



The Journal of the
Parliamentary and
Scientific Committee –
All-Party Parliamentary
Group

SCIENCE IN PARLIAMENT

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AUTUMN 2023

DIGITAL NATO

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ANNUAL LUNCH

The P&SC's Annual Luncheon was held on the 3rd July in the Cholmondeley Room, House of Lords. The event was sponsored by the President, Viscount Stansgate. Our guest speaker was Lord John Krebs FRS and the Vote of Thanks was given by the Chairman, Stephen Metcalfe MP.

Members and supporters were joined by a number of Parliamentarians including Adam Afriyie MP, Lord Taylor of Holbeach, Viscount Hanworth, Lord McNicol, Baroness Walmsley, Baroness Northover, Chi Onwurah MP and Carol Monaghan MP.



Stephen Metcalfe MP



Lord Krebs



Viscount Stansgate



Doris-Ann Williams MBE,
Gareth Giles and Francesca Scott



Seb Hargreaves and
Baroness Walmsley



Dr Megan O'Donnell, Natasha Stephenson and Dr Mathias Ruth



Professor Ian Haines, Baroness Northover, Paul Jackson, and
Professor Michael Elves



Andrew Mackenzie and
Carol Monaghan MP



Matt Rooney and Chi Onwurah MP



Tony Harding, Marijke Smith, Maggie Mitchell and
Lord Taylor of Holbeach CBE



All Guests



Stephen Metcalfe MP
Chairman, Parliamentary & Scientific
Committee (All-Party Parliamentary
Group)

A warm welcome to the Autumn edition.

My thanks to our distinguished contributors and to the Institute of Innovation and Knowledge Exchange (IKE) for providing us with another striking front cover.

Following the Summer Parliamentary Recess, I chaired, on the 18th September, the first of our three Autumn discussion meetings. The theme was *Digital Health in the 21st century*, and we were very pleased to be partnered by Northumbria and Newcastle Universities.

By the time this edition reaches you I will have welcomed to

Parliament the Rosalind Franklin Institute, sponsors of our 16th October meeting, the subject of which was *Changing how we see life*.

On November 20th The Physiological Society will be partnering P&SC in a meeting on *The impact of extreme heat on vulnerable populations*.

I thank our sponsoring organisations, their teams, and the excellent speakers who make these informative gatherings such a success.

My thanks to our Programme Committee, chaired by Carol Monaghan MP, who are arranging the meetings programme well into 2024.

Preparations are already underway for the 27th annual STEM for BRITAIN which takes place on Monday 4th March. The 2024 competition for Early Career Researchers in Parliament was launched on Monday 18th September.

The closing date for submissions is **Monday 27th November**. Please encourage applications through your various

academic and scientific society networks.

In July I was very pleased to welcome to P&SC Viscount Hanworth and Lord McNicol as Parliamentary Members.

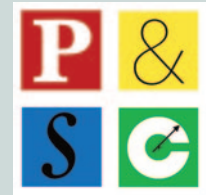
Regrettably I must end on a sad note, to record the passing on 2nd July of Dr Douglas Naysmith, one of my predecessors as Chairman of the Parliamentary & Scientific Committee.

Doug was Member of Parliament for Bristol North West from 1997 to 2010 and served with distinction on a number of Commons Select Committees, including Health and Social Care, and Science and Technology.

With his partner, Sue Wharton, Doug continued to support P&SC, particularly STEM for BRITAIN, which he had been instrumental in resurrecting in the 1990s. Sue has written an appreciation of Doug, which you can read on page 19 of this journal. Doug was a warm and delightful man whom we will greatly miss.



The Journal of the Parliamentary and Scientific Committee (All-Party Parliamentary Group).



Science in Parliament has two main objectives:

1. to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
2. to keep Members of Parliament abreast of scientific affairs.

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INNOVATION AND DIGITAL TECHNOLOGIES: UNDERPINNING NATO'S WARFARE DEVELOPMENT AGENDA



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Innovation and digital technologies have taken centre stage in redefining the contours of defence and security. Since its inception in 1949, NATO (North Atlantic Treaty Organization) has evolved continuously to adapt to emerging threats and changing geopolitical landscapes.

In an era delineated by rapid technological advancement, 'Digital Capability' has emerged as the new force reshaping defence and security strategies worldwide. This evolving arsenal is not characterised by bullets and missiles, but by lines of code, predictive analytics, and a mesh of Artificial Intelligence algorithms. Digital pervasiveness signifies a seismic-shift from traditional military planning and doctrine to that of a sophisticated and rapidly changing battlefield, where data and cyber capabilities are the cornerstone^{1,2}. Through the IKE Institute's work with NATO's Allied Command Transformation (ACT), we shall shed some light on the pivotal role of innovation and digital technologies play in realising NATO's strategic priorities and its future positioning.

THE KINETIC-DIGITAL BLEND

Kinetic forces are increasingly being equipped with digital technologies to enhance their capabilities. For example, Artificial Intelligence (AI) and Machine Learning (ML) are being used to improve targeting, reconnaissance, and logistics, enabling more effective and efficient operations. The integration of digital technologies

has resulted in a blended form of warfare where both kinetic and digital capabilities are utilised concurrently.

TRANSFORMING NATO'S STRATEGIC IMPERATIVE

In recent years, NATO has laid out a comprehensive roadmap for the future of its collective defence initiatives outlined in its new Strategic Concept in Madrid on 29 June 2022. Central to this roadmap is the Warfare Development Agenda, which prioritises novel warfighting capabilities to address emerging threats and challenges and underpin NATO's three core tasks – *deterrence and defence; crisis prevention and management; and cooperative security*³. Innovation and digital technologies form a central plank in underpinning NATO's capability to meet the alliance's 2030 aspiration of cohering multidomain operations, ensuring seamless interoperability across all domains, strengthening situational awareness at the point of need, and enhancing political consultation through data-driven decision-making processes. So, let's take a look at NATO's approach to commencing Digital Transformation⁴.

TOWARDS A DIGITALLY-ACTIVATED NATO

"Embracing digital transformation and innovation is no longer merely an option; it is an imperative. Our journey has commenced. It continues to evolve to harmonise the physical and virtual worlds creating a formidable force that is agile, adaptive, and ahead of the curve. Our commitment to harnessing cutting-edge technologies ensures that our Alliance is not only prepared, but is always a step ahead. Navigating this journey with the IKE Institute and other partners within our ecosystem is an exciting one that is gaining significant momentum."

Vice Admiral Guy Robinson
CB OBE

Chief of Staff, NATO Allied
Command Transformation

Agreed by the alliance in October 2022, NATO's Digital Transformation Vision sets out a comprehensive approach to embracing new and emerging digital technologies. A new paradigm that triangulates

people, process, and technology, and ensures data and analytics form the connective tissue has emerged, as shown in Figure 1.

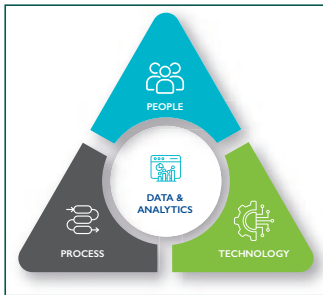


Figure 1: Key Pillars in Digital Transformation

STARTING WITH THE PEOPLE DIMENSION

Recognising that human capital was the most valuable asset, enabling or inhibiting the achievement of a desired outcome from DT, creation of a baseline position for digital literacy and dexterity has been ACT's Supreme Allied Commander and his Chief of Staff's shared strategic ambition. Establishing a DT lexicon to ensure consistency in the shared understanding of what DT meant to individuals and their functions, has been the starting point to help forge the new Kinetic-Digital capability. A designated Digital Champion role to corral participation and coordinate digital initiatives within ACT has also been established.

The IKE Institute developed and run a comprehensive series of certified educational and immersive training programmes in innovation and digitalisation. Examples of such programmes include:

- Understanding Digital Transformation

- Digital Transformation for NATO
- Warfighting in the Digital Age
- Certified Innovation Leader
- Certified Innovation Practitioner
- Prioritising for Innovation Success

Structured individual and group mentoring and support activities are also provided to help identify high value learning experiences and create actionable development plans for participants.

THE PROCESS DIMENSION

Process automation relies on having the right data in the right format and from the right sources. Aspects of data – *volume, veracity, velocity, variety* (i.e. how many points of reference are used to collect data) – have been part of building the initial understanding as to where the gaps may be within operational chains in a process. Any gaps in a data chain impedes coherency and consistency of actionable outcomes. Therefore, a review of data flows (*data chains*) at 'lines of delivery' level is being undertaken, as outlined in Figure 2.

The use of universal *digital libraries* that are validated and verified provided a valuable aid when defining the data chains in a process. Applications for process automation such as the Microsoft Power Automate – a Software as a Service platform (SaaS), offered a useful and readily accessible tool for exploring how to automate

recurrent tasks. In addition, the Microsoft Power Platform, which includes Power Apps and Power BI also provided an effective interactive data visualization environment for Workflow Automation. These 'No Code/Low Code' platforms continue to help users to define workflows and use knowledge graphs to create custom applications, and visualise their own solutions in line with project needs, without any knowledge of how coding works. Quality, security, privacy, and process lifecycle continue to form key considerations as part of introducing new digital process flow.

The hands-on training sessions, in using these tools, generated great enthusiasm and a slew of potential ideas for use cases. Exposure to agile practices such as DevOps and DevSecOps provided an effective accelerant to enhance teams' abilities to continuously deliver, monitor and scale applications and services rapidly.

THE TECHNOLOGY DIMENSION

In selecting from the expansive range of new and emerging digital technologies (EDT) such as AI/ML, Internet of Things (IoT), Augmented and Virtual Reality (AR/VR), Cloud and Edge computing and 5G amongst others, the focus here has been on considering which combination of EDT can create an *end-to-end experience total experience* for warfighter/civilian user, and integrate touchpoints at local, enterprise and federated levels⁵.

The "Everything-as-a-Service" notion is being used to: establish a set of guardrails ensuring integration with existing systems and platforms, assuring future-proofing, and enabling scalability. It's worth highlighting here that users only value what technologies can do for them and their functions! That means deploying EDT has to result in either *optimisation* of a task, process, or function; or *transformation* – offering new, innovative ways of creating and delivering value, in terms of gains and benefits, as outlined in Figure 3.

Technology selection continues to be guided by operational needs and their associated use cases. And therefore, this has mandated the need to establish technology development horizons, and define their associated implementation roadmaps.

