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Public Bill Committee

ADVANCED RESEARCH AND INVENTION AGENCY BILL

Second Sitting

Wednesday 14 April 2021

(Afternoon)

CONTENTS

Examination of witnesses.

Adjourned till Tuesday 20 April at twenty-five minutes past Nine 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,

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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

Dr Peter Highnam, Deputy Director, Defense Advanced Research Projects Agency

Professor Pierre Azoulay, MIT

Dr Regina E. Dugan, CEO, Wellcome Leap

Professor Dame Anne Glover, Former President, Royal Society of Edinburgh, and Special Adviser to VC, University of Strathclyde

Tabitha Goldstaub, Co-Founder, CognitionX (also Chair, AI Council)

Adrian Smith, President, The Royal Society

Felicity Burch, Director of Innovation and Digital, Confederation of British Industry

Professor Sir Jim McDonald, President, Royal Academy of Engineering

David Cleevely CBE, Chair of Focal Point Positioning Ltd and the Cambridge Science Centre

Bob Sorrell, Chair, CaSE

Public Bill Committee

Wednesday 14 April 2021

(Afternoon)

[JUDITH CUMMINS *in the Chair*]

Advanced Research and Invention Agency Bill

2 pm

The Committee deliberated in private.

Examination of Witnesses

Dr Peter Highnam, Professor Pierre Azoulay and Dr Regina E. Dugan gave evidence.

2.1 pm

Q27 The Chair: We will hear oral evidence from Dr Peter Highnam, deputy director at the US Defense Advanced Research Projects Agency; Professor Pierre Azoulay, Massachusetts Institute of Technology; and Dr Regina Dugan, chief executive officer of Wellcome Leap. We have until 3 pm for this session. I call on the witnesses please to introduce themselves for the record.

Dr Highnam: Thank you very much for the invitation. I look forward to your questions.

Professor Azoulay: Good afternoon. Thank you very much for inviting me to testify in front of the Committee. I look forward to the exchange.

Dr Dugan: I am Regina Dugan, the CEO of Wellcome Leap. I look forward to your questions.

The Chair: Thank you for coming to this important evidence session. You are all very welcome. We will start the questions with our shadow Minister, Chi Onwurah.

Q28 Chi Onwurah (Newcastle upon Tyne Central) (Lab): It is a pleasure to serve under your chairship, Mrs Cummins. May I also echo your thanks to our witnesses for taking the time to join us for this important session? I am in awe of the range and breadth of your experience in innovation and scientific research, and all the more grateful to those of you with experience of DARPA for joining us this afternoon, as the architect of the Advanced Research and Invention Agency, Dominic Cummings, the previous adviser to the Prime Minister, has apparently refused to give evidence to the Committee. We are able to go only by what he has said previously, and there seems to be some confusion as to what ARIA is and whether it should be engaged in cutting-edge research or in the translation of existing research. You might be able to comment on that.

Dominic Cummings said:

“The purpose of ARIA ought to be to sample in this broader design space, to do things differently, and to learn from the things that have been super-productive in the past. That means in very simple terms extreme freedom.”

Dr Highnam, does DARPA have “extreme freedom”? What does that mean in cultural terms? Does complying with, for example, US freedom of information laws or procurement regulations—it is proposed that ARIA would be exempt from them—impact on that freedom?

Dr Highnam: That is a great question. DARPA is an agency in the Department of Defense in the US Government. We have a number of regulations and laws that of course we operate within. We have a number of special authorities that allow us to operate a little faster and with a little more independence, but with oversight. It is a place that moves quickly. As you are probably aware, when you show up at DARPA, you have an expiration date on your badge, as we say, so you move fast and the whole place is geared to do that. The agency now has a record of 63 years of production—again, with oversight at all times. It gets the job done, in that context.

Q29 Chi Onwurah: I will follow up on that and then bring in the other witnesses. You speak about oversight. Would it be possible to give a bit more detail on that? In particular, the UK Government are currently mired in a cronyism scandal; indeed, that is what is being debated in the House today. DARPA is well known for having exchange between itself and the private sector, but how do you prevent projects or programmes from going to friends, mates and those with, if you like, special interests, without some degree of oversight?

Dr Highnam: I can speak only to how DARPA operates. We have very rigorous review processes—technical, financial and others. We have conflict of interest rules and so on that we all follow. There are robust processes and independent looks at those processes. Again, we could not operate any other way.

Q30 Chi Onwurah: Thank you very much. Could I ask our other witnesses to respond?

Professor Azoulay: If I might add one element to the question that the hon. Member asked, the programme managers at DARPA and also at ARPA-E—the Advanced Research Projects Agency-Energy—have a fixed expiration date, which means they will need to go back to academia or to the venture capital firm or large firm that they left, and generally they want to do so with their head held high and their reputation intact. I think that that has created over time a norm of correct behaviour, if you will, and the absence of cronyism. That norm element is also very important, in addition to the formal regulations.

Q31 Chi Onwurah: When they go back, are they allowed, for example, to direct finance at the companies to which they return?

Dr Highnam: No.

Chi Onwurah: That is very clear.

Dr Dugan: I served as the 19th director of DARPA and echo Peter’s statements that there are indeed oversight and regulations that govern the behaviour at DARPA. We have free and open competitions. One of the things it is important to understand is that part of the reason that innovation is so robust at DARPA is that there is a sense that there is an equal opportunity for many to apply to the programmes and to be fairly judged. As a result, many bring their ideas to DARPA. That is part of the robustness of the ecosystem that has developed around the agency. It is a very important element of the work.

Q32 Chi Onwurah: Thank you very much for your responses. May I ask one more follow-up question? I have spoken about some of the concerns about oversight

and so on, but may I ask each of you what you think is the key positive element of culture? You have spoken about the desire to return with your head held high. What should we be looking for in the directors and programme managers as the key positive part of the culture that ARIA should seek to build?

Dr Highnam: Honour in public service is top of the list.

Chi Onwurah: Honour?

Dr Highnam: Yes. You join a place like DARPA to change your field and make a difference for defence. We are a defence agency. When you come to DARPA, we give you the lever arm, we help you position the fulcrum, we give you the mass to make things happen, and we give you the processes around you to make sure, as Regina said, you do it fairly, openly and robustly. We do exit interviews when people leave DARPA, and one of my favourite quotes is, “If you don’t invent the internet at DARPA, you get a B.”

Chi Onwurah: Fabulous.

Professor Azoulay: I second that entirely, but I would also say credibility in both the scientific world and the business world. It is a relatively rare breed of individuals who have credibility in both domains at the same time, but that is to quite a large extent the X factor in the typical DARPA or ARPA-E programme manager.

Q33 Chi Onwurah: Thank you very much. Dr Dugan, I will ask you the same question. The tech sector and science and innovation are not known for their diversity, but we have heard that diversity of thought is very important in the agency. As shadow Minister, I would like to see a broad range of diversity in the people who are recruited, in terms of gender, class and race. I am asking this question of you because you are the last person that I came to. How can the culture promote diversity as well as being positive?

Dr Dugan: Let me take the questions in order. I would add that DARPA and ARPA-like organisations are optimised to create breakthroughs. Those breakthroughs happen at the intersection of some science and engineering that we are pulling forward in service to a new capability or a new problem solution. We design the programmes such that we have a very clear and ambitious goal that is also measurable and testable. Programme directors have a finite period in which they collect a group of performers from a mix of organisations and disciplines in service to that goal, and there is passion, spirit and urgency that comes with that. It cannot be created in the abstract; it has to be real in order to engender the kind of genius and collaboration that is characteristic of these programmes.

The programme directors are themselves scientific or engineering experts. They are great musicians, as you might think, but they are not playing an instrument at the time of conducting the programme; they are rather conducting an orchestra of expert musicians who together make a symphony. That is very important.

What I can tell you about diversity from my own experience, both in Silicon Valley and at DARPA, is that for decades we have known that specificity of goal and outcome is a good way to get more equality and diversity in assessment of ideas and in people conducting or pursuing those ideas. We know that across academic institutions and across companies. One of the things

that is important is to set crisp and clear goals, because the ideas are then measured against them, and they can come from many different individuals and organisations. As I said previously, I believe that is central to building that ecosystem out, and for that ecosystem to be diverse and more equitable.

Chi Onwurah: Thank you very much. I know that others have questions to ask so I will leave it there, but I just want to say how inspiring it is to hear such positive reference to the power of public service, science and research, and to oversight as being an enabler rather than a burden.

Q34 The Parliamentary Under-Secretary of State for Business, Energy and Industrial Strategy (Amanda Solloway): It is a great pleasure to serve under your stewardship, Mrs Cummins. I want to acknowledge the excellence of our witnesses and to thank them. With your permission, I will ask one question to each witness.

I am going to start with Dr Peter Highnam. How do you ensure evaluation and scrutiny of DARPA’s programmes outside what is mandated in legislation? What information do you gather to assess when to start and stop projects and programmes, and how are these decisions made?

Dr Highnam: That is a surprisingly big question. The p in DARPA stands for “projects”, which is critical for a place like DARPA. We are not doing technology area x or y just because, and we do not do it for the long term. We have projects that are well defined at the beginning. A case has to be made. They are monitored, they have metrics and all manner of independent evaluation associated with them before we go out to find the best teams we can to participate and to be funded to work on that research. Then that project ends. That is very important: things begin, and they end.

To make the case for a project to get off the ground, we use a structure called the Heilmeyer questions, named after the DARPA director in the mid-70s, George Heilmeyer. They are five very important questions. They look easy, but they are very hard to answer well. In my view, that is the creative act in the DARPA model—to answer those questions well and make that case. Once the project is approved and teams are onboard, you then have regular evaluations. As things change in the world around us, in science and technology, with us in defence, and in other aspects of our environment, they may be overtaken by events. That is very rare, but it would be grounds for no longer continuing. Were we too ambitious in certain aspects of the programme? Do we need to change it or change some of the people participating in the teams? And so on.

This is a constant process. It is not about starting it up and letting it run until it finishes. It takes a lot of effort to make sure you know what you are doing when you start with taxpayer funding and the opportunity cost that comes with that. Then you keep an eye on it, especially during the transition of the results to our national defence.

Q35 Amanda Solloway: Thank you. That was a very precise answer to what I know was a very large question. I would next like to come to Regina Dugan, if I may. As you well know, Wellcome Leap was created as a separate

[Amanda Solloway]

body from Wellcome Trust. Why was that decision made and how will it help Wellcome Leap achieve its objectives sitting outside of the Wellcome Trust?

Dr Dugan: The story of Wellcome Leap actually dates back to about 2018, when the Wellcome Trust, from its unique position in the world, asked, “Is there more we could do to have greater impact?” It did a pretty careful analysis of innovation as it happened in larger organisations in the venture world and also at DARPA. The assessment was that in global human health, there is indeed this innovation gap. That innovation gap is characterised by larger programmes with higher risk tolerance, which are not driven by consensus peer review. This is very much the way we conduct programmes at DARPA—the intersection of a goal and the science and engineering that need to be pulled forward in order to attain that goal. That effort—those large programmes—are what Wellcome sought in the formation of Wellcome Leap. What I have observed in the last year of operation is that, in fact, there is this innovation gap in human health. It is same one that was identified after Sputnik that led to the formation of DARPA. The coronavirus is showing us just how much work needs to be done in human health across policy, equity and the economics, but it also shows us the power of a breakthrough and how tough it is to get one.

I was the director of DARPA when the pivotal investments in mRNA vaccines were made. Many others came to the table to create this success for the world in this time, but we need more breakthroughs like that, and we need them faster. That is why Wellcome Leap was formed.

Q36 Amanda Solloway: Thank you very much. That is really helpful. My final question is to Professor Azoulay. In your paper you mention that organisations’ flexibility is essential to the ARPA model. Can you talk a little bit about what that flexibility involves please?

Professor Azoulay: Absolutely, it is essential and I think it happens at multiple levels. It happens in the relative administrative autonomy that those ARPA-like agencies have, relative to their Government Departments of reference, whether it is the Department of Energy for ARPA-E or the Department of Defense for DARPA.

It definitely also happens at the hiring level and in the fact that one can hire programme managers in ARPA-like agencies from very diverse backgrounds, not necessarily a background in the civil service, and pay them according to rules that might not be those of the traditional civil service.

Focusing on programme managers, that matters because they themselves have quite a bit of autonomy in the way in which they delineate and orchestrate their programme. They have a lot more discretion in choosing what projects to fund and assembling the teams that will perform those projects than would be the case in a traditional science funding agency, such as the National Institutes of Health or the National Science Foundation in the United States context or, I would think, UK Research and Innovation in the British context.

The Chair: I call Stephen Flynn, the spokesperson for the SNP.

Q37 Stephen Flynn (Aberdeen South) (SNP): Thank you, Ms Cummins. It is a pleasure to serve under you as Chair. I thank the witnesses for their comprehensive answers so far. They have been incredibly helpful.

I would like to pick up on a comment made by Dr Dugan, I think, in respect of the intersection of a goal, and using science and engineering to achieve that goal. It would appear, from looking at what is front of us, that the ARIA Bill does not have a goal. There is no mission or bright light that we are trying to get to. What is your collective view—all three of you—in relation to that? ARIA has no mission: is that a good thing or a bad thing?

