

New Horizons

The UK's Global Science Strategy Beyond
Horizon Europe



Summary report of an Onward event

ONWARD»

About Onward

Onward is a modernising think tank whose mission is to develop bold and practical ideas to boost economic opportunity and strengthen communities in all parts of the United Kingdom.

We are not affiliated to any party but believe in a mainstream conservatism. We recognise the value of markets and support the good that government can do, and believe that a strong society is the foundation of both. We want to seize the opportunities of the future while preserving the accumulated knowledge of the past. We believe that most people are hard-working, aspirational and decent, but that many do not have the opportunities to fulfil their potential.

Our goal is to address the needs of the whole country: young as well as old; urban as well as rural; in all parts of the UK – particularly places that feel neglected or ignored in Westminster – by working with ordinary people directly and developing practical policies that work.





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Executive Summary

The UK takes huge pride in its seasoned heritage in scientific and technological excellence. From Newton's reflecting telescope, to Crick and Watsons' deciphering of the double helical structure of DNA and the Oxford/AstraZeneca Covid vaccine these innovations have changed the world. And all were British. But heritage does not translate into a guarantee against future threats. The spirit of such triumphs must be harnessed to drive the next generation of world-leading innovations.

How can this be achieved? The UK is committed to association in the Horizon Europe programme, but we cannot allow our science community to simmer in uncertainty. The strength and longevity of these critical sectors will depend on our internal ambitions, but also the success of international engagement. Seizing the opportunities of Brexit to ensure our regulatory system is modern, agile and pro-innovation is a core enabler of success. This is why a 'Plan B' is crucial.

The ingredients for the UK to become a 'science superpower' are already present: an excellent academic base, thriving science parks and long-term government support – plus the creation of the new Department for Science, Innovation and Technology. Combined with strong leadership and a forward thinking strategy, the UK will remain and improve as a global science hub, attracting and retaining global talent.

In or out of Horizon Europe, how does the UK continue to support and nurture its thriving innovation sectors? To seize this debate and to be ready if we need to move in a different direction, Onward has brought together leading experts, including Science Minister George Freeman MP, to discuss the UK's global science strategy beyond Horizon Europe.

The challenges and opportunities Britain and the world presently faces are great. We already have the pieces of a sparkling new innovation engine, but they must now be assembled so it runs smoothly and efficiently. In doing so, not only will the UK's capacity to respond to great global challenges strengthen, it will deliver on the vision to become a 'science superpower'. No one questions the need for the UK to have stronger growth and greater prosperity. The solution lies in the sectors where our past and future strengths lie.



Sebastian Payne

Director, Onward

Keynote

The UK's Global Science Strategy Beyond Horizon Europe

Good morning to all of you here and to the 500 joining online.

Thank you Seb for that kind introduction. There's been no greater champion than you Seb, and Onward, on the importance of levelling up and the role of science, technology, research and innovation in driving local and national economic renewal, which is my key theme today.

Good politics needs good think tanks and Onward is doing brilliant work to help shape the wider policy debate around this key Government agenda.

It's a particular pleasure for me to be here today after a 15-year career in venture capital, starting high growth companies and experiencing the challenges and opportunities of building world class businesses from ideas to IPO.

And a real privilege to be here now as the Minister for Science, Research and Innovation and Technology, bringing that perspective and experience into Government as the first UK Minister for Agritech, Minister for the Future of Transport and as first UK Minister for Life Sciences in the Coalition – setting out our ground-breaking Industrial Strategy for Life Science and launching the 100,000 genome programme. (That really was a “moonshot” moment: deciding to sequence the entire genome of 100,000 NHS patients to make the UK a global leader in genomics – one of the reasons we were so advanced in sequencing the genome of the COVID virus and developing the vaccine. It also helped drive billions of pounds of inward investment – last year the UK biotech sector raised £4 billion – that's a 10 times increase since 2012.)

It's that experience that I bring to this role as Minister for Science, Research, Technology and Innovation. We want to repeat that Life Science success across the other high growth sectors here in the UK: from space to AgriTech, Fusion, AI & Quantum.

People often ask me why I am so driven by this technology agenda and so focused on it for 12 years in Government?

Put simply, because our science & technology sectors are the key to so much of what this country needs: high growth sectors driving growth & spreading opportunity all around the UK, attracting huge inward investment, improving UK productivity in both private and public sector through modernisation of public

services, major global technology transfer and export opportunities and geopolitical soft power and security.

The last 15 years - from the crash of 2007, the debt crisis, the political tsunami of the Brexit referendum and subsequent gridlock, pandemic, war and global energy supply crisis - has proven beyond any reasonable doubt that we need a more resilient, sustainable, productive and innovative model of economic growth.

And science, technology and innovation is in our national DNA. From the enlightenment scientists of the 18th century through the industrial revolution to the postwar era of pioneering work on the jet engine, Concorde, the invention of the world wide web and multiple Nobel prizes in science and engineering, the UK has always been a science and technology powerhouse.

From the industrial decline of the 1970s through our time in the European Union, we've seen the acceleration of the 'servicification' of the UK economy. But the last 10-15 years have shown that we need to be investing in the industries of tomorrow - backing the science and technology that will drive the high growth sectors in our economy - the only way to get our trend economy up to two to three per cent growth: by becoming the home to the new sectors, driven by new technologies, growing at 20, 30, 50 per cent a year.

And we've got those sectors here: from AI to agritech. This is about growing them for UK economic prosperity, global geopolitical influence and economic and industrial resilience: the last year has brought into stark relief the need for resilient global industrial supply chains - from silicon chips to energy.

But science and technology is also key to our international geopolitical security because the big causes of geopolitical tension in the next decade are increasingly going to be about resources: from the challenge of feeding nine billion mouths in 2050 which means doubling world food production on the same land area with half as much water and energy in the next 25 years, to tackling the challenge of climate change, clean oceans, safe space and global biosecurity. These are the big global challenges driving global insecurity.