THE DATA AND ANALYTICS DIMENSION

Undoubtedly, data is the key to unlock Digital Transformation. From the outset, the focus has been on understanding and agreeing data policies, and establishing data management strategies. Another focus related to this, has been on embracing standards. For example – the ISO/IEC 5259 guidelines for data governance, data quality assessment, measurement and improvement of datasets training and operation is being used to support the drive for interoperability and integration of different federated systems. A resilient and scalable digital backbone is also being



Figure 2: Steps in Developing Digital Workflows

architected with the support of NATO's Communications and Information Agency- NCIA.

within NATO enterprise, and across the nation members' digital defence and security organisations.

influence diplomacy or 'digital diplomacy'. NATO is likely to leverage digital platforms to negotiate, collaborate, and build

start-ups to advance the alliance's technological capability. The fund will focus on areas including artificial intelligence, space, and biotechnology. This transformation, grounded in innovation, underscores NATO's commitment to safeguarding peace and security in an increasingly uncertain digital world.

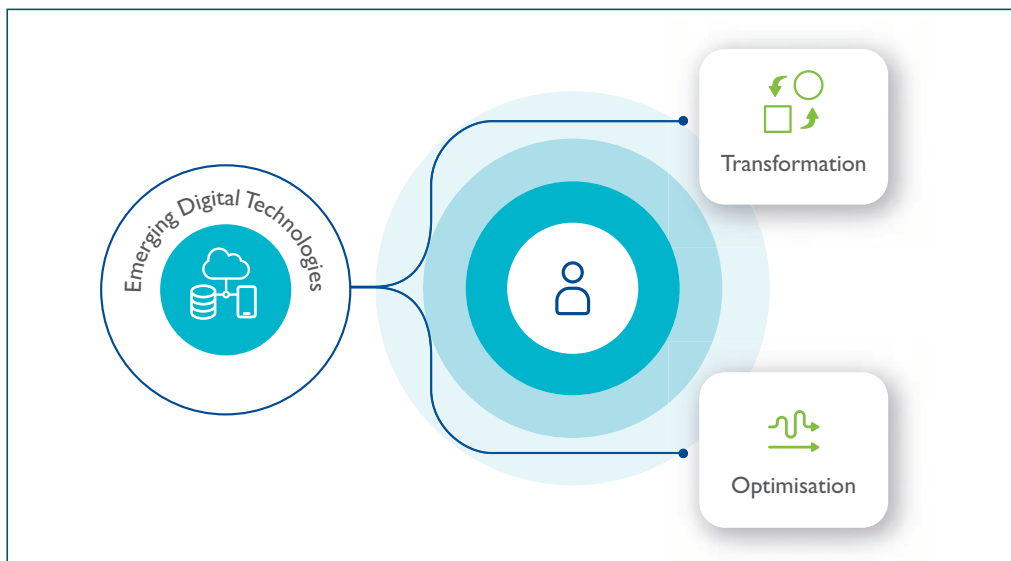


Figure 3: Outcomes of Deploying New and Emerging Digital Technologies

Analytics – a statistical technology with quantitative methods used to gain insights, predict shortcomings, uncover patterns, develop responses, and build strategies accordingly – is being introduced to provide invaluable input for advancing command and control, optimising logistics, supply-chains, and resources management, amongst many other decision-making requirements.

Currently, NATO aims to enhance its data exploitation efforts. In October 2021, NATO's Defence Ministers endorsed an Artificial Intelligence strategy, to accelerate and enhance a range of alliance capabilities. Subsequently, in October 2022, a NATO Data and Artificial Intelligence Review Board supported by an Autonomy Implementation Plan has been established, to ensure ethical and responsible use of these technologies. The recent establishment of the Office of the Chief Information Officer is now providing a steer in the DT strategy and its foundational elements, as well as advocating and coordinating its implementational solution paths

DIGITAL NATO: UNDERPINNING ALLIANCE WARFARE CAPABILITY

The growing prevalence of hybrid threats is mandating the need for NATO to ensure its warfare development agenda (WDA) is digitally enabled, thus delivering an integrated and interoperable multidomain operations defence capability^{6,7}. Digital Innovation is the "golden thread" that cuts across all aspects of the WDA. NATO Commanders continue to build their knowledge and skills to master cross-domain strategies characterised by agile and asymmetrical thinking. This will necessitate robust–frequently updated–communication and information systems. Cognitive superiority in a military sense, which revolves around strategic anticipation and situational awareness, is claiming the position of being a prime beneficiary of DT, contributing to NATO's immutable defence and deterrence postures. Equality and adaptive capacity to ensure resilience, is another clear gain from DT.

Digital will not only rewire the warfare agenda, but will also

trust with partner nations and stakeholder organisations. Furthermore, counteracting, and neutralising disinformation campaigns will also be a byproduct of DT.

CONCLUSION

NATO's Warfare Development Agenda is undergoing a seismic shift, driven by the potent combination of innovation and digital technologies⁸. From the battlefields to cyberspace, from the training grounds to global narratives, every facet of NATO's operations is being reshaped. As these technologies continue to evolve, so will NATO's strategies. From understanding future challenges to driving innovation and ensuring interoperability, ACT's role is comprehensive. As NATO continues its journey of digital transformation, ACT is also contemplating how the wider innovation landscape is morphing, and thus, is ensuring the alliance remains robust, relevant, and ready to tackle the challenges of the 21st century.

NATO continues to sharpen its innovation-edge. A recent NATO-backed € 1bn venture capital fund plans to inject some financial firepower into defence

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SELF-TESTING AND ITS IMPACT ON HEALTHCARE



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For over three decades, home tests for measuring glucose, cholesterol, a hormone that is indicative of pregnancy and blood pressure have proven their efficacy and laid the foundation for consumer trust in test kits and devices. Routine at-home testing for COVID-19 has added to the general public's comfort with self-testing, increasing the acceptability of, and demand for, home-use kits and health-related devices.

Besides disease-related testing, the health and wellness segment of at-home testing is experiencing significant growth as consumers, especially millennials and GenZ are increasingly taking responsibility for optimising their own health¹. This includes tracking heart rates and steps with brands such as London-based X-Wrist² and measuring sleep and optimal rest with wearables and smartphone apps. Demand in the women's health category, which includes fertility, perimenopause and post-menopause testing, is growing significantly with companies such as Chepstow-based Forth³ leading the way. Of the consumers who monitor their own health, over three quarters have said that the results have led them to change their behaviour with the younger generations being the most likely to make changes.

For the past five years⁴ and especially post-pandemic, access to self-testing kits and technology has been expanding. This is now a rapidly growing industry which runs in parallel with traditional testing by healthcare professionals and analytical laboratories. Today, self-tests and devices can be purchased in-store, online and from pharmacies, and measurement

or sample taking is done without the input of a healthcare professional. Measurements and samples taken are either processed at home or sent to a laboratory, and may offer screening, diagnosis, monitoring, or information about the risk of a disease. In some cases, tests are directly interpretable by the user (consumer), while the results of others are communicated to an



expert for interpretation and to judge if a further intervention is required.

The development of new tests is aided by advances in sensor technology, data interpretation, AI and the application of the Internet of Things to clinical/biological systems. This will greatly increase the scope of diagnostics and enable the consumer to make informed decisions about their health and wellness and allow consumers to take more responsibility for their own health.

However, in 2018, some UK doctors warned that at-home testing could trigger a need for additional primary-care consultation as consumers were likely to self-diagnose based on a single result rather than having the complete clinical picture⁵. Nonetheless, those same doctors indicated that the benefits of self-testing would improve patient health and well-being, provided that there are adequate regulatory systems in place to assess the suitability of tests and technology, and that tests come with high-quality, easy-to-understand information about their performance and interpretation. Further afield in the USA, a Deloitte review found that the opportunity for a patient to self-test at home, instead of a doctor's surgery, saves time and money⁶. This was recently confirmed by a review in the *Journal of Health Economics* which indicated that self-testing, device-assisted telehealth reduced care costs by 7%⁷.

It is our contention that the increased development and use of self-testing for infectious (e.g., COVID-type) and non-infectious (e.g., diabetes, cardiovascular disease, cognitive decline) diseases, as well as general health and wellbeing, will help in the early detection and preventative treatment of

disease and in optimisation of health status. This will support the deployment of healthcare resources to facilitate more effective use of these increasingly scarce resources and allow consumers to self-manage their health for beneficial outcomes.

INNOVATION

Self-testing for disease states, health and wellness is a new frontier that is consistent with the evolution of the virtualisation of industries like banking, travel and shopping. The first question that must always be answered is whether the new product is a medical device or a 'wellness' device? Or does it cross the boundary between the two?

Innovation offers significant opportunities in self-testing through the miniaturisation of technology, application of Artificial Intelligence and app development. Consider the Apple Watch that records heartbeat and rhythm using their ECG app, and the lightweight Aktiia¹¹ bracelet that records an average of over 70 blood-pressure readings per week without the need for a cuff. Cognitive behavioural therapy (CBT) apps like the FDA-approved AspyreRx™ for type 2 diabetics help patients to make and sustain meaningful lifestyle changes, and to connect these changes in behaviour to improvements in blood sugar and other biometrics¹².



However, the self-testing arena presents more challenges than other tech industries. These challenges involve regulatory scope and product definition, and product safety and quality, amongst others. Furthermore,

devices for self-testing have to be intuitive and simple to use as in most cases, they will be used and perhaps interpreted by untrained individuals. Doctors are also reluctant to accept results from devices that are

SELF-TEST TECHNOLOGY EVOLUTION

Self-test technology has evolved from finger-prick tests for glucose monitoring to those that can detect infectious diseases. Cuffs for blood pressure monitoring are being replaced by bracelets with embedded optical technology; and lateral flow devices have progressed from the detection of human Chorionic Gonadotrophin (hCG) in urine, in the case of pregnancy tests, to confirm the presence or absence of a target analyte from blood, serum, saliva, sweat and urine samples.

While older technology is still extensively used, innovation has expanded the range of home tests and devices available as well as what can be monitored, measured, detected and diagnosed.

Some examples include:

- Lateral Flow tests use body- fluid samples to detect hormones, infectious diseases and drugs.
- Finger-prick tests that detect infectious diseases and allergens are interpreted at home, while those for genetic screening can be sampled at home and then sent away for laboratory testing.
- Larger blood samples and swabs can be taken at home and sent away for laboratory testing. In the UK, the rapidly expanding London Medical Laboratory can perform most phlebotomy tests. Similarly, Forth,⁸ in Wales, focuses tests related to women's health and wellbeing.
- Swabs taken at home for faecal occult blood are sent away and tested by the NHS for colon cancer.
- Implantable Continuous Glucose Monitoring devices to help manage blood sugar levels for diabetic children, adults, athletes and people needing care and supervision.
- Optical technology, similar to that used in wrist-based heart-rate monitors, measure blood pressure day and night.
- Home-use ECG devices can detect heart rate irregularities, which is especially beneficial for those high-risk patients with congenital heart disease or a history of atrial fibrillation.
- Apps use mobile-phone camera technology to measure oxygen saturation or post-operative recovery after orthopaedic surgery.
- Tytocare's Home Smart Clinic is a hand-held medical device that enables a remotely-guided virtual consultation with a doctor. It reduces total cost of care, delivers 59% more accurate diagnoses than traditional telehealth solutions, and resolves 98% of visits without necessitating an in-person appointment⁹. It is now used by various NHS Trusts¹⁰.

unfamiliar to them, for example using photoplethysmographic data¹³ vs. inflating cuff measurements for blood pressure. In addition, where healthcare professionals (HCPs) charge for tests, self-testing using at-home kits and devices may have a negative financial impact on their practices, which could cause friction between developers and HCPs in the short term.