Secondly, and hopefully briefly, do you think that the UK needs ARIA in order to compete globally when it comes to science and technology research and development?

Dr Dugan: Let me start by clarifying. From its beginning, the mission of DARPA has been very simple: to both create and prevent strategic surprise. Its connection to national defence has been important to its success. The particular goals that I spoke about were related to the programmes themselves. The programmes are constructed such that we have a clear way of measuring success or failure for the programme at the end of the programme. It is those two things that fit together: the programmes with individual ambitious measurable and testable goals, in service to the overall mission.

I have said in previous testimony that there is some wisdom in thinking about ARIA as directed to specific areas of interest in the UK; I think that is worthy of some thought. There is a strong base of expertise in the UK related to health and the life sciences. Therefore, that could be an area of focus within the resources that you have available to you.

To answer your second question with respect to the UK on the global stage, I believe that at this moment there is a historic opportunity in front of your Government to take a position on the global leadership stage. My particular area of focus has been in human health over the last year—that might be a way for the UK to come from the perspective of both national efforts and multinational efforts, in service to a global vision for what we want the world to look like post pandemic and post Brexit.

Professor Azoulay: If I may, I would like to answer the first part of the question. I read the Bill carefully, and I too was looking for a mission, because DARPA and ARPA-E are mission-oriented agencies. Having a high-level mission is very important to define the programmes with the specific goals that Dr Dugan was talking about, which will fit in the overall mission. It is entirely possible that ARIA will be something new in the innovation funding landscape—a UK model that will blaze a new trail. But if we compare it explicitly to something such as DARPA or ARPA-E, in its current form it is lacking a high-level mission. To give an example, for ARPA-E that high-level mission is to overcome the long-term and high-risk technological barriers in the development of energy technologies. It is quite high level. Having that front of mind for everyone in the agency channels the energy and lets people animate or catalyse a community to allow the portfolio of projects to be more than just the sum of its constituent parts.

Dr Highnam: DARPA: defence and national security. Clear mission; clear scope in which to work. Of the ARPA-like entities around that I am aware of, the only one that very closely follows the DARPA model would be the Intelligence Advanced Research Projects Activity in the US intelligence community. When you change what I would regard as the key elements—ephemeral or temporary people, project based, and no fixed assets—that have made DARPA nimble and forward leaning for 63 years now, you get something else. That may be more appropriate for what you need, but if the objective is to mimic or replicate, there is only one example that I know, and there are three key ingredients.

Within that model, DARPA is a very shallow place in the managerial sense. Three layers deep: there is a front office, some tech offices and the programme managers. The overall mission provides the context, but the frequent hiring of office directors and PMs, and front office people too, means that there is always exploration—looking for that advantage. Part of our mission is to impose and avoid technological surprise. That is why we are here. It focuses everything.

Stephen Flynn: That is very helpful, thank you.

Q38 Stephen Metcalfe (South Basildon and East Thurrock) (Con): It is a pleasure to serve under your leadership this afternoon, Ms Cummins. Thank you to our excellent witnesses. I am interested in the practical approach. When you have made some breakthroughs on these various high-risk projects, how do you ensure that the breakthrough reaches its full potential? Is it done through the ARPA model, passing it on to someone else to take it to the next stage? Is it the project manager who has a role in ensuring that it goes into safe hands, or is it the churn of people—the revolving door—that helps transfer that knowledge out an ARPA and into business, so that it can create service and product?

Dr Highnam: If I may, I will take the first shot at this one. It is the first two: we do not rely on the churn, as you say, of people for transition, but when you show up—when you come here—you come to make a difference. So you are always focused on transitioning the knowledge that is discovered in a more systems-oriented research programme—the thing or the entity—across into service of the nation. It is part of what you do. I think, as someone said earlier, it is that intersection of managerial and technical expertise, and a passion: those are the people you want at DARPA at any given time to frame and to drive—and not just to drive to discover, but to drive to transition as well. We watch that very carefully and the responsibility belongs to all of us in the agency.

Dr Dugan: We used to say at DARPA—and this is, I think, generally true of most organisations—transition is a full-contact sport, always has been and always will be. It is very difficult. Transitions of breakthroughs that are showing what is now newly possible, or a solution that did not previously exist, require a tremendous amount of effort. I think that it is important to recognise that there are many transition paths that grow out of an organisation that is ARPA-like. Some of the programmes, in the case of DARPA, transition to our military counterparts. Some of them transition to the commercial sector and then are bought back by national security or military. There are many different pathways. In some

cases, programme managers go to other Government organisations to help in those transitions. In some cases, they rotate out and go to new things entirely.

It is important to recognise that the breakthrough itself is not sticky through the organisation that it was created in. The breakthrough then gets transitioned to impact and scale in the most suitable organisation in order to create that ultimate impact. I would add, in addition to the passion that many programme managers and directors feel, they are also impact junkies. They really come to make a difference. So the ultimate transition—the ultimate scaling and impact—is the goal. Make the breakthrough, and then transition it to scale.

Professor Azoulay: I want to note that there is a distinction between DARPA and other ARPA-like agencies in different contexts. I am sure Dr Highnam and Dr Dugan will think that it is an oversimplification, but to some extent there is one customer for the projects that come out of DARPA, whereas for something like ARPA-E it is a much more diverse and scattered ecosystem. The breakthrough needs to latch on to the energy system, and there are lots of different actors with lots of different interests. At ARPA-E that has meant that they have created explicitly a tech-to-market group, to try to get ahead of the translation problem of the project that has come out of the agency. I want to say that this is not independent of the mission. To create a good tech-to-market group, you need a certain scale within a certain scope, and to the extent that your projects are too scattered, it is going to be a lot harder to create that scale, and so harder to create the transitions.

Stephen Metcalfe: Just to follow up briefly, thank you for that; it is comprehensive and helpful. It highlights the fact that you are looking for more than just individuals with some inspiring ideas. They have got to have the ability to own the research and inspire the next stage in its progress. I just think we should put that on record—that programme managers have to be multi-skilled in a number of different areas. So thank you for that.

Q39 Dawn Butler (Brent Central) (Lab): It is great to serve under your chairmanship today, Ms Cummins. Thank you very much to the witnesses today. It is very enlightening. On the back of the last question with regard to managerial content I really like the idea that the transition is an impact or contact sport. You go in, do your best work and get out with your reputation intact. I have two questions about that. First, how do you reach those people who are not known—who may be working on something very creative but are not well known in the industry? Secondly, you have talked a lot about evaluations. Are they peer-to-peer evaluations, and is that evaluation transparent? Perhaps we will go to Dr Highnam first.

Dr Highnam: We do—I am very proud of this—full and open competition to the greatest extent possible. The process is approximately like this. A programme manager has framed a programme, using the Heilmeyer questions, and received approval to launch. They put out various announcements in different places. They organise industry days—these are more virtual than in person, but we do both. We put it into the various mailing lists in all manner of technical communities. We push it out through small business and make sure the

universities and the vice-presidents for research and development are all aware. We make the maximum push that we can, certainly for unclassified activities.

Then, when proposals come in—we are very clear on what we expect to see in a proposal, which is how we then evaluate proposals; we are very transparent on the requirements for that—we take a look and, surprisingly often, to respond to your point, you will find a technology or a small business had an idea that meets the goal. We do not over-engineer the request for proposals. We say, “Here’s what we want to do. Here are the boundaries, if you like, in terms of technical elements we are interested in. It’s up to you guys. Come back with the best team that you can and the best approach that you can for solving this.” And there is always a surprise. From a PM perspective—Regina and I have both been PMs at DARPA—you always find yourself saying, “Oh, I didn’t think of that. That may be the one that actually wins; we don’t know.”

Dawn Butler: I can see Professor Azoulay nodding.

Dr Highnam: On your second point, about transparency, we have, again, very rigorous processes. These are all fully documented, and feedback is provided in order to engender better proposals next time from those who happen to be unsuccessful in a particular programme.

Dawn Butler: Great—thank you. Dr Dugan, I saw you nodding as well.

Dr Dugan: If we want to get down to some specifics, I think it is important to recognise that the evaluation process for us is very much about separating the abstracts or the proposals into two baskets: those that are responsive to the call and could potentially help us to meet the goal; and those that are not. But it is not an explicit, peer-reviewed consensus rank ordering of those proposals, and the reason why we do not do it that way is that rank ordering tends to favour the most conservative of the proposals. What we seek instead is to take those that could contribute to the goal and, from them, construct a programme, with the appropriate pieces, the right risk profile and the right disciplines and mix of organisations, to achieve the goal.

In this respect, I want to be clear. There are practices and principles that we use here. We can write down some of the rules that we use and give you some elements of the playbook, but there is here a certain mastery of practice and principle that it is necessary to understand, and in that respect the programme construction is fair and equitable but also designed to take the elements of the proposer’s work that most substantively contribute to the goal, even if they are potentially high-risk. That is how you construct a programme that is optimised for breakthroughs.

Q40 Dawn Butler: My final question is to you all. How important do you think the link should be between ARIA and UKRI in the UK? Perhaps we will start with Professor Azoulay, because you have read the Bill very carefully.

Professor Azoulay: I think that those two modes of funding are complements, not substitutes. It is very important to have an ecosystem of funding. In the US, we are blessed with a very diverse ecosystem. Lots

of domains, such as health—there are many, such as agriculture—in some sense are missing the ARPA-like elements, when they have a lot of those other elements.

It is important not to put those two agencies in competition; they both have a role to play. Of course, there is a perfectly legitimate debate about the relative levels of funding, but they would both be doing things that are tremendously important and that would complement each other in the long run.

Dawn Butler: Thank you. Dr Dugan?

Dr Dugan: Pierre makes a very good point. These are important elements of a robust and functioning ecosystem. We talked about the advances in mRNA, which have been so important in the corona pandemic. That relied on basic science, curiosity-driven research that happened mostly through NIH, pivotal investments in this breakthrough mode, this Pasteur’s quadrant style of work that DARPA is famous for, and also the private sector, which was instrumental in bringing it to scale, use and impact.

To Pierre’s point, these things have to fit together in order to create the breakthroughs—that is the innovation gap that is often filled by an ARPA-like organisation—but you must have a foundation of science from which to draw and you must have a mechanism of transitioning to scale, if all of it is going to make sense in impact.

It is very important to understand those things and in appropriate measure. Just to give you a sense of it, DARPA has operated with about 0.5% of the DOD budget for its entire 60-plus-year history. Small investments, relatively speaking, in these breakthrough-focused activities can make a big difference.

Dawn Butler: Thank you. Dr Highnam?

Dr Highnam: I am afraid that I do not know enough about your structures to be able to give a sensible answer.

Dawn Butler: No problem. Thank you very much.

The Chair: Next, I have Aaron Bell and then Daniel Zeichner.

Q41 Aaron Bell (Newcastle-under-Lyme) (Con): Thank you, Ms Cummins. It is a pleasure to serve under your chairmanship. I thank all our witnesses and those who gave evidence to the Science and Technology Committee, which was greatly appreciated.

I have two related questions for the panel. First, notwithstanding your responses to Mr Flynn about the need for a mission, which it seems is going to be delivered by the chair and the chief executive of ARIA, how important is it that ARIA remains autonomous and free to pursue whatever its aims are, without interference from Government Ministers?

Secondly, what advice can you give the Committee about the funding methods ARIA might use? The Bill envisages potentially grants, loans, prizes, grant-prize hybrids, investments in companies. Could any of you give us advice on what has worked well in other settings? I would like to start with Dr Highnam, please.

Dr Highnam: On the funding mechanisms, we are an agency in the Department of Defense in the US Government, and we have a number of options available to us, which we make use of depending on the context.

Of those that you listed, the only one that we do not do is take investment positions in companies. That is not what we do. You can make a proposal to us for research. You may offer a cost-share, depending on whether it is a major company and very systems-oriented work, all the way to a standard research grant to a university or small business, or a combination of those things.

We have a number of other options in between, including a modified form of commercial contract called an OTA—other transaction authority. They are referred to as OTs and are a very useful tool. DARPA was the first user of that about 20 some years ago. It is a great way of doing business.

To the first question, we are an agency in the US Government. We work in the Executive branch. We work and deal closely with Congress on all manner of things. We have flexibilities as an agency. We have ways of doing business and we are very careful to make sure that the wins that we achieve are well-known, and that we work within those boundaries. Again, the Administrations and Congress over the years have watched and helped DARPA, and have been incredibly supportive. The agency—Regina and I can both say this—keeps delivering as a culture and a mission place, because back in '57,'58, they got a good recipe, and that culture persists despite 25% or higher personnel turnover. It is part of the Government, with all the benefits. All the—"constraints" is the wrong word—rules that come with that are there for a reason, and DARPA gets the job done.

Q42 Aaron Bell: Thank you. Yes, the culture is so important. Dr Dugan, could you answer on the point about autonomy and funding mechanisms?