UK Commitment

So, what are we doing about it? Well, a lot. Over the last few years we've made a set of major reforms to the UK ecosystem:

1. Since 2010 we have made a number of significant steps in support of a modern 21st century Industrial Strategy for Science, Technology & Innovation. From the original (10 year) Life Science Strategy in 2010, the Patent Box & Northern Powerhouse under George Osborne to the Eight Great Technologies led by David Willets as then Minister for Science, to the first Industrial Strategy

under Theresa May and Sajid Javid focusing on Place, to the ‘Science Superpower’ commitment and industrial activism in the pandemic and post-Ukraine.

2. In the Integrated Review we set out a major strategic commitment to Science and Technology as key to the UK’s post-Brexit economic and national geopolitical security.
3. We have set up the National Science and Technology Council alongside the National Security Council as the key Cabinet council to take the big decisions on the agenda I’ve just set out. The National Science and Technology Council is the architecture in government to make these big decisions. It’s chaired by the Prime Minister, and contains all the major Departments with science and technology roles, along with me as Science Minister, the National Security Adviser, and National Science & Technology Adviser, my good friend and colleague Patrick Vallance. (I want to take this opportunity to pay tribute to Sir Patrick Vallance and his work as chief scientific adviser and chief technology adviser in government, where he has been a tower of strength both in the public limelight and behind the scenes.)
4. Funding. R&D Funding: we’re delivering the biggest increase in UK R&D funding for a generation: a circa 30 per cent increase over this comprehensive spending review – from £15 billion per annum to £20 billion per annum in 2024/2025: that’s £11 billion extra over three years. Last Year in the 2021 comprehensive spending review Rishi Sunak as Chancellor announced it, and in this autumn statement the Chancellor Jeremy Hunt protected it in a necessarily difficult statement in the context of then market turmoil and the global energy supply crisis and recession.
5. We’ve committed to setting up ARIA, the agency for bold, innovative, advanced research, invention and science research and discovery. It has £800 million of ring fenced funding.
6. Connecting the City of London to our science base. The Prime Minister and Chancellor are overseeing reforms in the City to the rules and regulations currently preventing UK institutional investors from investing significant funds into high growth UK science and technology companies. Although the City is one of the world’s three financial hubs, we are investing a fraction of funds under management into science and technology companies compared to the US. We are determined to harness the power of the City of London to support our science and technology base so the UK is not just a start-up incubator globally with so many of our top companies floating increasingly on Nasdaq.

7. Regulation for Innovation. We are using the opportunities of our post-Brexit regulatory freedom to set the international standards in these new and exciting sectors, from autonomous vehicles to AI to agritech and medtech. We want the UK to become the global testbed for innovations and the research testbed for enlightened regulation and to set the international standards in these new sectors.
8. Established the UKRI as a single co-ordinating science, research, technology and innovation agency to oversee the UK research investment in Universities, PSREs, and Innovate UK.

Serious commitment to science and technology needs big leadership and in Rishi Sunak we have a Prime Minister and Jeremy Hunt as Chancellor we have a team in Downing Street who have made clear how committed they are to this agenda.

R&D Funding

We know you can't do world class science on a shoestring. That's why we set out the commitment to move from our historic 1.7 per cent of GDP on R&D to reach the OECD target of 2.4 per cent of GDP. Historically the UK has been in the lower half of the OECD R&D spending table. If we want to be a global science superpower, we must invest properly. That's why Rishi Sunak made clear in the 2021 comprehensive spending review that we're increasing investment from £15 billion to £20 billion a year in the UK - as part of a serious move up the global rankings as an R&D powerhouse economy.

It's a really important signal to international investors and to our own R&D sector of our commitment. And our commitment over the last 12 years is working: the ONS has recently confirmed that the last few years have seen significant growth of our start-up ecosystem and that we are now at 2.8, 2.9 per cent of GDP.

But we're not stopping here. We will shortly announce the next stretch target.

The key to the OECD figure is that it combines public and private R&D funding. So the key now is to leverage that 50 per cent public funding increase to attract more private funding from industry and investors. Traditionally science has worked on a three to one private to public ratio: for every £ of public investment we typically unlock two or three times £ of private funding. So we are working on a business plan for how we turn this extra 50 per cent into more private funding over the next 5-10 years.

How much can we raise in life sciences, space, AI, quantum, fusion, agritech, autonomous vehicles and the other high growth sectors? We need to start to think about these sectors as business units in the UK economy and set out a compelling proposition for UK and international investors to invest in our R&D science &

infrastructure, making it easier for the wall of international finance wanting to invest in R&D to invest in companies and funds, yes, but also in clusters, infrastructure and science parks.

That's why we've set up a new unit to work on delivering that private investment. I want to pay tribute to Gerry Grimstone, who was a powerhouse of support as Minister for Investment, and his successor Dominic Johnson, for their support for this vital mission.

We want to make it very clear to investors how they can invest in UK science, research, technology and innovation: by investing in R&D sectors, in companies, in Funds but also in our R&D cluster infrastructure. As well as the Oxford-Cambridge-London "Golden Triangle" (now one of the world's three great science and technology clusters alongside Silicon Valley & the Boston Bay areas, we are also home to circa 25 fast growth clusters - from the Cornwall space cluster, to South Wales compound semiconductors, to Manchester materials, Glasgow satellites, Edinburgh supercomputing, Belfast MedTech & many more - hubs of genuinely world class science and technology around the UK which are key to both the UK innovation economy and levelling up. That's why Michael Gove and I set out in the Levelling Up White Paper a groundbreaking commitment to R&D beyond the Golden Triangle to drive levelling up.