Wearables, both medical devices and wellness devices, provide sufficient impact on health and wellness for *Nature, Scientific Reports*¹⁴ to have published an entire collection on their development.

CYBERSECURITY CHALLENGES

The Deloitte 2020 Survey of US Health Care Consumers found that more US consumers are using technology to monitor their health, measure fitness, and order prescriptions, and that they are willing to share their data with healthcare providers and researchers, and even tech developers¹⁵. Fitness and health apps and devices may store name, address, locations, health records and banking information – valuable content in a world where data is currency. Hackers and cybercriminals may target data servers, connection signals (Bluetooth, Wi-Fi), devices or smartphones¹⁶. Cyber-attacks on healthcare are increasing. At CPX London it was revealed that in May 2023 there were 1383 cyber-attacks in healthcare per week, compared with 797 weekly in May 2022¹⁷. The former US Vice President, Dick Cheney had his heart implant device altered to prevent cyber-attack¹⁸.

REGULATION

A major consideration is how regulators will deal with new self-testing technologies and services marketed directly to consumers.

Regulators must ensure that patient safety and a high standard of care is maintained. Significant strides are being made by regulators in the acceptance of new technologies as medical devices. For example, the MHRA now have a pathway for Software as a Medical Device (SaMD) in response to the development of new technologies.

But can regulators keep up with the pace of innovation? At recent medical technology conferences, businesses indicated that they are unable to get regulators to approve their products on the basis that the regulators simply do not understand the technology. While the challenge of regulators keeping up with technology is by no means exclusive to the UK, it is an issue that has the potential to limit innovation and discourage investment¹⁹.

The growth in the market for polygenic risk scores (genomic testing to determine the susceptibility of an individual to disease) which are marketed direct to consumers, has led to calls for the Food and Drug Administration in the US to review its policies on scrutiny and enforcement of direct-to-consumer tests that are available without a health care professional as an intermediary²⁰.

DEVELOPING UK PLC

The global At-Home Testing Market Size was valued at USD 16.7 billion in 2021 and is estimated to surpass USD 45,582.24 million by 2031, growing at a CAGR of 10.5% from 2022 to 2031²¹.

In 2021, Core Medical Technology²² in the UK, which includes the developers of self-tests, employed approximately 113,000 people and generated GBP23.6 billion in revenue. This is driven extensively by SMEs which make up 77% of the UK

Life Sciences; indicating that the UK is well placed to take advantage of the global opportunities created by the self-testing market.

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A NEW OCEAN MONITORING TOOL FOR CLIMATE RESEARCH



Giuseppe-marra

Earth monitoring is essential to understand the effects of climate change. However, whilst the ocean plays a fundamental role in regulating the world's climate, it is still mostly unmonitored. New research led by the National Physical Laboratory (NPL) in Teddington shows that seafloor telecommunication cables could play a fundamental role in reducing this data gap.

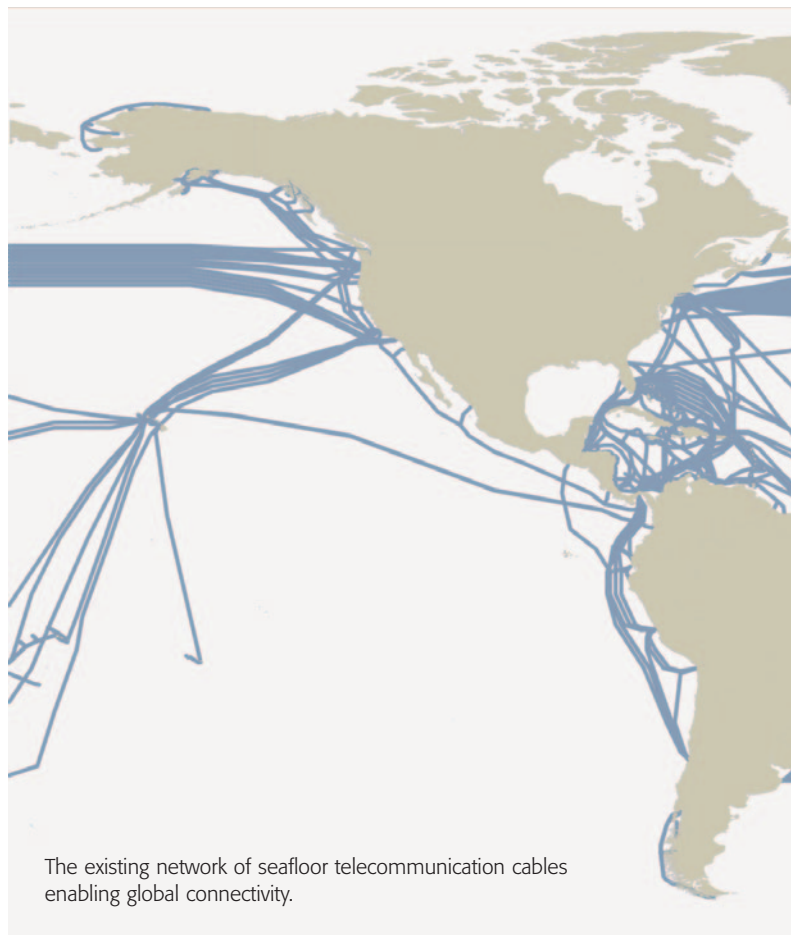
Climate change is one of the greatest challenges that the world is currently facing. Unprecedented temperatures and extreme weather events have dominated the headlines in several countries this summer, and more can be expected in future. In this changing climate, a fundamental role is played by the ocean and its complex circulation. Changes in these water conveyor belts can in fact have a dramatic impact on the world's climate and a full understanding of their behaviour is crucial to predict, and possibly mitigate, their effect. Over several decades, scientists have been equipping land and space with increasingly advanced monitoring capabilities, delivering crucial data for climate change research. However, whilst more than 70% of the Earth's surface is covered by water, it might be surprising to learn that the oceans are still largely unmonitored. Indeed, it is technically and economically very challenging to install and maintain a network of permanent sensors on the seafloor on a global scale. As a result, environmental data from the seafloor is scarce and available only from deployments with temporary sensors in specific areas of the world and a handful of permanent ocean-bottom scientific observatories,

limiting our understanding of the overall dynamic ocean behaviour.

Results from our recent research show a possible new way to start filling the large gap in ocean data, without requiring any additional seafloor installation. We showed that in the future, a network of ocean-bottom environmental sensors could be deployed by using the existing subsea

telecommunication infrastructure that already lies on the seafloor and enables internet traffic across the world.

By launching ultra-stable laser light into the optical fibres inside a 5,860 km-long seafloor cable connecting the UK and Canada and performing precise measurements of the time it takes for the light to travel through it, we were able to detect ocean currents at the



The existing network of seafloor telecommunication cables enabling global connectivity.

bottom of the Atlantic Ocean¹. Under the action of ocean currents, the seafloor cable is “strummed” like a guitar string, causing changes in the time of travel of the light in the optical fibre. These are very small changes which do not normally have any impact of the internet traffic transmitted over the optical fibre cables. However, by employing high-precision optical measurements, they can be detected so that the optical fibre becomes a sensor for deep-ocean currents. In seafloor optical cables, optical amplifiers are installed typically every 50 to 90 kilometres along the cable. This is because, whilst optical fibre inside the cables is made of very transparent glass, the intensity of the light still weakens significantly after travelling tens of kilometres through it. Thus, “light boosters” (the optical amplifiers) are employed at regular intervals to enable transmission over thousands of

kilometres. In our experiments, each cable span between optical amplifiers acted as an individual environmental sensor, thus achieving up to 20 sensors every 1,000 km. Expanding this technique to multiple cables, a network of hundreds, or even thousands of sensors could be achieved without changes to the seafloor infrastructure.

In the future, the same principle could potentially be used to monitor long-term changes in ocean-bottom water temperatures, currently unmonitored. Research in this direction has only recently started, but if successful, this novel way of monitoring the thermal changes in deep ocean could add crucial information to global warming research.

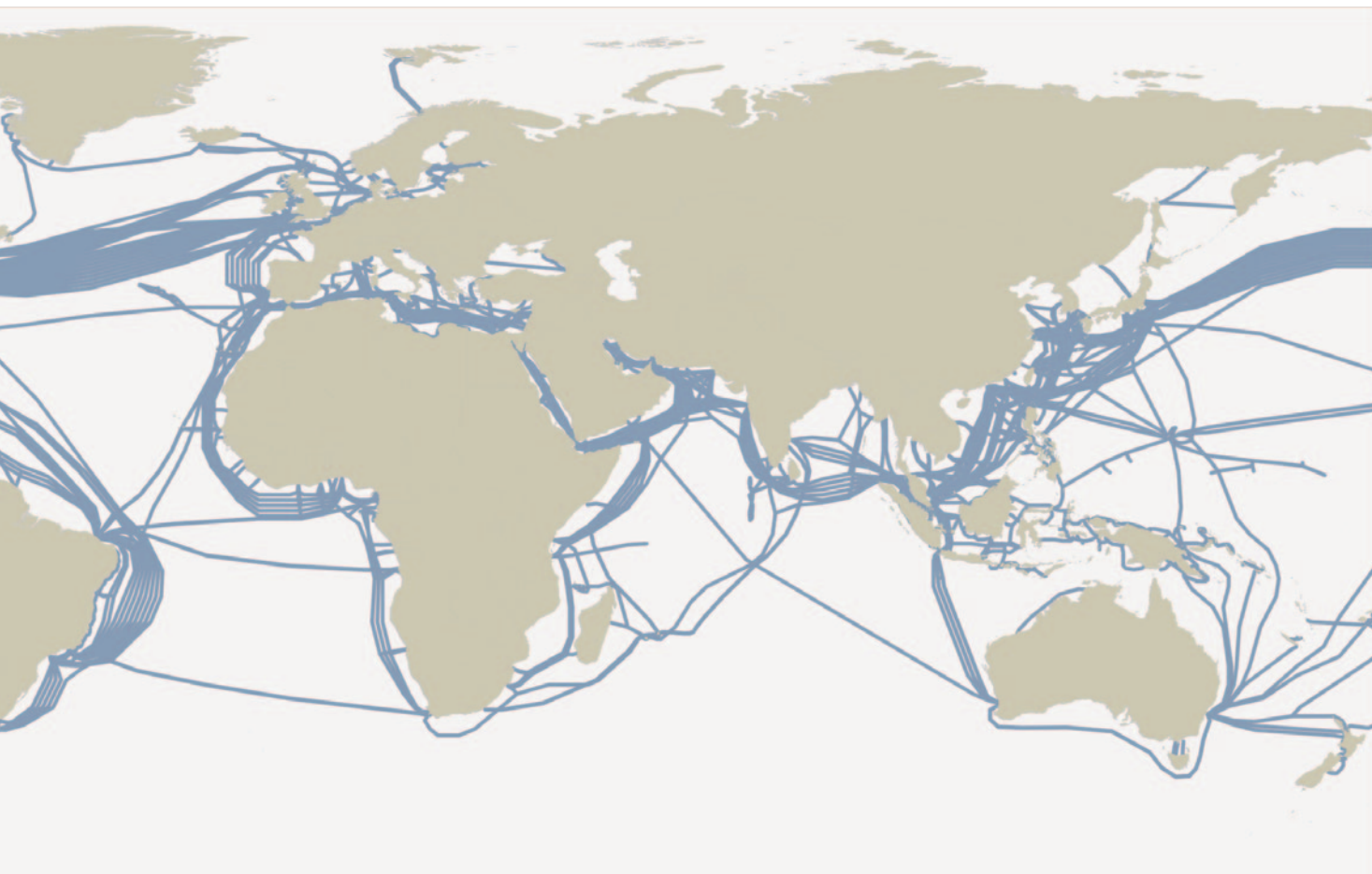
After enabling the digital revolution of the last 30 years, the web of optical cables that criss-crosses seas and oceans might be the key to a new