Dr Dugan: I want to attach independence and autonomy to desired goals and outcomes here. The reason the agency sits so independently with respect to its decision making is to find this intersection, and get through the Heilmeyer questions, as Peter has talked about. I would often refer to it as figuring out how to get a project inside Pasteur's quadrant—the idea of having a very specific outcome in mind and having the science and engineering to support the idea that you could achieve it. That is a difficult analysis. That is the creativity that Peter is talking about.

You cannot mandate that from outside the agency. That work happens on the part of the technical teams inside the agency who are assessing the state of the science and the engineering. They are working in service to the mission of the organisation with an understanding of national security goals, and they are finding that intersection. It is the single hardest thing that we do in the agency: forming programmes in that spirit. It is not possible to do that by mandate outside the organisation.

That independence of decision making and the crafting of those programmes in that spirit are coupled, and that is part of the reason why the agency has been so successful over years. I think independence is in service to those outcomes and those breakthrough objectives.

Q43 Aaron Bell: On the funding streams, could you perhaps tell us a little about how Wellcome Leap works with other bodies to fund or otherwise encourage research?

Dr Dugan: Much as Peter described, we use a variety of strategies. As you may have seen over the last year, one of the things that we did was to build a health

breakthrough network, which now has almost 30 signatories on six continents. The goal there is to speed contracting, so that we can move down to days or weeks what would more typically be months or even as long as a year in contracting. The particular way that we work is through contracts; we do not actually do grants. I also think that this position of not taking equity is important, because the non-profit element of it is part of the differentiation, and we have an entire commercial sector that is good at assessing value and figuring out return on investment. That is not what is pivotal or differentiating for the organisation—neither for Wellcome Leap nor for DARPA.

Q44 Aaron Bell: Professor Azoulay, would you like to comment on either the autonomy point or the funding mechanisms?

Professor Azoulay: Yes, absolutely. First, I second what my colleagues have said and agree wholeheartedly. I would say that in terms of the modes of investment, the track record of Government agencies taking investment positions in companies is not very good, to put it mildly. It is interesting that it is something that neither ARPA-E nor DARPA actually does.

At the same time, it is important to point out that one way for an ARPA project to transition is to give birth to a start-up company. I know for a fact that in the context of ARPA-E, at least, that is something that is happening on a fairly regular basis, and that is actually tracked as one of the outcomes that one could look like, in addition to maybe much more traditional intermediate outcomes such as scientific papers and patents.

The more general point about autonomy is very important. It is really difficult. It requires forbearance on your part because the kinds of missions and impacts that you are trying to achieve at a very high level are long-term goals fundamentally. I might be overdoing it, but I have a sense that if you start ARIA today, you will not know if it has actually fulfilled its high-level mission for at least 15 years, and that might even be too optimistic.

Aaron Bell: Understood. Thank you.

The Chair: Next we have Daniel Zeichner, followed by Jerome Mayhew.

Q45 Daniel Zeichner (Cambridge) (Lab): It is a pleasure to serve under your chairmanship, Ms Cummins. I thank the witnesses for what has been an extremely interesting insight so far. I represent the city of Cambridge, where, as you can imagine, many of these issues are a frequent source of discussion. From what I have heard so far, I take it there is not one model of ARPA. You have a number of models, depending upon the different sectors. I heard Dr Highnam say earlier that DARPA had not been replicated anywhere else, yet we are trying to model our system on what you have got. How much does it depend upon the context, not just within the sector and whether it is ARPA-E, ARPA-H or DARPA, but in the wider system? We heard from witnesses earlier today about other aspects of the ecosystem—public procurement, things such as the Small Business Research Initiative, which I understand we have a much less successful version of in this country, and having a single client or defence system. If you do not have clarity on any of that, what would be the consequences? Perhaps I could start with Dr Highnam.

Dr Highnam: I said in my previous comment that I am aware of only one example that replicated DARPA intact, and that was the intelligence ARPA in the US, where I served for about six and a half years. It is very true to DARPA as it stands. Others depend on context, which includes the context of discussions like this one where there is certainly the framing of an organisation. It is being pulled and pushed and moulded by many different forces and interests. What you get coming out will, I am afraid, naturally reflect that. In intelligence here, it was a straightforward thing. We wanted something very similar to DARPA. A number of us had come from DARPA and knew what that was.

Daniel Zeichner: Professor Azoulay?

Professor Azoulay: ARPA-E is not identical to DARPA, but we certainly try to inspire it to a very large extent. I think the difficulty here is that it is a tight bundle of practices that fit together, so one open question is to what extent can you pick and choose in terms of the menu of practices? What can you undo until you in some sense undo the entire model? It is important for us to level with you that we do not really know the answer to this question, because fundamentally there has been one DARPA, and that is the one we have been able to see for 60 years. One possibility that we might want to have in mind is that it does not take a lot of changes in the model to undo its effectiveness.

Daniel Zeichner: Dr Dugan?

Dr Dugan: I agree with what Pierre just said. I might use an analogy if you will permit me. I think most would agree that Guardiola is a great coach. We could ask him how he has achieved the track record of wins and successes that he has. How has he envisioned a new style of play, constructed a team, coached the players, made decisions on the way in? He could write down some of the principles associated with that. On a day-to-day basis and across the duration of a season, he makes countless decisions, which are in service to these basic principles that create such a winning team. It is those detailed decisions that come from intuition and experience—the mastery of the practices and principles as Pierre would say—that are important to success.

At Wellcome Leap, for example, our first rule is to make as few rules as possible. Part of that is recognising that we have these practices and principles and we need to adjust a lot as we go along in the process. In setting up Wellcome Leap, I think Wellcome did a very good job of saying, “We are going to do the few things that we think are central. We need independence and governance. We need an experienced team to lead it. We need to free it from a profit motive, and then we need to let it do what it does.”

So there is this combination of a few principles that we can write down for you and then many other things that are about the practice of that come from the intuition and experience of leading these types of programmes to breakthroughs.

Q46 Daniel Zeichner: Just to come back on one point there, you say free it from the profit motive. I was quite struck through all of this by this stress on public service and honour, which is wonderful—perhaps we are struggling a bit with that here at the moment. Who owns the intellectual property on all of this? It is a complicated question. Is there a simple answer?

Dr Dugan: The organisations that create the breakthroughs own the intellectual property in the case of Wellcome Leap, and that is usually the case in DARPA. Now we usually also have a backstop, which says we have march-in rights if the entity either chooses not to commercialise it or to transition it to impact. Then we would go and say, “We need to take this in service of national security,” but at its core the intellectual property belongs to the inventor of the breakthroughs.

Dr Highnam: One addendum to that is that we have a notion here of Government purpose rights. Yes, the invention is owned by the creator, but if you receive DARPA funding and the appropriate terms are in the paperwork and the arrangement that we have with you then there are limited rights available to the US Government for those inventions.

Dr Dugan: Just to clarify what Peter is saying, those limited rights are about making sure the invention can be practised in service of national security.

Daniel Zeichner: That is really helpful. Thank you.

The Chair: I am afraid this will probably have to be the last question to this set of witnesses. I call Jerome Mayhew.

Q47 Jerome Mayhew (Broadland) (Con): We are clearly taking a huge amount of inspiration from DARPA in the creation of ARIA. It is an organisation that has many strengths, but every organisation has weaknesses as well. I would like to give you the opportunity, given your huge knowledge and experience of DARPA, to give us advice on what to avoid. To put it more diplomatically, how can we improve on some of the DARPA processes?

Dr Dugan: One can look at any set of processes and ask, “Are they optimised for the outcomes?” I think ARPA-like organisations are very much optimised for the outcome, which is to catalyse breakthroughs. It is not optimised, as my colleagues have said, for multi-decade-type funding that supports basic research that is foundational and builds a body of knowledge and extends incrementally our understanding of the world. Neither is it optimised for commercial success. I think those things are okay, and there are other organisations and other funding mechanisms that are optimised for those types of activities.

Part of what we see is that the programmes very much take on the character of the programme directors. That is good from the perspective of speed, agility and getting the work done. Sometimes people do not agree with all the things the programme director says. That is the nature of the type of work we do, which is high-risk and breakthrough-oriented. We used to say that the good and the bad of DARPA is that it has no institutional knowledge, which means that we can take a shot at something that has been tried before, and most of the people who tried it before are no longer at DARPA. That is good, as it gives us multiple shots on goal in a changing science and engineering landscape.

Q48 Jerome Mayhew: Finally, to Professor Azoulay, DARPA clearly recognises the benefit of greater integration between the public sector and the private sector, but inevitably that exposes civil servants to political accusations of cronyism. How do you protect DARPA and DARPA servants from those kinds of attacks?

Professor Azoulay: I think there are two elements. One is rules—conflict of interest rules are very important in this regard—and the second, which I mentioned at the beginning, is norms. It is a lot about whom you choose to put in those roles. They typically have credibility and a reputation that is established in the world that they come from—it could be academia or the private sector. Serving as a programme manager at DARPA or ARPA-E is a wonderful opportunity to have an impact—

The Chair: Order. I am afraid that brings us to the end of this session, I am sorry. It is a perfect end to the session, but it is the end of the time allocated to the Committee to ask these questions. I thank our witnesses on behalf of the Committee for that evidence. Thank you very much.

Professor Azoulay: Thank you. It was a pleasure.

Examination of Witnesses

Professor Dame Anne Glover and Tabitha Goldstaub gave evidence.

3.1 pm

Q49 The Chair: We will now hear evidence from Professor Dame Anne Glover, president of the Royal Society of Edinburgh and special adviser to the vice-chancellor of the University of Strathclyde, and Tabitha Goldstaub, co-founder of CognitionX and chair of the AI Council. Could you both introduce yourselves, please? We have until 3.45 pm for this session. Welcome and thank you.

Professor Glover: I am Anne Glover. I have just finished my three-year term as president of the Royal Society of Edinburgh, so I am no longer president of Scotland's national academy. I am a molecular biologist by background. I have researched how we respond to stress at a molecular level, and I have looked at the diversity of microbes in the environment. I am very interested, and have worked in translating knowledge gained from research into policy making, and as such I was chief scientific adviser for Scotland from 2006 to 2011 and chief scientific adviser to the President of the European Commission from 2012 to 2015. I am currently at the University of Strathclyde.

Tabitha Goldstaub: I am Tabitha Goldstaub, the co-founder of CogX and the chair of the UK Government's AI Council. We are an independent council created in 2018 as part of the industrial strategy's AI sector deal. We support the Government via the Office for Artificial Intelligence, our secretariat, in offering independent expert advice, as well as community engagement. I am really here to share the thoughts of those I polled and workshopped with from that AI community. Thank you very much for inviting me.

The Chair: Thank you very much, both, and welcome. Our first set of questions will be from shadow Minister Chi Onwurah.

Q50 Chi Onwurah: Thank you very much to our guests for joining us and bringing your experience. It is a real pleasure to have an all-female panel. It is a real rarity when it comes to discussions of science generally.

There is some confusion about what ARIA should be. Should it be focused on cutting-edge research, should it be about the transformational translation of existing research, or should it bring the two together? What I would like to know from both of you, with your wide experience, is what you think ARIA's goal or purpose should be. What problem should it fix?

Ms Goldstaub, you have experience of artificial intelligence, which could be a critical area of research. Do you think it is going to change the nature of research, how we research and how scientific research occurs? How should we envisage ARIA responding to that?

Tabitha Goldstaub: First and foremost on your point around focus, really it needs to be about imagining how funding is done to find the breakthroughs that others describe as being at the edge of the edge, with freedom—testing, for example, things like the lotteries, the grants, the speed of contracting, loans, prizes and all the things that we have heard about throughout the whole of today. I really think that ARIA is about exploring these ideas.

If you are looking for a single focus, I believe wholeheartedly in Mariana Mazzucato's mission-driven approach to innovation. The AI community was incredibly catalysed by the industrial strategy grand challenges. And of course there are these urgent missions. Alondra Nelson said in her first speech post being nominated by Joe Biden that all science should address social inequality. That said, it is still unclear to me if there needs to be one challenge enshrined in law or whether the programme managers should have the freedom; I think we will hear more from others on what their decision is there. The most important thing is that I just kept hearing time and again from the community I spoke to, similarly to what the gentleman from DARPA said, that this is a time to serve. People really want to find a place to do research that saves people's lives, especially in the AI ecosystem.

I think that your question about the impact that AI has on research is a very good one. AI is impacting research, just as it does all areas of the economy, both in disrupting the fabric of its own self and advancing research. We have seen AI create state-of-the-art information-retrieving capabilities, sift through vast amounts of data and speed up the publishing process, so it is changing the process of research, but also in itself it is obviously making discoveries and scientific advancements.

Three per cent. of all peer-reviewed journals are now AI-related and this new trend of AI plus another science is really booming. So biology is currently experiencing its "AI moment". We saw in the State of AI report that there is a 50% year-on-year increase in papers; 25% of the output since 2000 is a biology and AI collaboration. DeepMind's AlphaFold is a really good example of that. Demis Hassabis has publicly said that one of the drivers at DeepMind is AI that could win a Nobel prize, so he has already set the bar for an ARIA.

Q51 Chi Onwurah: Thank you very much. And Professor Dame Anne Glover?

