



R&D and collab in Africa

Shared vision and leadership is key to
growth and prosperity

Greener housing

Why people are the key to
decarbonising our cities

Dame Ottoline Leyser Q&A

In an evening of conversation

Exascale computing

Pushing the boundaries of
large-scale computing in the UK

PLUS:

Guest editorial: Science for Climate Action, by Jim Skea of the IPCC

Foundation Future Leaders: Nuclear fusion and the UK's clean energy future

The Foundation for Science and Technology is a registered charity established in 1977. Its role is to facilitate debate between parliament, Whitehall Departments, the Devolved Administrations and the business and research communities on policy issues that have a science, engineering or medical element.

The Foundation holds regular discussion events and policy roundtables, debating issues such as AI, Net Zero, STEM skills, fusion, quantum technologies, and equity and diversity in the STEM workforce, among many others. It explores both how science, innovation and technology feed into all policy areas (such as transport, environment and energy), and the policy for funding and delivering science and innovation in the UK. All discussion events are free and open to all, with recordings available on our website.

The Foundation runs the Foundation Future Leaders programme, which each year brings together a cohort of around 35 mid-career professionals drawn equally from the research community, industry, and the civil service and wider public sector. Over a 12-month period, the group meet and discuss with senior figures from government, parliament, universities, large industry, SMEs, research charities and others. Just as importantly, Future Leaders present their own expertise, develop skills and make future contacts. The programme includes external visits and the development of an annual conference.

The Foundation for Science and Technology runs a regular podcast, publishes blogs, and produces this Journal. In addition, it provides advice on governance and operational matters to Learned and Professional Societies.

The Foundation is strictly neutral and does not express an opinion on any policy question.

Information about supporting the work of the Foundation can be found at www.foundation.org.uk/About/Support-Us

CHAIR

The Rt Hon the Lord Willetts FRS

TRUSTEE BOARD

John Neilson, Honorary Treasurer
The Rt Hon Professor The Lord Kakkar
PC FMedSci
Professor Sarah Main
Dr Horia Maier
Dr Dame Julie Maxton
Jonathan Neale FIET FIOD CEng
The Viscount Stansgate
Daniel Shah
The Rt Hon the Lord Willetts FRS

CHIEF EXECUTIVE

Gavin Costigan

VICE PRESIDENT

Dr Dougal Goodman OBE FREng

The Foundation for Science and Technology

22 Greencoat Place
London SW1P 1DX

Tel: 020 7321 2220

Email: office@foundation.org.uk

Editor Gavin Costigan

Editorial Charlotte Raynsford

Layout Simon Clarke

FST Journal publishes summaries of all the talks given at its meetings. Full audio recordings are available at www.foundation.org.uk/events

Neither the Foundation nor the Editor is responsible for the opinions of the contributors to *FST Journal*.

©2025 The Foundation for Science and Technology ISSN 1475-1704

A Charitable Incorporated Organisation registered with the Charity Commission of England and Wales, number 274727.

This Journal is also available in electronic format at www.foundation.org.uk/journal (ISSN 2756-0619)





Volume 24 Number 2 December 2025

FOUNDATION NEWS

- Life Sciences: what will the new UK sector plan hold? • Future Leaders: opportunities and challenges in science and technology • Foundation Chief Executive moves on 2
- DiveIn Centre partnership supports diverse, mission-driven research 8

GUEST EDITORIAL

- Science for Climate Action **Jim Skea, International Panel on Climate Change** 3

R&D COLLABORATION IN AFRICA

- How to harness Africa's potential through R&D 5

FOUNDATION FUTURE LEADERS

- Shaping the EPSRC's clean energy strategy **Ruqaiyah Patel** 9
- Architecting Trust: governance in fusion Energy **Phill Mulvana** 11

DECARBONISING THE BUILT ENVIRONMENT

- Why people are the key to greener housing 14

IN CONVERSATION WITH DAME OTTOLINE LEYSER

- An exploration of UK science and technology 18

LEARNED AND PROFESSIONAL SOCIETIES

- Advising on good governance, Royal Charters, AI and more 25

EXASCALE COMPUTERS

- How can we push the boundaries of exascale computing in the UK? 27

IN THIS YEAR... 2015

- The business of the environment 30

EVENTS

- Foundation events: recent and upcoming 31

LINKS

The online version of the Journal is available by scanning this QR code and includes links to featured research and reports.



DOI: 10.53289/QXN04237

Life Sciences: what will the new UK sector plan hold?

On Wednesday 12th November, the Foundation for Science and Technology joined forces with ARC | Advanced Research Clusters to deliver a discussion evening exploring Life Sciences.

In July 2025, the Government published the Life Sciences Sector Plan which aims to drive both economic growth and health innovation in the NHS.

Our expert panel included Steve Bates OBE, Executive Chair at the Office for



Life Sciences; Baroness (Nicola) Blackwood, Chair of Genomics England; Tony

Wood, Chief Scientific Officer at GSK; and Professor Sir John Bell FRS, Emeritus Regius Professor of Medicine at the University of Oxford.

Together they discussed the current state of UK life sciences, the UK's relative strengths and weaknesses, and the various challenges to deliver the ambitious aims set out in the plan.

You can watch the event back in its entirety [here](#).

News in brief

What's on next year?

After a busy Autumn and a brief break from public events in December, we will be back in full swing from January 2026 with two exciting events. Full details of speakers and booking information will be available on our web site soon.

- 25 Feb: Adapting to climate change-how prepared is the UK?
- 18 March: From publication to public action – the case for responsible activism

Podcast latest

We have had some exciting new guests on our podcast this Autumn/Winter season. From quantum technologies to UK fertility trends and Net Zero housing; episodes cover a broad scope of topics. Listen to quantum experts Professor Sir Peter Knight (Imperial College) and Dr Rob Lock (Atomic Weapons Establishment); and Rachel Cutting (Human Fertilisation and Embryology Association) [here](#).

Daresbury Laboratory

On 20th November, the Foundation Future Leaders visited the Daresbury Laboratory, a science and technology campus near Liverpool that is part of the Science and Technology Facilities Council (STFC). As well as discussions of the research carried out on site and tours of the laboratories, the Foundation Future Leaders met early career staff based at Daresbury and discussed building careers within science and technology.

Future Leaders: opportunities and challenges in science and technology

Liverpool Hope University played host for the 2025 Foundation Future Leaders' Conference in November, which was well attended and explored the barriers to successful Science and Technology in the UK, and the role of "place" in decisions on funding, (particularly through the UK devolution lens). Expert speakers ranged from senior figures across academia, policy and industry and there was a keynote address from Professor David Nutt, Chief

Scientific Officer at Gaba Labs Research and former Chairman of the Advisory Council of the Misuse of Drugs.

Following on from the conference, our FFL 2025 cohort are preparing for their grand finale outing to CERN (Geneva) and ESRF/ILL (Grenoble) in January. The call for applications for the Foundation Future Leader Programme 2026 is now closed, and the successful candidates will be chosen and announced soon.

Foundation Chief Executive moves on

Our fantastic Chief Executive of seven years, Gavin Costigan, who came to us from senior civil service and policy roles in Government and Southampton University, will soon be moving on. Among many accomplishments during his time here, he established the ever-popular [Foundation Future Leaders' Programme](#), which continues to grow in strength every year. Gavin will remain with us until March 2026, so there is



plenty of time to celebrate and see him off in style. Interviews for his successor are currently under way.

DiveIn Centre partnership supports diverse, mission-driven research

The Foundation is now an external partner for the new DiveIn Centre for Doctoral Training (CDT) at the University of Glasgow, which is focused on bringing together diverse teams to tackle interdisciplinary, mission-driven challenges at the forefront of research.

The Foundation's role will be to help

the PhD students understand the policy implications of their research projects and how to work with policy colleagues. Our Chief Executive, Gavin Costigan, presented a policy-related challenge at the first ever Annual Industry Showcase for the CDT on 11 November in Glasgow.

Science for Climate Action

Jim Skea explains how The Intergovernmental Panel on Climate Change communicates scientific progress and informs the policy process

[The Intergovernmental Panel on Climate Change \(IPCC\)](#) is the UN advisory body on climate change. As yet another Conference of the Parties (COP) comes around, people look to IPCC for new insight and analysis. Yet this is a challenge. IPCC works in lengthy assessment cycles. It may, indeed, appear to be the El Niño of the science world – appearing every two to seven years.

IPCC completed its [Sixth Assessment Cycle \(AR6\)](#) more than two years ago. The next report, a Special Report on Climate Change and Cities, will not appear until 2027. So how does the IPCC communicate scientific progress and inform the policy process?

The scope of the forthcoming reports has been agreed, and the knowledge gaps that they will address have been identified. At this stage, IPCC can bridge between the established knowledge in the AR6 report, and prospective findings from the Seventh Assessment Cycle (AR7). This can be illustrated by taking four specific topics: attribution; temperature overshoot; impacts and adaptation; and sustainable development and equity.

On attribution, the first sentence of the Summary for Policymakers of the AR6 Synthesis Report could not be clearer. “Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming”. There are high levels of confidence that some type of impacts, such as observable increases in hot extremes, can be attributed to human activities. It is likely that human activities are the main driver of the intensification of heavy precipitation. But there is lower confidence regarding human influence on agricultural and eco-



IPCC Chair Professor Jim Skea addresses delegates at COP28 in the UAE

logical drought. The AR7 Report will address these lower confidence topics with a view, if it is supported by the evidence, to reaching robust conclusions.

Work is under way to establish whether specific weather events can be attributed to human activities. The forthcoming Working Group I report covering the physical science basis of climate change will extend the attribution of large-scale changes in the climate system at global and regional levels to the attribution of local changes and extremes such as tropical cyclones. Work-

level in 2024. It is almost certain that global warming will exceed 1.5°C within the next five to 10 years.

Although the 1.5°C threshold will be exceeded in the near-term, it may be possible to limit warming to 1.5°C in the long-term. The consequences and means of managing overshoot, in other words, exceeding a specified global warming level before returning to or below that level through net removals of carbon dioxide from the atmosphere, will be covered in the AR7 Report. There are sig-

There are high levels of confidence that some type of impacts, such as observable increases in hot extremes, can be attributed to human activities.

ing Group II, which covers climate impacts adaptation and vulnerability, will extend the assessment of attribution to observed and projected impacts.

Turning to temperature overshoot, the World Meteorological Organisation, one of IPCC's parent organisations, has established that, based on a 20-year running average, the world was between 1.34 and 1.41 °C warmer than the pre-industrial

nificant knowledge gaps. What techniques and approaches can plausibly result in removals of carbon dioxide from the atmosphere at scale? What might be the wider social, economic and ecological consequences of deploying these options? How would the Earth system respond to lower carbon dioxide concentrations and a cooling climate? What irreversible impacts, such as species loss,



UK DFID / RAFIUR RAHMAN RAOU (CC BY-NC-ND 2.0)

A house in Bangladesh completely surrounded by contaminated floodwater as a result of flooding

may we suffer if we surpass a given threshold? How well would adaptation options planned today function at higher levels of global warming?

These questions will be addressed by the IPCC's three Working Groups during the AR7 cycle, and the IPCC's Task Force on National Greenhouse Gas Inventories (TFI) will be developing guidance for estimating emissions and removals associated with carbon dioxide removal.

The AR7 cycle will have an enhanced emphasis on climate impacts and adaptation, without neglecting mitigation. Adaptation has lacked the means to measure progress as it is difficult to separate from wider infrastructure investment and development patterns. To fill that gap, Working Group II will shortly start revising and updating Technical Guidelines on assessing impacts and adaptation. The guidelines will encompass goal setting, risk assessment, planning, implementation, and learning, monitoring and evaluation. The Working Group II report will, for the first time, include a chapter on finance, an indispensable precondition for successful adaptation.

Overall, the IPCC will be paying much more attention to the role that climate action plays in advancing sustainable development, including and beyond the

Sustainable Development Goals (SDGs). In AR6, IPCC showed that those who are most vulnerable to climate change have contributed least to greenhouse gas emissions. It also showed that across a range of human and natural systems, options for climate action, both adaptation and mitigation, have more synergies than trade-offs with the SDGs.

In AR7, there will be a substantial treatment of equity, just transition and the distributional consequences of climate action. Working Group II's regional and thematic chapters will address distributional aspects including human rights, equity and justice, and impacts on vulnerable groups. There will also be a chapter devoted to responses to losses and damages disproportionately experienced by vulnerable communities and groups.

Working Group III will have an entire chapter devoted to sustainable development and mitigation, covering the distributional consequences of mitigation actions, synergies and trade-offs with sustainable development, and implications for biodiversity and ecosystems, conservation, and restoration.

The scientific community is already working on these topics. But IPCC has a unique capacity to assess and synthesise the vast and exponentially growing body

of knowledge on climate change, its impacts, and available responses. Every individual scientific paper matters, but only when individual papers are placed in the context of the overall body of evolving knowledge does the full picture becomes clear.

IPCC identifies the level of confidence in key findings, drawing on different perspectives through its diverse author teams. It forges consensus between representatives of the scientific world and policy-makers, the prerequisite for informed and effective policy-making.

It is a unique and successful model adopted by other bodies, notably the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES). The IPCC's tried and tested ways of working will allow it to deliver clear, authoritative, timely and actionable findings for policymakers and other decision-makers in the coming years. □

DOI: 10.53289/RAGQ2088

Professor Jim Skea is Chair of the Intergovernmental Panel on Climate Change. From 2009 to 2023, he was Professor of Sustainable Energy at Imperial College London. He was Research Director of the UK Energy Research Centre 2004-12 and Director of the Policy Studies Institute 1998-2004.

How to harness Africa's potential through R&D

The Kohn Centre at the Royal Society was full of energy from an audience eager to hear from the evening's experts. **The first speaker, Dr Rhona Mijumbi**, began with a quote from Theodore Roosevelt, the 26th president of the USA: "It is not what we have that will make us a great nation. It is the way in which we use it".

