to fulfil that mission. So, this strategy is not completely new to the UK, but we should not pursue it as a siloed project; it must answer the big questions such as the digital divide, carbon neutrality, health ageing and so on. But you have the 2017 industrial strategy, so start there; we cannot keep rethinking from scratch each time.

Q19 Chi Onwurah: Thank you. Professor Wilsdon?

Professor Wilsdon: I do not have a mission in my back pocket that I want to push. My argument is simply that the thing needs to have more clarity. I do not really mind what it ends up doing, as long as we go into it with a better sense of what we are trying to get out of it, as Mariana said. It is worth going back to some of the other strategic documents that operate and run the UK system, including the industrial strategy, as Mariana says.

In July last year, the UK Government published its draft R&D roadmap. Again, that is a good idea and it is something that many other countries do. It set out a longer-term planned direction for the system, and tried to explain to the system and to wider stakeholders how the different parts fit together and their different functions. To me, the logical sequence of events would have been to conclude that process—I realise it has been a difficult year for everyone for obvious reasons—and then to identify the particular gaps and priorities to which a new funding mechanism could be directed. What we have done is fixate on a particular institutional model, imported from the US in the late '60s, and dumped into Britain today, as the way in which somehow, magically, we are going to cut through all sorts of real or perceived barriers and obstacles in our existing research and innovation system. I just think that is a very flawed way to do this.

We are where we are. The Bill is in front of Parliament. We need to focus at this point on how we can amend it, or you can amend it, to improve it. I think that trying to bring more clarity, or at least a sense of how this issue will be addressed through the governance of this new thing, is really important. Otherwise, you or your successors, and we or our successors, will be back here in a few years' time, asking ourselves why it did not work. I know that it has a tolerance of failure—we are all in favour of that—but the thing has to at least succeed in some respects, alongside its appetite for failure.

Chi Onwurah: Thank you.

The Chair: Professor Bond, did you want to comment?

Professor Bond: I just want to make a remark, if I may, on scale. Talking in the same breath of putting man on the moon, which cost up to 5% of US GDP, so roughly 60% of UK GDP, and ARIA, for which the figure is £200 million a year, is, I think, an issue.

I agree that there is confusion about challenge. The grand challenges are really better structured in different ways, which is why NASA has a director and why the Manhattan project had very strong, firm leadership. I want to use that to emphasise, first, that ARPA/DARPA mainly does not use challenges. There are some fields where it has done—robotics, autonomous vehicles and a few others—but that is not its main way of doing things. The issue about the word “challenge” is that for some things, particularly in computer science, it can be

a very good way to bring together people in different teams that would not normally operate in that way, but it is just a mechanism for doing that.

The question you have asked me is about the mission for ARIA. I totally agree, by the way, with what was said: it is much easier in life if you have a customer. But if a really good director is picked, they are going to go out and get some customers—probably within Government. There is so much that can be done in government; there are so many good things to be done that if you have an imaginative and intelligent director—I am sure that will happen—that person can find plenty of sensible things to do. I therefore think you do not need to be overly prescriptive; you can try to leave it open.

I was also involved in the structuring around the industrial strategy grand challenges. First, they are another step up in scale. Secondly, I do not think we should be binding anyone to having to focus on those at all. It is rather obvious that there are many interesting and important problems societally. It is obvious that there are many, many ways in which somebody could look to do things, whether with education and helping kids to learn better, or with the NHS or anything else. I would leave it up to the director and the mission folk to do. The whole point of a DARPA is really to leave it open.

What you want these people to do is one thing: you want to demand of them that they make their best attempt to do radical innovation—to do things that, were they to work, would mean a step change in what should be done. It is going to be easier if that can get implemented in some efficient and effective way, so how that is done is a great question, especially as it will be a small office. That is somewhere that the office is clearly going to have to work with Government and find customers within Government, and do things that are so impressive that that will work. That is a challenge, but that is why you get a director.

Chi Onwurah: Thank you.

The Chair: Minister?

Q20 Amanda Solloway: Thank you, Ms McVey, and thank you to all the witnesses. I have just one question for Professor Philip Bond. We have tried to balance giving ARIA independence and ensuring good governance. What are your thoughts on the ideal size of ARIA's board and giving ARIA's chair the freedom to decide who sits on it?