Professor Glover: You were asking if the UK's ARPA or ARIA should have a single purpose, or focus, and in terms of subject area, I would argue not, because you do not know where the good ideas are coming from. It would be really valuable to have quite a wide and

informed debate from a very broad spectrum of interests as to where the calls should come from regarding ARIA. Therefore, when they are looking for a call for research, what are the big areas? In a way, this is quite similar to looking at the grand challenges, which Tabitha has already mentioned.

However, there is an opportunity here in looking at grand challenges, because who decides what those grand challenges are? Voices that are very frequently missing in that debate are citizens' voices. If I think of some of the big grand challenges—certainly a number of those were funded at the European Commission—often they would be narrowed down, so that there would be three absolutely superb proposals in quite different areas of research, which would have come through the review process. Then it would be a decision about which one we should fund. And that is an ideal time to say to citizens, “What is it that you're interested in?”

Of course that makes the research very relevant; it would tend to make it translatable into the economy, the life/wellbeing environment and so on; it also then has a substantial buy-in from citizens. That is not unimportant, because at the moment we are enjoying a big buy-in from citizens around science, as they see the relevance of what funding science over a period of years actually does, in being able to deliver us—in this case—from a pandemic, and of course there is climate change there, as well. So that is important.

The focus of the purpose needs to be crystal clear, so that there is no confusion with other funding agencies. That would just lead to mini-chaos, or things falling through the gaps and being shuffled around, which is not at all helpful.

The last thing I would say in this context is that there is an opportunity to look at how you fund. For perhaps quite understandable reasons, current research funding is quite formulaic; it is box-ticking to get the funding. What sort of projects will be funded? Normally, low risk. There is an opportunity to look at high risk, high reward. I would hope that the leadership of ARIA considered that, to fund things that are really innovative, you yourself have to be innovative. We will need to think and be imaginative about how you go about sourcing and funding projects, so that we do not just get a modified version of what we are currently seeing, but can fund in a way that is more bespoke. By doing that, we are opening up what I hope would be exciting possibilities.

Q52 Chi Onwurah: Just to follow up with two brief questions. The points you raise, though different, have raised similar questions in me. First, in terms of deciding what areas of research and challenges should be addressed, what if we rely on the leadership, as you suggest, Professor Dame Anne? What ARIA seems to support is what I would call the “big man” model of research: choose five or six great men—generally, they are men—and give them the freedom to be geniuses and to choose what they want to research, to have, as Dominic Cummings says, “extreme freedom”.

Ms Goldstaub, you say that AI is changing how research happens, and also the scale, I would say. Is it possible that we can find five or six great people who know all the different potential areas of research, who can make these kinds of choices on behalf of the British people, using public money, and can integrate the changing

nature of research, while at the same time being innovative and having, we would hope, diversity of thought and hopefully also of gender, region, discipline, etc? Is it possible to find five or six people like that? What elements of the structure of ARIA are important to promote that?

Tabitha Goldstaub: It is totally possible to find those people. I cannot speak across all science, but I definitely feel there is a generation of young, mid-career AI talent that feel they are in a sort of gap—the fuzzy middle, as Andy Hopper calls it. They are asking themselves, “What am I doing? The planet is burning, I don't want to work at the big banks or the big tech giants.” They want the academic freedom of the universities but they do not want to work alone. They see the financial reward of successful start-ups, but they want to take long-term bets. Generally, they want to make the world a better place.

It is people like that who fit into the mould that we are looking for. I worry also about the lone genius model. We are well beyond individual success being seen like that. This is all about community. One of the things I have heard time and again is that people do not want to be funded as individuals but as groups of people. It is a community that would come together around a programme manager that is really important.

Yes, we have to find four or five of those individuals, but it is the people who work with them who make a huge difference. It is the open science, open data and spirit of openness that will go a long way to finding those people who will culturally fit and enable us to engage well beyond just those five individuals and find the edge-of-the-edge breakthroughs that we really need. I hear people saying, “I have ideas that I just don't even put forward right now; they are unthinkable, because they are unfundable.” Once people can come together, you start to unlock that, which saves you from this lack of diversity where you are just funding individual after individual and effectively asking people to compete with each other.

Q53 Chi Onwurah: Thank you. Professor Dame Anne?

Professor Glover: Just for easiness, can I ask Committee members to just call me Anne? Otherwise it is a bit of a mouthful.

On the idea of five or six individuals, I would caution on that slightly. I am partly bought into the idea, but if you are identifying five or six individuals, you have already pinned your colours to the mast in what you want. You have already prejudged the areas you want to work in or the ideas that you are interested in.

Where the five or six people might be really important to identify is for the running of ARIA itself. Whether it is the overall director of ARIA or the research leaders in the different themes that might be funded in ARIA, they will be key people and they need to be credible, trusted, very effective at communication and really open-minded. In my view, a large part of the success of ARIA will come from having quite inspirational leaders throughout.

In terms of how you fund and who it is that you are funding, I would go back to what I was alluding to earlier. There needs to be a big conversation about this. There are often older men who have got a reputation in

research, so they are naturally the ones we go to, but as I know from bitter experience, as you get older, sometimes your thinking closes off in particular areas and you are less open to ideas. I am thinking of Professor Donald Braben, whose comments the Committee would probably be very interested in. He set up a venture research unit in BP, back in the '90s I think, and has written several books about this kind of blue skies research area.

What Braben said is that we should look for “irreverent researchers and liberated universities”. Do not look for people who have a research area that we think is really important and we must go there. Debate widely among researchers, of course, but also Government Departments, devolved Administrations, foresighters, businesses, citizens. Let us imagine the future. ARIA could be the stepping stone, if you like, to inventing that imagined future. For a future to exist, you have to imagine it in the first place and you have to convert it into what you would like. There are lots of different ways of doing that. With inspirational leadership, you can move towards that. You can probably increase dramatically your chance of getting it right by having an irreverence around what you do, and not the usual measures of success.

Q54 Amanda Solloway: Thank you to our great witnesses. I have one question for both witnesses. What is the importance of giving ARIA independence from Government and Ministers, compared with other parts of the R&D system?

Professor Glover: I would argue that there is huge value in that. Obviously, the funding is coming from Government, but by giving it freedom from Government you might also be giving it the freedom to fail in many ways, and that is exceptionally important. If it is seen as very close to Government—whichever Government is in power—it potentially becomes a bit like a political football, either in what is being funded or in the direction suggested for where ARIA funding should go.

If there are notable failures of funding, which you would expect if it were a high-risk, high-reward funding agency, political opponents will also say, “Well, look, this is a complete disaster under your custodianship. Here are all the failures.” You just want it to be separate from that. It is also part of trying to embrace the unthinkable, if you like, in terms of the research we do and the areas we go into. Necessarily, those will sometimes be difficult areas, and not ones that you should expose Government to either. In the spirit of opening everything up, I would say that keeping that independence is extremely valuable.

Tabitha Goldstaub: I totally agree with what Anne just said—I would have said exactly the same thing. I think that the separateness and independence are really vital to the success of ARIA. The only thing that I would really think about adding here is how important it is that ARIA does have a relationship with Government, because it will need to have many customers, both private sector and public sector. The programme managers will need to create those bonds with central Government Departments individually.

I think that a commitment from Government to remain independent but to become good customers is very important. The health and transport sectors are good examples of where that might work. What is different is that a surprising number of these next big scientific fields, and these next big breakthroughs, such as artificial

intelligence, are going to depend on systemic transformation, where you cannot separate the technology from the policy and regulation.

So yes, ARIA has to be independent, but it also needs to ensure that it works really closely with central Government and with regional and local government. Local government spends about £1 billion on procurement, and cities are key investors in infrastructure, so finding a good link with local government, as well as with central Government, is important. This will hopefully end up creating, as Anne suggested, a way that people feel part of this. Regional strengths deliver benefits to actual localities. Even if it is within the next 10, 15 or 20 years, it is really important that government feels part of that, even though ARIA is independent.

Q55 Stephen Flynn: Thank you, Tabitha and Anne, for your detailed responses so far. I have a couple of points, if I may. I think it is safe to say that you seem broadly in favour of ARIA, and you think it will perhaps fill a void. In terms of the resources that ARIA will have, we heard earlier today about the benefits of being a small, agile agency, and £800 million is being allocated. Do you feel that is sufficient for ARIA to meet its needs?

On independence from Government, from looking at your bio, Anne, I can see that you have worked for a few public agencies. If ARIA does not have the public contract regulations and freedom of information in place, will that free it to do what it needs to do? Should we see that as a positive as opposed to a check imbalance, given that we are referring to public money?

Professor Glover: I will deal with that point first—it is an exceptionally interesting point. Initially, when I saw that it might not be subject to FOI, I was thinking, “What are the pros and cons of that?” There is one thing that needs to be fundamental in ARIA, and that is an openness and transparency about what it is funding and why, and how it is doing it. For most things—UKRI would be similar to this—what you provide information on obviously cannot be something that would break the General Data Protection Regulation or that would be commercially sensitive. That should hold exactly true for ARIA as well.

There needs to be some thinking around the whole aspect of openness and transparency, because that brings along with it trust and engagement. If there were any suggestion that Government funding was going into ARIA and it was being syphoned off into particular areas, and we could not find out what those areas were, there would be nervousness. People would, quite rightly, object to that, so there would have to be some greater thought given to how the agency is able to be open and transparent. It might be writing its own rulebook in that area, about what it will provide information on and what it should not.

On whether £800 million is enough, you are asking a scientist and a researcher here, so no, it is never going to be enough, but we have to start somewhere. I cannot make a direct comparison with DARPA’s funding, which is about \$3.5 billion or \$4 billion per annum, but I might be a bit out of date on that. It does not seem unreasonable to me to start at that level of funding and to start off on the journey to see what is and is not working, where there is greater demand and where you

might need more funding to meet it. What you would want to see is that this was such a success that there was substantial demand for funding.

On the other hand, you do not want to get into the situation that standard research funding has—I have certainly visited it many times during its lifetime—where you are putting in 10 research proposals to get one funded. That is an enormous waste of everybody's time, including the agency that is funding the research. There needs to be a balance between how much money is available and what you hope to do with it.

The last thing I would say is that how that funding is apportioned needs to be carefully thought out, because there needs to be some security of funding. Traditionally in the UK, we have normally had three-year tranches of funding. Long before the end of the three years you have to try to think about how you get continuation of funding. You might hope that ARIA could look at a different model of funding, which might span different timescales depending on what the nature of the project was.

Many projects, particularly ones that are quite disruptive in thinking, will not deliver in a short period—two or three years—of time. Some could do, but some will not, so there needs to be that security of funding over different annual budgets to allow the investment over a period of time.

Tabitha Goldstaub: I will start with the amount of funding. I see the £800 million as just a start. I think that £800 million is sufficient as long as ARIA works in partnership with Government Departments, the private sector and other grant makers. ARIA should not be restricted in matching or exceeding the Government funding with funding from the private sector. There are people in the community that I have spoken to who think that for true intellectual and financial freedom, ARIA should be able to more than double the Government funding. It was good to see in the Bill that the potential for ARIA to take equity stakes in companies and start-ups in a venture fashion could lead to increasing that part over time and making more funding decisions. I see the £800 million as really just a starting point.

On freedom of information, I agree with Anne that openness is key. Transparency fosters trust, and I do not think there is any need to stop freedom of information. We need to keep freedom of information to help with the efforts for connectivity. If the community are going to feel part of ARIA and will it to do good things, they need to be able to use freedom of information. I cannot see any argument against this for the administration costs. Earlier this morning, we heard Ottoline Leyser say that UKRI gets 30 requests a month. If ARIA is 1% of the budget of UKRI, perhaps it could get 1% of the requests, which would be fewer than four a year. I cannot see it, for that reason.

The other reason why there is a desire for secrecy and no FOI is that people traditionally are not comfortable to innovate and fast fail in the open, but that is changing. DeepMind has teams. I have spoken to Sarah Hunter, who is at Google's moonshot factory, X. She explained how they started in secret and everything felt so appealing, to protect people from any feeling of failure, but what they learned is that there are so many other much better ways than secrecy to incentivise people and to give them

the freedom to fail. Actually, allowing for more transparency builds much more trust and encourages more collaboration and, therefore, better breakthroughs.

Anne has spoken about the community. I definitely will speak again about the community, but in addition to the community engagement, ARIA will need to have a press department and media engagement teams that are separate from BEIS, separate from the grid and separate from the Government, to enable it to be agile in its communication and foster a two-way conversation. In order to answer your question, I really think this is the key point: openness and transparency create more trust and more breakthroughs.

Stephen Flynn: That is really helpful. Thank you, both.

Q56 Stephen Metcalfe: Good afternoon and thank you for joining us and for your excellent contribution. Anne, you made a very interesting point about the independence of ARIA, to avoid it being used potentially as pointing at political failure. If you are investing in high-risk, high-reward research, there will be failure—that is undoubtedly true. May we ask for your advice on how we should measure the metrics of an ARIA over the early years, before potentially there is any output that has demonstrated a transformational benefit to society? On top of that, could you give us some advice on advising project managers on how they should go about selecting projects to explore? Should it be just on the basis of interesting science, or should there be a vision of the commercialisation of that science at the end, to motivate them? We are only going to be able to fund a certain number of projects, and presumably applications will outstrip the funding fairly quickly.