Delivering the Innovation Nation mission needs cross Whitehall co-ordination. Whilst as Minister for Science Research Technology & Innovation at the Department of Business, Energy & Industrial Strategy I'm responsible for circa 75 per cent of the total UK R&D figure, other key departments have significant R&D budgets and roles and drive this mission too: MoD, DHSC, DEFRA and others have substantial R&D budgets so I've set up an informal, inter-ministerial group so key R&D Ministers and their chief scientists can work on joined-up Whitehall delivery in support of the National Science and Technology Council.

Let me turn to the UK's international R&D investment: in Europe and then the rest of the world.

UK International R&D

European programmes

The big three European programmes are Horizon, Copernicus and Euratom. We were clear in our Brexit Agreement that we never wanted to leave those programs and negotiated and agreed to stay in them. We still don't want to leave and are pushing for that association to be formalised.

Copernicus is the Earth Observation program. We've committed to £400 million in Earth observation, £300 million of which is via our £1.75 billion investment in European Space Agency programmes.

On Euratom, we've been delighted since Mrs Thatcher as Prime Minister negotiated successfully in the early 80s, to host the Joint European Torus (JET) at Culham which this year sets out those spectacular results alongside the Livermore Lab in the US. With commercial fusion energy now within reach, we are determined to lead in deploying that at an industrial scale and we are now working actively with the UKAEA to invest and support the industrialisation of fusion.

Horizon

But Horizon is the big one. It's the world's biggest research club in which over 30 countries pool circa £100 billion for collaborative research. The UK has been one of the top two or three players for years, with our universities and our institutes leading many of the research programmes. That's why we're committed to pushing to complete our negotiated Association. We continue to do so.

Horizon has three pillars:

1. **The talent pillar**, which is completely key to the UK with a very high proportion of the top European Research Council professors and MSRC fellows. They are senior people anchoring key labs across the UK. We want to ensure that they're able to remain here through European Research Council membership or through our support in the same way.
2. **The global industry pillar**. We don't do so well on the industry pillar. But there are some important projects for companies like Rolls-Royce and a lot of university and SME projects.
3. **The innovation pillar**. You might expect us to be a big beneficiary on the Innovation pillar. Strangely we're not. That seems to be because of the way that Pillar is structured as an academic application process not well suited to UK start-ups and SMEs.

Beyond Europe

Beyond Europe, we have also invested heavily in R&D over the last four years through the Newton Fund and the Global Challenges Research Fund (GCRF). I've also just announced on my visit to Japan the first tranche of the International Science Partnership Fund.

So in this three year comprehensive spending review, we are committed to invest circa £45 billion on UK science and research, circa £7 billion earmarked for

European Programmes and circa £0.5 billion for global science and research (beyond Horizon Europe). That's the picture today.

The Mission

Let me set out the mission we are pursuing going forward: 'Science Superpower' and 'Innovation Nation' and explain why I've set the mission out in that way.

It's because being a science "superpower" is different from being an academic powerhouse. And requires us to do a number of things differently - in particular recognise that you can't be a global science superpower if we aren't also an innovation nation: with innovation much more central to our domestic economy - and our public services.

As I set out in my speech in Tokyo, being a science superpower means a few key things.

1. **Basic science:** continuing to lead the key academic blue-sky discovery that is the pillar on which everything is built.
2. **Global impact:** ensuring that we're using our science leadership to help tackle the great global challenges from climate change to biosecurity.
3. **Global talent:** science is an increasingly international and collaborative venture. We need to ensure the best scientists here in the UK can go international and the best international scientists can come here.
4. **Industrial R&D:** if we're going to be a powerhouse in this global innovative economy, we have to attract more international R&D investment.
5. **Values & Rules:** you can't do science behind a closed wall and without a commitment to international collaboration, free speech, free thinking, open data, sharing and peer review. In a global race for science and technology leadership we have to be prepared to stand behind the values underpinning open science, which underpin free speech, free societies and liberal democracies. Research integrity and security is a key part of national security.
6. **Geopolitical soft power:** harnessing demonstrable UK commitment to all of the above for heightened geopolitical soft power and influence.

UK science soft power

Our science soft power is formidable. Around the world the UK is regarded as a global leader in science, research, technology and innovation through our longstanding leadership in global science - both in research and multi/lateral partnerships: from the polar regions to space, tropical medicine, genomics and agritech.

Through the UK Science and Innovation network we fund 120 science, research, technology and innovation staff embedded in our embassies around the world working to deepen collaborations, attract investment and grow that geopolitical footprint.

Through the G7 science summit, the G20, the Eureka and the Northern European Ministerial forum, I'm making clear that the UK is, and intends to deepen our commitment to being, a global force through Europe and beyond.

We're looking at a whole range of opportunities to deepen our role. There are a number of areas from biosecurity to post-pandemic resilience to polar research to clean space to agritech where the UK is widely regarded as a leader, with the capability to convene global collaborations. We're looking at how to do that more actively in the coming months and years.

To be a science superpower we also need deeper bilats with the key R&D economies around the world. That's why, in the last 15 months, as part of my work to deepen our bilateral collaborations with the big R&D countries, I've been around the world to Israel, Switzerland and Japan to negotiate science and technology collaborations. Each is based on three pillars: 1) deep science, 2) commercial collaboration, 3) government public policy collaboration.

Innovation Nation

I have made 'Innovation Nation' the second pillar of this mission because we can't be a science superpower if we're not also an innovation nation.

That isn't just a sound bite. I have defined it clearly as meaning a specific set of actions & reforms: building on our great academic and research strengths in our universities and PSREs, through technology transfer and spin-outs and start-ups (where the UK has seen a quiet revolution over the last 15 years) but also the key next bit of scaling our high growth start/ups and growing global scale science and technology companies here in the UK: by better using our catapult network to attract bigger and deeper industrial R&D, using our Regulatory and Procurement freedoms to use the power of HMG and UK plc to nurture UK technology and innovation and unlocking the power of the City to finance them so they float and stay here in the UK, instead of the Nasdaq.