Professor Bond: I would probably have a board and another structure. Certainly one of the super-important things that works in the US ARPA is that the programme managers are challenged in a sort of dragons' den. It is a friendly dragons' den, but they have to convince very capable, technical people that they can do what they do. That is one structure that would need to be slotted into place.

As for the board, I think you could have a slightly unusual board. I do not think it needs to be big; it could be very small. It could be less than 10 people, for sure, but you could also expand it a little bit with something that is a bit like a non-executive director, or NED—somebody from a different area with a rather different take on things. The balance will be important. You want a balance of people; I think you want some very

radical thinkers in there, some people who know how things work in industry and some people who know how things work in academia, and so on.

As for the autonomy, I am personally a big believer in giving the chair and the director enormous amounts of autonomy. You pick people you are willing to bet on and then hand them a lot of trust. In fact, if you want to define the ARPA model at some level, it is this: it is a different model of trust. Bureaucracies occur because although we like to trust people, we have to throw up lots of rules and regulations to make sure that things work the way we feel they should work. What you are doing in creating this kind of model is handing trust to people. You want people with high integrity who are brilliant, and then you let them get on with it, and you trust that they will do something that reflects their character.

I do not think the board needs to be big; I think it needs to be very good. There should be a small number of outstandingly good people, who can tap into a broader network and bring in people to give a different vision and view from that which you will only ever get with a small number of people.

The Chair: Before I go to Stephen Flynn, can I just have an indication of who wants to ask questions? I have got Sarah, Daniel, Aaron, Jane—okay. Thanks very much indeed.

Professor Mazzucato: Can I make one super-quick point on what Philip just mentioned?

The Chair: Absolutely, and then I will go to Stephen.

Professor Mazzucato: One of the things that DARPA is very good at is not only turning the tap on, in terms of funding the things that we have been talking about, but knowing when to turn it off. Knowing how to pivot and to be flexible and agile is absolutely necessary. Not only should this agency be free from burdensome bureaucracy, it needs to proactively get an agile and flexible structure, and the metrics that tell you when to turn the tap off, because this is the challenge. You want to be long-termist—going for the difficult things and not the easy ones, which you do not need an ARIA for—and also to have the metrics internally to tell you when things are not going right and when you actually have to stop.

Q21 Stephen Flynn: Thank you to the three of you for your information so far; it has been incredibly helpful.

I have a question for James and Mariana, and then one for Mr Bond. James and Mariana, you both clearly want to see a mission. However, I do not think we should necessarily kid ourselves that the Government will be minded to agree to any amendment in line with that. Do you have any other wider concerns about the Bill whatsoever, or around ARIA as an entity? Do you see any positives at all? In a previous evidence session, we heard about the good prospect of it being small and agile. Is that something that you would see as a positive?

Mr Bond, you are placing a lot of emphasis on the director—I think you used the words “people with high integrity who are brilliant”. That is pretty vague, to say the least. I am sure we could all pick people who we think are brilliant and have high integrity, so are there any definitive qualities, or anything at all with a little

more substance, that individuals should have, perhaps in relation to scientific merit, or their background and commercial activities?

Professor Wilsdon: You are specifically thinking about aspects of the Bill that can be tightened and improved, accepting that there is only so much that can be done at this stage. The National Academy of Sciences—the Royal Academy—has published a very good and detailed set of probing amendments to the Bill just this week, and I would certainly endorse several of them. They include inserting a clause that requires ARIA to complement the work of UKRI. That would go at least some way to dealing with the concern that persists over boundary skirmishes, shall we say, or fuzziness at the edges of what the big public funding agency is there to do and what this new thing is there to do.

Accepting that it is going to be hard in the middle of the Bill to define the mission—it is the wrong way to go about it—I wonder whether tightening up some explanation in the legislation of how the process of defining the function and orientation will work, whether on a cyclical basis, for example, choosing particular things to focus on over a five-year cycle or whatever, would also help.

I worry greatly about the touching faith that Philip and others seem to place in the capacity of the chief executive and chair to be these sort of omniscient, wise characters and, indeed, in the Government to choose the right people. It is very important when we are spending £800 million of public money that we establish proper mechanisms of transparency and accountability. I do not think that has to inhibit innovation. I do not think there is any supporting evidence that freedom of information or other measures that currently exist are inhibitive of effective innovation. I do not recall any discussion of that coming up during the passage of the Higher Education and Research Act 2017, three or four years ago, which Committee members may have been part of, and when UKRI was being created. It was not a problem to which any discussion was directed, so I am confused. Such provisions apply to DARPA and other bodies in the US system.