revolution, this time in Geophysics and climate research, by enabling a unique new way of detecting deep ocean currents and, potentially, temperature as well. Today 1.4 million kilometres of optical fibre, across 550 cables, are already installed on the seafloor. With the ever-increasing demand for more connectivity, the number and geographical coverage of these cables can be expected to increase substantially over the coming decades. Consequently, the coverage of this seabed infrastructure will expand, reducing the number of areas of the oceans not crossed by cables. By applying the environmental sensing technique developed at NPL, crucial data could be collected to better monitor changes in the ocean, enhancing our understanding of ocean circulation and climate change research.

It is interesting to note that this potentially game-changing monitoring technique was derived from research on ultra-precise time and frequency distribution over optical fibre links that NPL has been developing over the last two decades. Once again, by pushing the boundaries of precision measurements in research laboratories like NPL, new innovative outcomes and applications are achieved. Just as the improved resolution of the James Webb Space Telescope is now allowing us to discover details of space we couldn't see before, pushing the precision of measurement provides a fundamental tool to set the landscape for new discoveries and applications, with huge potential benefits to society.

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iMAGINE – 7,500 YEARS OF SUSTAINABLE ENERGY FROM NUCLEAR WASTE



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Let’s create sustainability through technology development to unlock new energy resources, thereby bolstering national energy security and supporting the UK’s transition to net-zero.

Creating a limitless, zero waste, clean and uninterrupted supply of energy for the world – this sounds like a utopian vision for all humanity. But as energy security becomes an increasingly important issue for the UK in the face of turbulent geopolitical events and challenging net-zero carbon targets come into sharper focus, is there a way to turn this dream into reality?

Most of us would think that even if such an ideal technology could ever be invented, it certainly would not be economically viable and must involve a ‘high-risk, high-reward’ development process. Imagine, if this dream was not as far-fetched as it seems – developmental risks were low due to existing experience but rewards still as high; the technology was financially feasible; and, most importantly, public concerns were addressed by making people an important stakeholder during the development life-cycle. Maybe all we need to create such a breakthrough energy technology is to embrace a new vision for the future by moving away from limited, linear thinking and adopting transformational strategies for the entire system from *cradle-to-grave*.

iMAGINE – A NEW APPROACH TO ENERGY

At the University of Liverpool, we are taking on this challenge

by developing iMAGINE¹, a novel and holistic nuclear system designed to generate vast amounts of energy while solving the current nuclear waste problem. iMAGINE will allow us to harvest almost 100 times more energy from mined uranium as compared to current commercial nuclear reactor technologies and dramatically reduce the amount of nuclear waste. It is an integrated nuclear system based on a chloride molten salt reactor where fuel exists as a molten mixture of chlorides of uranium (UCl₃ + UCl₄) and sodium (NaCl or common salt). Being in a liquid state means the fuel also acts as the coolant, addressing most safety issues of present reactors. iMAGINE’s design also allows the fuel to be accessible, enabling an integrated fuel cycle instead of the currently complex, time consuming and segregated one.

Our research shows that iMAGINE can operate on *spent nuclear fuel* (SNF; see Figure 2) from existing reactors^{2,3} without the need for prior separation of uranium and plutonium from other material in SNF, a process known as *reprocessing*. Extracting energy from the 7,000 metric tonnes of legacy spent nuclear fuel⁴ with iMAGINE can deliver low-carbon electricity for around 250 years for the UK at current consumption levels! Moreover, it can also use currently stored *tailings* – a by-product of the uranium enrichment process used during fuel production for current reactors – as fuel. By using the approximately 200,000 metric tonnes⁴ of uranium locked in tailings, iMAGINE could provide electricity for 7,500 years – worth more than £1,000 trillion^(a) at today’s market value!

iMAGINE, thus transforms the



Figure 1 – Benefits of iMAGINE

existing nuclear waste burden in the UK into a precious asset – a virtually inexhaustible energy resource. Importantly, this source of energy is already stored in the UK making us independent of electricity related fuel imports and global energy security issues. This innovative system also addresses important public concerns around nuclear waste disposal by reducing the amount of waste requiring long-term storage by almost 100 times in comparison to current commercial reactor technologies, and decreasing the storage time to only a few hundred years for bulk of the waste.

discarded as waste, either in the form of spent nuclear fuel or tailings. Think of it like buying an electric car with a huge battery capacity only to realise that just 10% of its capacity could be used before the battery needs to be replaced or recharged. Nuclear engineers have known about the energy waiting to be extracted out of the mined uranium since the initial days of reactor technology in 1950s.

The *closed nuclear fuel cycle* was proposed as the solution to extract more energy from uranium. It involves reprocessing SNF (as is done at Sellafield), using the separated uranium



Figure 2 – Interim storage of spent nuclear fuel (Source: SKB⁷)

CURRENT NUCLEAR ENERGY SYSTEMS

Nuclear energy has undoubted potential to contribute towards our national decarbonisation goals, with the UK committing to “delivering new and advanced nuclear power” under the Government’s Ten Point Plan for a Green Industrial Revolution⁸ published in 2020. This commitment was reiterated in 2022 with the Government setting a goal to deliver up to 24GW of nuclear power (25% of our projected electricity demand) by 2050⁹.

However, the currently existing commercial nuclear reactors typically harvest less than 1% of the energy contained within mined uranium. The rest is

and plutonium as fuel in fast reactors (as is done at Dounreay), and repeating this process multiple times. Think of this as having to recharge your electric car battery, but after using only a small fraction of its total capacity, and repeating this process many times over. Fast reactor technology – which uses high-energy or *fast neutrons* for fission and can convert left-over materials into new fuel – has been pursued by various countries but high costs and complexity prevented its successful commercialisation. Besides this, the need for separation of uranium and plutonium raises concerns about their potential misuse to produce weapons.

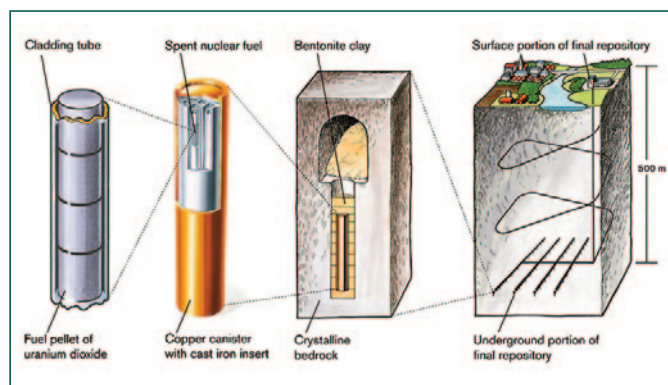


Figure 3 - Spent nuclear fuel disposal (Source: SKB¹⁰)

Due to the limited commercial success of closing the fuel cycle, spent (or already burnt) nuclear fuel is currently destined for *deep geological disposal*¹¹ (Figure 3) in most countries, including the UK. This involves isolating the waste for more than 100,000 years in underground vaults hundreds of metres below the earth’s surface. This is required as some of the constituents of nuclear waste, mostly uranium, heavier elements, and some fission products, have a very long *half-life* – the time taken for the radioactivity of a material to reduce by half. One of the main drivers of public concern around this method is how reliably and accurately scientists can predict safe storage so far into the future and ensure that no radioactive material leaks out.

TURNING NUCLEAR WASTE INTO ENERGY FOR THE UK

Our aim for iMAGINE is to support the UK’s demand for decarbonisation using sustainable, low-waste, affordable, low-carbon 24/7 energy with resource security by developing a demand-driven technology, rather than creating technology-driven demand. iMAGINE also addresses public concerns around nuclear weapons proliferation by avoiding the need for separation of uranium and plutonium, thus eliminating all possibilities of their potential misuse for

producing weapons. Moreover, recycling existing waste material as fuel means there is no need to mine new uranium. iMAGINE is also safer than current reactors as the molten salt acts as both fuel and coolant making the system inherently resilient against cooling failures. High boiling point of the salt means there is no need to operate the system at high pressure, thereby ruling out accident scenarios which dominate the safety designs of current nuclear reactors.

iMAGINE focusses on holistic thinking by considering all stages – mining of uranium ore, energy production, final disposal of waste, and most importantly, the public. However, like other nuclear reactor technologies, this novel and innovative system also has a long maturity horizon from conceptualisation to commercialisation. Therefore, a long-term development plan (Figure 4) is essential for its success which must be supported by sustained and concerted efforts. After all, efforts during COVID-19 proved the value of targeted research! Such long-term coordinated efforts can only be assured through the creation of a robust research infrastructure at the national-level in the UK.