We must also use the post-Brexit freedoms to drive enlightened procurement. We've made the commitment to be much more strategic about supporting key science research and technology. The Department of Health is doing it through life sciences with our recent major procurement deals of mRNA and vaccine technology through BioNTech and Pfizer, and the funding of One Web (with our golden shareholding securing satellite manufacturing and launch rights in the UK) but we can do it in other areas. For many emerging start-ups and scale-ups, the validating value of a first procurement by HMG in the UK is far more valuable than a grant (especially if secured through a long slow & time consuming application process).

Regulatory Freedom Dividend

There is also a huge opportunity in our post-Brexit regulatory freedoms. Whether you voted for them or not - we do have a chance to use our regulatory freedom to set the new agile, digital responsive regulatory frameworks for these new technologies.

From AI to Automated Vehicles, investors - and consumers - need confidence that there's a regulatory pathway for innovation to be properly tested, validated and approved as safe. The pace of technological innovation is creating an opportunity for the UK to be a global test bed of innovation - linked to our well-established reputation as a global regulator of choice and leader in international standards. Companies can come here to get your innovation proven to work in the UK with the validation "Proven to work in the UK". With the data package with which to then secure approval in other countries. That's a strategic opportunity for the UK.

We need to rethink the role of regulation from being a preventative barrier to innovation to being a key part of our innovation ecosystem. Regulation done properly is a hugely valuable part of our innovation ecosystem. History shows how important setting the international standards can be for securing global influence. In the recent Task Force on Innovation, Growth and Regulatory Reform that myself and Iain Duncan Smith and Theresa Villiers put together we set out how the UK can grasp this opportunity. We can learn from the MHRA experience in the pandemic and be leaders in the economy of tomorrow and change the way we think about regulation.

And it's why HMG is backing the Regulatory Pioneers Fund and supporting those test beds all around the UK. Some of our clusters are becoming globally recognised as test beds: like the Northamptonshire F1 and Autonomous Vehicle corridor and the South Coast Marine technology corridor which is becoming the place to test your underwater drones, autonomous submarines and port technology.

Clusters

Nurturing our clusters is a key part of being an “innovation nation”.

In the “golden triangle” of Cambridge, Oxford and London we are home to one of the world’s top three global hubs of science and technology. But to grow our innovation economy - to balance the R with more D, to build an Innovation Economy - we have to nurture the other established and emerging clusters around the UK: from agritech in Norfolk to the space cluster down in Newquay to compound semiconductors in South Wales, robotics in Warwick, marine technology on the south coast, satellite technology in Glasgow, the bioeconomy in York, advanced manufacturing in Sheffield and much more.

We know they’re there. People in them can see and feel what’s happening. But we haven’t had a coordinated approach in Government to support them strategically. So we’re setting up a new unit to oversee this. We’re integrating our various tracking research cluster data. We’re working on a new integrated tool for digital tracking of these clusters, both as a policy tool but also as a tool for local leaders.

We’re mapping them. Some are very mature; some are just taking shape. By better mapping, monitoring, empowering and championing the clusters we want everyone in this country to benefit from the extraordinary opportunities this sector is creating.

What do I mean by “clusters”? There have been whole libraries filled on the science of defining clusters. But I use a very simple definition which is rooted in my experience of working around UK R&D clusters for 30 years:

I mean Clusters as “places in which people take risks in pursuit of opportunities”. Or as one of Cambridge’s leading medtech angels Dr. Andy Richards CBE, founder of Vectura, puts it: “a cluster is a low-risk place to move your family to pursue a career in a high-risk sector”.

It isn’t a high risk to move your family to Cambridge. If your company doesn’t work, there’ll be hundreds of others. Thousands, actually.

Clusters are made primarily by the mix of people in that area and their infrastructure, culture, education, environment and landscape.

If we’re going to attract the best people from around the world, we must ensure our clusters are attractive places for people to come and live. We are looking at what holds a cluster back. Is it skills? Is it a lack of opportunity? Is it a lack of public funding? Is it infrastructure? By being clearer about what’s holding each cluster back, we can support those clusters to attract the private funding I talked about earlier.

I want to pay tribute to Michael Gove, who's been a huge supporter of this agenda. We're seeing a quiet revolution in long-term funding - of both infrastructure and R&D, through the emergence of big long-term funds like Legal and General, now deploying substantial funds to R&D infrastructure which is much bigger than anything we've seen hitherto. And the big science and technology innovation funds like Northern Gritstone, Cambridge Innovation Capital, IP Group, Imperial Ventures and Oxford Science Investments, now investing significant long term venture growth capital into high growth UK science and technology companies.

Horizon and Beyond

Let me come back to Horizon. We remain committed to pushing for association. The Prime Minister is overseeing hugely improved relations with leaders and member states across Europe, following the pandemic, the appalling scenes of war in Ukraine and the consequent energy crisis and heightened geopolitical tensions threatening some key industrial supply chains.

Across Europe, every scientist and minister I meet says "we really want the UK in Horizon". But our association is still sadly caught up in the high politics of the bigger post-Brexit relationship and Northern Ireland Protocol negotiations.

That's why whilst we have continued to push for our association we have moved in this last year to make sure that the UK research sector is properly supported via:

- The funding guarantee I set out for the "in-flight" projects (ie. that would have had Horizon funding under association) which I have recently renewed;
- The Prime Minister's commitment made a year ago that the money we would have been receiving via Horizon is ring-fenced for R&D;
- The £480 million Horizon relief package of funding set out in December by the Chancellor, for the UK universities that are most seriously affected;
- The first £119 million tranche of the International Science Partnership Fund I set before Christmas in my speech & announcement in Tokyo.