When it comes to people, I hope very much that the Government manage to secure talented people. I hear Lex Greensill is available and has impressed many senior figures in Government in the past with his innovative and disruptive approach to various financial mechanisms. That is the point: if we want this thing to survive and persist and be a valuable addition, it needs to be set up in a way that will avoid capture by anyone—by me, by Mariana, by Philip, by anyone. That is the reason why we have the structures. It really is incumbent on Parliament now, through this process, to try to put more of those mechanisms in place. I just do not see the evidence that they will inhibit its effectiveness.

The biggest barrier to effective, creative, high-risk funding of research and development in this country over the past 10 years has been lack of investment, period. That is the issue: lack of investment. It is great—it is wonderful—that the Government are tackling that with its doubling of public R&D by 2025, if they get there. As I said at the start, that creates the space in which new initiatives such as ARIA can thrive—I hope they do—but there is no evidence that I am aware of for some of these unsupported assertions that are being bandied around about bureaucracy in the system and

transparency being the problem. I just do not see it. In terms of the legislation, it is very important to try to tighten those provisions.

Professor Mazzucato: I would agree with a lot of what James said on investment. It is very important to remember that the UK continues to have a below-average GERD—gross R&D spending—over GDP, but also a below-average BERD—business investment in R&D. One of the key things that the DARPA model did in the past was precisely through being ambitious in areas that were market creating, not just market fixing, and also really cheap to crowd in business investment. Again, as I mentioned before, we need metrics to make sure that is happening—in other words, that it is actually creating additionality and getting investment to happen that would not have happened otherwise.

Coming back to the big question, which is a very important one, there are three big things we need to make sure we are doing. One is to have a very clear idea of the innovation landscape in the UK and exactly the gap that this new agency would be filling, because even though it might be exciting to form a new agency, if it is not filling a real gap and is just creating a bit of confusion and repetition, or creating something we do not need, that is a huge problem. Personally, I think it is a good idea, especially if we structure it in the right way.

One of the things I did in the European Commission was put forward this idea of mission-oriented innovation. On the back of that, missions are now a new legal instrument within the European Horizon programme. What that does is ensure that the part of the European budget that used to be challenge-oriented in a very vague way now has the concept of missions to guide it. I argued that we needed to make sure we know what we are talking about when we use the word. I argued that five different conditions had to be there.

The first was that missions be bold and inspirational with wide societal relevance. The second was clear direction—targeted, measurable and time-bound. That is the point before: making sure you can answer “Did you achieve it or not?” The third was to be ambitious but realistic, supporting existing research and innovation actions as well as applying them to those difficult new areas, and, again, areas where there is actually a customer basis. The fourth was that they have to be cross-disciplinary, cross-sector and cross-actor. I gave an example where it is not just about going to the moon—a carbon-neutral city would also require all sorts of innovation across multiple sectors. So it is making sure this does not replace a sectoral approach, but really fosters that inter-sectoral approach. The fifth was that it has to stimulate multiple bottom-up solutions. That is where we need to make sure we are not confusing the concept of missions with projects—often pet projects.

Third is the whole point about expertise in Government. Of course we need expertise in Government and we often have that expertise. When we do not have that is also when you are most open to capture. In my recent book “Mission Economy” I dug out some really interesting documents in NASA, during the Apollo programme, where they said “If we stop investing within our own brain, our own R&D, we are going to get captured”—by what they called “brochuremanship”. At the time, businesses did not have sexy PowerPoints, like, say, PwC, Deloitte and so on: companies came in with brochures to argue why they should be working with NASA. They said,

“We need to be working with the best businesses out there, and in order to know how even to write the terms of reference with the businesses and know which ones to work with, we ourselves have to be knowledgeable.”

This comes back to the point, do we have a Government who have been, over the last decades, investing within their own dynamic capabilities within the public sector? I think, here, we need to look at what has been recently coming out in the news. Lord Agnew argued that we have been infantilising Whitehall by the over-use of consulting companies. So the lack of investment within Whitehall, within Government, in their own capabilities, is the biggest opener to the possibility of getting captured; because they do not necessarily then know what they are doing in different landscapes.