Professor Glover: How we measure success in the early years is a very important question. I am not going to give you an exact answer, but what I might say is that maybe we should not try. That would be unusual, wouldn't it? That is what I meant earlier about not just following the formula of, "You need to tick these boxes to demonstrate success." Of course, you would hope that whoever is leading ARIA would have an idea of how you are developing the innovation ecosystem that will be supported by ARIA. They might have some ideas about numbers of applications, where they are coming from, and having a good look at and analysing that, and looking at the amount of interdisciplinary or multidisciplinary research that comes forward. That is always quite hard to fund. Historically, when I have been involved in such things, interdisciplinary research tends to get kicked around different agencies: "This is more for you." "No, this is more for you." Everybody is worried about their budget and thinks, "If you fund it, we won't have to fund this from our budget." Thinking about the number of applications that could come from a broad range of different disciplines—that would be good. I am not answering your question directly. I am just saying that it is very easy to say, "Let's have a way of measuring success," but sometimes that can be stifling.

It is a bit like—perhaps not in the years timescale of ARIA—how it is around the time of year when we plant seeds in our garden or wherever. If you want to measure how well a seed is germinating, if you keep pulling it up and having a look at it you are really going to set it back, so sometimes you just need to think,

“I’m hoping that in four or five months’ time this is going to be a broad bean plant with broad beans on it. I just need to wait and see.” I know that that is difficult to do.

The second thing you asked is about commercialisation. I cannot for the life of me remember who said this, but someone once said that there are two types of research: applied research and research not yet applied. That is quite true. There might be some areas where you think that there is a very easy market for this, but if we look back and learn from experience we find that an awful lot of research has been developed. The whole area of medical diagnostics, for example, was pure research. There was no commercialisation; it was just a fundamental biological problem that was being investigated. Some of the outcomes of that research led to molecules called monoclonal antibodies. It is quite a beautiful specific diagnostic—supremely sensitive—that can pick out particular molecules of interest that might tell you if you have a particular disease or have been exposed to a particular compound or whatever.

In renewable energy or an area around that, you might understand that there will be a lot of potential commercial partners and opportunities. In some other areas, perhaps not. This might be an opportunity to think about what the relationships would be like between ARIA and existing research funding, because it might be part of an ecosystem. I would hope that there were distinct roles for UKRI and ARIA but very good communication between the two, as well as very many other stakeholders, in order to identify areas that might not be suitable for UKRI funding but that might have a strong commercial or development potential that ARIA would be much more adept at supporting.

Q57 Sarah Owen (Luton North) (Lab): It is a pleasure to serve under your chairmanship, Mrs Cummins. Anne, you talked about citizen buy-in. That would take an element of trust, so my two questions are around that. What could or would good transparency look like without stifling innovation, in both of your opinions? Secondly, if we do not have FOIs and we do not know precisely how this will be reported to us, do we need an ethical baseline to ensure that we are spending public money on the greater good?

Professor Glover: On the citizen buy-in, I think that would be reasonable to consider achieving. I do not think that it would be insurmountably difficult in many ways. If I give you the example of some of the grand challenges that were funded at European Commission level, it was getting down to three brilliant projects. Which one will we fund? If the European Commission made the decision about which one was going to be funded, inevitably different member states would complain: “Why is that getting funded in that member state? This other project was just as good.”

All sorts of problems can arise. Whereas, if you asked European Union citizens which one they would like to be funded, they would say what matters most to them. That is quite an interesting insight into the mind of the European citizen, or it would have been, in that particular instance.

I do not think you are in any way betraying confidences; you are talking about whether it is a project looking at delivering limitless amounts of sustainable energy, or a project in mapping the functioning of the human brain,

so that you might be able to exploit that in other ways. You are not saying how you are going to do those things; you are not revealing confidences or information that would be inappropriate or undermining of those doing the research. I think we might be worrying needlessly about that.

As to the ethical baseline, of course this has to be ethical. Tabitha and I are probably agreeing too much with each other, or perhaps we are going back to the same thing. If you are not open and transparent, you will have problems. That is just not rocket science. For example, there are many agencies that are not part of Government but that might receive governmental funding. Scotland’s National Academy, the Royal Society of Edinburgh, is one of those. We are completely independent from Government. We get funding from the Scottish Funding Council, which gets its money from Government. We are not subject to FOI requests but we voluntarily behave as if we are. If we did not do that, people would say, “They’re being directed by Government, so the reports that come out of the RSE will be influenced by Government.”

If we say, “This is how we approach it,” and if somebody comes to us and asks for information, we behave as if it were an FOI. It has never been too onerous. The only onerous time for me with FOI requests was when I was chief scientific adviser to the President of the European Commission, when it became unrealistic, because I had such a small team and there was such a lot of FOI requests. Generally, that is the direction we should be moving in. You do not want to hobble a new agency by making it seem that any aspect of it is secretive. To be able to demonstrate ethical compliance, you need that transparency.

Tabitha Goldstaub: Ethical transparency is key, but we also have an opportunity with ARIA to set a robust, rigorous ethical review process that is fit for the AI era. We do not currently have that.

There has been a tremendous amount of attention on the public-facing ethical principles and frameworks for assessing AI products, but relatively little on the frameworks and practices for assessing research, or how to launch and manage a data science and AI ethics review board, in any way that would cut across disciplines, organisational, institutional or national boundaries, as ARIA would need to.

If ARIA can work with others, such as the Health Foundation, which is in collaboration with the Ada Lovelace Institute, or the Alan Turing Institute, on this problem, ARIA could achieve its mission responsibly, become a beacon for other ARPA-like programmes, and tolerate failure much more safely; because ultimately we need to break new ground and to do so with an ethics review, specifically with research that has anything to do with artificial intelligence. It would enable us to set real international standards, if we can get that right. It is both a risk and a huge opportunity for ARIA.

The Chair: Virginia Crosbie. I am afraid this will have to be the last, very quick question.

Q58 Virginia Crosbie (Ynys Môn) (Con): Thank you, Chair. It is a pleasure to serve on this Committee. I, too, thank the panel. Tabitha, it is lovely to see you again. You are an inspiration to so many, especially women.

[Virginia Crosbie]

My question relates to both your expertise and experience in encouraging the next generation of visionary innovators. What do you see as ARIA's role in future-proofing the next generation? In Anne's words, they are the future generation of irreverent researchers. How can we ensure that that is spread equally across the four nations of the UK?

Tabitha Goldstaub: Anne made it so clear that it has to be about engaging with citizens—directly with citizen scientists, but also with citizens who do not care about this yet; we have a real opportunity to excite them. A lot of people say it is really hard, but my answer to that is that it cannot be harder than protein folding. Ultimately, the big challenge for ARIA is to engage with those citizens.

Professor Glover: Briefly, of course I agree with that, but the biggest challenge might be—this will help in engaging with citizens—being up front right at the very beginning that we expect failure, and that failure is part of the measure of success for an agency like ARIA, because if you were not taking any risks, you would not get any failure. The challenge is that, culturally in the UK, and quite differently, I think, from North America, we see failure through an emotional lens, not a scientific lens, whereas I think the opposite is the case in North America. We need to think about that. In a way, just talking about it and saying that that is the case makes it easier for people to understand that we need to fail in order to get the big rewards.

Tabitha Goldstaub: I have heard Anne say in the past—

The Chair: Order. I am really sorry, but I am afraid that that brings us to the end of the time allocated for the Committee to ask questions of this panel. I thank the witnesses on behalf of the Committee for their evidence.

Tabitha Goldstaub: Thank you. Good luck.

Examination of Witnesses

Adrian Smith, Felicity Burch and Professor Sir Jim McDonald gave evidence.

3.46 pm

Q59 The Chair: We will now hear oral evidence from our fifth panel of witnesses, which comprises Adrian Smith, president of the Royal Society; Felicity Burch, director of innovation and digital at the Confederation of British Industry; and Professor Sir Jim McDonald, president of the Royal Academy of Engineering. We have until 4.30 pm. I would be grateful if the witnesses please introduced themselves for the record. I believe we are waiting for Professor Sir Jim McDonald to appear.

Adrian Smith: I am Adrian Smith, president of the Royal Society, and I have a day job as director and chief executive of the Alan Turing Institute, the national institute for artificial intelligence and data science.

Felicity Burch: I am Felicity Burch, director of innovation and digital policy at the CBI.

The Chair: Thank you very much. I think we are still trying to get Professor Sir Jim McDonald online. We will start off with Chi Onwurah, our shadow Minister.

Q60 Chi Onwurah: As my first question was for both the Royal Society and the Royal Academy of Engineers, I will start with a question to Ms Burch. Neither the ARIA Bill nor the explanatory notes refer to private sector investment. Is that an issue, and is it possible for ARIA to achieve its mission without engaging with the private sector? Can you suggest improvements to the Bill or its context in order to ensure that that happens?

Felicity Burch: That is a really important question. It is definitely the view of the business community that ARIA needs to be designed with the business community and the private sector in mind. When we think about some of the challenges that we are trying to solve in the UK, as well as the science superpower ambition and the goal of spending 2.4% of GDP on R&D, we will not hit any of those targets unless businesses are involved and engaged. The design of ARIA will be quite important to whether it will work for businesses or not.

The wording of the Bill is less important than the design and make-up of who is involved in ARIA and in thinking about what challenges the institution is trying to solve. Thinking about the individuals for a moment, we would very much like to see industry represented alongside the science base. Thinking about the design of it, we would be making sure that we do not focus too much on whether we are looking at basic or applied research or commercialisation, but flipping that on its head and thinking about what market problem we are trying to solve, who the end customer is, and then working back and thinking about who you need to engage along the way.

Q61 Chi Onwurah: Just to come back briefly, you have made an important point that echoes some of what we have heard already today. In terms of setting out a mission, or where ARIA should be looking, do you feel that more direction needs to come from Government or from public engagement, or should that be left more generally to the executives? As to ensuring private sector engagement, we echo the Government's ambition to reach 2.4% of GDP spend on R&D; indeed, Labour wants us to go from the average to the excellent, and reach 3%. The private sector is integral to that, so perhaps there could be a little more detail on how to ensure the new agency supports that ambition.

Felicity Burch: Definitely. It is great to hear an even bolder ambition for R&D investment. I am sure the majority of the business community would support that as well.

Thinking about the role that ARIA can play, particularly in the role of missions, what is really exciting about a mission, a problem statement or a challenge is that it not only does give an opportunity to bring together cross-sectoral players—we just heard about the role that AI and biotechnology can play when you combine them, and having a really clear mission helps to bring together those cross-sectoral players—but it also helps to advertise what you are doing.

One of the really exciting things for me about ARIA is that it is a big play—a big investment—that the UK is saying we are now making in science and innovation: “This is a change in the way that we are doing things, and this is the problem that we are trying to solve.” I do not think it matters, necessarily, if that problem is defined now or by the challenge director, but we need to think quite carefully about what the problem or challenge might be, and about some of the criteria that sit around that.

For me, there are probably two things that stand out as vital. The first is the sense of a market for a product at the end. One of the strengths of ARPA and DARPA in particular in the US is that customer relationship and an end customer saying, “This is the challenge that we need to solve, and probably we will buy it in the end if you do that really well.” The other thing that we want to think about is what challenges we need to solve as a society. What are the really thorny issues, where we know we need some game-changing steps forward in technology and where potentially Government can play a big role and have a big lever? A couple of areas that stand out in conversations with businesses are things like net zero and health, where clearly we have some big commitments that we want to reach as well.

Q62 Chi Onwurah: Thank you very much, those are excellent answers. I see that we have been joined by Professor Sir Jim McDonald, so before my next question I want to welcome all three witnesses and say how much we appreciate your joining us this afternoon.

For Adrian Smith and Professor Sir Jim McDonald: we have, very recently indeed, achieved some clarity on this year’s science budget. I know that that was a matter of concern for both the Royal Society and the Royal Academy of Engineering. There has certainly been a sense, and I wonder whether you would echo that sense, that we need long-term funding certainty—that it helps in the support of science and research more generally. Where do you see ARIA sitting in providing that long-term funding certainty, and how do you feel it can or should fit into the wider research environment? I will first ask Adrian Smith, please. It is nice to see you.

Adrian Smith: Thank you. Going back to the allusion to recent uncertainty about next year’s funding and where the Horizon Europe fee would come from, I stress that we need a coherent narrative and plan, not chopping and changing, and creating uncertainty. Uncertainty is bad, both within the community and for those who have to plan in the UK, but also for what we hope and assume will be our narrative of the UK being a global science and innovation player. Clarity of narrative and sticking to the plan is fundamental.