We are still pushing for association. But let me be very clear. We cannot allow UK research to be benched. The world needs UK R&D and we need global collaborations. If we can't play in the European Cup of science, then we simply have to go and deploy that UK research funding and leadership in the World Cup of science.

That's why I have been working this last year with the research sector on an alternative "Plan B" programme. We haven't yet finalised that package which is still to be approved by the Prime Minister and Chancellor, but I want to outline my thinking.

Firstly, talent. We need to make sure we are supporting world class prestigious Flagship Fellowships to retain those top European Research Council and other Professors and a bolder offer for early career, mid-career and late-stage career pathways.

Secondly, innovation, industrial challenges & technology. We're looking at how we can deploy the Horizon Pillar 2 and 3 funding on innovation, industrial challenges, technology missions in a more dynamic, agile and catalytic way that supports the National Science and Technology Council priorities and the deployment of UK technology more strategically to attract major international industrial co-investments.

Thirdly, global collaborations: a big global pillar looking at deepening those bilateral relationships with key R&D economies and looking at opportunities for global collaboration, and the “mini-lateral” projects around urgent challenges.

Fourthly, infrastructure: great science needs great infrastructure resources and facilities. Our PSRE and University campuses need public investment in infrastructure.

We are listening and working with the sector to define this package. You'll be hearing in the coming weeks and months a much clearer picture of how we intend to deploy this funding if we can't secure association.

The Opportunity: a new era of prosperity and global soft power for the UK through science and technology

If we grip this properly we have the opportunity to make the UK - again - a global powerhouse of science and technology, discovering, developing, testing, commercialising, scaling and exporting world class R&D for global good, attracting billions of inward investment and building a more sustainable, resilient, productive economy: that is how we break the cycle of boom and bust because the new economies of tomorrow are growing sustainably.

That's how we'll generate the money to fund twenty first century modernised public services, and a more innovative state.

It's how we can create that private, long-term sustainable funding flow to drive regional economic prosperity giving people around this country the chance to participate in the most exciting businesses, sectors and technologies of tomorrow.

And, perhaps most importantly of all, I believe it's the way we give a new generation of young Brits the hope they need that both their and this great country's best days are not behind but ahead of us: in a United Kingdom renewed

by both a new era of long term sustainable economic growth based on this country as a force for good in the world.

By answering that old challenge from US Secretary of State Dean Acheson when he said that Britain had “lost an empire and yet to find a new role”.

I believe that the ‘Science Superpower’ and ‘Innovation Nation’ mission is that role: by better harnessing our deep science, engineering and technology expertise to tackle the urgent global grand challenges we all face; and in doing so attract billions of pounds of inward investment to R&D, kickstart a new golden era in the city, and unlock a sustainable cycle of long term growth and economic resilience and productivity creating opportunities all around the UK for the many people and places who have watched the pace of globalisation and technological innovation unsure if it was a force for good for them.

Great Britain renewed through a return to our historic leadership in science, technology, engineering and innovation in a global race for the science and technology solutions the globe so desperately needs is not only a major economic opportunity but an inspiring mission for the next generation: whose prospects, optimism and ambition we all ultimately rely on.

We have a once-in-generation historic opportunity. Let’s seize it.



George Freeman MP

Minister of State for Science, Research and Innovation

Panel Contributions

"We need to think harder about how we work together to solve big problems."

It is not optional for the UK to become a 'science superpower'. The truth is, if we do not become a superpower, the nation as a whole will suffer. As it is probably the only way to generate the levels of productivity and economic growth to remain a leading country in the world.

In life sciences for example, we already hold a strong position globally. Thanks to a number of really successful, big companies. A cluster of emerging and developing SMEs, particularly in the areas of cancer and digital. And, a strong academic base, with some of the best universities in the medical research arena here in the UK. We also boast of a strong charity cluster.

But the reality is that this is a dynamic space, and we have a rather classical approach to science in this country. It is largely in the academic setting. Largely based on peer review response mode funding. And while that is crucially important, and has been the fundamentals of how we build our science base, it has now become clear that other forms of science funding are crucial if we are going to be able to advance these fields quickly.

One of those forms is mission based funding. It is not about getting a grant, doing some research or writing a paper. It is about trying to head towards a result, one which makes a difference in a specific field. So it is actually directionally based. An approach often adopted in industry. In contrast to the academic space, most industries are very mission based.

This has become apparent since publishing the Life Sciences Vision and strategy.¹ The strategy consists of a set of missions, and it has been interesting to monitor the confusion caused by the concept of adopting interdisciplinary collaboration to solve big problems. This is therefore a domain that we need to develop. There is already enough 'response-mode' funding out there.

To propose an alternative, we need to think harder about how we work together to solve big problems. For example, we are currently trying to solve the problem of how do you diagnose cancer early, so that you treat people early, so you get more successful survival data? There are technologies to do that. But that has required a big effort from academics, industry all working together to try and solve that problem with new bits of technology.

Similarly, Genomics England's 100,000 Genomes Project,² was another successful mission driven project. More recently, the Government has signed a series of deals aiming to develop cancer vaccines,³ again mission driven. It is not exploratory science. It is not 'response-mode' funding. It is "we need to see whether you can stimulate an immune response to people's personalised cancers to be able to give them a response". So going forward, whether in or out of Horizon, a question that must be answered is: how do we better incentivise and fund mission based research to lie alongside 'response-mode' research?



Professor Sir John Bell

Regius Professor of Medicine at Oxford University

"The UK needs to be a science and technology superpower"

The challenges facing the world are ever-growing. The UK has seven years to contribute to keeping the global average temperature rise to below 1.5 degrees. And that must be achieved in a post-pandemic world, with increasing geopolitical tensions, with an education system that is not fit for an AI age, and with an NHS and social care system which is under huge strain. In addition, we need to narrow the gap between the experience of the richest and poorest in ensuring the economy prospers.