Indeed, this long-term effort will have technical, financial, political, and societal risks. However, these can be mitigated and minimised effectively

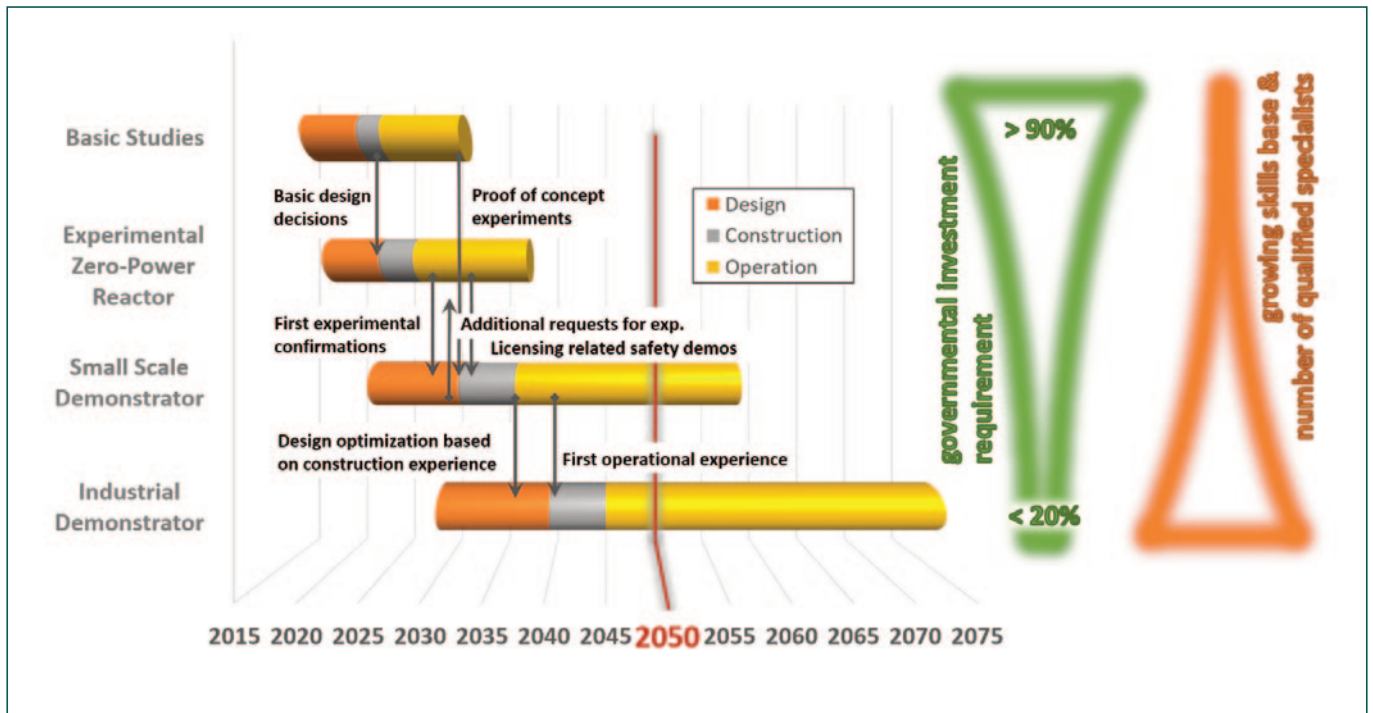


Figure 4 – Development plan for iMAGINE

through our proposed stepwise development plan.¹ Swift progress can be achieved through planning the appropriate steps to ensure quick feedback. Our approach enables capacity building – industrial, regulatory and human capital – alongside technology development (see graphic on the right of Figure 4). Not only has the adoption of such a stepwise paradigm delivered success in the past, such as during the early stages of nuclear energy technologies in the 1950s,¹² similar plans have been adopted by other countries for the development of innovative reactor technologies¹³.

It is important to embed active risk mitigation at every step of the development process with effective risk communication in order to transparently convey the pros and cons of a new technology to the public. Moreover, there is a strong need for social justice and democratisation of the technology development process, especially for all things nuclear. This is being done through early engagement with the public to understand

people’s perception, expectations and demands. After all, addressing the public’s needs is the key to creation of a successful demand-driven technology.

iMAGINE’s technology might not be currently ready, but let’s dare to imagine this breakthrough opportunity of the 21st century. iMAGINE has the potential to make the UK a scientific, technological and energy superpower, cementing our position at the forefront of the global sustainable energy and climate change challenge. However, to be successful in the future, we must take the first steps today.

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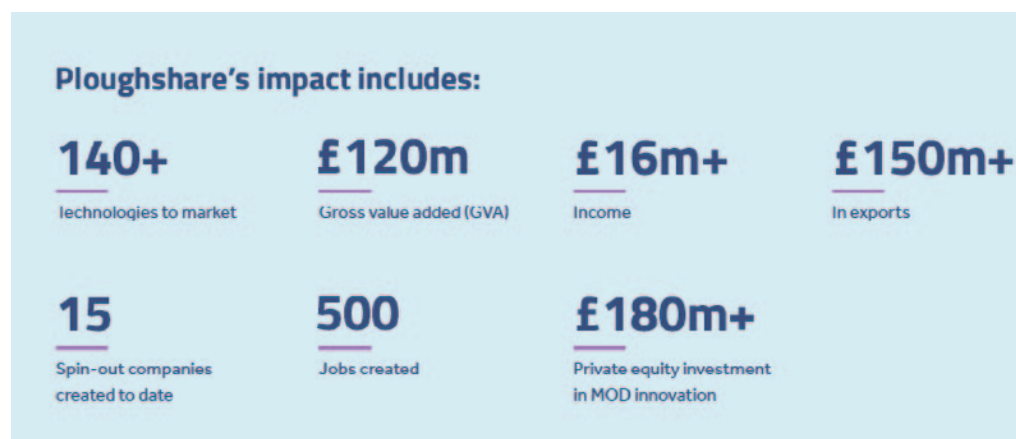
(a) Current annual electricity consumption in the UK is worth £143 billions Average electricity price UK⁵ = 52p per kWh; Total annual electricity consumption UK (2022)⁶ = 275.24 TWh = 275.24 billion kWh

DISCOVER, LIBERATE AND SCALE: UNLOCKING INNOVATION IN THE PUBLIC SECTOR



Hetti Barkworth-Nanton
Chief Executive Officer, Ploughshare

What is the right role for government when it comes to unlocking the value of public sector innovations? Some would argue for a light touch approach, for government to effectively get “out of the way” on the route to market, and others would recommend holding a steadfast interest and firm hand in the commercialisation journey. At Ploughshare we know liberation is key to success, but it takes so much more.



When we consider the most successful, highly innovative startups one important factor is how effective they are in maximising the value of the intellectual property they hold. At Ploughshare we work across Government to discover, liberate and scale existing innovations, to find new and inspiring uses for government inventions and investment in science and technology.

This continues the application of public sector research which has shaped the world, including those inventions originally born out of defence R&D and later incorporated into civilian application, including computers, radar, antibiotics and the jet engine.

We operate in an auspicious time for UK science and

technology with Government priority and increased investment set to the goal of achieving science superpower status for the UK. Last year Ministers confirmed the UK's largest ever budget for public R&D, covering £39.8 billion over 2022 - 2025. This year, the Science and Technology Framework provided strategic focus to five critical technologies; more recently the Chancellor's Mansion House speech unveiled further measures to drive investment from UK funds into unlisted, high growth UK companies. These are significant steps to address a long-standing issue in the conversion of world-class UK research into new world-class companies, growth and commercial success.

The public sector offers a rich

seam of untapped knowledge assets, across central government these are estimated to total a value of £104 billion, according to analysis in the Dr Andrew Mackintosh's comprehensive report "Getting Smarter" (2021) which set out the implementation strategy to unlock this greater value, focusing around three pillars of good practice, incentives and access to support.

Ploughshare works with the MOD and public sector partners to unlock innovation and put it into the hands of users for economic and societal benefit – and is working to build further partnerships across the public sector. It was established in 2005 by the **Defence Science and Technology Laboratory** which recognised that a wholly-

owned, but separate company, would be better suited to engage with industry to take on the increasing amount of commercialisation activities and in particular to translate defence science into groundbreaking solutions for wider society. Hence the choice of name of our organisation, with its analogical reference to the biblical phrase of turning “swords into Ploughshares”.

Since then, our remit has expanded to identify, channel and provide support beyond the defence portfolio and more broadly across the public sector. Now we are positioned as an accessible service which partner organisations, such as the **National Oceanography Centre** and the **Met Office**, can use to commercialise their IP.

Independent analysis by SQW reveals that this work has unlocked the licensing of more than 140 new technologies, creating over 500 high-value jobs and £120 million in GVA. This work has leveraged over £180 million in total additional public and private investment through the 17 new companies spun-out of government-owned IP, which include:

- **Presymptom Health**, a company spun-out of the MoD, uses research originally intended to tackle threats from biological infections. Presymptom has created a revolutionary test that can predict when patients will develop infection and sepsis three-days before symptoms appear, an advantage that would be crucial to saving lives, reducing treatment costs and supporting the fight against antimicrobial resistance.
- **P2i** is a company which has revolutionised the conformal coating market, protecting over a billion electronic devices – such as smartphones, wireless stereo

headsets and hearing aids – with the world’s largest electronics manufacturers. P2i’s patented plasma process increases reliability of products whilst reducing manufacturing costs. It is now a global company with headquarters in the UK and China, and customers across eighteen different countries.

- **Sentinel Photonics** are developing sophisticated technology to detect and protect against laser threats. Ploughshare supported their journey from whiteboard discussion to frontline application in only five years. Sentinel is now exploring the



Copyright Sentinel Photonics 2023

technology as a method of detection and threat level assessment when lasers are shone at commercial aircraft or at sporting events, an excellent example of IP translation.

Our record was recognised in the Government’s Defence Command Paper (2023) which acknowledged that, in an increasingly “contested and volatile” world the Ministry of Defence will take on an “ambitious new approach to the exploitation of intellectual property (IP)... developing the Government’s existing vehicle for spinning out IP, Ploughshare Innovations Limited, and promoting larger-scale commercialisation – to accelerate military capability

delivery... as well as tech sector growth and job creation.” We look forward taking up this opportunity to delivering further economic dividend as well as increased capabilities and resilience.

Our expertise is focused on providing the inventors of breakthrough IP the support needed to create spin-outs and provide the prospect for commercial success. There are two levels of challenge here. First is to increase awareness amongst officials in the public sector that they have the option and capacity to take their innovation beyond government. Second is to provide those

officials with the incentive to take and continue that journey to full completion. The world of work is changing quickly and we offer support on different commercialisation pathways, providing flexible employment models and introducing those in the public sector looking to develop entrepreneurial skillsets.

This is where the Ploughshare Spinout Playbook comes to hand for the public servant as a concise guide. It provides an overview of the steps, from exploratory conversations to deciding on a licensing option or spin-out route to market. Decisions being informed by market insights, a realistic business plan and robust assessment of the IP position.

Readers will be familiar with the metaphorical ‘valley of death’, the challenging transition point where private financing options for founders are limited. Here we have established the Ploughshare Accelerator Fund (PAF), which allows access to early financing to accelerate innovation and build momentum without delay. This funding can cover – and essentially de-risk the costs of – developing new technology prototypes or covering the business planning phase for founders’ salaries, providing security on expenses which would otherwise present significant challenge.