We stand at a critical juncture. On the one hand, we face unprecedented global challenges: climate change; food security; insecurity; health crises; the digital divide, and increasing geopolitical tensions. On the other hand, we also hold extraordinary tools: research, innovation and cross border partnerships. Africa is home to more than 1.3 billion people, and it is poised to play a central role in shaping our future. It is not simply a recipient of innovation, it is a source of ingenuity, resilience and transformative ideas. The question we must ask ourselves is how can we harness Africa's potential through research and development partnerships that not only support sustainable growth in Africa and the UK, but also advance a broader agenda of global prosperity.

Dr Mijumbi reflected on three key questions which she believes are essential to understanding and enhancing research and development collaboration with Africa.

1. Why Africa?
2. Why should sustainable growth be a shared agenda?
3. How can we build strong, long-term collaborative frameworks?

Africa is rich in natural resources, cultural depth and human potential, but faces unprecedented global challenges. Many believe science, technology and innovation are the keys to the continent's prosperity

Africa is rich in natural resources, cultural depth, and human potential. There are an additional two billion people expected to populate the world, and nearly 80% of them will come from Africa, mostly from countries such as Nigeria, Tanzania, Ethiopia, Angola, the DRC and Niger. In fact, the DRC and Niger will double their populations in a very short period of time, but this is not just about demographics. Africa is already home to a rising generation of researchers, entrepreneurs and policy innovators. At the Malawi Liverpool Wellcome Programme, we have already seen some of the continent's brightest minds. The Weber-Parkes Prize recipient in 2022 was [Professor Henry Mwandumba](#), who is currently director at that institution, and is a globally respected immunologist in Uganda. Dr Mijumbi's team developed the continent's fast, rapid response service for urgent policy-making, and this model has inspired similar frameworks across the continent, with colleagues in Brazil, Canada and Norway. She explained

EVENT BACKGROUND

The UK benefits hugely in scientific and cultural terms from international collaboration in R&D. Traditionally, it has looked to its R&D links with more developed nations to support its own economic development and supported collaboration with developing nations through Overseas Development Assistance. With the Foreign Commonwealth and Development Office currently developing a new strategy for the UK working with Africa, how, if at all, can UK R&D collaboration with African nations support the UK growth agenda alongside meeting core in-country development objectives?

In the year in which South Africa is chairing the G20, are there priority areas of collaboration (for example in renewable energy) which can bring

economic benefits to both the UK and African countries, and underpin a prosperous Africa? In an evening discussion on Wednesday 11th June 2025, the Foundation explored these issues as well as how they might shape the view of ODA funding for R&D.

Speakers included:

Dr Rhona Mijumbi, Co-Director at The Center for Rapid Evidence Synthesis (ACRES), Makerere University and Head of the Policy Unit at the Malawi-Liverpool-Wellcome Programme
Professor Ambreena Manji, Dean of International for Africa at Cardiff University
Professor Christopher Smith, Executive Chair of AHRC and UKRI International Champion

EVENT REPORT: R&D COLLABORATION IN AFRICA



CC-BY-NC 2.0/ FLICKR: ROGIRO

The World Health Organisation shipped around 24,000 Ebola vaccine doses to help tackle the 2021 Ebola outbreak in N'Zérékoré, Guinea

that the same team is now pioneering AI applications in evidence-informed policy-making, and that across Africa there are hundreds of such initiatives – innovative, locally grounded and globally relevant.

The Africa Union's [Agenda 2063](#) and [STISA-2034](#) (science technology and innovation strategy for Africa) are speaking to a continent that is investing in its own growth. African governments are increasingly prioritising education, infrastructure and, most of all, creation of innovation ecosystems. This sets the stage for deeper partnerships. UK expertise can align with African ambition to co-create solutions for mutual benefit.

Sustainable development is not a regional aspiration; it is a shared agenda with shared visions and responsibility and accountability. As a scientific leader, Dr Mijumbi said that the UK bears both opportunity and responsibility to collaborate in solving challenges that affect us all. Climate change was the first example given to demonstrate this. She said that Africa is among the most vulnerable to its effects, including droughts, floods and other weather events. Collaboration on climate, smart agriculture, clean energy and water conservation technologies has benefits on both sides.

The UK's leadership in green technology, combined with Africa's pressing need for scalable solutions, presents a powerful alignment of interests. She also considered urbanisation. Cities such as Nairobi, Dar es Salaam, Kigali, and Lagos are experiencing rapid growth, but the infrastructure is really struggling to keep pace, leading to congestion, energy inefficiencies, and waste management challenges. However, through joint research, the UK can work with

African cities to leapfrog carbon intensive models and develop smart, sustainable infrastructure.

She went on to say that Africa carries a disproportionate share of the global disease burden, especially in infectious diseases, which impact not just on health systems but economic productivity and security. With the UK's deep expertise in medical research and biotech and a growing R&D budget, there is a clear opportunity to collaborate on solutions that work for both contexts.

Empowering institutions

Partnerships must empower African institutions and researchers to lead, not merely benefit from, the innovations that shape their future. She said, "that is what true sustainable growth looks like – you have local ownership, global collaboration and shared impact."

The second speaker, Professor Ambreena Manji, set out what she saw as the most salient and important features of the recently published summary of the [UK's consultation on a new approach to Africa](#). The UK Government has committed to a new relationship with the continent of Africa with commitments to genuine partnerships, that are based on notions of mutual respect. At the end of last year, David Lammy, the UK Foreign Secretary, launched a five-month consultation to hear the views of African partners, and up until May 2025 this year, there have been very extensive country consultations supported by 25 UK ministerial visits. Professor Manji said that the need for an emphasis on listening and respect and equality was highlighted in the report with a focus on African-centred thinking that characterised particularly the immediate post-independence



Debates led from Dar es Salaam University in Tanzania focused on the future of African intellectual sovereignty

period. East Africa was a key location for some of those debates. Sometimes known as the ‘Dar es Salaam’ debates, they were led notably from Dar es Salaam University in Tanzania and were about the future of African intellectual sovereignty and about the risks that lay ahead of infringement on intellectual freedom.

These debates explain a lot about the recent recommitment of African colleagues in higher education to the pursuit of science by African colleagues in their own right, after years of structural adjustment and externally imposed austerity, which depleted institutions to the point of near collapse. The UK consultation recognises that there is now a younger generation seeking to reclaim the academic and intellectual space and to assert its importance to the future of the continent. Also, that there is a young generation who are thinking beyond formal spaces, universities and formal institutions. She said that any recent visitor to Nairobi will know that you are spoiled for choice on a Friday evening with book clubs, gallery showings and creative industry events. There is a lively cultural and political ecosystem that needs to be read generationally. She hopes that there will be more discussion of the significant generational shift that must not be underestimated.

Professor Manji talked about the consultations’ acknowledgement that a significant reduction in Official Development Assistance (ODA) spending was having an effect on civil society groups working on human rights, inclusion and peacebuilding. As a lawyer, she felt duty bound to point out that many civil society groups were left stranded by the disinvestment including work on the

rights of women and children. Talking of the impacts that the ODA reduction has had on the UK’s credibility and on its reputation, she said that it was time for the UK to think about what things would look like beyond ODA. What would it look like to achieve some of the things we needed to do, for example, in relation to Ebola outbreaks, without having to rely on partners outside the continent?

Finally, she explained that there is an acknowledgement of the very real challenges that African countries face in accessing global research and knowledge. UK funding and UK initiated partnerships are greatly valued in terms of supporting African science. This includes examples such as [The British Academy](#) having a significant international fellowship programme which gives mid-career academics an opportunity to expand their academic networks, and to take part in international research at a point in their careers when their career is in danger of coming to a shuddering halt. That mid-career point has long been known to be an important one for intervention.

The final speaker was Professor Christopher Smith. He began by saying that it is incredibly important to think about the different narratives that Africa is telling about itself. He said that when we think about Africa, we should think about its richness, its phenomenal capacity in terms of minerals and natural resources, and its incredible innovation.

A lively cultural and political ecosystem is being created by the younger generation



While solar power is a natural fit for Africa, its construction is quite damaging in terms of its environmental impact

[The World Intellectual Property Organisation \(WIPO\)](#) has statistics which look at how African countries are performing (given where their economy is), and show that they are outperforming European countries in their innovation index. Professor Smith said that it is important to think about Africa-centred solutions, so that the problems being answered are problems that come from Africa, rather than the problems we perceive or force on them.

Sustainable solar power

One example is solar power. On initial thought, many people think it would be a great idea for Africa to pour resources into this due to the amount of sunshine there. However, the construction of it is quite damaging in terms of its environmental impact. There is an innovative project, co-created with African innovators, to produce a sustainable solar power energy kit. Professor Smith explained that you are getting things which are doing good in terms of energy production, but they are not having the same negative impact as they would if they came using disposable parts. Rather than creating issues, African versions are solving that problem and producing energy.

[UKRI's ODA scheme](#) was mentioned as an important tool that the UK has used effectively to support UK universities to engage with problems across the Global South. It has done great work but has come at the price of science from one perspective. When Professor Smith came into his role as International Champion at UKRI, one thing that evolved from ODA was the [Ayrton Fund](#) which was looking at ways to create solu-

tions around energy that were really based in growth, ideas and creating capacity within a country, rather than majoring on outside interventions.

In the USA, across Europe, and in Australia, we are seeing a crunch in liquidity. The UK Government has made a commitment to put considerable money into R&D. Professor Smith said that we should use that money flexibly. He also said that there are interesting multilateral opportunities, including American-led global research centres, which have not yet been removed under the current political climate. We must think about more ways to collaborate with [Horizon Europe](#). Professor Smith expressed concern about [Open Science](#) based on online publication. He said that there is a risk that we could start moving back on some of the advantages that Open Science gave us, if for example important research disappears from the internet 10 years after it was published. The cost of long-term digital preservation is enormous. We have not solved that issue here in the UK or in Europe, and we must support others to be able to work for long-term digital preservation too. Any digital preservation system created must be able to work across borders.

Overall, the key messages conveyed excitement and anticipation for future collaboration between the UK and African nations, but that any joint work must benefit both parties and particularly allow for autonomy and leadership from African experts, as well as British ones. You can view and listen to the whole event including [the Q&A here](#). □

DOI: 10.53289/BNAY2706



Shaping the EPSRC's clean energy strategy

Strategic science for green growth – Ruqaiyah Patel discusses EPSRC's role in shaping the UK's clean energy future through investment in research and innovation

In 2024, the UK Government set out the [Clean Energy Superpower Mission](#) which seeks to secure clean power by 2030 and to accelerate to net zero emissions by 2050.

As the Clean Energy team at UKRI's Engineering and Physical Sciences Research Council (EPSRC), we target research that will significantly reduce and ideally result in net zero greenhouse gas emissions from our energy system, from the generation, transmission, storage and use of clean energy vectors. We also focus on mitigation routes such as carbon capture, storage and utilisation (CCUS) technologies, and solutions that increase our resilience and adaptability to the known and anticipated effects of climate change.

EPSRC has a long history of investing in new technologies and energy system disruption to deliver transformations and solutions to our climate challenge. Our past, current and future investments in immature technologies, systems approaches, and exploratory research will continue to provide the new knowledge needed to deliver clean energy for the UK. EPSRC has led targeted clean energy interventions for over 25 years investing over £1.5bn, which by 2018 alone had generated around £500bn in UK revenues and employed over two million people.

Examples of key successes include:

- Flexible solar cells powering farms and crops: With support from the [EPSRC's SPECIFIC IKC award](#), The Application Targeted and Integrated Photovoltaics (ATIP) programme has been pioneering the design and manufacture of next generation photovoltaic solar cells that could enable farms to harvest food and power in the same space. Alongside their 11 industrial partners, including emerging companies in the sector like Polysolar, NSG, Oninn and Powerroll, ATIP have developed the design and manufacture of flexible solar cells that can be printed in a roll-to-roll manufacturing process - like newspapers, only with sunlight-capturing ink.

- Smart heat pumps could cut bills and ease grid pressure – benefitting both people and the planet. [UK research led by the University of Southampton with Good Energy](#) shows heat pumps could cut emissions, lower bills, and help balance electricity demand, keeping homes warm and easing pressure on the grid. The study tested how homes using smart air source heat pumps could automatically adjust their usage to balance the grid during peak demand periods. The findings show that with the right technology and coordination, smartly managed heat pumps could help reduce pressure on the grid at critical times, such as during cold winter evenings. This could also help lower consumer costs and support the UK's shift away from fossil fuels. As the UK transitions to green energy and works towards net zero, effective grid management will become increasingly vital to ensure a stable and resilient energy system.

A decade of impact in research funding

I started my career as an Engineering Portfolio Manager at EPSRC in January 2015. Over a decade later, I continue to serve as EPSRC's Joint Head of Clean Energy. Throughout this journey, I have been fortunate to have the privilege of driving exciting programmes across the breadth of EPSRC's remit, leading partnerships with industry and international partners to ensure UK science and engineering remains well positioned to deliver impact for the UK economy and society and can contribute meaningfully to global challenges.

My focus is now on establishing EPSRC's clean energy strategy and defining our forward priorities, the areas where EPSRC's research can have the greatest impact, and ensuring our investments continue to support the UK's transition to a clean, resilient energy future.

Future Leaders 2025 cohort

This year, I joined the Foundation's Future Leaders programme which has allowed me to focus on furthering my network across the science and technology landscape, and to have time to personally reflect on my career journey to date. The opportunities from the programme have broadened my horizons and demonstrated the need for each part of the research and innovation (R&I) system.



Ruqaiyah Patel is the Joint Head of Clean Energy at UKRI's Engineering and Physical Sciences Research Council. She has strategic leadership of EPSRC's clean energy portfolio, including hydrogen, negative emissions technologies, decarbonising heating and cooling, industrial decarbonisation, and whole energy systems.



Thanet, Kent,
offshore wind
farm in the UK

The programme has reignited my passion for developing research funding strategies that deliver focused benefits to the UK economy and society. Discussions at the various drop-ins, meetings with colleagues from government, parliament, the university sector and the private sector, have reminded me of power of curiosity. Being curious about the work others do, the impacts they are driving towards, and the wider context we all operate in.