Where does ARIA fit? The starting point that most have accepted and signed up to is that having a new kid on the block in the high-risk and high-reward long-term space is welcome. Even though we have a plethora of agencies in the current ecosystem, there is nothing that sets out defines itself in that way. However, if this is to work, there are a number of things still to be clarified. I will mention a few, and Jim can pick up on this. ARIA has to have operational independence, if we are in the high-risk and long-term space, but it also has to have high focus. If we are aiming for £22 billion by 2024-25, £800 million is not a large sum of money, so if we have a plethora of missions, then I think we will go wrong. ARIA has to have focus of mission and a commitment to the model over the long-term, but also, and fundamentally, leadership.

This is an incredibly difficult agency, given the multiple stakeholders out there, and it will only work if it has the image and the street cred to attract and retain talent. I welcome the addition to the landscape. We need long-term commitment, but the recent experience of uncertainty about next year’s funding, the chopping and changing,

and the lack of clarity about Horizon, would not bode well for this. We need absolute clarity on the plan and how this is going to fit into that.

Q63 Chi Onwurah: Thank you very much. Professor Sir Jim McDonald?

Professor McDonald: Just to echo what Adrian has been saying, I welcome Felicity highlighting net zero and health. The additional funding is absolutely welcome. As you have pointed out, there was great concern about the uncertainty around the funding generally. The Government’s commitment to making the UK a science, engineering and innovation superpower is exciting. It is built on what is a genuinely world-class research base here in the UK, but of course traditionally we have not done the D in research and development terribly well, so ARIA coming forward to fit into the landscape is key.

To Adrian’s point on longevity, it would be good to get a planning horizon that was long—10 years de minimis and hopefully even longer, because many of the technological developments that come through these accelerated high-risk, high-reward programmes can take decades to come to fruition. Felicity mentioned the concept of a customer, and I could not agree more. The customer might be a Government Department but, for this acceleration of technology for solving challenges of scale at pace, we would increasingly need to see agencies, companies and industry sectors that can take these technological advances into practice. Late-stage R&D, which costs a lot of money, would be counter-productive. In fact, it would be even more damaging if we start the journey to have this innovation acceleration, this high-risk, high-reward agency, only to discard it within a few short years. I think that would damage business confidence, and we would also miss out on the opportunity to get the translational ability to feed out from the UK’s great research base to create new technologies.

Of course, there are a number of schemes that are suggested—Felicity touched on them—and there is the exciting legal commitment that the UK Government have made to net zero. There is an economy and opportunities to build around that. Healthtech, and the whole piece around global health and how we deal with that, is another great opportunity for the UK to mark out its capability.

ARIA should fit and integrate within the existing landscape. It should be a disruptive innovator, but it should not necessarily damage the existing system, much of which is working well, but there are gaps that ARIA can hopefully fill in the coming years.

Chi Onwurah: Can I follow up briefly with Adrian and Sir Jim? Thank you very much for your responses—
[*Interruption.*]

The Chair: Order. The sitting is now suspended. I shall resume the Chair at 4.9 pm. I apologise to the witnesses; it is how this place works. If you can just hang on, we will see you in 10 minutes.

4 pm

Sitting suspended for a Division in the House.

4.10 pm

On resuming—

The Chair: This session will now be slightly extended, for another 10 minutes. It should finish at 4.40 pm. We will start where we left off, with shadow Minister Onwurah.

Q64 Chi Onwurah: Thank you very much, Mrs Cummins. I shall endeavour to restart the exact sentence I was saying. It is noticeable that, while the Bill provides a minimum length of time for ARIA's existence of 10 years, there seems to be no provision for a minimum length of time for funding. Those research scientists who have recently lost their funding at very short notice because of cuts to the overseas development aid budget may not feel reassured by that.

I have three very specific questions. Adrian represents the Royal Society; Jim represents the Royal Academy of Engineering. We have had some discussion about whether ARIA should be looking at blue-skies research or transformational translation. I assume that you both think it should do both. Or maybe not—will you let us know?

Secondly, the Bill makes provision for public sector R&D funding to be spent by ARIA internationally. I understand that there might need to be collaboration—collaboration drives research—between UK and international bodies, but do you think it would be appropriate for ARIA to fund exclusively international research programmes?

Thirdly, do you think the UK should get some kind of tangible return from this level of investment in high-risk, high-reward research?

Adrian Smith: The answer is both, of course. If there were no research element, it would be something we completely understood and all that was left would be to deploy it, in which case this does not seem to be the right kind of agency to do it. I think it starts off with a substantial element of R, but that is perhaps pointless if it does not end up with the D.

Internationally, it is hard to think of anything really, at scale—even if it were only in terms of being a magnet for global talent of one sort or another, an international dimension is almost inevitable and appropriate, but if it were all offshored, that would make nonsense of the agency.

I have now forgotten what your third question was.

Chi Onwurah: Should the UK get a return on this investment?

Adrian Smith: High risk, high return is the mantra, isn't it? So I think an expectation of substantial transformational return is implicit.

Professor McDonald: First and foremost, ARIA should be a funding mechanism that delivers innovative solutions to ambitious, real-world challenges, bringing together and developing breakthrough research and technology. It is worthwhile reiterating that. Of course, that has to be driven by substantial funding. The flexibility—I am sure we will come back to this—the independence and autonomy for this agency are going to be fundamental to its success.

Adrian has mentioned skills a few times. I absolutely agree with that. While the fundamental research is not viewed as the primary focus of ARIA, it should be

keying into a rich base to draw from in the UK research base. Of course, there is an opportunity here for international collaboration as we drive development towards application. However, it is not unreasonable to imagine that ARIA could commission basic research work that emerged as it sought to solve some of these major challenges.

The international connectivity is important, even at the highest level. Telling the world about our ambitions around being a science superpower and trying to become one of the world's most innovative nations is not something that we should keep to ourselves. We should be promoting that, showing confidence in the UK that we are building on our outstanding research base but we now have another mechanism through which we can drive technologies, find solutions and indeed build economies. So I echo Adrian's point: this could be a great magnet for talent into the UK and those excellent international individuals who want to come here, some of them pursuing research but many of them also engaging in that exploitation, in that high-risk, high-reward programme. So I would encourage international connectivity, but, speaking as an engineer, I would like to see good outcomes that impact on the economy positively, build industry, support the creation of supply chains, support indigenous supply chains and create new ones around new technologies, whether in net zero, health tech or AI, to build an industry through which we can drive the economy to keep that virtuous circle of driving economic strength so that we continue to invest in science, research and innovation. There is a circularity here, and I would suggest that we do not fragment and see these things in a systems perspective—that is what engineers will propose in any case—but see ARIA as part of a larger system. But driving that through to economic and societal benefits is key for me.

Chi Onwurah: Thank you very much for your answers.

Q65 Amanda Solloway: Welcome to the witnesses—it is lovely to see you this afternoon. I have two questions that are relevant to all three of you, please. Given that we know how important ARIA is to the UK economy, what importance do you put on patience when we think about funding high-risk transformational research? How necessary is it that we have a long-term view?

Felicity Burch: As I know you are aware, I think having a long-term approach to funding R&D matters hugely. From the perspective of the business community, having institutions that are in it for the long run that they know they can come back to and that they are aware exist is really important for their own confidence to invest.

Thinking about the agency slightly more specifically, when it comes to its own patience, one of the things that CBI members have highlighted to me as a particular benefit of the DARPA model is the commitment to funding their programmes for significant periods of time. For example, there might be 10-year funding with three-year gates to check if the project is working. Those commitments, with that 10-year view—so long as everything is going more or less according to plan—is hugely important for bringing business funding alongside that. So if we can bake a long-term view and patience into ARIA from the start, it will certainly help it to be successful.

Amanda Solloway: Thank you. Sir Jim?

Professor McDonald: It is nice to see you, Minister. There is a requirement here to have a significant cultural change—that is embedded in your question—to move away from the value-for-money concept that is deeply embedded in the UK Research and Innovation funding structure. That is important, but of course we would need to innovate the funding model, which is what is being sought here. Value-for-money assessments for disruptive innovation may not be assessed, as you indicated, until decades later, so we will need a longer-term outlook or alternative approaches to assessing value, such as a means of building capability and capacity in both technology and skills.

Of course, projects that were deemed unsuccessful in achieving their goal may produce value in terms of people, skills and lessons learned, so we must take a long-term view. I think we see that notion of patience, but it is about the ability to have that highly driven, focused approach that the executive officers and the board of ARIA will take and—we may come on to this—the ability to fail fast and elegantly and not be punished for failure as long as the process has been driven openly, transparently and with excellence underneath it.

I would say, absolutely long-term vision and drive forward. If everything worked and everything was successful, we should challenge ourselves and think maybe the questions were not quite as challenging as we thought they might be. Failure is not something we should be discouraging—it is about risk and collaborative approaches to driving problems to a solution—but long-term vision is absolutely essential. That is why, as you have heard from Adrian and Felicity, that patience and that long-term view is key. It should become a very natural part of the UK landscape, so that it is something that we boast about and that acts as an attractor for business and investment, and to attract and retain talent.

Adrian Smith: Let me echo everything that Jim said. The scale of mission that we would hope to see from such an agency means that the timescales will be long and we will need to build new research capability over those timescales, in so far as we are interacting with technologies, and perhaps new supply chains. If those are to come out of the woodwork, they need to believe that we are in it for the long term and that there is patience on the part of the funders and others. The timescales are really important, not just in terms of if it is a hard problem, it will take a long term to solve; if it is a hard problem, we will need to build all sorts of new capabilities and capacities. To have the courage to invest in those, we need to know we are in it for the long term.

Q66 Amanda Solloway: Thank you. Sticking with you, Sir Adrian, I was thinking that we have heard an awful lot about the importance of ARIA recruiting people from a variety of backgrounds. I wonder how we attract the best people, from industry in particular.

Adrian Smith: Is that a question for me? It is probably a better question for Felicity. Going back to the earlier comments, a fundamental is to trust long-term commitment from the Government that we are really in this, and we have a plan with clear funding milestones and we will stick to that plan. That is what will give the international community the message that we are in it to be really serious. That serves two purposes: for the narrative of

the UK, and as an attractor for brilliant people, whether they are in research or industry around the world, to come and join in this long-term challenge.

Professor McDonald: How do we attract them? The scale of the ambition will be a major attractor to someone, with that executive excitement and experience that they will bring. Large-scale ambition and, as we said earlier, a commitment to the long term to making this work for the UK, in that it is a long-term integrated approach. I suggest that the CEO would have to have experience beyond academia; preferably, as you have suggested, Minister, including industrial experience—that ability to take the journey from concept through to proof of concept, demonstration at scale and deployment. Ultimately, commercial exploitation is key.

I can assure you that the engineering community will be well engaged with this as we help to bring forward individuals of the right stature. Industry expertise and understanding should be a prerequisite for ARIA personnel. An interesting example, which many of our colleagues in the Committee will be familiar with, is the vaccine taskforce: bringing together industrial expertise—traditionally competitive companies large and small within their supply chain—with Government officials and the National Institute for Health Research. That was a fantastic microcosm of large-scale, high-risk and ultimately high-reward outcomes. In many ways, that gives us a precursor for some of the approaches and cultural changes that would be needed to take that forward. For the chief executive or chair of the board, it would be great to have industry-relevant background, a commitment to innovation and excitement about the scale and potential impact of the work that they are taking on.

Felicity Burch: I listened to a number of the earlier sessions, and I was delighted to hear about the focus from so many stakeholders on the need to build a diverse team within ARIA, but also thinking about the diversity of the community that we engage in it. One of my reflections is that we are trying to build something that looks a bit like US DARPA, but we are 60-plus years on now, and the international, national and social picture is completely different. We have an opportunity to build something that really excites, for the next generation of researchers and business people.

If you look at businesses that are trying to achieve those same goals and the practices they put in place to try to recruit brilliant people, you will see that, first and foremost, purpose really matters. Clearly defining the mission of what ARIA is trying to achieve when we get the team in place, making sure that it is something that excites people, having a clear market, and also solving national and international social problems will help encourage really bright, brilliant people to get involved.

Secondly, it starts with the senior team. We are building this team from scratch, and we need to make sure when the team is being recruited that it is diverse in the broadest sense possible—that we see women, ethnic minorities, and those with disabilities represented on the senior team for ARIA to really send a signal that the way we want to innovate in the UK is diverse and that we want to make the most of all our talents around the country.

Q67 Aaron Bell: I thank all three of you for your time today. I have one brief question for Ms Burch and then one for Sir Adrian. In terms of the funding ideas and

[Aaron Bell]

streams available through ARIA, would the CBI and your members welcome the potential of investments in companies or joint ventures with ARIA?

Felicity Burch: One of the really exciting opportunities from ARIA is the potential for joint ventures and engagement. Essentially, my answer here is pretty short. Go ahead and do it, but make sure you engage with business communities a bit further down the line in exactly the design of how those funding mechanisms might work. Different businesses at different stages of their journey will be interested in different funding mechanisms.

Q68 Aaron Bell: Thank you. Sir Adrian, speaking to your professional interest and expertise as a Bayesian statistician, which I share as a layman, how can we use Bayesian statistics to help decide which projects to fund and also when to pull the plug?