When we talk about motivating those innovation leaders to invest their time and commitment, an essential element to consider is the question of equity in the potential spinout. Historically other organisations, including universities, have been accused of retaining too much equity when creating spinout companies, and not providing enough incentive to founders to be successful, which effectively suffocates the company at the earliest stages, hindering development and making it almost impossible to attract external investment. However, certainly amongst the bigger research universities this is changing, with a recent report by TenU, the University Spin-out Investment Terms (USIT) Guide 2023, saying that ‘Starting (founding) equity percentages for the universities between 10-25% are typical’.

Ploughshare and the MOD have been bold and are leading the way across the public sector in this regard, announcing over a year ago that we will only take 20% equity in spinout companies, with the remainder being shared across the founders and management teams. This is a game changer and is already making a huge

difference to the pace and ambition of our spinouts.

Central to our approach in unlocking the wealth of innovations across the public sector is embedding the principles of Equality, Diversity and Inclusion (EDI) through the whole journey to market. This starts internally, where the diversity of our organisation has been transformed over the last 3 years, and we work tirelessly to encourage an open and inclusive culture. Aside from the intrinsic value of this approach, inclusion is key to ensuring we can discover and unlock the maximum amount of IP. When we consider the importance of speed to successful commercialisation, we cannot afford for high-potential IP to be left sitting on the shelf because

of a failure to engage talent from a variety of different backgrounds.

These EDI principles are of value at every stage of the spinning-out pathway. Management teams from spinouts need to benefit from a true diversity of perspectives in that critical early stage, both in terms of considering market applications through to engagement with partners and investors. There has been some good progress in recent years, but there is a huge distance to go, as shown in the Commons' Treasury Committee finding that businesses with all-female founders received only 2% of venture capital funding in 2021, with less than that figure going to black and ethnic minority-led businesses.

Achieving this shift requires sustained and deliberate effort, and success will deliver huge rewards – in terms of bolstering the economy, strengthening our national resilience, and unlocking the myriad benefits of new technology to wider society. Ploughshare has set the ambition of unlocking £1 billion GVA by 2030 and we are keen to engage with all those working on this agenda to share perspectives and examine opportunities for collaboration.

The UK public sector is a leading source of innovation with transformational societal and economic potential. Within government, exploitation of IP needs to be seen as a natural consideration for innovation leads, rather than the exception. The Government Office of

Technology Transfer (GOTT) is working extensively across Government to ensure departments are identifying and protecting their knowledge assets, whilst simultaneously putting in place the policies and the enablers to succeed.

Alongside this, where organisations believe they have different innovation assets to be unleashed, Ploughshare is interested in partnership. There is a new generation of innovation-led businesses waiting to emerge out of government. We can give them the best start and ensure that these public innovation assets deliver true public benefit. ■

PHYSICS INNOVATION: THE ENGINE ROOM OF THE ECONOMY



Professor Martin Freer
Vice-President for Science and
Innovation, Institute of Physics

The UK Government has committed to increasing the share of GDP devoted to R&D. This is a vital goal if the country is to achieve its ambitions to compete internationally as a 'science superpower'.

Businesses are by far the biggest investors in R&D in the UK, though government has an important role to play. This article draws on research commissioned by the Institute of Physics (IOP) which shows the innovation performance and potential of physics-based businesses, and the impact of physics-based industries on the economy. The research shows the huge opportunity that exists to fuel economic growth and the development of industries built on cutting-edge innovation. It also points to some of the barriers to innovation that businesses are facing.

The IOP is committed to transforming the physics R&D ecosystem so that it can better contribute to innovation, discovery, research, growth and debate.

We believe it is vital to improve the conditions that foster business innovation and grow levels of business R&D and innovation investment. The societal and environmental benefits of physics innovation are vast: in simple terms, physics innovation is essential to developing industries that can decarbonise the economy and will underpin developments from healthcare to defence to

food security. It will also provide jobs and prosperity: innovative businesses are the engine room of the economy.

RESEARCH INTO PHYSICS-BASED BUSINESSES

In 2021 the IOP commissioned CBI Economics to survey the innovation activity of 304 physics-based businesses across the UK and Republic of Ireland. We wanted to gain a better understanding of the amount and type of physics-related innovation taking place, the challenges experienced by businesses, and where the

opportunities lie to increase innovation activity and investment.

The research focused¹ on businesses that were actively engaged with physics technologies or research areas, and which had undertaken research & development (R&D), product/service innovation or activities to directly improve production process within the previous five years. (Other forms of innovation, such as new business practices, were not considered.)

The research found that physics-based firms are by nature innovative and are active investors in scientific discovery and technology. For the vast majority of these companies (91%) R&D and innovation is a strategic priority. Furthermore, 63% of UK physics innovators expected their R&D/innovation spending to increase over the next five years compared with the previous five years.

What does this mean in economic terms? We know from research measuring the impact of physics-intensive industries on the UK economy² that around a third (34%) of all business-conducted R&D is done by physics-intensive industries (those industries where physics research is most concentrated). This amounted to £8.9 billion in 2019.

Not only do physics-based businesses contribute a disproportionately large share of R&D investment today, but they also expect to grow that investment in the coming years. Physics-based businesses are pivotal to the Government's ambition to boost private sector innovation.

A MISSED OPPORTUNITY

Business-led physics innovation therefore represents a big

opportunity for the UK. The right support from Government can help unlock this additional investment and ensure that physics-based firms play their part in building economic growth and an innovation economy.

However, the report also lays bare some major challenges facing physics innovators. With development times often stretching to many years, physics innovators face a complex mixture of challenges related to funding, project risks and access to resource. Perhaps the most striking finding is that a shortage of skills has already put a brake on the innovation activities of physics-based businesses. 66% of UK survey respondents said that skills shortages had caused innovation activity to be suspended or delayed in the past five years. Indeed, only 11% of UK innovators said they faced no difficulties recruiting.

This represents a missed opportunity. How much greater could the contribution of physics-based businesses have been, were it not for the inability to fill critical skills gaps?

Another IOP report on workforce skills tells us that the demand for physics skills is growing quickly, which will cause the skills gap to widen even further, stalling plans to increase R&D activity and scientific output.

So, to fully seize the opportunities offered by increased investment in R&D and build a more innovative economy, we need an increase in the scale and diversity of the R&D workforce to fuel scientific progress.

FUNDING CHALLENGES

Other issues identified in the survey are more inherent to investment, with direct costs and the risky nature of physics-based R&D being cited as challenges by 50% and 48% of respondents, respectively.

Given the high costs and typically long timeframes associated with physics-based R&D, it is perhaps unsurprising that 67% of physics innovators in the UK said greater access to direct funding for early-stage R&D could encourage more R&D/innovation activity.

Funding pressures were most acute at later stages in the innovation pipeline, notably production, scaling up, and commercialisation.

In view of these challenges, it is especially important to note the high value placed on government support for physics-based R&D/innovation activity. Well over half (59%) of the physics-based businesses in the survey reported financing R&D/innovation activity using some form of public funding over the past five years.

In fact, the report makes clear that public funding is not just important, but essential:

- 70% of survey respondents that had received public funding for R&D/innovation within the last five years said that it filled a financing gap without which the activity would not have taken place.
- 55% that had received public funding within the last five years said that it supported the development of products/services that otherwise may not have been produced.

This report adds to the growing body of evidence that public funding for R&D helps attract private investment by accelerating the innovation process and providing a mark of quality for potential investors. Public funding acts as multiplier for private sector investment in R&D.

Public funding is also seen as delivering significant, long-term spill-over benefits too, such as

increased collaboration, the development of skills, and improvements to equipment and infrastructure that benefit future products.

WHAT FORM SHOULD GOVERNMENT SUPPORT TAKE?

We asked firms which policy enhancements would encourage and support them to undertake more R&D and innovation activity in the coming five years.

Two thirds of UK respondents (67%) said that direct funding for early-stage research and later-stage development could help unlock additional spending by their companies. Long-term funding schemes were cited by 61% of UK respondents.

This finding - along with the fact that publicly funded innovators are also more likely to be concerned about future funding - indicates that, currently, support is not being offered with enough certainty to allow innovators the confidence to continue with long-term projects.

Policy also has a role to play in supporting innovation in ways that go beyond addressing funding pressures. Almost a third of respondents said that improved government procurement would support greater R&D/innovation activity, while better digital infrastructure and an improved regulatory environment were also highlighted as changes that would allow physics innovators to undertake more R&D/innovation activity.

PHYSICS' HISTORIC ROLE

The research we have commissioned gives us great cause for optimism. There is much to celebrate in what we have learned about physics and its contribution to innovation in the UK.

Historically, physics has played a vital role in driving forward technological change. Each of the industrial revolutions we have been through – steam power, electrification, the nuclear age – has been built on the application of discoveries made by physics. We only need to look at today's emerging technologies to see that physics is continuing to play its historic role in innovation. Developments in quantum technology, photonics, advanced semiconductors, satellite technology, and many of

the green technologies that promise to help decarbonise our economy, are all heavily reliant on physics-led innovation.

We can see from the report that activities built on physics skills and expertise are associated with high levels of innovation. Of those companies that are doing physics, most are innovating, and those that are doing the most high-intensity physics, tend to be innovating more. Crucially, we can also see that this is driving significant investment in the economy.

The right support can help it to deliver even more.

This article is adapted from a presentation given to the Parliamentary and Scientific Committee as part of its session on 'The Deep Tech SME Ecosystem – Supporting research-intensive SMEs to maximise their contribution to economic recovery', on 22 May 2023.

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HOW THE UK CAN LEAD THE 'THIRD AVIATION REVOLUTION'



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Power Engineering,
Cranfield University

In the 1940s, the UK made large, speculative investments into a new technology: the jet engine. This led to the 'second aviation revolution', transforming the nature and commercial potential of a global aviation industry. The UK's sudden leap forward, made possible through a combination of bold funding and engineering expertise, created a commercial and technological leadership internationally which continues to endure, 80 years on.

The 'third aviation revolution' – the development of a sustainable aviation infrastructure that protects both the environment and economic growth – is an essential and urgent ambition. The UK's net-zero aviation emissions by 2050 target is getting closer.

Again, the UK has the chance to be the prime mover of transformation by taking a global lead in green aviation with hydrogen and electric propulsion as a practical and long-term solution for delivering on all criteria: protecting the environment through zero or ultra low carbon and other greenhouse gas emissions, while also ensuring economic viability. That will mean UK leadership



Cranfield has been at the forefront of innovation in aviation for decades

across decades, new market and investment opportunities internationally, employment and upskilling opportunities, and a means of inspiring and engaging generations of young people with careers in STEM and what is explicitly a world-changing technology.