Strategic leadership in clean energy

This renewed perspective has directly influenced how I approach my current role. In my current role as EPSRC's Joint Head of Clean Energy, I provide strategic leadership of our clean energy R&I agenda. This involves commissioning, investing in and evaluating strategic R&I programmes that deliver our priorities in clean energy. My team ultimately are the domain experts in clean energy within EPSRC, offering deep insights, powerful support and leadership to shape our portfolio and intelligently invest across this portfolio.

We work collaboratively across the R&I ecosystem, engaging academia, industry and government to ensure our public investments align with our national priorities. These professional networks are critical to delivering our vision to lead the research on the discovery, development, and deployment of clean energy technologies through a whole systems approach, delivering affordable, sustainable, and secure energy solutions that enable the UK to achieve net zero by 2050, and beyond – driving green growth by ensuring economic prosperity and climate resilience.

A key part of our approach is ensuring benefits realisation, actively tracking and demonstrating the tangible impacts of our investments. This includes scientific breakthroughs, industrial uptake, policy influ-

ence and societal outcomes. By doing so, we demonstrate the value of public funding, and generate insights that inform strategic decisions in the delivery of clean energy for the UK.

Lessons from the journey

Networking with professionals from across the sector in the programme has helped reinforce a few personal lessons I have earned from my own career journey.

1. Fan clubs and connections: build the networks of people who support you – trust, goodwill and challenge are invaluable.
2. Have fun in everything you do: your career is a part of your life journey, enjoy the experiences.
3. Embrace change (and the chaos!): focus on your adaptability and resilience.
4. Be uncomfortable and never stop learning: take that leap of faith and challenge yourself.
5. Value what you bring to the workplace: remember you are capable and deserve to be here.

I cannot recommend the Foundation's Future Leaders Programme enough. It has been an incredible opportunity as I leave my first decade in the world of research investment, deepening my understanding of the UK's R&I system and building connections and knowledge I need to deliver my work in UKRI.

Final thoughts

Ultimately, delivering clean energy for the UK is not just about technologies and strategies. It's about people, partnerships, and purpose. I'm proud to be part of a system that's driving change, and excited for what the next decade will bring. □

DOI: 10.53289/BTRP1342

Architecting trust: governance in fusion

Nuclear fusion offers clean and abundant energy for humanity. Phill Mulvana outlines the progress of STEP Fusion, the UK prototype fusion powerplant

Fusion energy represents one of humanity's most ambitious and transformative endeavours. Unlike any other energy source, it promises clean, abundant, and inherently safe power, capable of meeting long-term global demand without the carbon cost or fuel limitations of today's systems. The Spherical Tokamak for Energy Production (STEP) programme delivered by [STEP Fusion](#), the UK prototype fusion powerplant, stands at the forefront of this mission.

STEP's goal is not only to demonstrate that net energy can be generated from fusion, but also to prove that it can be achieved commercially. To that end, the programme aims to design, construct, and operate a prototype spherical tokamak capable of delivering net energy from fusion – putting power on the national grid.

This goal is proof that the global fusion effort has now advanced beyond proving scientific feasibility. The challenge is no longer if fusion can be achieved, but how it can be built, assured, and operated at the speed and scale required for future commercial success.

While fusion's technical challenges are substantial, one of the greatest tests of success will not be found in physics or materials science, but in governance. Building trust, across governments, industry, and the public, requires frameworks that are mature enough to support a first-of-a-kind system within an energy landscape accustomed to proven technologies, long safety records, and established operational norms. Without trust in what we build, it may be impossible to use it.

Trust here is especially important in fusion, not only due to its first-of-a-kind nature, but because of the high epistemic uncertainty that surrounds the domain. There is no historical precedent to guide assumptions about plant reliability, no validated models that predict plasma behaviour in a spherical tokamak of this scale, and no established regulatory playbooks to define expectations for organisations entering this space.

STEP Fusion, therefore, presents a once-in-a-generation opportunity to define the governance playbook; setting a precedent not just for this plant, but for

the future of fusion itself. Done well, governance is not bureaucracy; it is the architecture that enables agility without compromising integrity.

It must be shaped not only by documentation, but by a deliberate mix of people, tools, and behaviours that together form a socio-technical system built for scale, learning, and credibility.

Aims

The STEP programme exists to deliver fusion within a multi-partner environment, providing the catalyst for UK industry to develop the talent, supply chains, and systems that will sustain fusion as a credible and competitive sector.

The programme is delivered by UK Industrial Fusion Solutions Ltd (UKIFS), a lean organisation of direction-setters orchestrating a broad coalition of partners. UKIFS does not seek to deliver every element directly; its role is to create the framework that allows these partners to deliver successfully.

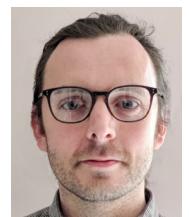
This orchestration extends across disciplines: scientists, engineers, project managers, and policy specialists working together to build not just a prototype, but a capability. The approach offers a rare opportunity to architect governance from the ground up, to define how a national endeavour of this magnitude operates responsibly and efficiently.

To achieve this, the STEP Fusion Governance Function has assembled a focused team of specialists in engineering lifecycle, policy and risk with access to many more. Each discipline contributes a unique perspective, collectively defining the STEP Fusion approach to governance. The emphasis is on consistency of approach rather than prescription of methods; setting expectations and interfaces that enable delivery while preserving flexibility.

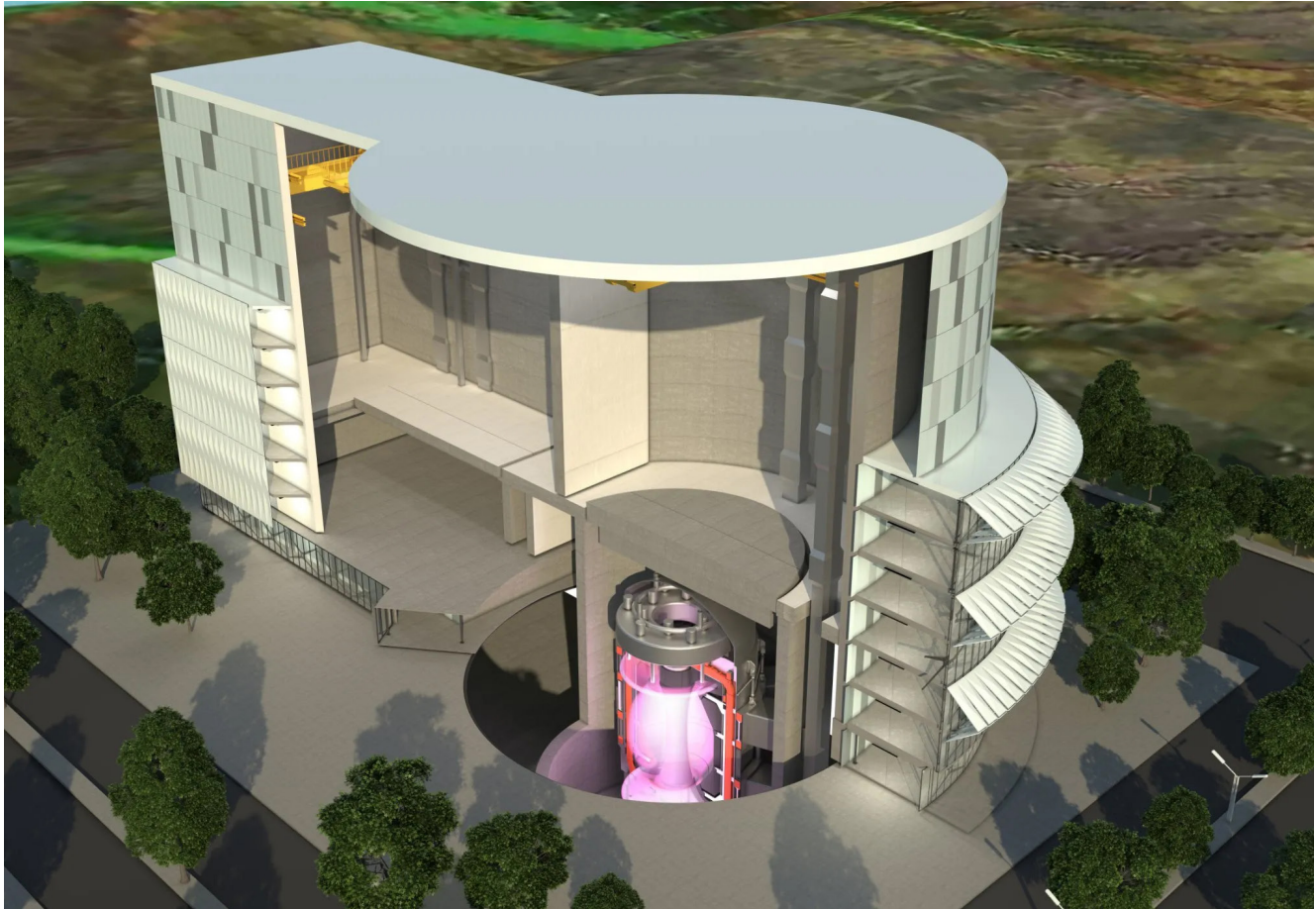
Paradoxically, we operate within a regime where we are developing a high-integrity systems, known for demanding rigour, but in this case fusion demands agility – two elements that are often known for friction. Governance must therefore be proportionate: ensuring strong traceability, predictability, and repeatability, without constraining innovation. Every team must understand what success looks like and how, when, and by whom it will be measured.

Design intent to deliverable reality

The governance function serves as the bridge between design intent and engineering execution. Its core



Phill Mulvana is Head of Engineering Governance for the STEP Fusion programme, where he supports the development of frameworks that enable innovative yet trusted fusion system design. He has contributed to local, national, and international policy across fusion energy, AI, and clean energy systems.



CC-BY-NC 2.0 / FLICKR: ROGIRO

Artist's impression of the STEP Fusion plant

responsibility is to ensure that the requirements of the Design Authority, the ultimate owner and certifier of the plant, are effectively translated into actionable and verifiable outputs within delivery teams.

The UKIFS Design Authority manages all Level Zero plant requirements. It ensures that the final plant is safe, secure, environmentally responsible, and operable. This authority must coexist with highly empowered, agile Integrated Project Teams (IPTs), each delivering components or systems derived from those top-level requirements.

Governance provides the ecosystem that allows IPTs to execute with autonomy while ensuring that the systems they produce meet the Design Authority's strict criteria. The art lies in translating abstract design philosophy into tangible engineering deliverables; bridging the gap between aspiration and assurance.

The Governance function's key deliverables reflect this translation process:

- The Written Governance Set: The policies, procedures, and processes that define how a complex organisation of this scale operates with consistency and accountability.
- Digital Tool Integration: Embedding governance directly into digital systems so that the path of least resistance is also the compliant one. Wherever possible, ways of working are hard-coded into our tools; making governance inherent, not optional.

- The Engineering Lifecycle: A guiding framework that allows maximum flexibility in project delivery while ensuring that design reviews, verification steps, and cross-programme integration points maintain rigour and alignment with shared objectives.

These mechanisms together form the guardrails of STEP Fusion's delivery environment, connecting the aspirations of governance with the practicalities of engineering.

Guardrails here are the preferred means of governing, specifying goals and terms which support this guided empowerment of design teams as they work through a problem space with a high degree of uncertainty.

Strong governance here offers compound benefits over classical prescriptive approaches, by finding, tracking and addressing uncertainty. The use of digital tools to capture options, decisions and outstanding questions allows us to objectively assess uncertainty as it arises and to later look back at the provenance of the decisions which sought to manage it. This data-informed approach is supported by classic systems-thinking approaches to verification and validation, ensuring that for each option that exists a strong means of understanding and testing potential solutions exists.

This means balancing classical linear development models with those suited to highly iterative development, allowing engineers to confidently move through

simulation, probabilistic analyses and incremental design, knowing they are working within the policy remit, and that when the time comes, a clear pathway exists to transition their concept design into the increasingly rigorous final plant baseline.

Cultural governance

Even the most elegant governance framework will fail if it is not adopted at scale. True governance operates not through documentation alone, but through culture, through the collective habits, expectations, and behaviours that guide how people make decisions. Engineering governance, therefore, must be as much about mindset as it is about method.

Processes can be well intended and well written, but embedding them across organisations, disciplines, and even national boundaries requires trust. Governance must, therefore, shape how people think, collaborate, and resolve problems; especially when operating in Volatile, Uncertain, Complex and Ambiguous (VUCA) environments.

From trust flows empowerment. There can be no doubt, that in projects of this complexity and scale, engineers closest to the problem are those best placed to solve it. Governance must not suppress this agility, but enable it. The role of governance is to create the conditions where expertise can flourish safely, where those with the knowledge and proximity to act are empowered to do so, within a framework that maintains traceability and integrity.

This is not however open-loop autonomy in every area, it is guided empowerment. Specifically, the system must ensure that empowered individuals are supported by clear structures, transparent accountabilities, and tools that make good decisions visible. Training, mentoring, and accessible digital systems provide the guiderails that keep empowerment aligned with organisational purpose.

As the boundaries blur between rigid processes and the adaptive ingenuity of human teams, governance becomes the medium through which both coexist, structure without stagnation, agility without anarchy.

Design for replication

While UKIFS leads the STEP programme, its ambition extends beyond the construction of a single prototype. The greater goal is to establish the benchmark for how fusion will be delivered in the future, technically, operationally, and institutionally; to effectively create the blueprint for delivering again at scale.

Throughout the whole plant lifecycle, the artefacts and decisions produced will not only describe the plant itself; they will capture the how of we arrived at the final design, effectively; the history of governance, assurance, and integration that led to its creation.

Every model, rationale, and decision forms part of an auditable narrative. The richer this narrative,

the better equipped the next generation of fusion developers will be to build upon it. In this sense, governance becomes the golden thread of progress; carrying forward knowledge, lessons learned, and proof of integrity.

The success of any future replication depends on clarity; how well the governance models, lifecycle frameworks, and cultural lessons from STEP Fusion can be translated into future contexts. If we build governance with transparency and foresight, we build not just a plant but a platform for the industry to grow upon.