Lastly, I would argue that one of the things that most distinguishes the UK innovation landscape from the US one, even taking size into consideration, and everything else, is the lack of confidence. Since I have lived in the UK, for the last 20 years—I am now proudly a UK citizen—there has been constant change in names, whether it is the Technology Strategy Board becoming Innovate UK or what is now the Department for Business, Energy and Industrial Strategy having changed its name four times in the past 20 years. If Government do not know what innovation is for, and if they have these constant consultations with others telling them what to do, that exudes—it kind of reeks of—lack of security. I am not saying you should be confident for the sake of it. I do not even think that is necessarily a value to be held; but this idea that actually we do not even know what we are talking about in terms of what the role of BEIS is, or what the different types of institutions are, what their role is and how they can work together with a dynamic, innovative division of labour, instead of constantly changing the names of existing institutions or bringing forth new ones: that is just something that someone is going to have to deal with.

The Chair: Professor Bond?

Professor Bond: I think the question I was asked was about the qualities I might look for in someone. I think that the principal quality that you want in a director, and in the programme managers, is divergent thinking. We have a tremendous system for educating people to become extraordinarily good convergent thinkers. That means they are very good at solving problems in a specialised domain; and that is a valuable set of skills. Here, you need something that goes beyond it. We have heard a lot about NASA. NASA famously realised this in the early days and set about looking for divergent thinkers—and had a test for divergent thinkers. You want someone who shows the ability to be both a very good convergent thinker—a conventional thinker—but also a very good divergent thinker. That is a much rarer thing.

I think you want someone who has shown that they have a real interest in cross-cutting by having done it much of their life. A lot of people talk about it but do not do it. So you want someone who does. When I say cross-cutting I mean across different disciplines—someone who has actually done more than one discipline and someone who has actually worked with industry and academia. That is what I think would be ideal—someone who has an insight into science but also engineering, because you are going to need engineering know-how,

and engineering thinking is not the same as scientific thinking. I have worked a lot with Formula 1, for example, and with Rolls-Royce, and it is a different form of thinking.

It is a little closer to what Professor Mazzucato was referring to when she said that you want to combine the thinking of fundamental research with really pushing the limits and boundaries of things. I think you want someone like that. Someone phrased it to me recently as not wanting to see the usual suspects; that is probably one way you can frame it. I think you want somebody who is clearly respected, because people who know them know that at least they have solved some hard problems.

I would like to address the point about avoiding capture. You can talk about people having special interests. Lots of people have come out and said what they think this should do. I have tried rather hard to say exactly what I do not think it should do. I do not think it should do this, that or the other and I do not think that you should necessarily say that it should do this, that or the other, so I am not someone who would want to end up capturing it, in that sense. I want to firmly assert that you put trust in people. When you put trust in people, those people will have some ideas, expertise and background, so you will be making choices. Making choices does not equate to capture, and it is entirely possible to put trust into excellent people and let them do things. We do that with democracy and with Parliament.

In terms of the level of transparency, transparency is a good and wonderful thing in most areas, but if you are asking people to go out on a limb to really push the envelope, I would assert that there is an argument, which has some validity, that you make it psychologically much easier for them if they do not feel that they are under a microscope. Many people tend to step back when they are there. Unless there is some overarching reason for it, I think that they can absolutely be over the size of what is done—they should be and will be—but I do not think it needs to be excessively burdensome in terms of the transparency of what is happening. Again, it comes back to the trust model that you have. The trust model I have is that I believe you can find people you can put trust into, even with £800 million.

The Chair: Thank you very much. I am just going to give the timing because I do not want to run out of time and we have less than 15 minutes left. I have the list of people wanting to speak and I will take it in this order: Daniel Zeichner, Jane Hunt, Sarah Owen and Aaron Bell. Did I miss anybody out? No. I move now to Daniel Zeichner.

Q22 Daniel Zeichner: Thank you very much, Ms McVey. I have two questions; the first is to Professor Mazzucato. You obviously set a lot of store by the 2017 industrial strategy—you waved!—yet its current status seems somewhat uncertain. Were that not to be going forward, does this whole system then work, in your view? What would be the impact of not having those great challenges and goals set out?

Then I have a question for Professor Bond, which was actually posed by Professor Wilsdon in an article he wrote a while ago. He asked:

“What empirical evidence is there of the problems in the UK’s R&D system to which the Aria bill is the solution?”