HYDROGEN: FROM 'CRAZY' TO CANDIDATE

Cranfield has been working on delivering hydrogen-powered aviation since the early 1990s. Then, it was considered to be a 'crazy, niche option for the future. Within the last decade, as the limitations of electric and

other fuel sources became apparent (the problems around the weight of electric batteries in particular), hydrogen has become a real candidate. Now it's very fashionable — and the large challenges involved in transforming the industry infrastructure into hydrogen-based rather than a kerosene are looking increasingly worth taking on — because the benefits for the long-term are so clear.

programme provided further impetus.

In essence, the research confirmed the qualities of liquid hydrogen as a zero-carbon emissions fuel, one that would also remove sulphur oxide and soot from the aviation emissions profile. Hydrogen brings a promise of much leaner combustion than any hydrocarbon fuel (fossil, bio or synthetic) delivering ultra-low



Courtesy of EU H2020 project ENABLEH2. The ENABLEH2 project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 769241.

The change has come about largely due to the European Horizon 2020-funded project ENABLEH2 (ENABling CryogEnic Hydrogen-Based CO₂-free Air Transport), which has provided hard evidence for the case for hydrogen. Findings and the roadmap forward, including the need for the makings of a new regulatory framework, have gained EU approval. Cranfield played a leading role in ENABLEH2, alongside Chalmers University, London South Bank University, Heathrow Airport, GKN Aerospace Safran, the European Hydrogen Association and Arttic. Industry involvement included support from Airbus, IATA, ICAO, International Airlines Group, Mitsubishi Power Systems, Rolls-Royce, Siemens and Total. Cranfield's contribution to the UK's Fly Zero

nitrogen oxide emissions (nitrogen oxides contribute to acid rain and the 'ozone hole').

Cranfield researchers continue to work on each aspect of technologies needed to make the shift to a hydrogen-aviation infrastructure, from hydrogen production, storage and transportation, to airport fuelling processes and safety. A key challenge and focus of large R&D investments is the development of certification processes and rules to ensure that the introduction of hydrogen will continue to deliver the safety standards of today, or better.

NEW PRODUCTION TECHNOLOGY HOLDS GREAT PROMISE

A new generation plant for testing production of 'blue' hydrogen has been installed on

the University campus. The Bulk Hydrogen Production by Sorbent Enhanced Steam Reforming (HyPER) project (funded through the Department for Business, Energy and Industrial Strategy and its Energy Innovation Programme) has led to a 1.5 megawatt-hour pilot plant. Partners include the US-based Gas Technology Institute (GTI) and British energy company Doosan Babcock.

The plant is based on a compact technology that captures carbon dioxide during the hydrogen-production process and shifts the chemical reactions to favour the production of more hydrogen. HyPER has the potential to produce high purity hydrogen at up to 30% lower cost than conventional steam methane reforming methods that require CO₂ capture as an additional and expensive step in the process. HyPER also captures carbon in solid form, much more convenient to sequester and store.

proportion of the UK's hydrogen needs by 2050.

The H₂ production facility based on sorption enhanced reforming, demonstrated in HyPER, is cheaper to build than a conventional hydrogen production facilities (50% less) and leads to hydrogen production at a 20-30% lower levelised cost. Carbon emissions are cut by 97%. Building on this work, Bio-HyPER research is testing the feasibility of using biogas feedstocks (supplied from anaerobic digestion plants processing food, plant and animal waste around the UK) for the HyPER pilot plant.

RESEARCHING THE HYDROGEN ECOSYSTEM

Other research is exploring how hydrogen production processes can be made more efficient and cost effective; storage vessels for compressed and liquefied hydrogen; the use of ammonia for carbon-capture hydrogen storage and waste-to-



Cranfield's HyPER project demonstrates an effective way to produce hydrogen

The process is scalable for use in much larger hydrogen production plants and leads to the production of both high-purity hydrogen and carbon, which can be stored, sold and transported to where it is needed. Once scaled up, the process is predicted to have the potential to produce a significant

fuel processes; and the value of hydrogen aviation for reducing 'contrail' effects, the vapour trails from aircraft that can produce cirrus clouds with potential implications for climate change.

The Centre for Air Transport Management at Cranfield is investigating the practicalities of

implementing hydrogen refuelling across airports using compressed gas and/or liquid hydrogen. This has included a study alongside Heathrow Airport.

The University is building up direct experience of production and refuelling via its own solar-powered electrolyser, producing up to 40kg of 'green' hydrogen per day (meaning hydrogen produced using a renewable source of energy). An electric refuelling truck supplies research projects working on hydrogen fuel-cell aircraft.

The networks of activity are growing. As a result of its history of research, expertise and facilities around hydrogen, the UK-Aerospace Research Consortium (an aerospace consortium of 11 universities) has appointed Cranfield as its hydrogen theme lead. In 2023 Cranfield hosted a Hydrogen and Fuel Cell Showcase event with 250 delegates from more than 100 industries, including

leaders from Airbus, Barclays, Heathrow Airport, Rolls-Royce, Siemens, BP and Reaction Engines; alongside academics from Bristol, Southampton, Coventry, Wolverhampton and Aston universities.

A LEAP TOWARDS RESILIENCE AND ENVIRONMENTAL SECURITY

The building blocks of technology and evidence for their practical implementation for a genuine future of sustainable aviation — one with UK technologies, universities and business as leading players — are all falling into place. But moving to a new infrastructure of hydrogen generation and supplies remains a huge leap in terms of the need for investment into emerging technologies alongside substantial energy and water demands to make large-scale hydrogen energy use viable. A huge leap, though, that will mean a sustainable, de-

carbonised UK: long-term resilience and environmental security for the foreseeable future.

Cranfield's big picture-modelling of hydrogen needs in the UK suggests around 25,000 tonnes would need to be produced each day (for total fuel needs, not just for aviation, around 10,000 tonnes of the total would be necessary as liquid hydrogen for aircraft use). To put this into context, global production of liquid hydrogen currently stands at under 100,000 tonnes a year.

Green hydrogen production is crucially dependent on electricity for electrolysis. To meet hydrogen demand, the UK would need an estimated fourfold increase in electricity supplies. This is not as unrealistic as it might appear: the UK power generation system achieved fourfold increases due to changes in the nature of population and industry demands in both the 1920s and

1940s. Hydrogen would be another major driver for the shift to renewable energy provision.

Electrolysis also depends on large volumes of water: 25,000 tonnes a day production would require 250,000 tonnes of water. Compared with the rest of the world, the UK has a major advantage in being able to access supplies of freshwater rather than seawater which is both more expensive and leads to serious problems with corrosion of hydrogen production plant facilities. Only a few countries such as Canada and Russia have ample freshwater supplies.

Visionary changes depend on large-scale investment and levels of commitment. With this in mind, the recent news that the UK is re-joining the Horizon Europe research programme could be crucial: here is the opportunity for sharing investment development with the EU. The UK can develop a global lead with vast returns. ■



DISCUSSION MEETING ON DIGITAL HEALTH IN THE 21ST CENTURY, 18TH SEPTEMBER 2023

In partnership with Northumbria and Newcastle Universities

L- R: Stephen Metcalfe MP; Dr Gemma Wilson-Menzfeld, Associate Professor of Ageing and Digital Living/Health Psychologist, Northumbria University; Professor Abi Durrant, Professor of Interaction Design, Newcastle University; Professor Matt Kieman, Professor, Mental Health and Veteran Studies, Northumbria University; and Chi Onwurah MP.

Photos: Andrew Mackenzie





HOUSE OF COMMONS SELECT COMMITTEES

BUSINESS AND TRADE COMMITTEE

The Committee scrutinises the policy, spending and administration of the Department for Business and Trade, and its public bodies.

Membership:

Bif Aflolami MP, Conservative
Douglas Chapman MP, Scottish National Party
Jonathan Gullis MP, Conservative
Antony Higginbottom MP, Conservative
Jane Hunt MP, Conservative
Ian Lavery MP, Labour
Anthony Mangnall MP, Conservative
Andy McDonald MP, Labour
Charlotte Nichols MP, Labour
Mark Pawsey MP, Conservative

Current Inquiries:

- Decarbonisation of the power sector. Opened 20th May. Report published 28th April 2023. Government response published 14th July 2023.
- The Semiconductor Industry in the UK. Opened 25th May 2022. Report published 3rd February 2023.
- Post-pandemic economic growth: UK labour markets. Opened 27th May 2022. Report published 21st April 2023. Government response published 20th July 2023.
- The work of the Investment Security Unit. Opened 15th June 2022. Published 23rd March 2023.
- Batteries for electric vehicle manufacturing. Opened 17th January 2023.
- Export-led growth. Opened 26th May 2023.
- The performance of investment zones and freeports in England. Opened 9th June 2023. Deadline 8th September 2023.

For further details: Tel: 020 7219 5777
Email: commonsbtc@parliament.uk

ENVIRONMENTAL AUDIT COMMITTEE

The remit of the Environmental Audit Committee is to consider the extent to which the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development, and to audit their performance against sustainable development and environmental protection targets.

Unlike most select committees, the Committee's remit cuts across government rather than focuses on the work of a particular department.

From its beginning in 1997, in carrying out its environmental 'audit' role the Committee has had extensive support from the National

Audit Office, providing seconded staff and research and briefing papers.

Membership:

Rt Hon Philip Dunne MP, Conservative, Chair
Duncan Baker MP, Conservative
Sir Christopher Chope MP, Conservative
Barry Gardiner MP, Labour
James Gray MP, Conservative
Ian Levy MP, Conservative
Clive Lewis MP, Labour
Caroline Lucas MP, Green Party
Cherilyn Mackrory, Conservative
Jerome Mayhew MP, Conservative
Anna McMorrin MP, Labour
John McNally MP, Scottish National Party
Dr Matthew Offord MP, Conservative
Rt Hon Chris Skidmore MP, Conservative
Cat Smith MP, Labour
Claudia Webbe MP, Independent

Current Inquiries

- Mapping the path to net zero: Opened 25th June 2021.
- Net zero aviation and shipping: Opened 20th July 2021.
- Accelerating the transition from fossil fuels and securing energy supplies. Opened 31st March 2022. Report published 5th January 2023. Government response published 23rd March 2023.
- The financial sector and the UK's net zero transition. Opened 30th May 2022.
- Sustainable timber and deforestation. Opened 25th July 2022. Closed 8th September 2022. Report published 19th July 2023.
- Technological Innovations and climate change: onshore solar energy. Opened 3rd November 2022.
- Environmental Change and Food Security. Opened 10th November 2022.
- Enabling sustainable electrification of the UK economy. Opened 4th May 2023.
- Outdoor and indoor air quality targets. Opened 10th May 2023.
- Heat resilience and sustainable cooling. Opened 3rd July 2023.
- The role of natural capital in the green economy. Opened 31st July 2023.

For further details: Tel: 020 7219 5776 Email: eacom@parliament.uk

SCIENCE, INNOVATION AND TECHNOLOGY COMMITTEE

For further details: Tel: 020 7219 2793

Email: commonssitc@parliament.uk

The Science, Technology and Innovation Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Department of Science, Innovation and Technology, and associated public bodies.