How do we do all of that? The UK needs to be a science and technology superpower. So whether in or out of Horizon Europe, the challenge remains the same. These are huge global problems, and opportunities, and we cannot solve or capture them alone. So increased collaboration with Europe and the rest of the world is crucial, regardless.

What needs to be done? First, the continued commitment to science and AI is welcomed. AI permeates across the whole of science and in the tech landscape, and supports the UK to be a thriving example of what makes a 'science superpower'. The challenge now is maintaining this and also ensuring we become an 'innovation nation' which benefits from the hugely talented research base in this country. The national AI Strategy does go some way to highlighting how this can be achieved.⁴ So hopefully it is useful, maybe even as a blueprint to address the three pillars.

The first addresses the fundamental long term requirements, including infrastructure, compute, talent, and data. Presently there is a race for a UK foundational AI model, for example, which would serve to galvanise and speed up activity in the listed areas. The third pillar in the strategy is focused on regulation, ensuring the UK gets the governance of the AI right.

The second pillar focuses on adoption. The key here is *how* we encourage the diffusion of AI across the economy. We cannot just be at a place of invention. We need to increase the deployment of the innovations in the real world use cases. And in doing so, we need to think about small business, medium business, large business, all becoming 'innovation nations' within themselves, leveraging this new technology and increasing productivity, reducing cost and delighting customers. And we need collaboration between government and the tech sector in order to upskill and retrain and make innovation like this less daunting, both locally and nationally.

While the responsibility and power of the Golden Triangle is palpable, there is a big area of the 'science superpower' narrative that is often overlooked. And that is

for the UK to be *the* place where the benefits from science and innovation are better distributed and truly felt by the general public. We need to continue to renew our social licence to operate while we think about *how* to build a ‘science superpower’.

To be a ‘science superpower’, that benefits the people, requires different choices and a different distribution of power. We need to design processes around the strength and fragilities of humans. With ways for them to voice their problems, propose solutions, and claim a share of the productivity gains embedded. So it should be proposed that every time we think of ‘innovation nation’, what if we think about innovation *for* the nation? Because maybe that could go some way to addressing the existing widening inequalities and build a brighter future for the many not the few.



Tabitha Goldstaub

Executive Director of Innovate Cambridge; Chair of the Government’s AI Council

"We need to identify which niches we could exploit."

The institutions of science have not kept pace with the changes in how science and technology has been operating over the last 30 years. We need to create new kinds of institutions and funding approaches adapted to this, and that are particularly attractive to global junior talent.

Three major things which come to mind when thinking about the next decade in UK science and technology in the context of our global position and Horizon Europe.

First is the need to benchmark the UK against the very best science and technology ecosystems in the world, both in terms of investment and performance. The UK has had decades of underinvestment in science and technology. We still are under investing. We shouldn't kid ourselves into thinking this hasn't had negative consequences, or be satisfied with being near the top of the group in Europe. Places like the Bay Area and Boston for example are significantly ahead in cutting edge areas like synthetic biology, AI, and quantum. Europe is lagging behind, including the United Kingdom. There are major first mover advantages in science and technology, from talent attraction to patents. Being at the cutting edge matters.

Second is the dramatic change, over the last two decades, in how science and technology works. Science now is much more interdisciplinary, much more multimodal. Any given paper in synthetic biology from the Broad Institute could have: molecular biology advances, synthetic biology advances, robotics advances, material science advances, artificial intelligence advances, all being brought to bear on a problem. That approach to science is challenging to adopt in a conventional academic department, on conventional academic grants. Yet there has not been a cultural shift in science towards a team based approach, or to the close integration of discovery science and engineering. It is often no longer possible for an individual researcher to fully know how to do every technique in a paper or product , there are simply too many skills required. The institutions supporting scientific research have not adjusted to this.

Third, from a strategic perspective we need to think not only about what we are weak at, but what other countries are weak at. We need to identify which niches we could exploit. For example, the terrible situation for junior scientists globally. There is an enormous pool of talented people around the world for whom the existing scientific structures do not work. Nowadays, at the age when the likes of Marie Curie, Lovelace, Francis Crick, Newton, and Einstein were doing their best work; young researchers are working in someone else's lab on short term contracts, often doing work for people who may not have touched a test tube

themselves in 20 years. While this was an eccentric view five years ago, we are now seeing the increasing despondency amongst junior scientists recognised in major journals like *Nature*. These junior researchers are an amazing resource. We should be creating institutions to attract them, offering an alternative to their current servitude

So what does this look like in terms of what we should be investing in?

Alongside the Advanced Research and Invention Agency (ARIA),⁵ we should create a network of what Rob Miller and Eoin O'Sullivan call the creation of 'Disruptive Innovation Labs',⁶ which is similar to ideas proposed by Number 10. These would be environments at the intersection between science and engineering. For example, you might have an organisation focusing on understanding and healing the brain-body connection through new technology, or in a particular area of synthetic biology, not structured like an academic department, but structured more like an organisation such as DeepMind, bringing together a diverse set of skills to work on a common broad vision or mission.⁷

There's a tremendous amount of attention on what Google DeepMind is doing and the transformative impact it is having. Yet there is almost no attention paid to the fact that DeepMind is organised very differently to conventional academic departments, or to most of the organisations which are funded through public R&D. And likewise, if we go back to the origins of molecular biology, of telecommunications, of personal computing, organisations like the early LMB, like Xerox PARC, like Bell Labs can be found, which looked very different to conventional academia and are much more oriented to bringing together discovery science, invention and application under one roof.

If we made institutions centred on those principles, they would be a major pull for global talent and get us back to the front of the technological race.