What success looks like

Effective governance is without doubt a journey, a sequence of incremental steps linked by learning, reflection and evolution and as the organisation matures in its technical capability our governance must evolve alongside it.

Done well, governance allows innovation to thrive responsibly; It ensures that time, budget, and decision-making are applied proportionately, balancing creativity with control. It facilitates an environment where failure is encouraged, used to learn, but without compromising safety or integrity.

When formal lifecycles are established, they will provide the means to make binding commitments to the final engineered baseline all linked by a golden thread of traceability. The objective is simple but demanding: to balance governance while preserving space to safely explore new ideas... without inertia.

Such balance is rarely achieved in established industries, where legacy systems and regulatory expectations can slow change and therefore innovation itself. Fusion, by contrast, offers a clean slate, an ability to co-develop with partners and regulators, a once-in-a-generation opportunity to design governance as a facilitator rather than an impediment.

Governance is the unseen enabler of engineering; get it right and no one should notice, getting it wrong can, and has however, led to some truly catastrophic programme failures.

The governance regime we aspire to balances the pace of delivery with the assurance of integrity, ensuring that confidence in what we build is equal to the brilliance of how we build it.

As the first components of the STEP prototype are designed, manufactured, and eventually operated, the governance suite will stand as an equal artefact, a socio-technical narrative documenting how trust was engineered alongside technology.

Ultimately, technology does not exist without governance and in fusion, perhaps more than in any other field, trust is both the product and the prerequisite of progress. □

DOI: 10.53289/EFEZ3676

Why people are the key to greener housing

The UK has the oldest and leakiest housing stock in Europe. How can homeowners, manufacturers and local authorities be persuaded to embark on the daunting task of retrofitting our old dwellings?

The evening's Chair, Professor Paul Monks, explained that the UK has the oldest and leakiest housing stock in Europe, but in addition to this, really understanding the social and behavioural aspects of this mission is key. Houses are more than just their fabric and people are the driving factor.

The first speaker, Professor Jennifer Schooling, began by stating that the challenge is above all, a socio-technical one, with people at the centre.

The people at the centre of the challenge are householders, homeowners, the retrofit supply chain, product manufacturers, and local authorities, all of whom play crucial roles. According to a 2023 Housing Survey, the UK has 25.4 million households: 64% owner-occupied, 19% privately rented, and the rest, a type of social housing. This translates to approximately 16 million individual homeowners, 4.7 million in the private rented sector, and four million in various types of social housing.

There is a significant age diversity in the UK's housing stock. Nearly nine million homes were built

before the end of the Second World War, around another nine million constructed between the end of the war and 1980, and a smaller number built after 1980. This spans various building codes, many of which were introduced after these homes were built. As a result, we see a wide range of skills and technologies available at the time of construction. Additionally, there is a variety of property types involved – everything from small and medium-sized terraced houses to semi-detached, detached homes, bungalows, converted flats, and purpose-built high-rise buildings. This diversity presents a complex challenge as many people need to come together to address a multifaceted problem.

So, what can we do about it? We need to build confidence in the retrofit supply chain, and we required a skilled workforce for it. We must invest in the skills of our suppliers and build trust among property owners. One key approach is to aggregate demand, something Professor Schooling termed: 'community buying schemes.' By aggregating demand and possibly segmenting it by locality and property type, we can provide the supply chain with the confidence it needs to invest in upskilling, recruiting, and building capacity. For instance, through a community-based scheme, we could create frameworks for groups of vetted supply chain practitioners. This framework establishes a trusted group of providers, which could reassure homeowners.

EVENT BACKGROUND

Moving towards net zero is a massive multi-sector challenge. One of the more challenging areas is decarbonising the built environment, partly because buildings have a long lifespan and have millions of separate owners. The majority that will exist in 2050 have already been built so we have a large retrofit agenda as well as the task of designing new buildings. On Wednesday 21st May 2025, the Foundation held an evening discussion at The Royal Society to explore how (with a policy backdrop of the Government's Warm Homes Plan), social science and engineering could contribute to solving this challenge.

Speakers included:

Professor Paul Monks, Chief Scientific Adviser at the Department of Energy Security and Net Zero [Chair]

Professor Jennifer Schooling, Professor of Digital Innovation and Smart Places at Anglia Ruskin University

Helene Gosden, Associate Director, Retrofit at Scale Taskforce Leader at Arup

Professor Chris Wise FREng, Senior Director at Expedition Engineering and the Useful Simple Trust

Professor Mari Martiskainen, Director of the Energy Demand Research Centre at the University of Sussex.

Retrofitting can often fall into the ‘too hard’ category. Professor Schooling used a personal anecdote to illustrate how, if there was a community scheme in place, homeowners could cooperate and rely on the scheme to handle the hard work. She said that her experience with community buying schemes made her a strong advocate for them. In Cambridgeshire (where she resides), the county council enabled a community buying scheme for solar power. It had been straightforward, and the additional reputational aspect of the work created a system where the supplier had been motivated to do a good job because their future opportunities depended on maintaining a positive reputation.

The second speaker was Helene Gosden. She explained that while we know the technical steps needed to decarbonise a home, there are many other considerations that complicate the situation. She said that we must tackle questions such as: Who pays for the work? How do we deliver it? How do we convince people to allow us access to their homes for the required work? Ms Gosden’s task force started by identifying the key challenges within this system and focused on six areas to guide efforts. These include:

1. **Data:** Understanding the baseline condition of our housing stock.
2. **Finance:** Determining who pays for the retrofitting and how we can demonstrate value and return on investment.
3. **Supply chain:** Overcoming fragmentation and encouraging investment, especially from small and micro enterprises.
4. **Neighbourhoods:** Enabling communities to act from the grassroots level and supporting local initiatives.
5. **Materials:** Being mindful of the additional embodied carbon that could result from retrofitting efforts.
6. **Human behaviour and the user experience:** Acknowledging that these structures are more than just assets; they are homes.

Housing sits at the nexus of climate change and social equity. There are many benefits to good housing and thinking broadly about the reasons to intervene means more action and benefits. These include thriving and increased equality within populations, better climate resilience and jobs.

We need to scale projects to the level of neighbourhoods, where actions multiply benefits. When you think about a community, the benefits begin to scale exponentially. For example, there is potential for microgrids and demand-side flexibility to lower overall grid demand. We also see a reduced burden on health and social care systems due to warmer homes in winter and cooler homes in summer. Additionally, investments to create and expand green areas in towns

and cities help to reduce the urban heat island effect, leading to less cooling demand in buildings. The “co-benefits” of retrofitting should be recognised as core benefits of community decarbonisation at scale.

Looking next at the [Warm Homes Plan](#), Ms Gosden explored the flagship [Social Housing Decarbonisation Fund](#) (SHDF) and the [Home Upgrade Grant](#). She said that these programmes are world-leading in their scope. The SHDF supports local authorities and housing associations, while the Home Upgrade Grant is aimed at low-income privately owned homes and channels through local authorities.

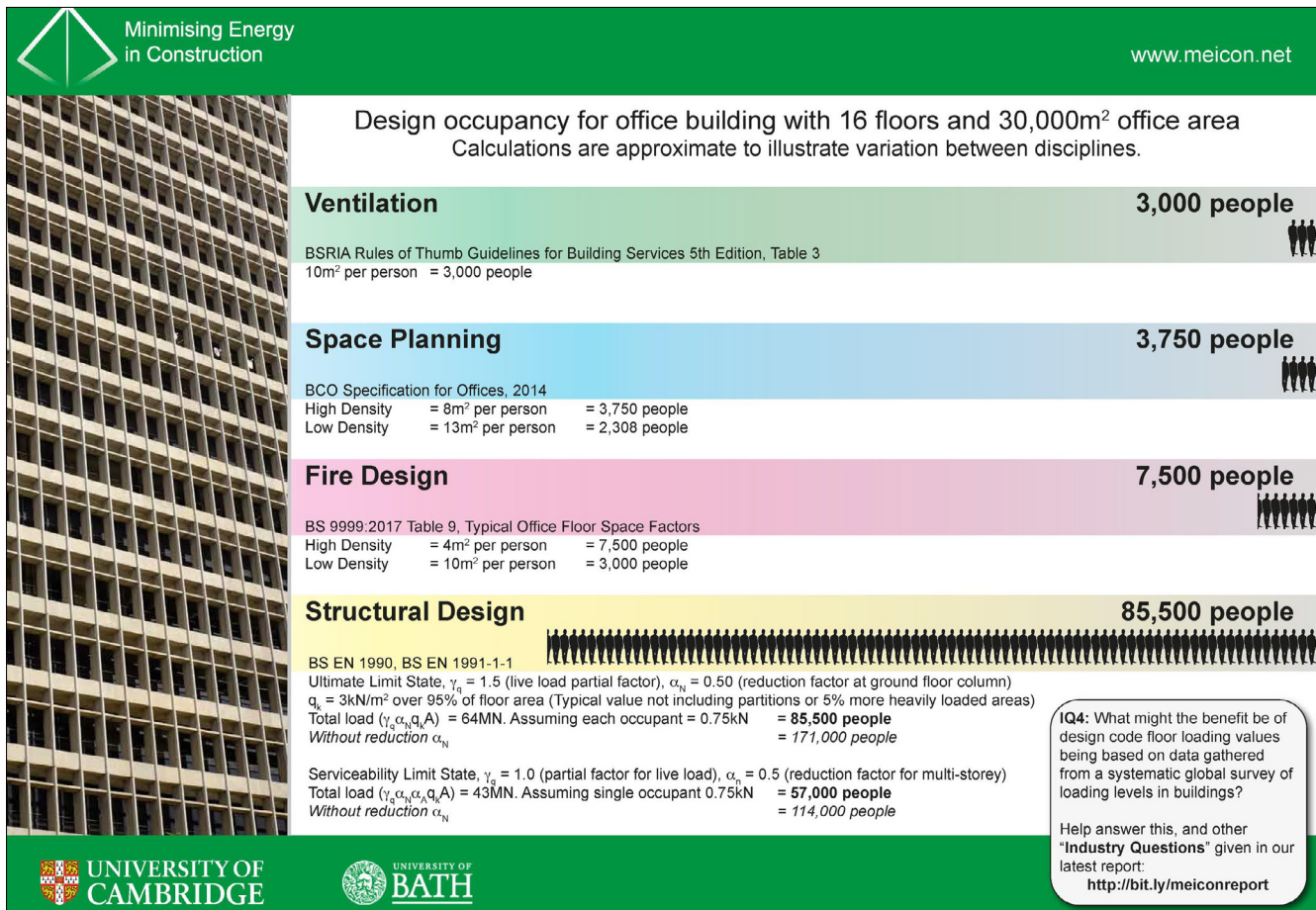
Over the last two years, Ms Gosden noted that one of the critical success factors for the SHDF has been tenant engagement. It is essential to bring tenants along on this journey and help them understand how the disruptions will benefit them – by reducing bills

One of the critical success factors has been tenant engagement. It is essential to bring tenants along on this journey and help them understand how the disruptions will benefit them – by reducing bills and enhancing comfort and health

and enhancing comfort and health. It is all about winning hearts and minds. Homeowners receiving grants who recognise the value of this engagement and plan for it early see less resistance and greater satisfaction, creating a positive feedback loop that makes future conversations easier. On the other hand, the key challenge for the Home Upgrade Grant lies in identifying eligible homes. Since those homes do not belong to the local authority, engaging with homeowners and keeping them in the customer journey is difficult. The conversion rate from an expression of interest in the Home Upgrade Grant to completed retrofitting is quite low.

Building trust involves fostering relationships, ensuring quality delivery, and maintaining good communication. We need an army of advocates within our communities. There are community organisations doing valuable work, and their energy needs to be harnessed and supported. They should work together, rather than trying to tackle the same challenges in isolation.

The third speaker, Professor Chris Wise, discussed design, designers, and what we can do to instil confidence in people that there are practising experts working to address the challenge of decarbonising



Different codes for ventilation, space planning, fire safety, and structural integrity can produce vastly different occupancy figures

buildings, in practical terms.

He said that systems integration in design is currently not well developed. To illustrate this, he referred to a slide from a study conducted by the University of Cambridge, as part of their industrial steering group (see figure 1 above). In one aspect of their research, they analysed a hypothetical building in a city centre, measuring 10,000 square metres, and found that different codes for ventilation, space planning, fire safety, and structural integrity produced vastly different occupancy figures.

Professor Wise said that our mission should be to bridge these compartmentalised professions to establish a system of integration. We should acknowledge the unknown factors or considerations we had not yet identified, which need to be included in our framework.

He added that, over time, the world has grown increasingly complex, leading to a rise of specialised compartments. This vast array of boxes has become increasingly unstable, risking the collapse of the overall system. Even when we attempt to incorporate regenerative design, biodiversity, and other factors, the instability remains. Professor Wise believes that a better approach is to layer systems over one another. Within Ian McHarg's 1969 book, *Design with Nature*, the author analyses not just the physical systems interacting at a location, but also social factors like crime, poverty, wellbeing, and health, with the goal of understanding the connections between these systems in a

way that fosters development without conflict. Professor Wise said that, as part of landscape and architecture practice, we should strive to support these systems and promote their co-development.

Professor Wise has worked on several well-known and progressive architectural projects, including the Millennium Bridge, the world's [first green ecological skyscraper](#), in Frankfurt, and the [Velodrome](#) in London. Discussing an ongoing project – the South Kensington Zero Emissions Nature Positive ([South Ken N+](#)) Programme, (which focuses on South Kensington and Albertopolis in London), he said that this initiative involves 23 institutions in the area, including several museums and Imperial College, which collaborate on a neighbourhood-scale project for Net Zero, circular economy, sustainable transport, and nature-positive initiatives. The teams have been working on this for three years and are making significant strides.

Emissions tracking

In the process of collecting emissions data for the South Ken N+ project, it became clear that many institutions were unaware of how their emissions compared to best practice. The project also conducted surveys to establish a benchmark for biodiversity, from the South Ken N+ park down to the new garden at the Natural History Museum.