Professor Mazzucato: Talking about innovation policy without an industrial strategy or an industrial strategy without an innovation policy are equally futile. The problem is what do we even mean by an industrial strategy. I have already mentioned that I think that the wrong kind of industrial strategy is one that makes a random list of sectors, technologies or types of firms, to find SMEs and so on. It is more one that focuses on problems and then gets all sorts of different sectors to solve those problems together and then, for example with SMEs, it gives them extra support because they are small. The support they get is not because they are small, as though small is great quality, but because they become an active member of a transformation strategy in which both the industrial and the innovation side are equally important.

It has been talked about that the UK Government are abandoning their industrial strategy; I do not think that is actually true. I speak to very able civil servants working today in BEIS and I think action on an industrial strategy is going forward. My question is, why have we decided that it is no longer called an industrial strategy? That actually comes back to my previous point about the lack of confidence—perhaps someone decided that it sounds too ideological, although I am not sure why because it is not at all. The US Government are reviving their industrial strategy. Many countries have industrial strategies. The reason that Denmark is the No. 1 provider of high tech green digital services to China, which is spending more than \$2 trillion greening its whole economy, is because it has had an industrial strategy.

One thing is to name things for what they are. The UK continues to have an industrial strategy. Wonderful documents have come out about the innovation policy from BEIS, but if we are not calling things what they are, that creates confusion. The way to attract top people to Government is to be clear, as I said before, about what Government are for.

Let us look at the way that the US Government managed to hire a Nobel prize-winning physicist to direct the Department of Energy, Steve Chu. He set up ARPA-E back in 2009, where the first director was Arun Majumdar, who then went on to direct the energy programme for Google. He was not told to come in because he was a geek, or to incentivise business for the sake of it; he was told to come in to help Obama direct the stimulus programme, which was \$800 billion, in a green direction. That sounded incredibly exciting and, of course, he was willing to leave Stanford for some years to do that.

The best way to bring top thinkers and experts with different types of expertise into Government is to make it exciting in terms of what Government are there to do. That has to be not just fixing market failures but being actively part of the co-creation and co-shaping, alongside business, of the markets of the future. DARPA has been really good at doing that within its space. It does not matter what the budget is—I would argue for a larger budget for innovation in general in the UK, but even with a fraction of that budget, what is the remit of that organisation? If it is just fixing problems along the way, or asking business what it needs, or being a clear, proactive, mission-oriented shaper of markets, that will definitely impact its success, but especially who will want to work in it with high expertise.

Professor Bond: I was asked, what evidence is there of issues in UK R&D to which ARIA is a solution? First, we have a wonderful science base but it has largely become incentivised to publish papers in fancy journals—that is how you make your mark and get promoted and respected. That is a fabulously good thing, but ARIA can do something quite different. When you work in industry, your goal is to build or make something or move something forward, not worry about publishing it. In fact, usually you do not bother to publish it. For all that we are a tremendous scientific nation, there has been such a focus on that, but we could focus a lot more on doing things rather than feeling that there should be publications. I am not saying that there should not be publications, but that certainly should not be the focus.

A lot of what happens in academia, for perfectly good reasons, is to move things to some low-level prototype at most. There is often a lack of the kind of engineering that companies are required to do. That is not to wave a finger at academia—that is not what it is there to do. You need to do things differently when you are in industry. There is a role to be played by a group that can do those two things very well. Industry also does not necessarily do everything as well as one would like. There are exemplars where everything gets done very well, I hasten to add. It is absolutely possible, as Professor Mazzucato put very well, to link applied research to develop things and to bring in deep expertise when you need it. We can do more of that, and I think this can be an exemplar of a good way of doing it. If you want evidence, it is that the Americans have done that with ARPA and have been really successful at it. We have not had one. I will use that as the evidence.

The Chair: Thank you. Mindful of time, I call Jane Hunt.

Q23 Jane Hunt (Loughborough) (Con): Thank you, Ms McVey. It is a pleasure to serve under your chairmanship. My question is to Professor Mazzucato and Professor Bond. In the previous session, it was very interesting what UKRI said about there being almost a language of going through the process of bidding for and gaining R&D funding in the UK, and they do it very well. But they talked about there being an area that could be developed to free up minds. How do we attract fresh ideas and thinking from some of the experts and inventors of our generation who are not always able to engage in the current R&D structure?