Adrian Smith: I was not expecting that question. The problem with the kind of mission that we would like to see in ARIA is probably that there are very few precedents. So where we are going to get our prior information from to deploy my wonderful Bayesian analysis, I am not quite sure. Let me use that to point out something else. It will be very interesting to see how we creep up on a mission and why ARIA would be appropriate for that mission. There are two things that you will all know about and I am involved in. I am on the board of the UK Atomic Energy Authority, and fusion, you could say, is the ultimate mission of all time. The mechanism there is with an authority and long-term Government funding in a different model. Solving the problem of batteries you could say would be an absolute fundamental mission, but there we have set up the Faraday Institution. I suppose the question as we go along is: what makes ARIA the right kind of place for what mission, given that we have lots of missions and lots of other ways of trying to solve them?

Aaron Bell: Perhaps we need someone with particular expertise in portfolio management as well, because it seems the risk/reward of these missions is so key. I will leave it there.

Q69 Stephen Metcalfe: Good afternoon, all. I have a quick question for Felicity. We heard earlier from Dr Highnam from DARPA about the high level of churn among the project managers and that they move between academia, business and, in their case, DARPA and that creates the right culture. Presumably it requires flexibility from the businesses themselves. Do you see your members embracing that kind of secondment into a research body such as ARIA, even though it may not lead to anything?

Felicity Burch: I have not talked to them directly about this in the context of ARIA, but I can reflect on conversations about business and university collaboration more generally. I think our members do see value in seconding people to research teams to learn new skillsets. Likewise, we would love to see more people from university sectors being seconded into businesses. Were there a world-leading agency like ARIA, being able to say, "My people have worked on one of these teams" would be quite a prestigious thing for businesses. I guess the

flipside of that is this: how do we make sure that we build ARIA to be that prestigious body that businesses feel comfortable seconding their people to?

I think that time and again we hear businesses saying that that fluidity of people between the business sector, the university sector and the research sector more generally is really important for successful innovation and building an ecosystem. I am sure that if any business pointed to any one individual, they might not want to lose them, but I think this is much more about how we build a really flexible and really brilliant innovation ecosystem, and to that extent I think that businesses would be really happy to see those moves.

Q70 Stephen Metcalfe: Have you any advice on how we should approach building such an organisation?

Felicity Burch: In the sense that it would encourage businesses to second people on to ARIA?

Stephen Metcalfe: Yes. You said that we have to build an ARIA that encourages that kind of collaboration. What is your advice about doing that? Where are the risks and rewards from an employer's point of view?

Felicity Burch: One of the challenges is making sure that ARIA has its own clear purpose, so that businesses know why they would second people to it. The truth is that we have a lot of other institutions in the research/innovation landscape, as we have already referred to throughout this conversation, and as you have heard from the previous panels today. However, once ARIA is up and running, has a clear mission, and has some really great people on it who you can point to as being leaders in their field and really pushing the boundaries—when you can tell a clear story about what the organisation is set up to do—it will become a lot easier for a business to make the case that, "Yes, it makes sense for me to put a person on there; they are really aligned to what I am doing," or not.

Q71 Daniel Zeichner: A few years ago, we were told that there was no magic money tree. That seems to have been parked temporarily, but I fear that it will return at some point. I detect enthusiasm from all of you for this project, but how much is your enthusiasm dependent upon the money being genuinely new and additional in terms of the wider research environment?

I have a second question. Through the day, we have heard from different witnesses mainly a view that there needs to be a mission but also some difference of opinion as to who should set that mission. Who do you think should be setting it? Maybe I can go to Sir Adrian first.

Adrian Smith: In terms of new money or old money, I think the key thing is really to look at the big picture. The aspiration—the 2.4% aspiration—is aiming at the average of the OECD, which has probably crept up now in any case to 2.5%. In the meantime, the United States is around 3% and Israel is around 4.7%. The big picture stuff is the total amount of investment in the R&D landscape. So I think there would be less warm support for this body if it were at the expense of that wider investment.

As for who sets the mission, I think it is an extremely interesting question. There is an interesting tension between what most of us would see, which is that if this

agency is to have real street cred, it needs tremendous operational independence, but on the other hand the thinking behind it is that the mission will be of great benefit to the UK. Clearly, therefore, Government and a multitude of stakeholders have an interest in what the mission will be, and how the leadership of the new organisation will satisfy the desire on the part of all those stakeholders to have a finger in the pie of influencing the mission. I think that will be very interesting to see.

Q72 Daniel Zeichner: That sounds like a gloriously British response to me, but I agree with it. Felicity?

Felicity Burch: Similarly to Adrian's response, support for this body comes alongside the fact that it is new money, and we need the new money in order to grow the level of R&D in the UK. The level of Government spending on today's level—obviously, there are longer-term plans, but at today's level—would not hit the target. I think we do need new money in the system, and it makes sense that ARIA is one of the places to which that money is directed. But we do not want to undermine other institutions, such as UKRI and Innovate UK, and catapults in particular are hugely important to businesses. We do not want to undermine that, and this is definitely about building up a coherent system.

One other thing to note is that we have tried to create something that looks like ARIA quite a few times before. For a long time, there has been a sense that we needed to do something like this. Initially, when what was the Technology Strategy Board was founded, people talked about it looking like a UK version of ARPA. When we established the industrial strategy challenge funds, people also talked about them being a UK version of ARPA. The difference with ARIA is the legislative approach and the creation of an independent body, which means we are genuinely doing something different. This is a really exciting way to leverage some of the Government's R&D investment. As to who precisely sets the mission, I understand that BEIS would like the ARIA team to do that. There is a lot of sense in that, but they cannot do that in a vacuum; it needs to make sense to a wider science innovation community, and to society in fact. That comes back to the importance of a long-term market and the social issue that we might want to address with ARIA. We will be looking out for it to do those things.

Daniel Zeichner: Sir Jim?

Professor McDonald: Thank you. Coming back directly to the question, this must be new money to enhance the credibility of what is sought to be done. As you know, we said earlier that the UK's research, science and innovation base is an absolute national asset. We cannot exploit that research base if it is underfunded and not attracting the very best talent with the very best facilities. This has to be additional investment to complement existing funding.

I agree with some of the implicit elements of your question that that investment must sit within the system perspective, so although this will be a new funding model that brings a new type of leadership into the research and innovation landscape, there must be plenty of dialogue between ARIA leadership and UKRI, BEIS and other entities that Adrian mentioned. There might be some competition, which would be healthy, but there

may be some articulation in complementarity that will emerge if we are doing the right things. It needs new money and long-term commitment.

As to who should lead this, I buy into the model of greater independence and autonomy. The customer will exert influence; to go back to the comment about the customer being a Government Department or Departments, and industry as well, they will have an influence and try to prioritise where the CEO and the team and board will take the direction of travel for ARIA. I would like to see it exercise independence and autonomy going forward.

This may have been raised earlier, but I think public communication will be critically important. Let us have the public understand why this is important, and give a voice to the science, engineering and innovation community. They should be accountable for ensuring that the idea is understood by the nation. I am not suggesting that the public would be directly involved in the agenda, but that public engagement would raise awareness of what science innovation is all about and turn some of the Government's superpower commitments into a reality for individuals out there in society.

New money, please, and a long-term commitment, and let us give this entity independence and autonomy but the accountability that sits behind it should respond to our customers' drive for new technological solutions. That should be done in a way that drives value into the UK economy.

The Chair: Thank you. We will have a very quick sneaky question from the shadow Minister, Chi Onwurah.

Q73 Chi Onwurah: Thank you very much. Adrian, I was very interested in what you said about the number of people in organisations who want to influence the terms of the mission. Obviously, if the Government set the mission, they have a democratic mandate. If the CEO or the director sets the mission, how would you suggest that we can test that he or she is not simply being influenced by their pet projects and preferences? What kind of test could we set out?

Adrian Smith: Whoever is chosen to be the chief executive and whoever surrounds that person in governance must be people the rest of us will trust. They will have the stature to be trusted. Without that, I think we are in trouble.

Q74 Chi Onwurah: So you think it is only trust, and there has to be trust in governance?

Adrian Smith: I think it is an essential element. As I said earlier, I think genuinely that whoever is going to lead this and oversee the governance has to think very hard about how you interact with both the hard-nosed stakeholders and, as Jim and others have alluded to, the public, in terms of taking them along with the idea that this is a mission that is ultimately for the good of all of us.

Chi Onwurah: Thank you.

The Chair: Thank you very much. If there are no further questions from Members, then we are dead on time. May I thank the witnesses for their evidence before we move on to the next panel? Thank you very much.

Examination of Witnesses

David Cleevly and Bob Sorrell gave evidence.

4.40 pm

Q75 The Chair: We will now hear oral evidence from David Cleevly CBE, chair of Focal Point Positioning Ltd and the Cambridge Science Centre, and Dr Bob Sorrell, chair of the Campaign for Science and Engineering. We have half an hour for discussion. Could the witnesses please introduce themselves? Thank you very much; it is lovely to see you both.

David Cleevly: I am David Cleevly. I am a serial entrepreneur with a background in telecoms and biotech. I have done a lot of work on Government policy, been a board member of the Ministry of Defence and founded networking organisations, including the Centre for Science and Policy at the University of Cambridge. I am glad to see that Bob, who helped me get that off the ground in the early days, is on the panel with me. I am currently chair of the Enterprise Committee at the Royal Academy of Engineering and, for my sins, I am chair of the Cambridge Autonomous Metro Technical Advisory Committee.

Bob Sorrell: Good afternoon and thank you for inviting me to the Committee. My name is Bob Sorrell. I am the chair of the Campaign for Science and Engineering, which is the UK's leading independent advocate for science and engineering. I come into that with quite a lot of experience in research and development, and I also served two terms on the board of Innovate UK, as well as being a non-executive director in a start-up company, so I have a variety of experience.

The Chair: Thank you very much. I will start the questions with Chi Onwurah, the shadow Minister for the Opposition.

Q76 Chi Onwurah: Hi, David and Bob. It is great to see you both and thanks for giving your time. I do not know whether you have been able to follow our evidence sessions, but we have had a lot of discussion about the purpose and remit of ARIA and the extent to which it addresses fundamental failings—if there are fundamental failings—in how the UK chooses and commercialises research. I would like to ask you both your opinion on the remit and purpose of ARIA. What is the failing that you see ARIA fixing? How does it need to change to fix that? Are there things that it is not addressing that it needs to? I will start with David Cleevly.

David Cleevly: Thanks, Chi. I would like to start by saying three things rather briefly. First, serendipity does not happen by accident, so we need systems and processes to enable the network diversity and uncovering the unexpected. I am hoping that the new agency will do all of that.

To begin to address some of your other points, we need to improve the whole of the national innovation system. That means not putting in late stage R&D, translation and, in particular—this is something of a bugbear of mine—procurement. If you do not have revenue and if you cannot get product into market, no amount of R&D at the front end will necessarily get you anywhere. If we do not do that, we are always going to be trapped into saying that we need more and more R&D and simultaneously mourning our inability to translate this into economic growth and productivity.

I have one other thing to say, which is slightly cheeky, but I have been listening to the proceedings so far, and they are extremely interesting—it is one of the most interesting sessions I have ever attended. All the examples given of contributions that make a difference have all been, it strikes me, about engineering, so I suggest that we rename this the “Advanced Research and Engineering Agency”. To be honest, “invention” strikes me a bit like something in the 1950s, with somebody emerging from a shed with a gadget that has just blown their hair off. Peter Highnam pointed out “projects”, so we might actually consider it to be the “Advanced Research and Engineering Projects Agency”. No doubt we will get on to why I might say that. The point is that we need to think about this, as Felicity said, in a coherent way, including all the way through to procurement.

Q77 Chi Onwurah: As a chartered engineer, I am always happy to put engineering in anything. The Advanced Research and Engineering Projects Agency would be AREPA. Your point, which has come up a number of times, is whether this is about, if you like, cutting-edge research, or whether it needs to be looking at transformational translation of existing research, or whether it needs to do both. Certainly, the economist Mariana Mazzucato, as you probably heard, made the point that having the basis there is important, and you seem also to be saying that it needs to look at both, and that it needs to get its purpose right. Let me go now to Bob, and then we will come back.

Bob Sorrell: Thank you very much. Picking up on David's comments and your question, I am very excited about the potential creation of ARIA. Having something that can respond to the types of challenge that we face, which quite frankly do not respect sector or skills boundaries, is really important today. In particular, there are real opportunities to learn off the back of the covid experience, which has allowed us to really accelerate innovation at quite an incredible pace. If we can take some of that and operationalise that within an ARIA-type environment, that would be a very positive thing.

One thing I have heard, because I have also been listening to the sessions through the day, is mention of crossing the valley of death. For me, there needs to be a matching market pull for the wonderful research products that will come out of ARIA. To get that in place would mean having a really good dialogue between academia and industry and all parties involved to understand what those challenges really are. I also suggest, looking at the DARPA model, that we should back this up by having a really strong public procurement model. Again, we have seen that in covid, and we could see it here, providing a first customer and enabling some of these technologies to be developed. That would be really key.

The final thing I will say is about the personnel involved in this, because that has also come up several times. They really need to have autonomy; they need the ability to make the decisions and choices on what projects they pursue. Equally, they need to be able to start and, critically, stop things. I have much more to say, but I will stop there.