Lean design, which emphasises using only what you need, is often overlooked. Professor Wise argued

Climate change means that homes need to become more resilient



Photo: Screenshot from BBC News

World Meteorological Association:

“The past ten years 2015-2024 are the ten warmest years on record 2024”

“Long-term temperature goal of the Paris Agreement not yet dead but in grave danger”

that this was evident in existing codes of practice. Additionally, many technologists tended to over-design due to time constraints in the commercial landscape, leading to inefficiencies. [The MeiCon study](#) at Cambridge found that designers were over-engineering by 25-30%.

The final speaker, Professor Mari Martiskainen, emphasised that the reason we were discussing warm homes was to ensure that our homes were resilient in the face of climate change. She displayed a photo taken from BBC News during the wildfires in Los Angeles and said that it served as a devastating reminder of the threat of climate change (*see image above*).

Despite some recent political trends, there is significant public support for climate action. Professor Martiskainen said that [the UNDP](#) found that 80% of people globally wanted their country to take greater action on climate change, and 72% wanted to move away from fossil fuels. Many individuals want to act on climate change, and we need to make clear that our homes are part of that solution. It is essential to think beyond just bricks and mortar. As a social scientist, Professor Martiskainen is concerned with behaviour inside and outside of the home, as well as a ‘just transition to net zero’ which she says simultaneously addresses inequalities while moving towards low-carbon interventions that prioritise restoration, reconstruction, and redistributive justice.

Questions of justice

Justice is subjective; it varies from person to person. Ie: What does it mean to have a just transition toward warm, sustainable, and low-carbon homes? Who are the individuals we expect to act in this area? Are they homeowners, tenants, or landlords? It is crucial to recognise that people have very different starting

points in terms of improving their homes or making their homes for more warmer or cooler in a heating planet. In research conducted by her colleagues, Professor Martiskainen found that trusted relationships are extremely important. For example, in the UK, people tend to trust individuals they already know, more than they trust the government, businesses, or the media. She said that it is therefore crucial to foster greater confidence in low-carbon homes by leveraging the trust that already exists within people’s social networks.

Another critical aspect is to communicate in straightforward terms. For instance, we should avoid jargon like “kilowatt hours” or “retrofit”, as many people outside of academia or the energy field may find such terms confusing. Instead, we should explain what these concepts mean in practical, everyday terms.

There remains a disconnect between complex government policies and the positive local actions we are observing in our case studies. While local initiatives can foster trusted action, they require substantial time, resources, and specific skills, particularly in terms of interpersonal relationships and the technical knowledge needed for the intricate aspects of building improvements.

We must be mindful of who can act. While we are witnessing an energy transition, we must be aware that not everyone is currently involved or has the means to participate. It is crucial that we address this gap to ensure that everyone can contribute to the collective effort towards low-carbon homes.

To listen to the Q&A and debate that followed the presentations, view the [full event recording here](#). □

DOI: 10.53289/JSUU3451

The 2025 Los Angeles wildfires have served as a devastating reminder of the threat of climate change

In conversation with Professor Dame Ottoline Leyser

The recently retired Chief Executive of UKRI, Professor Dame Ottoline Leyser DBE FRS took to the stage at the Royal Society on Wednesday 8th October, for an ‘in conversation’ evening with Foundation chair Rt Hon Lord (David) Willetts FRS

The audience were treated to an exploration of topics across UK science and technology, a look back at Dame Ottoline's tenure in UKRI and a view to the future. Below is a summary of that conversation. [You can view the full event here.](#)

Lord Willetts: It is wonderful to be here with Dame Ottoline Leyser, the Regis Professor of Botany at the University of Cambridge, with a very distinguished record as a plant scientist, but also recent Chief Executive of UKRI. I had the pleasure indeed of serving on the board for a long time, overlapping with Ottoline while she was CEO. So, I think this is one of the rare opportunities to hear from Ottoline with her reflections on UKRI, before she moves on to other projects. I understand she has already given evidence to the House of Commons Science and Technology Committee and may be giving evidence to the Lord's Committee. Without further ado, my first question is, how did your experience of UKRI compare with your expectations?

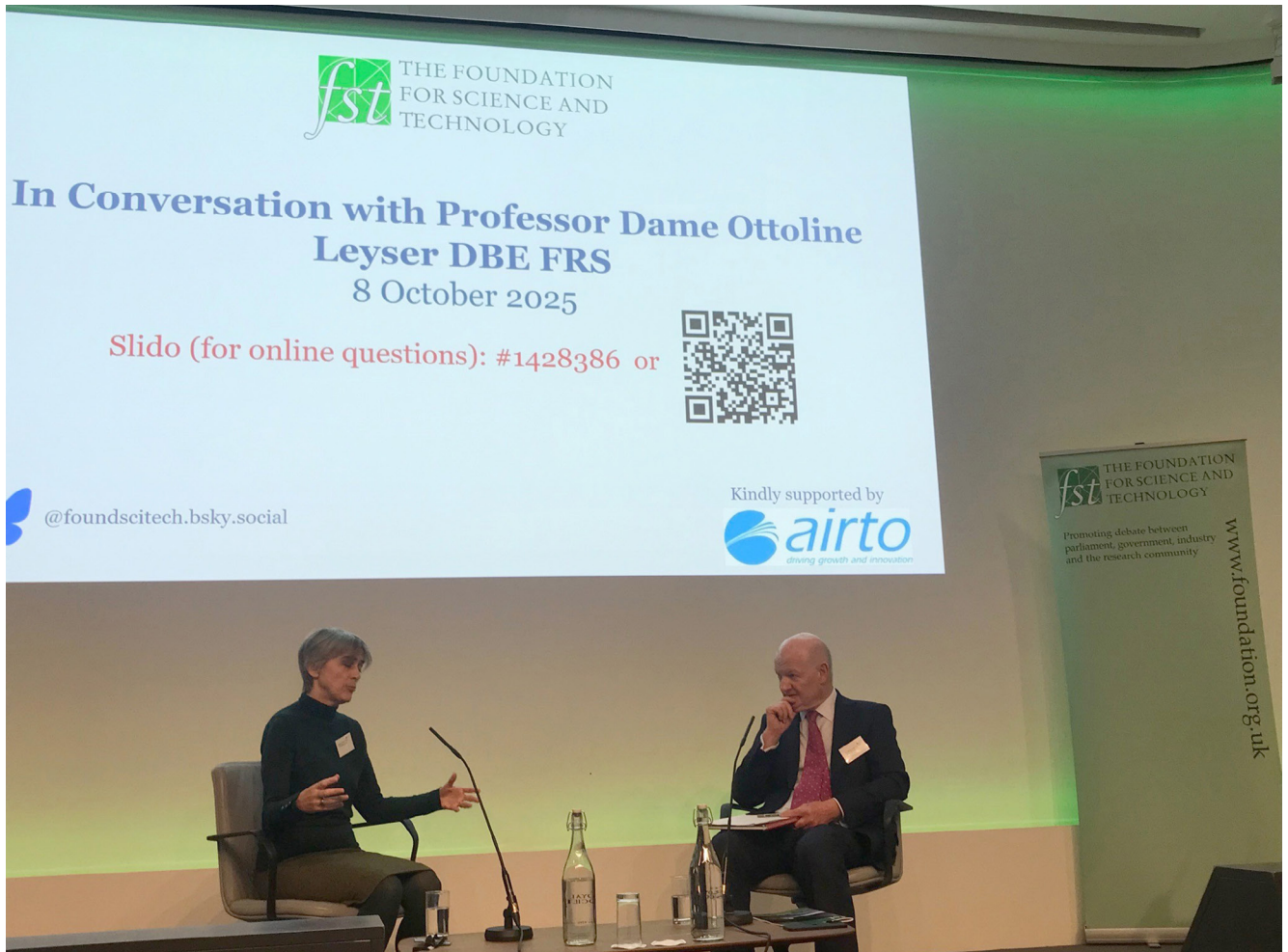
Dame Ottoline: I'd had a lot to do with the Biotechnology and Biological Sciences Research Council (BBSRC) before that. I was also involved in the Nurse Review that led to the establishment of UKRI, and I thought it was an incredibly important project that actually is, I think, transformative for research and innovation in the UK at a time when having nine separate councils did not make much sense, and there was an opportunity to join up. I think 'join up' is critical for getting the benefits out of research and innovation that we need. I suppose I partly applied for the job because, at the time, it was a relatively new organisation. There were still a lot of people who were very 'nay say' and quite a lot of those people were 'folded arms' com-

plainers, rather than 'step in and do something about it' complainers, which I thought was not acceptable. If it is not working for people, you have got to do something about it. I knew that there was a lot of culture change needed, given it was nine organisations coming together, only some of which wanted to be part of UKRI at the time. I think in terms of surprises, when I got there, I was less prepared for the immense amount of time it would take to do things like replace the ERP system and those kinds of classic things that you need when you are integrating nine organisations in the public sector. I was less prepared for that part than for creating a team of people who really wanted to work together. That was the part I joined for.

Lord Willetts: You mentioned the Nurse Review and the research councils. What was your experience of bringing the different research councils together? Do you think there is a future for the individual research councils?

Dame Ottoline: I think disciplines exist. My research has been very interdisciplinary for quite a long time, but there are disciplines. Maths is not the same as history, and I think there will always be a place for defined councils whose job it is to look after disciplines. However, the power of all disciplines is massively amplified if they very easily can work together, either for the benefit of their own fields, or because there are things you cannot possibly address through only one discipline. The power of UKRI is that there are strong disciplinary anchors, and there are communities and relationships which make it possible to work well in different permutations and combinations, whether that is through a bottom-up driven collaboration or through a top down driven, challenge-oriented activity. There is still a need for councils, and there needs to be easy ways for councils to collaborate and for activity to happen truly jointly.

Lord Willetts: Having seen you working as Chief Executive, I think that you displayed great skill in promoting interdisciplinarity, and I think people trusted you with that agenda, and that, in turn, enabled you to promote it more effectively than might otherwise have been possible. Looking back, what are the highlights of your time?



Dame Ottoline: I think the organisation grew in a way that allowed it to deliver a lot of those kinds of collaborative benefits, and I do feel very proud of that, and very excited about the potential for that in the future. Particularly that there are specific interdisciplinary schemes. One of the things that continues to be an opportunity is for seamless communication across the organisation, so everybody knows what everybody else is doing, and everybody can tune their work to adapt to somebody else doing something cognate over there. It is a very exciting organisation.

Lord Willetts: Now let us focus on the nine councils of UKRI. We might just pause on councils eight and nine (Innovate UK and Research England). There has always been a debate, does Innovate UK fit into UKRI? Should Innovate UK have a separate, independent role?

Dame Ottoline: I think it is critical that Innovate UK is part of UKRI, because it is essential to join up the business-led innovation and research with the other stuff. The way I have always seen it is that there are discipline-focused councils, and then there are sector-focused councils. So, Research England is obviously University-focused. Innovate UK is business-focused. I think that that kind of horizontal, vertical match is important for getting the full tapestry woven together.

It is true that helping that to happen when you've got organisations like Innovate that were very separate and different, it has taken longer to get to the point where we are really benefiting from those interactions, but it's happening, and I think that is also very exciting.

Lord Willetts: What about the practicalities of that? I know it is a difficult judgement to make. For example, sometimes a classic Research Council and Innovate UK, might be doing things differently, and this feature can gradually be eliminated, or it can reflect an underlying difference in the way they should function, things like grant conditions, grant monitoring, timescales, follow-up etc. Do you think that those sorts of differences were understandable and benign, or would you look forward to a time when they are more closely aligned?

Dame Ottoline: There is quite a lot of difference between the research councils as well. I think everybody can learn from everybody else in terms of good practice, and that is something else that evolves gradually over time. We did a big review of peer review and are now working very hard to ensure that all of the good things that have been learned in the various parts of the organisation over the years can be spread and deployed, because different grant calls have different purposes, and you absolutely need to run those differ-

The discussion ranged across topics from UK science and technology to a look back at Dame Ottoline's tenure in UKRI and a view to the future



The second Nurse Review was about how we should fund labs that are not necessarily part of universities

ently to deliver those different purposes. And then, of course, where there is a big difference with innovators, is that they're in a very different legislative framework, with competition controls and all those kinds of things that need to be taken into account. They will always be different. But I do not think that is a problem.

Lord Willetts: How do universities – where current financial pressures are intense – fit into all this? The second Nurse Review was about how we should fund labs that are not necessarily part of universities, with if anything, a bit of a rebalancing away from universities. There has also not been much increase in research funding for universities via Research England. Some figures suggest that there is a deficit of £5 billion in research funding. So how much do you worry about the state of research in the universities? And do you think that the new [Research Excellence Framework \(REF\)](#) can help address that in any way?

Dame Ottoline: I think the first thing to say is that UKRI absolutely has a particular responsibility for the research base in universities, and it is important to point out that, it does also include Innovate UK, which is business-led. In addition, many of the Councils fully own, or provide core funding to a very large number of institutes. There are 50 different

institutes that UKRI supports. So, the proportion of the overall UKRI budget that goes into universities is not as large as people think. I do not think it is correct to say that there is a deficit in university research funding. What is happening is universities, which are independent organisations, are choosing to spend the income that they generate in a variety of ways on research. Which is fantastic. It is great that universities have decided that they want to take £5 billion of their own money and spend it on research. The problem is that those sources of income are unstable, and in the context of the real financial challenges that universities are facing, their ability to spend that money on research is undermined, and so there is less money to spend on research.

I don't like the deficit notion, because it sort of comes with this tacit implication that, therefore, this £5 billion should be miraculously found from somewhere else. I think universities have made choices, and they have made choices which are good choices for the UK. However, it is not a fairy godmother's responsibility to fix those when the situation is different. The second thing to say is that where I think the system has a much stronger role to play, is the incentives that have led to some of those decisions. There is a complex web of incentives that influence how universities choose to act. These are quite often in conflict with one another,

and I think the REF Funding has contributed to that.