James Phillips

Former Special Advisor to the Prime Minister for Science and Technology;
Honorary Senior Research Fellow in Science and Technology Policy, UCL

"If innovation is to serve society, we must communicate the benefits of it better."

The rest of the world is a bit obsessed with Silicon Valley. While there is a lot to learn from Silicon Valley, what we actually need to think about is what can we do better? Where can we take the best of the valley and then actually do things slightly differently? There are things that those tech ecosystems have not done well in the past, and areas like inclusivity are prime examples. The challenge is taking what they've already done, and doing it better.

Looking beyond that. One of the things that Silicon Valley has done very well is the funding landscape. The UK needs to bring the City of London much closer to the innovation ecosystem. It is a source of intense frustration that the pension funds supporting UK innovation are not the powerhouses of the City. Rather, they come from the US, Canada and elsewhere. We need to change that because the science that we want to be commercialised and scaled requires patient capital. Presently we do not have enough of that patient capital in the UK.

Interdisciplinarity is an area no one and nowhere have yet to get right. The best new breakthroughs of science are no longer just going to be created from someone with a specific sectoral expertise. To make something successful will require varying perspectives coming together. And that is something that the UK could and should hone in on. Interdisciplinarity should not be confined to academia. It must be linked to business. There is still a cultural barrier between business and academia, and it needs to be much more of a seamless interchange. Allowing people to develop skills that will apply in both sectors throughout their career.

Talent and people must be at the core of future plans, strategies and missions. Whether with Horizon or through Plan B. The UK has incredible talent but will need more to stay at the forefront of innovation. The challenge lies in not only retaining existing talent, but also being a magnet for talented individuals from around the globe. Talent is key to the future.

The biggest problems faced globally are actually problems where science can provide the solution. This is not confined to conventional scientific fields. Science is and will be the solution to many of the problems faced by society in the days, months and years ahead. The solutions will only be found, however, if we adopt an inclusive approach to enable everyone to contribute their ideas and be part of the solution.

Lastly, if innovation is to serve society, we must communicate the benefits of it better. Only when we communicate the opportunity innovation presents can we reap the benefits for people across the whole of the UK, but indeed to people across the whole world.



Priya Guha

Venture Partner, Merian Venture; Non-Executive Director, UK Research & Innovation

"To be an 'innovation nation'... we need innovation cities and innovation regions all across the UK"

What are we talking about, when we talk about being a “Science Superpower”? This is part of that broader question of how the UK finds its place in the world.

The UK represents a little less than three per cent of the world’s high tech economy. It is not the USA, it is not China. But it does have a real potential competitive advantage in the strength of its science base – it is genuinely outperforming, at least (and this qualification is important) when it is judged on purely academic metrics.

The challenge – the “Innovation Nation” mission – is applying that science strength to the critical issues the UK – and the world – faces. These challenges include:

- The UK’s more than a decade long stagnation in productivity growth;
- The wrenching economic transition we face to achieve a net zero energy economy;
- Ensuring good health outcomes for our citizens;
- National security in an increasingly dangerous world.

To begin with productivity, it cannot be stressed too much how the stagnation of productivity growth after 2008 underlies pretty much all the difficulties the country faces – stagnant wages, the persistent fiscal deficit, the difficulties we are seeing in funding public services to the standard people expect.

To get economic growth back we need to be accelerating progress in high tech sectors. But there is a paradox here – the economist Diane Coyle from the Productivity Institute⁸ has analysed the productivity slowdown, and finds the biggest contributors to the slowdown are precisely those high-tech sectors that we think should be our strength.

In Pharmaceuticals, productivity growth was 0.6 per cent a year on average between 1998 and 2008. But between 2009-2019 pharma industry productivity actually fell, by 0.2 per cent a year on average.

So, we need to do things differently.

Money is important, and the Government’s spending uplift is real, significant in scale, and to be welcomed. ARIA is welcomed as a chance to try and experiment with different funding mechanisms. But from the perspective of Oldham, for

example, the biggest and most welcome change is the new focus on place and clusters across the UK.

The UK is two nations – a high performing Northern European economy in the Greater Southeast. And beyond, in the North, The Midlands, Wales – we have places with economies comparable to southern Italy or Portugal. Our big cities – like Birmingham, Greater Manchester and Glasgow – have productivity below the UK average. This is not normal – in most developed countries, it is the big cities that drive the national economy. Why can Manchester not be more like Munich, a similar size city, that is one of Germany's innovation hubs? If it was, it would generate about £40 billion a year more value for the UK.

This is a huge waste of potential. We need to identify nascent clusters, and work with those places to build up their innovation capacity, build industrial R&D, attract outside investment, and give people in places like Oldham the opportunity to take part in this high tech economy.

But money is not everything. For example, we do health research to support the health of our citizens as well as to create economic value. The Oxford vaccine was a brilliant example of this.

But even pre-pandemic, a man born in Oldham 2016-2018 could expect to live in good health for 58 years. For a man in Oxfordshire, healthy life expectancy was 68.3 years.⁹

Ten lost years for Oldhamites! The human cost of those years of ill-health and premature death is huge. But so is the economic cost – this ill-health is a major contributor to the productivity gap in Oldham and places like it, all across the UK. That's something R&D should do something about – this truly would be “innovation for the nation”.

We have to do things differently. We need to apply our science to address the big strategic problems the UK faces, and we need that to be an effort that the whole nation takes part in – and benefits from. None of this should take away from the power of great research centres like Cambridge and Oxford – that really is a supercluster, a massive asset for the nation.

The question is, how can we build on that and spread the benefits across the rest of the country? There are plenty of great spin-outs from Cambridge and Oxford. We need them to scale-up in the UK, and not feel they have to move to Germany, or California, to succeed. So why should their first factory not be in Rochdale or Rotherham, or Dudley or Stoke-on-Trent?