Professor Mazzucato: Wow, that is a fantastic question, and of course it also goes back to the education system. This may be too broad a point, but the more unequal an education system is, the less able a country is to access the full range of potential innovators, so we should always be linking up the two. Education should really be the great leveller. There is this big distinction between private and public, and even within the public and state system there are huge differences. One could even look at the whole A-level system. I once asked myself how many people in the UK study mathematics. Only a few do an A-level in maths. Do you even study calculus? In most countries, everyone, whether they become a poet, an engineer, a geologist or an English teacher, studies calculus as part of their training. Going back to the education system and looking at how it is distributed, in terms of the high quality within a country, but also regionally and by class, is a big point.

On the other part of that question, the first point that I made today is that the discussion about ARIA should not get confused with the fact that we always need curiosity-driven research. The National Science Foundation funding or the Research Councils UK funding in the UK really should reward great ideas because they are great ideas, whether or not they are talking about some big societal challenge. That should always be properly funded. Again, if you compare us with some other OECD countries, we are not necessarily on par with that.

We should have a conversation at the same time about what institutions galvanise the mix of thinking between basic and applied. That is why Vince Cable set up the catapult centres, which were modelled on the Fraunhofer institutes. The difference between Fraunhofers and catapults is not only that the German Government spend 10 times as much on Fraunhofers as we spend on catapults, but also that the same person—the same individual human being—goes from being a civil servant to being a businessperson within the Fraunhofers. There is a much less fuzzy distinction that we tend to make in the UK between the bureaucrat and the entrepreneur. That itself is a really interesting function of an agency, coming back to Professor Bond's point that we should not have these siloed areas, with academies just doing the academies and then businesses on the other side. Finding those interesting corridors, where there is a basic needs supply but the same person breaks down the false dichotomy between bureaucrat and entrepreneur, is something that is perhaps missing in the UK's innovation landscape.

The Chair: Thank you. Can I just interrupt and say that there are three minutes left and I have two questions left? Can people be to the point?

Professor Bond: I think ARIA cannot and will not address every creative mind that we have in invention, but we can do more as a nation for inventors. We can do something like Kaggle, which is a fabulous way of bringing people together. We can do more easy seeding of things, and we can have a lot more Makerspaces. Those are a couple of ideas. I could keep going on, but we do not have time.

The Chair: Thank you.

Q24 Sarah Owen (Luton North) (Lab): It is a pleasure to serve under your chairmanship, Ms McVey, especially in my first Bill Committee.

We have heard a lot of evidence in the two sessions about the need for ARIA to identify what it is for. We should also be clear about what it is not for. Professor Wilsdon, do you think that moral and ethical boundaries need to be placed on ARIA?

Professor Wilsdon: You mean in terms of the research areas it would work in?

Sarah Owen: Yes.

Professor Wilsdon: I am not sure whether one would need to legislate for that. I would expect that most provisions in those areas would apply, but it is a good question and one that bears more thought. It links a bit to my point about accountability mechanisms. As I have said already, the nervousness is that you combine an institution with a fuzzy, ill-defined purpose with very loose mechanisms of accountability. That is a recipe for

all sorts of problems down the line, as well as potentially for great things—who knows? It is a model that has very obvious potential flaws. It is not going to work in the defence arena, which is clearly the one, as I understand it at least, that would raise the most issues in that respect. The key thing is the governance structure for this entity, which I see as too loose.

The Chair: I think we are going to hear your question, Aaron, but we will not get the reply.

Q25 Aaron Bell: Professor Bond, you said that opacity is useful because it avoids too much pressure being put on people. Does that apply to trying to get new people into the space?

Professor Bond: Sorry, when you say “new people”—

Q26 Aaron Bell: People we are trying to get in through the challenges and so on.

Professor Bond: Yes, I think so.

The Chair: Perfect. We have come to the end of the time allocated for the Committee to ask questions, and indeed for this morning’s sitting. I thank our witnesses on behalf of the Committee for their evidence. Professor James Wilsdon from the University of Sheffield, Professor Mariana Mazzucato from University College London and Professor Philip Bond from the University of Manchester, thank you very much indeed.

Ordered, That further consideration be now adjourned.
—(Michael Tomlinson.)

11.25 am

Adjourned till this day at Two o’clock.