One of my main concerns is the volume incentive. So, REF puts money into universities and the money follows the REF assessment according to the number of principal investigators (or similar). That means it makes sense for universities to have more of those kinds of people, and fewer of the people who support them to do fabulous research. That creates all kinds of problems. Not least, because you then have many people in a system which, at an individual level, incentivises them to write grants. Therefore, there will be many people writing grants and bidding into a pot of money that has not grown in proportion. I think doing less better, is important. We have got to find a good way to consolidate and make sensible choices.

I think that the other big incentive change is competition between universities. This needs to flip into collaboration between universities. What are Vice Chancellors doing allowing people to apply for research grants where they will end up, (even if they succeed) with 70% funding and the other 30% coming from a university budget that is heading into deficit.

Lord Willetts: Another feature of the redesign of the REF (led by you, Jessica Corner and others) was in valuing the team rather than the individual star researcher, and part of the cultural shift was to recognise that a lot of science and research now is a team sport. I can remember, just anecdotally, conversations with researchers who would accept that they had done well, but that the software engineer who had helped with all the compute work that was necessary was not recognised in the REF and the university were now proposing to economise by getting rid of the very person who they felt had been part of their research success. How do you see that debate playing out now, and what will the final version of the REF look like with those pressures being reassessed?

Dame Ottoline: Firstly, I should say that the REF is inherently a collaboration between Research England and the devolved funding bodies, so it is, technically not a UKRI responsibility. However, it fits into the wider UKRI system, and that is important. I think valuing the full range of people necessary for the research endeavour is critical for the long-term sustainability of the system.

I find it interesting how difficult the notion of valuing the team and the system, the full set of people you need, has been as a concept, and that somehow or other, it plays against the notion of excellence, which we only envisage as the kind of fancy, shiny star person. It just does not make any sense to me that those things are somehow incompatible. We are not in any way denying that there are brilliant individuals coming up with brilliant ideas, but those people cannot do a damn thing without everything else.

Meanwhile, there is a brutal competition out there on citations where names and references to names are counted. So the papers have many authors, and the senior author is the person who is being counted in that way, and the other authors are undervalued, in my opinion. But also, everybody knows that those kinds of metrics, while they are very useful, are not a straightforward, objective measure of how good the research is. They are not a replacement for understanding what you need in the system.

Science is not like a sport, where the person who crosses the line at the end in the shortest time has won. There is not a defined winner, because the questions are all different and all over the place. There is not a single activity that you are trying to win. You are trying to find out stuff, but you are also trying to make stuff better. You want to do it for the immediate problems, but also for the problems that we have not even thought of yet.

Science is not like a sport, where the person who crosses the line at the end in the shortest time has won. You have got to have a much more sophisticated and eclectic way of thinking about what success is, and what you value and reward

You have got to have a much more sophisticated and eclectic way of thinking about what success is, and what you value and recognise and reward. That is really important, including for those star people, because it is no fun working in a system that recognises and rewards such a limited range of things. 'Star people' can have a very hard time in thinking that their worth is only as good as their next fancy publication.

Of course, we are having this conversation in the week where each day we are hearing of a maximum of three individuals winning a Nobel Prize. And in a way, what you're engaging with is a much wider debate, which is live in in the science community – what constitutes great science. It is simply not the case that any of those brilliant discoveries being celebrated can properly be attributed to those three people and not a lot of other people too.

Lord Willetts: At UKRI, you were dealing with politicians, a strange group with their own distinct requirements, and the Haldane principle was, of course, classically formulated to protect rigorous assessment of the merits of research grants from political interference. How did you find dealing with politicians?



At what point will AI be able to come up with a sensible set of experimental tests that is better than the one you could think of?

Dame Ottoline: A lot of academics would like the Haldane principle to be, 'give me lots of money and let me get on with it'. However, that is not what the principle says. The principle says that it should not be the politicians who decide who gets the money, because you need expertise to understand where the money should go to deliver a particular outcome. It is legitimate for the elected government to say what the outcomes should be, through an industrial strategy for example with priority areas. I think that having that relationship with ministers is one of the benefits of UKRI. It's a big organisation that brings together all those parts and is the interface with government. There is an opportunity to build a strong relationship that allows that to work better, to provide confidence that the outcomes ministers want are being delivered, through the process of funding allocation that UKRI mediates.

Lord Willetts: How did you find those types of conversations with departments on priorities?

Dame Ottoline: Almost the whole job at UKRI is about tensioning priorities and articulating the opportunity costs for the solution that you come up with. You are sometimes tensioning ministers against one another, not ministers' priorities against overall

systems health. For example, funding for centres for doctoral training involves tensioning training to support the overall health of disciplines with targeted training addressing particular priorities. But it also involves tensioning those priorities against each other, which requires tensioning the needs of different Ministers against one another.

Lord Willetts: There are of course, other areas of tension and one is place, geographical distribution. Linked to the endless argument about the extent to which certain universities receive more and less funding. What are the lessons you've learned from the geographic pressures and how do you manage those pressures?

Dame Ottoline: Place has been quite a high priority for quite a long time, and it started off as a debate where people were trying to sort of tension place against excellence, which I thought was an insidious, unhelpful and inappropriate way to talk about it. That comes back to this question of diversity and collaboration. I think we have accidentally embedded a system where universities are competing against one another, against a very narrow set of criteria that drives homogenisation between them. They are all trying to run the 100 metres, when really, it is track and field, and different universities should be focus-

ing on different areas. There should be more diversity, and that diversity also requires collaboration so that you are covering the bases. That would inherently make this question of place, and certainly the place/excellence debate a much more sensible and sophisticated conversation, because it is not about everybody trying to do the same thing. The very fact that you have got a small specialist institution in the North should be a great USP for that institution, in a way that should allow it to compete.

Lord Willetts: This might be an area where Scotland is ahead of us. Certainly, because of its size, it seemed to be able to create coherent groupings, thinking about physics as a discipline and capital investment for physics across Scottish universities. I do not know if it was ever tackled, but I believe it is still the case that cannot receive a grant as a group and cheques have to be written to individual universities.

I think all the Devolved Administrations have done a better job of thinking about the ecosystem of higher education institutions that they have and how they should work together. There is an opportunity to do that in England, and that is a conversation going on now in the context of university financial crisis. How do you incentivise those appropriate behaviours?

Dame Ottoline: I think that groupings would be a good idea. One of the things I really enjoyed doing was visiting cities which had a small number of very different institutions. In lot of them, they were working brilliantly together in a way that really supported the local innovation ecosystem. If you have got a big research-intensive university, but also another that is very vocationally focused and providing highly skilled people to work in local industries, you can really build that in a very powerful way as there is more opportunity and incentive for collaboration between institutions. There is some very interesting economic analysis that shows cities that have a two-university model (such as Sheffield) are particularly good for the civil economy.

Lord Willetts: One final question. We should touch on AI. What does AI mean for research?

Dame Ottoline: AI is going to change everything and there is a huge opportunity to do research differently because of AI. Using AI as a research tool – that is one whole area which is very exciting. I was in a discussion this morning about genomics and how you could use AI to help bridge the genotype phenotype gap. Then of course there is using generative AI to write your grant for you. At UKRI, we are following the principle that you should not use AI to referee a grant proposal, for all kinds of reasons. Not least because it is a confidential document that you cannot just put ‘out there’, and also, what we are asking for is



people's expert opinion on the proposal. I do not want the AI opinion. I want the opinion of the person whom I have invited to give one.

Using AI to write the grant is a whole different deal at some level, to improve your English and make it easy to understand and so on, that is fine. At what point will AI be able to come up with a sensible set of experimental tests that are better than the ones you could think of? Well, that then becomes a very interesting question. Maybe that is also fine. We are interested in solving the problem, not whether it was Bill Smith who did it. We are interested in people understanding how the world works so that they can make it a better place.

Lord Willetts: That is a very good note to end, because you are fundamentally very principled and very optimistic about the power that science still has to tackle the world's problems. I think we should record that that was the spirit in which you approached the role in your in your time as chief executive of UKRI. □

Scotland has had success in making capital investment for physics across Scottish universities

DOI: 10.53289/YLVD3213



The FST podcast invites senior figures across science, research, technology and innovation to take a deep dive into their field of expertise

www.foundation.org.uk/Podcasts

Services for Learned and Professional Societies

The Foundation assists a wide range of **learned and professional societies** with regulatory, administrative, governance and policy matters. This bespoke support is available to societies who are members of the Foundation.

- Bespoke support provided by the Foundation's Learned and Professional Societies Liaison Officer
- Access to almost 50 guidance notes on a variety of relevant topics, including data protection, professional discipline, conflicts of interest, Royal Charters and more
- A quarterly newsletter that covers relevant legislative and regulatory developments, news, events and consultations
- Access to the newsletter archive, dating back to 2001
- Invitations to Foundation for Science and Technology events throughout the year

www.foundation.org.uk/Learned-Societies



Support our work by becoming a member

Conversation is more important than ever.

We are a UK Charity whose mission is to bring together key figures from across Government, academia, research, industry, charities, and other sectors to discuss key issues relating to science and technology in a neutral space.

We also host regular roundtables, a podcast, and run a Foundation Future Leaders Programme for early to mid-career professionals.

www.foundation.org.uk/About/Support-Us

Advising on good governance, Royal Charters, AI and more

Lori Frecker writes about the Foundation's valuable work supporting learned and professional societies

Journal readers will be familiar with the Foundation's role in providing an impartial platform for debate of policy issues that have a science, research, technology or innovation element. Journal readers may be less familiar with an equally important aspect of the Foundation's work: supporting learned and professional societies with governance, regulatory and policy matters.

The Foundation was originally established to support the work of learned and professional societies and has consequently been advising such societies for almost 50 years. Today, we support more than 90 learned and professional societies across a range of sectors, including engineering, mathematics, philosophy, transport, healthcare and more.

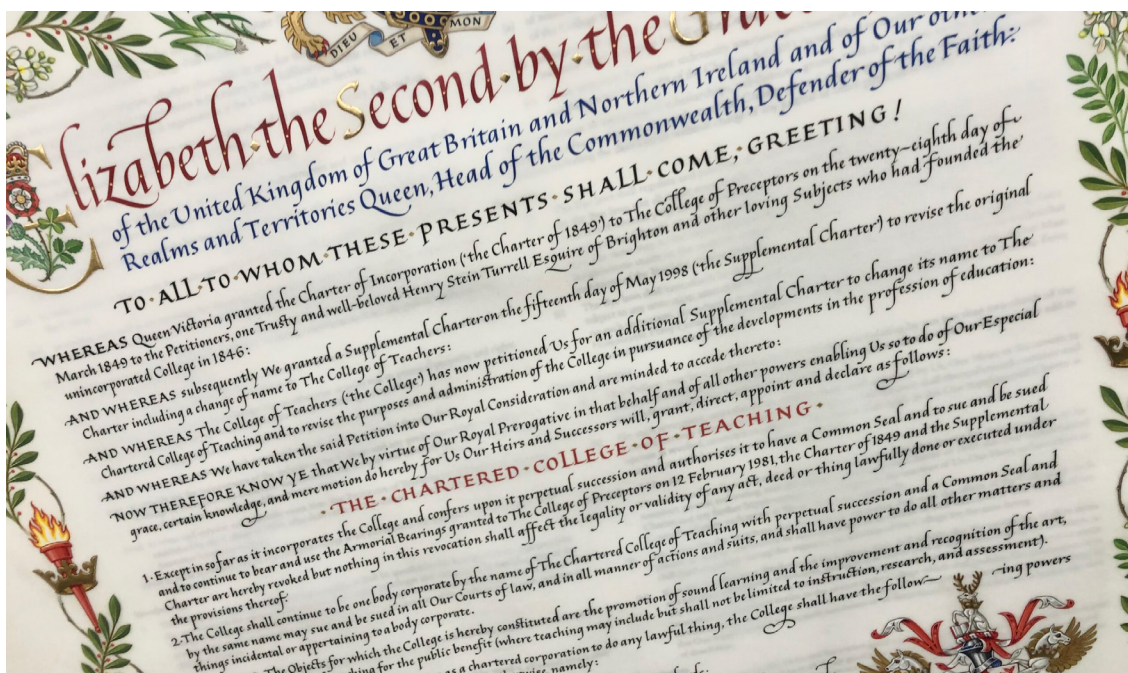
How it started

The Foundation was established in 1977 to deliver the vision of a London Science Centre for learned and professional societies – a physical base to share accommo-

dation and facilities all under one roof. By the 1980s, the Foundation provided meeting space in London for learned and professional societies, as well as organising informational seminars and other events for them.

Although the Foundation stopped providing meeting space in the 1990s, its work to provide advice and guidance to learned and professional societies continued, alongside the expansion of other activities. In 1997, the first specialist Learned and Professional Societies Officer, Keith Lawrey, was appointed to lead this work. The role consisted of organising seminars and events, organising surveys, providing advice on governance and other matters, and producing a regular newsletter. Lawrey also produced many guidance notes on a range of governance issues.

In recent years, the support provided by the Foundation has evolved. The initial demand for seminars fell away as other providers entered the marketplace and more information became available online. Similarly, the annual survey of learned societies was phased out as it was no longer needed. As a result, the Foundation's work to support learned and professional societies became more focussed on providing discrete guidance to those organisations.



Lori Frecker is the Learned and Professional Societies Liaison Officer. She supports learned and professional societies on governance, legal and regulatory matters, and publishes the Foundation's quarterly newsletter for those societies.



How does use of AI intersect with the obligations in a society's code of conduct?

How does the Foundation help learned and professional societies today?

The most valuable – and sought-after – part of this work continues to be the one-to-one support that the Foundation provides to learned and professional societies.

The Foundation advises on a wide range of regulatory, governance and policy matters – from Royal Charters to disciplinary issues, from changing governance documents to data protection. We receive regular enquiries from senior leaders, trustees and board members, as well as governance and policy managers.

Common queries include how to obtain or amend a Royal Charter (including the process involved and likely timescales) charity registration, managing potential conflicts of interest, and reviewing governance documents. Lately, the Foundation has been receiving an increasing number of queries regarding AI, such how use of AI intersects with the obligations in a society's code of conduct.

The types of questions we receive range from straightforward to tricky to completely left field. While no two queries are the same, the Foundation has built up a wealth of experience over the years that enables us to assist members with finding the right answer, developing a pragmatic and practical way forward, and – in the event we cannot help – signposting to other relevant sources of advice.