So yes, we must aspire to be an ‘innovation nation’, but to build that, we need innovation cities and innovation regions all across the UK.



Professor Richard Jones

Chair of Materials Physics and Innovation Policy; Vice-President of Regional Innovation and Civic Engagement at Manchester University

"Technologies and missions cannot be conflated... we need both"

The UK boasts about its top universities, four of which are in the top ten globally. But this only serves to reinforce a system of assessing research excellence solely focussed on getting articles by Nobel Prize winners in prestigious journals. Therefore, focusing on this first, we must look beyond this one narrow definition. The more we focus solely on one particular form of excellence however, the problem is worsened, not rectified.

A second focus would be on missions. Trying to accurately predict which application or technology is going to be most useful in the future is incredibly high-risk. Problems thus emerge if there is a focus on missions, and no investment in general purpose technologies. Technologies and missions cannot be conflated. Otherwise crucial funding may be lost or redirected. It must be remembered that general purpose technology is often the most disruptive. It cannot be forgotten that successful missions depend on prior investment in general purpose technologies. When President Kennedy announced the moonshot, there had already been at least five years of American funding of rocket technologies. That is what made the mission possible, the complementarity of missions and technologies. Success needs both.

Third, there is the great question of whether the UK continues to associate with Horizon and what a potential Plan B may include. There is a percentage of interested stakeholders who would argue the best alternative is to redirect the funding that would otherwise have gone into Horizon, on refining and improving our research and innovation ecosystem. And that could be how Plan B funding is utilised. Interestingly however, the wider academic community has not yet bought into that proposal.

Support for Horizon still, rightfully, permeates beyond academia across the UK and Whitehall. And why is that? Is it just because they have not yet gone through the full five stages of grief and accepted Brexit and now have not jumped up to invest in Plan B? It is not easy to judge.

There are features of Horizon Europe which explain its appeal to the academic and research community. These must be taken into account when mapping out and developing any and all alternatives. These include, firstly long term patient funding. One of the great advantages of these international treaty organisations, be it European Organisation for Nuclear Research (CERN) or Horizon Europe, is a commitment and a funding programme that goes beyond the periods of a conventional comprehensive spending review (CSR). A lot of weight is attached to that.

Paradoxically, one of the benefits of joining a science-centric international treaty organisation is that, to some extent, it offers a wider, more patient long term funding framework than otherwise available domestically. It is also beneficial not to be the only one marking your homework. It becomes a more competitive environment. Other researchers pitching for funding, and having to compare your research with that of others, who are international, first rate competitors, often accelerates innovation. Competition is thus a crucial component of the benefit of international partnerships.

Ultimately, while these are all crucial considerations, if the UK is not to be a contributor to Horizon, we will only know if the UK is a ‘science superpower’ if we are still winning in tough international competitions.



The Rt Hon. Lord David Willetts

Former Minister for Universities and Science

Biographies

Professor Sir John Bell

Professor Sir John Bell is Regius Professor of Medicine at Oxford University. He has been extensively involved in the development of research programmes in genetics and genomics and in the development of a clinical research programme across the UK. Professor Bell was the Founder of the Wellcome Trust Centre for Human Genetics and has led the significant expansion in biomedical research activities in the Clinical School in Oxford since 1992.

Tabitha Goldstaub

Tabitha Goldstaub is the Executive Director of Innovate Cambridge, which aims to initiate an inclusive, ambitious, and broad-ranging innovation vision for the Greater Cambridge area. She is Chair of the Government's AI Council, a member of the DCMS Digital Economy Council and on the TechUK board. Tabitha is the author of *How To Talk To Robots – A Girls guide to a World Dominated by AI*, and an advisor to The Stack, TeensInAI, Raspberry Pi, Tortoise Media and The Alan Turing Institute.

Priya Guha

Priya is a Venture Partner at Merian Ventures, investing in women-led innovation, she is also an advisor to Kheiron Medical Technologies (a UK start up using deep learning to transform cancer diagnostics), a Non-Executive Director at UK Research and Innovation and a Member of the Innovate UK council.

She was previously General Manager for RocketSpace, launching their UK operations. Priya used to be a career diplomat, most recently as British Consul General to San Francisco and previously in India and Spain. She also Chairs the Board of Trustees of Modern Muse and is an advisor to The Youth Group. Priya was awarded an MBE in 2021 for services to international trade and women in innovation.

Professor Richard Jones

Richard is Chair of Materials Physics and Innovation Policy, and Vice-President of Regional Innovation and Civic Engagement at Manchester University.

He is part of the University of Manchester's Faculty of Science and Engineering. In 2006, he was elected a Fellow of the Royal Society and in 2009 he won the Tabor Medal of the UK's Institute of Physics for his contributions to nanoscience.

He was Pro-Vice-Chancellor for Research and Innovation at Sheffield from 2009 to 2016 and chaired Research England's Technical Advisory Group for the Knowledge Exchange Framework.

James Phillips

James Phillips was a Special Adviser to the Prime Minister and Secretary of State for Science and Technology from April 2020 to September 2022. He is an Honorary Senior Research Fellow in Science and Technology Policy at UCL, and holds a PhD in Neuroscience from the University of Cambridge.

The Rt Hon. Lord David Willetts

Lord Willetts FRS is President of the Resolution Foundation and former Minister for Universities and Science. He was MP for Havant from 1992–2015. Before becoming an MP, he worked in HM Treasury and the Number 10 Policy Unit and was Director of the Centre for Policy Studies.

Lord Willetts has taken on a number of research-linked commitments. He is Chair of the Foundation for Science and Technology, Chair of the Sanger Institute, Chancellor of the University of Leicester, and a Visiting Professor at King's College, London.

Endnotes

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