Q78 Chi Onwurah: Thank you for both of those responses. To follow up, you both emphasised the importance of procurement and market pull. It seems to me that there is such a vast range of areas, issues or

challenges that ARIA could look at. What are your views on who should decide what it looks at? Is there a need for a mission, and who should that be set by? If it is left to four, five or six individuals to set the missions, how do we ensure that it is not simply about vanity or pet projects, and that cronyism—we are having some challenges with that at the moment—is not promoted? How do we avoid cronyism and support diversity?

David Cleevly: I notice that this came up in the previous session. I think the answer is, in one sense, very straightforward. I think it is for the Government to set the priorities where they feel that there are specific challenges. We have talked about climate change, for example. That is one, and there may be others that one would want to address, either in health or in other topics. That is the point at which the handover occurs and whoever is running ARIA takes that particular domain or challenge. I have been involved, for example, in the Longitude prizegiving, and it was very interesting how we focused down on antimicrobial resistance and testing. A lot of interesting things came out of that. By the way, all the solutions were engineering.

The point is that we should listen to Peter Highnam's testimony really carefully. Honestly, that was one of the most interesting insights into DARPA that I have had. He talked about the way in which there is autonomy within DARPA to do things within a general area set by Government. Then, within that, there is a peer-review system that enables us to overcome some of the cronyism that you talk about. The more open you are about what you are doing, the less easy it is to hide the fact that you have let particular contracts and so on, so there ought to be a mechanism within the governance structure of the agency to do that.

There is a two-level thing here, but it is up to the Government to decide where the UK's priorities are. Are we, for example, really concerned about climate change? Can we specify challenges within climate change that will make a difference? In the same way, for defence it was to not be surprised by innovation and to make sure the technology was available for defence in the United States. Within that, DARPA went ahead and looked for things that met that overall goal.

Bob Sorrell: I think there needs to be an overarching structure set for the areas ARIA pursues. In identifying these grand challenges, there is a list that we could reel off right now that would fit the scope. Earlier, I heard conversations about having six wise people who would make these decisions and cover these areas. I worry about that approach. I think you need people who are really up for engaging people to understand the nature of the problems and translating them into meaningful challenges.

The other part that is often missed in this is the social science aspect, because there has to be a level of public acceptance around the things that people are developing on their so-called behalf, and that part is also incredibly important. We need to have a very open process for how we decide on those projects so that we avoid, as you say, falling into the traps of vanity or pet projects. If you have clear criteria from the outset and stick to them, you will be fine in that regard.

Chi Onwurah: Thank you. I could ask you lots more questions, but I will stop there and hand over.

The Chair: The next set of questions is from Minister Solloway.

Q79 Amanda Solloway: It is lovely to see our two witnesses this afternoon. The first question is to Bob. You mentioned in your written evidence to the Science and Technology Committee that a body like ARIA will need an understanding of failure. What does a new understanding of failure look like, exactly?

Bob Sorrell: That is a great question. If you compare and contrast us with the Americans, there is a definite culture in the UK that failure is something that you hide under the carpet, put away and forget, but science is all about failure and pushing the boundaries. If you are not failing, you are really not challenging those boundaries. I think it is about establishing a culture in which we can accept failure and move on.

The problem comes, in both industrial and academic environments, in facing that day, because there is a tendency to keep things creeping along because you have invested so much effort to get them to this particular point. You do not want to kill it, because then you have to stop the project, and people feel emotionally involved in it. That creates a whole series of issues associated with it. It is about making the hard decisions and learning from failures. We describe them as failures, but actually they are some of the most valuable learning experiences that we gain, and they stop us reinvesting in making the same mistakes in the same areas if we are really careful about what we extract from them, and do not just try to shut them off in a box, in a rather embarrassed way, and say, "That's something that we will leave to one side."

Q80 Amanda Solloway: Thank you very much for that. I have a more general question to both of you. One of the things we have heard a lot about today is the importance of fitting ARIA into a larger innovation system. What advice do you both have about how ARIA can forge the most productive relationships with a range of public and private sectors, for example?

David Cleevly: As well you know, I am very keen on establishing networks of individuals and making sure there is lots of exchange. Part of the essence of putting an agency like this together is to ensure that you get a lot of cross-fertilisation. There should be a great deal of exchange going with that, and you would, of course, have to have in place the conflict of interest and various other peer-review processes.

It is very important that an agency like this would work closely with the private sector. My first encounter with DARPA goes back to 1977. At that point, I was working for Post Office Telecommunications, which shows how long ago it was. We were discussing the idea of funding this funny thing where you cut information up into packets. A lot of the collaboration that was done on all of that involved a great deal of what was then a monopoly, though a commercial entity, helping to fund those things. That kind of stuff is extremely important and needs to be built into the processes by which this agency operates.

Can I just pick up on the notion of failure? There are two kinds of failure. There is the kind of failure that we have seen with SpaceX, where you send a rocket up and you land it and it crashes or burns up after about 12 minutes because it is leaking fuel. That is one kind of failure. Quite honestly, the private sector got involved in replacing NASA because NASA became too cautious about dealing with that kind of thing.

There is another kind of failure where you have picked the wrong technology—the wrong way of approaching a problem. I think we are talking about the second kind, and about recognising how to stop that. That is a peer-review process; that is a way of making sure you do things. What we need to avoid is reacting to failure where the rocket is crashing on touchdown. That is not really failure; that is simply experimentation.

Q81 Amanda Solloway: Thank you, David. Bob, any further thoughts on the relationship and how to engage with public and private sector?

Bob Sorrell: I would say three quick things. First, ensure that there is a real partnership between industry, Government and academia, in actually shaping the agenda for ARIA. I would have flexibility; we heard that earlier, I think, from a colleague from the CBI talking about models in which we could second people into the ARIA organisation. I think there is an opportunity to do that, and we have had experience of doing that previously.

The other thing is that ARIA provides some really important learnings, and it should be able to integrate those back into UKRI, and vice versa. UKRI has some valuable learnings that it can impart to ARIA. This is an evolutionary process through which both parties will definitely benefit, and it should be framed in that light.

The Chair: Thank you, Minister. Daniel Zeichner.

Q82 Daniel Zeichner: Thank you, Chair. Welcome, both of you; it is good to see you. I have been struck throughout today by the evidence that we have been looking at an American model, trying to learn lessons from it and importing it into what looks to me like a rather different environment and landscape here. I would like both of you to ignore all that we have heard today and answer the question I would ask at the beginning, which is: what is the big problem facing the UK R&D system? Do you think ARIA, as it is presented, can be bent to fit whatever problem it is that you think needs to be solved?

David Cleevly: What is the big problem? The big problem is that we do not have procurement systems that buy enough stuff from small and medium-sized enterprises. Half the employment growth in this country comes from 7% of the SMEs that are fast growing. If you look at a place like Cambridge, as you well know, Daniel, we have 20 \$1 billion companies. Companies that have come into existence that were not even a glimmer in somebody's eye in 2014 and are now about to be floated.

That is the kind of process we need to understand, and why we do not have more of those successes. In particular, if I may blow Cambridge's trumpet, we need to understand why we have those things happening in Cambridge, and why they are not being replicated elsewhere. From my personal point of view, having sold a company to an American buyer last November, which, as you can imagine, was an interesting experience, it was because it had innovative technology. We were absolutely the best in the world and hardly anybody from the UK bought anything from us. The majority was being bought by Americans—American defence and security stuff.

It is a great disappointment to me that we do not have the ability to nurture and bring on. The way the Americans do it is that they have that complete system. They have an awful lot of money and effort going into procurement.

Somebody spoke earlier about the infantilisation of Government Departments, and the way in which that expertise is not there. I will mention engineering again here. We need more engineers in Government, who can take those kinds of decisions and understand what we need to procure to be able to do things. That strikes me as so important. It is not to detract from AREPA, as we might call it, but in order for it to be as functional and effective as possible, we need to look at the entire system.

Bob Sorrell: That was a great answer from David. I will just pick up on a couple of things. I go back to the fundamental issue of matching the research that is coming out of ARIA with the market pull for it. It is important to define what the challenges are up front. The role of public procurement, as David raised, is critical, as is supporting the growth of the so-called *Mittelstand*—the mid-sized companies—and understanding what is behind the culture that leads to so many of those companies being sold at around the £50 million level, as opposed to growing to the hundreds-of-millions-of-pounds companies that they could be. How do we support them through that whole growth cycle? There is much more that I think we could do in that space.

Q83 Daniel Zeichner: To summarise slightly—I do not want to become a grim AREPA—what we need is not only an ARIA that can do the things that we have been talking about today, but possibly other things alongside it to make it work. Would you agree with that?

David Cleevly: It is fine tinkering around with the engine and putting another turbocharger on it, but if the chassis, the transmission system and the wheels will not deliver what you need, all that energy and power is going to go somewhere. In an international system, all we will do is to help to accelerate other countries that are willing to buy our stuff from us. That is fine; I am all for international co-operation, but I really would like to see a bigger contribution to economic growth and productivity improvements in the UK.

Bob Sorrell: To pick up on what David is saying, ARIA is part of the solution. We need all the things that we have, effectively, to put us in a position to lead against the challenges that we face. We would not be in this position if we did not have such a brilliant research community in the UK to start with. It is fantastic that we are having a conversation about how we capitalise on that. It is not just £800 million for ARIA, which is just seed money to start it, but the investment in the overall infrastructure that will make many of these things possible. We need to commit to doing that as well, if the UK is really going to lead and be the test bed and demonstration centre for the technologies that it can lead in and deploy globally.

David Cleevly: I think Bob and I are absolutely in agreement on that.

Q84 Chi Onwurah: If nobody else has a question, I will take the opportunity to come back on that point, particularly on procurement. I remember having a great deal of difficulty persuading the Prime Minister that the American Department of Defence was far better at buying stuff from UK small businesses than the UK Ministry of Defence, as the figures show. What do you think we could do, or what should Government be doing, to enable, require or ensure that ARIA, or AREPA, better supports small business growth and, at the same time, addresses the issue of market pull?

David Cleevely: The general thrust of what AREPA—if we are going to adopt that word—is trying to do is right. There are a number of things going on in bits of defence, for example. You have DASA and various others playing around with projects within the different services, for acquiring different kinds of technology. I think the phrase “a bit more coherence” was used by Felicity. I think we need to understand what the map of that innovation system looks like.

I am pretty convinced that people are pretty smart—they will make the right decisions. You just need to give them the right structure, hence my point that serendipity does not happen by accident. These kinds of things happen because you have constructed systems and processes so that people bump into and talk to each other, and will exchange ideas. ARIA is fine as it stands, but it sits within quite a complex system. I would like to see much more recognition within Government about how complex that system is, and how it actually operates. I completely agree with you that it has been far easier, in all my companies, to sell stuff into the United States—particularly into the United States defence market—than it has ever been to sell into the UK.

Bob Sorrell: To build on that, I did a couple of terms at Innovate UK and we tried stimulating public procurement during that period. I think a lot of it is about the culture and getting it right, to allow people to invest in those smaller companies and different technical solutions, to move them away from the existing ones. We got that to work during covid. We managed to get it to work, and we managed to get ourselves investing and procuring things in a different way. That is why I keep coming back to that and looking at what we did differently then that allowed people to make those different choices. I think we have to take some of that learning to see how we can get public procurement to work in a better way going forward.

The Chair: We have one last very quick question from Sarah Owen.

Q85 Sarah Owen: Bob, you mentioned engagement and trust. We have heard a lot today about accountability and trust. How do you feel that we can get that trust without stifling innovation, and do you think FOIs are the best way to do that?

Bob Sorrell: If you are to get trust, you need to be transparent about the choices that you are making and how you are making them. Then, when you move to the execution phase, you need to allow the programme managers and the people who are driving the programme scenario to make the choices flexibly and in the quickest way possible. I understand in part what you are perhaps playing into, but I think you just need to strike the right balance between transparency on how choices are made and holding to account on that, and allowing people to get on with executing against those programmes once those choices have been made.

David Cleevely: I think the acid test is whether you can explain something to someone who is independent and is one of your peers. If you are happy explaining it back to somebody like that, that is fine. That is the way in which the system works. If you listened to Peter Highnam talk about how DARPA was organised, that was built into the DNA.

Q86 Sarah Owen: Do you think it would be useful to have that built into ARIA from its inception?

David Cleevely: I think it is essential. I would be very uncomfortable if you had an agency that did not have some degree of—accountability is not exactly the way to describe it, but you have to have a group of independent people reviewing what you are doing, not quite in the same way as you would do an audit, but it is basically that kind of principle. If I have to explain something, as I am having to do for this Committee, it is a lot clearer and more straightforward, and I feel a lot more comfortable about the way in which I can rely on the ideas and what I am doing. I think that process is very, very important.

The Chair: If there are no further questions from Members, I thank the witnesses for their evidence. The Committee will meet again on Tuesday at 9.25 am to begin line-by-line consideration of the Bill.

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

5.10 pm

Adjourned till Tuesday 20 April at twenty-five minutes past Nine o'clock.