What are the other benefits?

Learned and professional society member organisations pay an annual subscription, which gives them access to the bespoke support provided by the Foun-

dation. Subscribing members also have access to 48 guidance notes produced by the Foundation, which are available in the members' area of the Foundation website. The guidance notes cover governance, legal and regulatory topics that are relevant to member organisations, including charity and company law matters, Royal Charters, data protection, insurance, professional and ethical conduct, and more.

Members also receive the Foundation's quarterly newsletter. This provides editorial content on administrative and governance matters, as well as updates on news, court and tribunal decisions, and reports that will be of interest and relevance to readers. Foundation newsletters from 2018 onwards are available on the website for download by members only.

Collaborating with others

Collaboration rather than competition has been the rule of the Foundation's activities. Over the years we have partnered with a huge range of organisations, including the Geological Society, the Royal Society, the Royal Society of Chemistry and many others. We are always on the lookout for organisations to partner with, so if you're interested in collaborating with us by hosting or sponsoring an event, contributing to our journal or podcast, or working with us on another activity, we would love to hear from you.

How can I find out more?

Lori Frecker, Learned and Professional Societies Liaison Officer, is happy to answer any questions you may have. You can contact her by email: Lori.Frecker@foundation.org.uk

How can we push the boundaries of exascale computing in the UK?

Large-scale computing has become a crucial requirement that underpins research across all fields. How can we ensure the UK stays ahead of the curve?

The first speaker was Professor Mark Wilkinson, who laid out a case for putting people front and centre.

He began by giving some thoughts on how things had changed with regard to large-scale computers. Large-scale computing has become a crucial requirement that underpins research across all fields – be it scientific research, industry, academia or government. We should view these large-scale computers as essential research instruments rather than just laptops – they are integral to the research process. One key challenge is that research continually evolves. As research questions change, we need to refine our tools – both hardware and software.

There are several reasons why research questions lead to changes in computational requirements. For instance, researchers might need increased resolution to conduct more accurate calculations or incorporate new processes into their studies. In fields like social sciences, there might be a need to consider different types of actors, while in fields like meteorology, researchers may need to merge small-scale effects, such as ocean temperatures, with larger-scale phenomena. Another vital aspect is the quantification of uncertainty.



SHUTTERSTOCK/IRSTONE

Professor Wilkinson said that, ultimately, researchers seek actionable outcomes – information that can be used to inform decisions. This requires an understanding of the associated uncertainties, which often calls for more computational resources. Regardless of efficiency, larger and more complex questions consistently demand greater computational power. A case in point is the [Tersa GPU-based system](#), part of the Dirac facility based in Edinburgh, which had been designed for particle physics theory research. When large language models became prominent, this system was perfectly suited for training them. This flexibility

EVENT BACKGROUND

The UK has provided a succession of increasingly powerful high-performance computing facilities for UK researchers for many years. Do recent developments in AI change what researchers need in terms of high-performance computing? What are the implications of any future provision of exascale computing of expected developments in quantum computing? what is the environmental impact? On Thursday 29th May, the Foundation held a discussion event in collaboration with the University of Edinburgh, which is the home of UK national high performance computing research systems such as ARCHER2, Cirrus and DiRAC-Tursa.

Speakers included:

The Rt Hon the Lord Willetts FRS, Chair of The Foundation for Science and Technology [Chair]

Professor Mark Wilkinson, Professor of Theoretical Astrophysics and Director of the DiRAC High Performance Computing Facility at the University of Leicester

Professor Mark Parsons, EPCC Director and Dean of Research Computing, College of Science & Engineering at the University of Edinburgh

Professor Katherine Royse, Director at Hartree Centre, STFC.

The Scientific Method Has Been Humanity's Best Model for Discovery. It Has Evolved Over Time and Has Entered a New Paradigm of Discovery.

1 st Paradigm	2 nd Paradigm	3 rd Paradigm	4 th Paradigm	
Empirical Science	Theoretical Science	Computational Science	Big data-driven Science	Accelerated Discovery
Observations Experimentation	Scientific laws Physics Biology Chemistry	Simulations Molecular dynamics Mechanistic models	Big data Machine learning Patterns Anomalies Visualization	Scientific knowledge at scale AI generated hypotheses Autonomous testing
Pre-Renaissance	~1600s	~1950	~2000	2020

The combination of big data and high-performance computing is generating new paradigms, much more quickly than in previous generations

highlights the importance of having a diverse ecosystem of services that can evolve with research needs. The first large language model trained entirely on UK-based computer resources was developed on the Tera system.

So, what are the components of a productive ecosystem? People are crucial. It takes talented individuals to design, build, and run systems, as well as to write software and conduct research. The significance of the human element is often overlooked, yet it is vital.

The second speaker, Professor Katherine Royce, focused on the adoption of exascale technologies by the SME community.

According to Professor Royce, the final column (Accelerated Discovery) in the diagram above is where research is at, regardless of the discipline. This is where new discoveries will be made. The combination of big data and high-performance computing is generating new paradigms, much more quickly than in previous generations.

The IBM diagram on page 29 is what the future of computing looks like, according to Professor Royce. It is going to be about qubits (the quantum mechanical analogue of a quantum bit), neurons, and neuro-morphics (computing inspired by the function and structure of the human brain). She predicts that the convergence of high-performance computing, AI and quantum computing is where the next big discoveries

will be. For SMEs, a variety of tools will be essential to achieve early adoption, so composable infrastructures (where [compute](#), storage, and networking resources are abstracted from their physical locations and managed by software through a web-based interface) are going to become increasingly important to run things efficiently.

Being smaller, the challenges of adoption for SMEs can come from funding, skills and knowledge, and not having big AI or data teams, meaning that they are going to be reliant on collaboration with others – whether that is with the big hyperscales or with other providers of HPC AI algorithms. We must understand that there is a community out there with training needs. We also must understand the ethical and regulatory considerations. People often approach the Har-tree Centre with ideas for which they want to use quantum computing, but quantum computing is not always the answer to every problem.

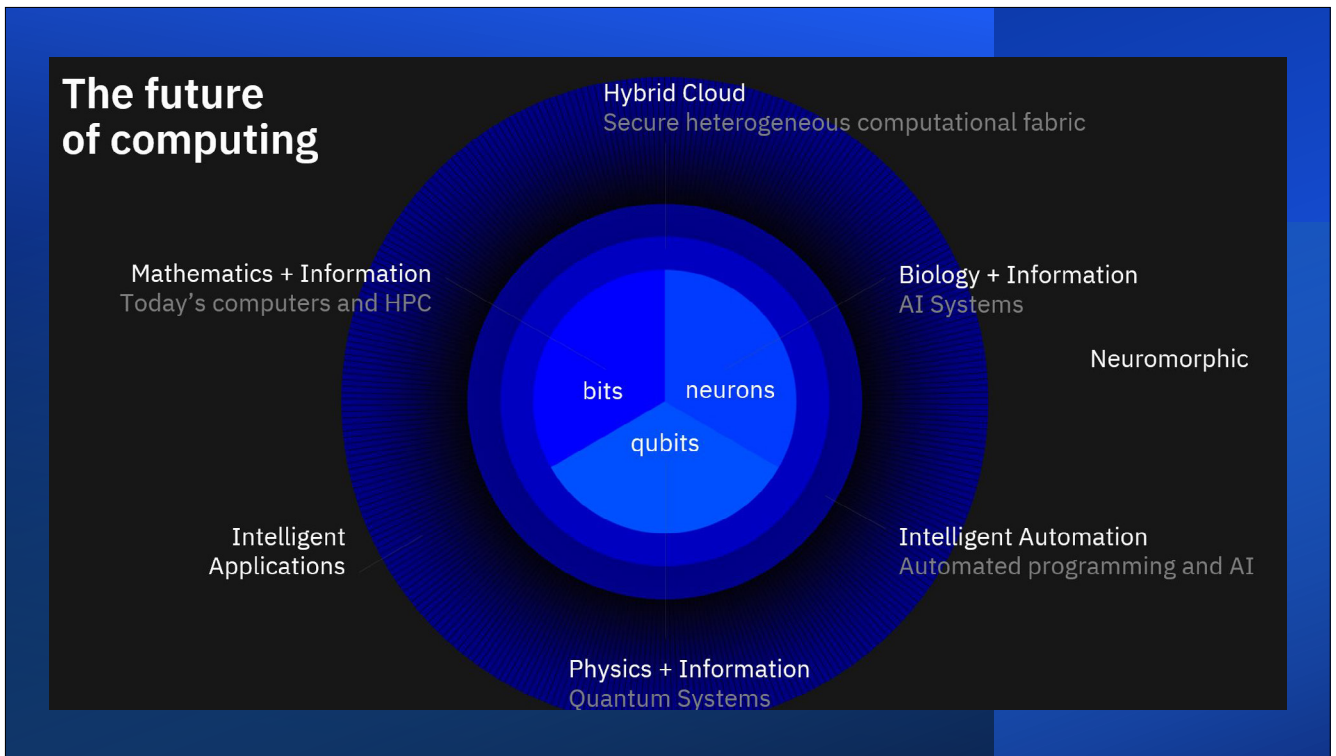
For example, data might not be in a usable format, or there might not be a suitable data policy or governance in place – which could lead to questions around data bias and its impact on the decisions. It could be that machine learning or AI would be more useful than quantum.

SMEs need to have a breadth of understanding across emerging digital technologies, so that they can piece them together to resolve challenges.

Professor Mark Parsons, the final speaker, began by passing around the audience a GPU typically found inside [‘Frontier’](#) - the world's first exascale computer.

The UK has a good surfeit of plans around super-computing such as the [Future of Compute review](#) linked to the [Science and Technology Framework](#).

SMEs need to have a breadth of understanding across emerging digital technologies



Also the [AI Opportunities Action Plan](#), and the Government's response.

Professor Parsons explained that long timelines for investment decisions have presented problems. In his view, the UK spends far too long trying just to get to the point where somebody provides funding, and if we can reduce that, we could really speed up the value of supercomputing in the UK. There are some good examples of complex systems built with Chinese technology. The [Sunway system](#) has 41 million cores. On average, we have four cores in a laptop. The world's first exascale supercomputer (publicly) was the Frontier system and [Aurora](#) followed by El Capitan.

The chip that was being passed around the audience was funded by a programme called [Fast Forward](#) (about 12 years before Frontier came into being), and that was funded in part by the US government. He explained that the US government realised early on that science can push the boundaries of computing forward, but it was also lucky to have companies able to commercialise and make significant amounts of money for the American economy – and tax receipts for the government. Giving some European examples, including The [Jupiter system](#) from Germany (unveiled in early September), he suggested that the UK was not playing the right game yet.

What is next for UK national supercomputers? We have now got the [Archer2](#) extension continued until November 2026. Professor Parsons noted that the UK is not going to have an exascale system. Instead, we are going to have the next National Supercomputer Service, because we are in the 'post exascale age'. He said that the UK should aim for two 'exaflops' – a measure of performance for a supercomputer that can calculate at least one quintillion floating-point operations per

second. He said that we should also be planning for 2035 and looking at the next system, beyond exascale.

With reference to AI and quantum computing, Professor Parsons said that he viewed AI as an application of supercomputing for many years. He does not think playing exascale or numerical supercomputing off against AI makes sense and said that it is the same thing. As a professor based at Edinburgh, he is around quantum-based work a lot, particularly through collaborations with the National Quantum Computing Centre and the Quantum Software Lab.

According to Professor Parsons, we should explore how we programme these devices, what sort of algorithms they could solve and what languages are needed to programme them with. Supercomputers could be used to simulate quantum computers, allowing us to start solving some of these challenges in parallel with developing the quantum computers themselves. He noted that quantum simulation was happening regularly and that supercomputing was going to be critical to delivering the commercial application of quantum computing over the next five to 10 years.

With regards to sustainability, Professor Parsons said that Archer2 is operationally Net Zero, and there are plans to reuse heat created by exascale computing by heating the water under data centres. This would flow towards built-up areas in Edinburgh, and heat would be taken back out with heat pumps. He concluded that we should be pushing the boundaries of exascale, AI and quantum and competing again as a country on the world stage.

To listen to the Q&A and debate that followed the presentations, view the [full event recording here](#). □

DOI: 10.53289/XQUR8281

The future of computing will be about qubits (the quantum mechanical analogue of a quantum bit), neurons, and neuromorphics

2015 The business of the environment

In each issue, the Foundation will look back at an event from our archive. In this edition, we will be digging into an FST discussion that we hosted at The Royal Society a decade ago on the fragility of the environment, human impacts and issues surrounding its protection.

Annual COP negotiations were based in Brazil in this year – the home of the Amazon rainforest, a model of ecological complexity and a case study in the fight against the damaging impacts of climate change. With significant rollbacks on environmental legislation in the USA and beyond, [COP30](#) was always set to be a heated and poignant event.

On 24th June 2015, the Foundation held a discussion entitled ‘The business of the environment’ which explored whether the tension could be resolved between resource extraction and environmental protection. Speakers at this event included:

- **Professor Duncan Wingham**, Chief Executive, Natural Environment Research Council
- **Professor Simon Pollard**, Pro-Vice-Chancellor, School of Energy, Environment and Agrifood, Cranfield University
- **The Lord Oxburgh KBE FRS HonFREng**, House of Lords
- **Professor Jane Francis**, Director, British Antarctic Survey
- **The Lord Selbourne**, Chair of the Foundation for Science and Technology.

This debate was one of a series of events celebrating the 50th anniversary of the creation of the [Natural Environment Research Council](#). Beginning the panel discussion, Professor Wingham said that issues of environmental science were high on the UK national agenda, often higher than in other countries. Debate on the subject, involving development goals, had increasing environmental and social aspects. It was no longer a question of

resource extraction versus development. With many natural resources now diminished or exhausted, it was more than ever necessary to define what we are protecting and why.

Professor Wingham also described the value of the NERC, which could give independent scientific advice on issues such as the impact of CFCs on the ozone layer, variations in air quality, and the effects of pollution on biodiversity – and how best to cope with the changing environment and extreme weather.

The second panellist, Professor Pollard, said that we had to work out strategies for reframing the role of environmental sciences in a green economy, set up a circular economy that could mend itself where necessary, and establish new skills in systemic risk, creation of resilience and appropriate use of big data.

In a few words this meant decoupling economic growth from extraction of resources, and working on how to do business that could take account of such factors as environmental governance, self-regulation, capacity for adaptation, respect for ethical standards and ability to take account of innovation, particularly in the field of technology.

Next, Lord Oxburgh spoke of the need to take due account of the enormous changes taking place in a world created by humans who should be seen as an invasive species with multiplying numbers and

increasing demand on resources. Our approach, he said, should involve better coordination of skills and disciplines.

Some issues were easier to understand than others, especially at local rather than global level. For example, acidification of the oceans, increases in greenhouse gas emissions, the effects of acid rain, or the impact of such projects as the Athabasca and North Alberta oil sands using open-cast mining and hydrogenation of the extracted bitumen. The next big challenge involved the issues surrounding the exploitation of the Arctic.

Antarctic development

In discussion, Professor Francis said that the role of the [British Antarctic Survey](#) was a good example of what could and should be done. It had already been approached by industry and was working with it. Development of the Arctic and Antarctic offered great opportunities, but science had to establish the parameters of future action by the littoral states bordering the Arctic and under the framework of the Antarctic Treaty in the Antarctic. Here the role of the NERC could be critical. In summing up the debate, Lord Selbourne drew particular importance to better valuation of natural capital and the need to make better use of opportunities for developing the green economy.

Read the full event summary and listen to everything speakers said [here](#). □



UN CLIMATE CHANGE / KIARA WORTH

Forthcoming and recent events

Presentations and audio recordings from all meetings of the Foundation for Science and Technology are available at: www.foundation.org.uk

From publication to public action: the case for responsible science activism

Wednesday 18th March 2026

The Royal Society

Further details TBC

Adapting to Climate Change – how prepared is the UK?

Wednesday 25th February 2026

The Royal Society

Further details TBC

Resilience of the UK's national infrastructure

Wednesday 28th January 2026

The Royal Society

Recent events have shown the damage that can be done when there is a lack of resilience in national infrastructure. What are the key threats to our national infrastructure? How can technology help us address them? Further details TBC.

Opportunities and challenges in science, technology & innovation

Wednesday 19 November 2025

Liverpool University

The Foundation Future Leaders Conference. [Applications are now open for the 2026 Foundation Leaders scheme.](#)

The UK Life Sciences Strategy

Wednesday 12 November 2025

London

Steve Bates OBE, Executive Chair, Office for Life Sciences

Baroness (Nicola) Blackwood, Chair, Genomics England

Tony Wood, Chief Scientific Officer, GSK

Professor Sir John Bell FRS, Emeritus Regius Professor of Medicine, University of Oxford

AI and the Future of Work

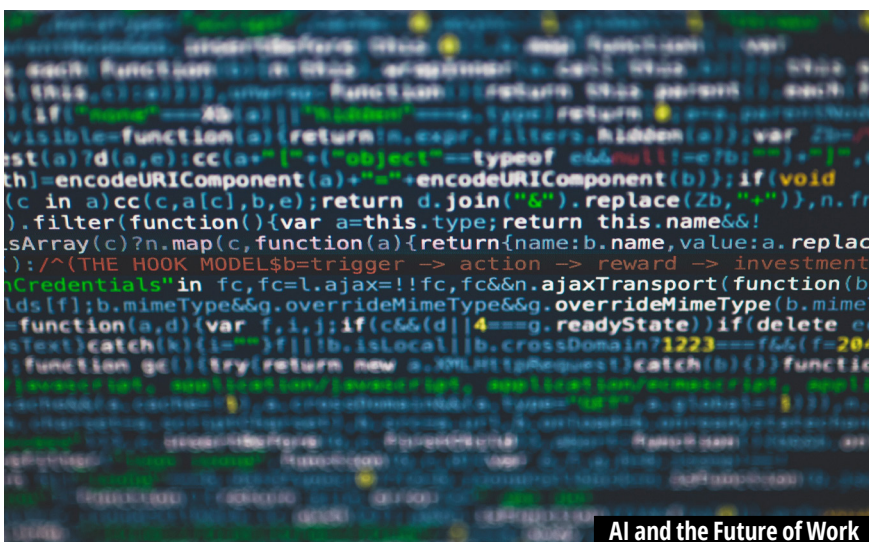
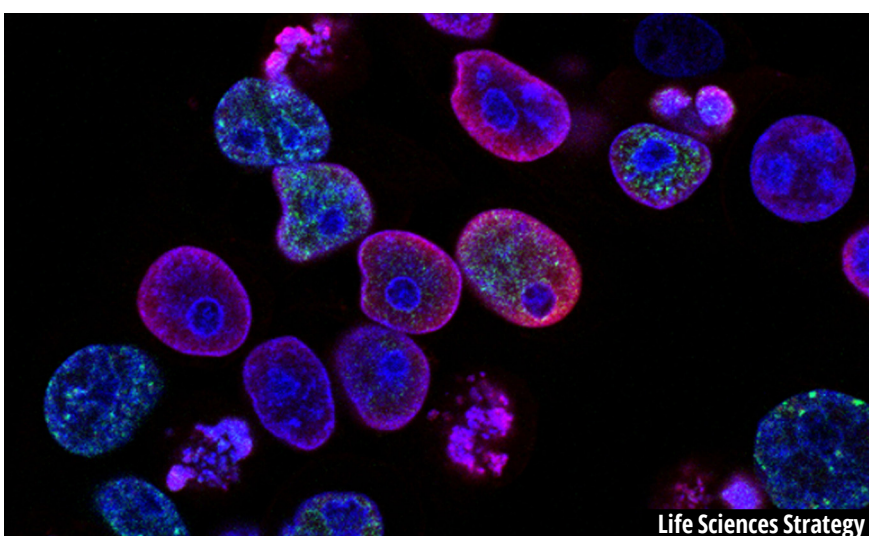
Wednesday 22 October 2025

Belfast

Patricia O'Hagan, Deputy Chair, Matrix
Professor Helen McCarthy, Chief Scientific and Technology Adviser, Northern Ireland Assembly

Professor Philip Hanna, Dean of Education, School of Electronics, Electrical Engineering and Computer Science, Queens University Belfast

Dr David Jordan, Lecturer in Economics, Queens University Belfast, and Ministerial Adviser on Productivity



Past events

Exascale computing for research and the implications of quantum computing, AI and Net Zero

May 29, 2025

Professor Mark Wilkinson, Professor of Theoretical Astrophysics and Director of the DiRAC High Performance Computing Facility, University of Leicester

Professor Mark Parsons, EPCC Director and Dean of Research Computing, College of Science & Engineering, University of Edinburgh

Professor Katherine Royse, Director, Hartree Centre, STFC

How can R&D collaboration with Africa support an agenda for sustainable growth in the UK and beyond?

Wednesday 11th June 2025

The Royal Society, London

Dr Rhona Mijumbi, Co-Director at The Center for Rapid Evidence Synthesis (ACRES), Makerere University and Head of the Policy Unit at the Malawi-Liverpool-Wellcome Programme at the Liverpool School of Tropical Medicine

Professor Ambreena Manji, Dean of International for Africa at Cardiff University, and former director of the British Academy's British Institute in East Africa

Professor Christopher Smith, Executive Chair of AHRC and UKRI International Champion

Decarbonising the built environment and delivering the Warm Homes Plan - the role of social science and engineering

May 21, 2025

Professor Jennifer Schooling, Professor of Digital Innovation and Smart Places, Anglia Ruskin University

Helene Gosden, Associate Director, Retrofit at Scale Taskforce Leader, Arup

Professor Chris Wise FREng, Senior Director, Expedition Engineering and the Useful Simple Trust

Professor Mari Martiskainen, Director, Energy Demand Research Centre, University of Sussex

How can space science missions advance science, drive innovation and create a vibrant UK space industry?

April 30, 2025

Professor Carole Mundell, Director of Science at the European Space Agency and Head of the European Space Astronomy Centre

Professor Adam Amara, Chief Scientist, UK Space Agency

Dr Tudor Williams, Chief Technology Officer, Filtronic

Critical Minerals – how can science and technology help deliver the UK Strategy?

February 24, 2025

Professor Paul Monks, Chief Scientific Adviser, Department of Energy Security and Net Zero

Dr Gavin Mudd, Director, Critical Minerals Intelligence Centre, British Geological Survey

Dr Sarah Gordon, Chief Executive Officer, Satarla, and Co-Director of the Rio Tinto Centre for Future Materials, Imperial College

Professor Emma Kendrick, Chair of Energy Materials, School of Metallurgy and Materials, University of Birmingham

Governing AI for Humanity – what is needed globally and in the UK?

January 29, 2025

Feryal Clark MP, Parliamentary Under-Secretary of State for AI and Digital Government, Department for Science, Innovation and Technology

Dr Douglas Gurr, Director of the Natural History Museum and Chair of The Alan Turing Institute

Professor Dame Wendy Hall DBE FRS FREng, Regius Professor of Computer Science, University of Southampton, and Member of the UN High Level Advisory Board on AI

Adrian Joseph OBE, Board Member and AI Advisor (DirectLine Group, National Lottery, GOSH and Natwest), former Chief Data and AI Officer BT Group

How can science and technology contribute to the UK's Industrial Strategy?

December 2, 2024

Dr Julia Sutcliffe, Chief Scientific Adviser, Department for Business and Trade

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

Dr Peter Waggett, UK Director of Strategic Relationships, IBM Research Europe, IBM UK

Rt Hon Greg Clark, Executive Chair, Warwick Innovation District, and former Secretary of State for Business, Energy & Industrial Strategy

Building Careers and Skills in Science and Technology for National and Global Challenges

November 8, 2024

Professor Sarah Sharples, Chief Scientific Adviser, Department of Transport

Dr Stephen Hendry,

Programme Manager Socioeconomic Inclusion, Royal Society of Chemistry
Dannielle Croucher, Policy Lead for Skills and Talent, National Centre for Universities and Business

Dr Billy Bryan, Evaluation and Research Leader, RAND Europe

Professor Christopher Smith, UKRI International Champion and Executive Chair of AHRC

Professor Marika Taylor, Pro Vice Chancellor and Head of College of Engineering and Physical Sciences, University of Birmingham

Alex Hale, Technology Programme Manager, National Composites Centre

Dr Geoffrey Neale, Royal Academy of Engineering Research Fellow and Lecturer, Cranfield University

Should R&D policies and budgets be devolved to English Regions?

October 23, 2024

Professor Tim Jones, Vice-Chancellor, University of Liverpool

Thomas O'Brien, Vice-Chair, Liverpool City Region's Innovation Zones Program

Dr Lesley Thompson, Vice-President Funders Global; Business Development, Elsevier

Dean Cook, Executive Director – Place, Innovate UK, UKRI

In Conversation with Professor Dame Angela McLean

October 9, 2024

Professor Dame Angela McLean DBE FRS, Government Chief Scientific Advisor

The Rt Hon the Lord Willetts FRS, Chair, The Foundation for Science and Technology

Quantum Technologies – from research to reality

September 24, 2024

Dr Dame Frances Saunders, Chair of the Royal Academy of Engineering's Quantum Infrastructure Review 2024

Professor Melissa Mather, Professor of Quantum Sensing and Engineering and Royal Academy of Engineering Chair in Emerging Technologies, University of Nottingham

Simon Andrews, Executive Director, Fraunhofer Research UK Ltd

Rachel Maze, Head of Quantum Technologies Policy, Department of Science, Innovation and Technology

MAJOR SUPPORTERS IN 2024/2025

A

Advanced Research Clusters
Arts and Humanities Research
Council, UKRI
Association for Innovation,
Research and Technology
Organisations (AIRTO)
AstraZeneca
AWE

B

Biotechnology and Biological
Sciences Research Council, UKRI
British Geological Survey
Brunel University London

C

Chartered Institute of Credit
Management
Comino Foundation
Cranfield University

D

Defence Science and Technology
Laboratory
Department of Health and Social
Care

E

Economic and Social Research
Council, UKRI
Elsevier b.v.
Engineering and Physical Sciences
Research Council, UKRI

H

Health and Safety Executive
High Value Manufacturing
Catapult

I

Imperial College London
Innovate UK, UKRI
Institute of Biomedical Science
Institute of Materials, Minerals &
Mining
Institute of Mathematics and its
Applications
Institute of Quarrying
Institution of Chemical Engineers
Institution of Mechanical
Engineers

K

King's College London

M

Matrix - The Northern Ireland
Science Industry Panel
Medical Research Council, UKRI
Met Office

N

National Centre for Universities
and Business
National Physical Laboratory
Natural Environment Research
Council, UKRI
Nottingham Trent University

P

Parliamentary and Scientific
Committee

Q

Queen's University Belfast

R

Research England, UKRI
Rolls-Royce

Royal Society of Biology
Royal Society of Chemistry
Royal Statistical Society

S

Science and Technology Facilities
Council, UKRI
Society of Operations Engineers

T

The Academy of Medical Sciences
The Royal Academy of Engineering
The Royal Commission for the
Exhibition of 1851
The Royal Society

U

Ulster University
University College London
University of Birmingham
University of East Anglia
University of Edinburgh
University of Exeter
University of Glasgow
University of Hull
University of Leeds
University of Leicester
University of Nottingham
University of Reading
University of Sheffield
University of Southampton
University of Westminster

The Foundation is grateful to these companies, departments, research bodies and charities for their significant support for the debate programme.



Foundation for Science and Technology

Resilience of the UK's national infrastructure

Wednesday 28th January 2026, 5:30pm

The Royal Society, London

Details and registration via our website
www.foundation.org.uk/events

The Journal of The Foundation for Science and Technology

The Foundation for Science and Technology
22 Greencoat Place
London SW1P 1DX

Telephone: 020 7321 2220
Email: communications@foundation.org.uk

www.foundation.org.uk