It also exists to ensure that Government policies and decision-making are based on solid scientific evidence and advice.

Membership:

Rt. Hon Greg Clark MP, Conservative, Chair

Aaron Bell MP, Conservative

Dawn Butler MP, Labour

Chris Clarkson MP, Conservative

Tracey Crouch MP, Conservative

Katherine Fletcher MP, Conservative

Rebecca Long-Bailey MP, Labour

Stephen Metcalfe MP, Conservative

Carol Monaghan MP, Scottish National Party

Graham Stringer MP, Labour

Christian Wakeford MP, Labour

Current Inquiries

- The role of technology, research and innovation in the COVID-19 recovery – Opened 24th July 2020.
- UK space strategy and UK satellite infrastructure – Opened 23rd April 2021. Report published 4th November 2022.
- Reproducibility and research integrity. Opened 22nd July 2021. Closed 30th September 2021. Report published 10th May 2023. Government response published 21st July 2023.
- Diversity and inclusion in STEM – Opened 22nd November 2021. Report published 24th March 2023. Government response published 16th June 2023.
- The right to privacy: digital data – Opened 16th December 2021.
- My science inquiry. Opened 12th July 2022. Report published 8th November 2022.
- Delivering Nuclear Power. Opened 19th July 2022. Published 31st July 2023.
- Governance of artificial intelligence (AI). Opened 20th October 2022. Report published 31st August 2023.
- The antimicrobial potential of bacteriophages. Opened 9th November.
- Emerging diseases and learnings from covid-19. Opened 15th December 2022.
- Commercialising quantum technologies. Opened 16th March 2023.
- Insect decline and UK food security. Opened 20th March 2023.

- UK Astronomy. Opened 10th September 2023. Deadline: 27th October 2023.
- Cyber resilience of the UK's critical national infrastructure. Opened 15th September 2023. Deadline: 10th November 2023.

HEALTH AND SOCIAL CARE COMMITTEE

The Committee scrutinises government and in particular the work of the Department of Health and Social Care.

The Committee also scrutinises the work of public bodies in the health system in England, such as NHS England and Improvement, Public Health England and the Care Quality Commission, and professional regulators such as the General Medical Council and the Nursing and Midwifery Council. They do so by holding inquiries on specific topics and accountability hearings with the Secretary of State, and Chief Executives of relevant public bodies.

Membership:

Steve Brine MP, Conservative, Chair

Lucy Allan MP, Conservative

Paul Blomfield MP, Labour

Paul Bristow MP, Conservative

Amy Callaghan MP, Scottish National Party

Chris Green MP, Conservative

Paulette Hamilton MP, Labour

Dr Caroline Johnson MP, Conservative

Rachael Maskell MP, Labour

James Morris MP, Conservative

Taiwo Owatemi MP, Labour

Current Inquiries

- NHS litigation reform: Opened 22nd September 2021. Report published 28th April 2022.
- Digital transformation in the NHS. Opened 13th May 2022. Report published 30th June 2023. Government response published 6th September 2023.
- Integrated Care Systems: autonomy and accountability. Opened 6th July 2022. Report published 30th March 2023. Government Response published 14th June 2023.
- Assisted dying/assisted suicide. Opened 5th December 2022.
- NHS Dentistry. Opened 7th December 2022. Report published 14th July 2023.
- Prevention in health and social care. Opened 18th January 2023. Report published 27th July 2023.
- Future cancer. Opened 21st March 2023.
- Pharmacy. Opened 8th June 2023.
- Men's health. Opened 20th July 2023.

For further details: Tel: 020 7219 6182

Email: hsccom@parliament.uk

ENERGY SECURITY AND NET ZERO COMMITTEE

The Energy Security and Net Zero Committee scrutinizes the policy spending and administration of the Department of Energy Security and Net Zero and its public bodies, including Ofgem and the Committee on Climate Change.

Membership:

Angus Brendan McNeil, Scottish National Party, Chair

Rt Hon Hilary Benn MP, Labour

Rt Hon Vicky Ford MP, Conservative

Barry Gardiner MP, Labour

Mark Garnier MP, Conservative

Sir Mark Hendrick MP, Labour

Mark Jenkinson MP, Conservative

Mark Pawsey MP, Conservative

Dr Dan Poulter MP, Conservative

Lloyd Russell-Moyle MP, Conservative

Alexander Stafford MP, Conservative

Current Inquiries:

- The work of the Department for Energy Security and Net Zero. Opened 14th June 2023.
- Preparing for the winter. Opened 7th July 2023. Report published on 23rd September.
- Keeping the power on: our future energy technology mix. Opened 7th July 2023.
- Heating our homes. Opened 7th July 2023.
- A flexible Grid for the future. Opened 7th July 2023.

For further details: Media 07720 202 985

Email: commonsesnz@parliament.uk



HOUSE OF LORDS SELECT COMMITTEES

SCIENCE AND TECHNOLOGY COMMITTEE

The Science and Technology Committee has a broad remit *"to consider science and technology"*.

The Committee scrutinises Government policy by undertaking cross-departmental inquiries into a range of different activities. These include:

- public policy areas which ought to be informed by scientific research (for example, health effects of air travel),
- technological challenges and opportunities (for example, genomic medicine) and
- public policy towards science itself (for example, setting priorities for publicly funded research).

In addition, the Committee undertakes from time to time shorter inquiries, either taking evidence from Ministers and officials on topical issues, or following up previous work.

Members:

The Baroness Brown of Cambridge DBE FREng FRS, Crossbench, Chair

The Lord Borwick, Conservative

The Viscount Hanworth, Labour

The Lord Holmes of Richmond MBE

The Lord Krebs, Crossbench

The Baroness Neuberger, Crossbench

The Rt Hon. the Baroness Neville-Jones DCMG, Conservative

The Rt Hon. the Baroness Northover, Liberal Democrat

The Lord Rees of Ludlow OM

The Lord Sharkey, Liberal Democrat

The Viscount Stansgate, Labour

The Lord Wei, Conservative

The Lord Winston, Labour

Current Inquiries

- Delivering a UK science and technology strategy. Report published 4th August 2022. Government response published 6th March 2023.
- People and skills in UK science, technology, engineering and mathematics. Opened 20th July 2022.
- Clinical academics in the NHS. Opened 18th November 2022.
- The effects of artificial light and noise on human health. Opened 30th January 2023. Report published 19th July 2023.
- Long-duration energy storage. Opened 26th July 2023.

For further details: Tel: 020 7219 5750

Email: hlscience@parliament.uk



PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

AUTUMN 2023

The Parliamentary Office of Science and Technology (POST) works to bring the best available research evidence to bear on the legislative process and scrutiny of Government.

RECENT PUBLISHED WORK

POST research is published on our website. POSTnotes produced since September 2023 were:

- 704: Child food insecurity and Free School Meals
- 703: Local area energy planning: achieving net zero locally
- 702: Measuring sustainable environment-food systems interactions
- 701: Public health and climate change: a One Health approach
- 700: Problem-solving courts
- 699: Heat pumps
- 698: Data science skills in the UK workforce
- 697: Marine Protected Areas and Highly Protected Marine Areas
- 696: Hypersonic missiles

POSTbriefs produced since September 2023 were:

- 54: Indoor Air Quality
- 53: Factors shaping gender incongruence and gender dysphoria, and impact on health services
- 52: The use of short prison sentences in England and Wales
- 51: Plant biosecurity in Great Britain

POST has also produced a Rapid Response:

- Psychedelic drugs to treat depression

Ongoing and future projects approved by the POST Board

Over coming months, POST will work on a range of projects, including:

- Demand side response
- Consumer debt and mental health
- Just sustainable transitions
- Biodiversity net gain
- The future of horticulture
- Environmental impact of and risks for the food production system
- Hormone Treatments for Children with Gender Dysphoria
- Reform of the Mental Health Act – people with learning difficulties and autism
- Reproductive organoids and artificial germ cells
- Men's health
- Policy implications of artificial intelligence

- Social and psychological implications of fraud
- What behavioural changes are needed to deliver net zero?
- Use of artificial intelligence in education delivery and assessment
- Green skills in employment and education

THE POST BOARD

The POST Board oversees POST's objectives, outputs and future work programme. It meets quarterly.

Officers

- Chair: Adam Afriyie MP
- Vice-Chair: Professor the Lord Winston, FMedSci, FRSA, FRCP, FRCOG, FEng

House of Commons

- Rt Hon Greg Clark MP
- Katherine Fletcher MP
- Stephen Metcalfe MP
- Maria Miller MP
- Carol Monaghan MP
- Dr Ben Spencer MP
- Alan Whitehead MP

House of Lords

- Baroness Brown of Cambridge
- Lord Haskel
- Lord Ravensdale

Non-parliamentary

- Professor Elizabeth Fisher, FMedSci
- Paul Martynenko, FBCS
- Professor Sir Bernard Silverman, FRS, FAcSS
- Professor Susan Owens

Ex-officio

- Oliver Bennett MBE, Head of the Parliamentary Office of Science and Technology
- Grant Hill-Cawthorne, House of Commons Librarian and Managing Director of Research & Information
- Ariella Huff, Select Committee Team, House of Commons
- Xameerah Malik, Head of Science and Environment Section, House of Commons Library
- Amy Creese, Clerk of Select Committees, House of Lords

Head of POST

- Oliver Bennett MBE

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY

Houses of Parliament
Westminster
London SW1A 0AA



HOUSE OF COMMONS LIBRARY



The House of Commons Library is an impartial research and information service for Members of Parliament of all parties and their staff. The Science and Environment Section (SES) is one of eight teams in the Research Service in the House of Commons Library..

Library provides confidential, impartial and bespoke briefing to Members of the House of Commons and their offices supporting the full range of parliamentary work, from policy development to constituency issues. Members and their staff can request briefing by visiting the Member's Library in the Palace or by emailing HCLibrary@parliament.uk. SES has recently provided confidential briefings to MPs on a wide range of issues including energy, planning law, health, environment, water quality, telecommunications and animal welfare.

The Library also publishes a range of products including topical research briefings, shorter insight articles and briefings for non-legislative debates, all of which are available online for MPs and the public. These briefings include analysis of all major pieces of legislation. You can find publications on the Commons Library website (<https://commonslibrary.parliament.uk>) where you can also sign up for alerts.

In recent months, SES has published and updated briefings on issues including:

Debate on human-specific medical research techniques

Published Friday, 30 June, 2023, CDP 2023/0153

A debate pack published ahead of a Westminster Hall debate on 4 July 2023 on human-specific medical research techniques. Medical research may involve the use of animals to develop new treatments and test the safety of pharmaceuticals. Alternative approaches are sometimes termed 'new approach methodologies', 'non-animal methods' (NAMs) or 'non-animal technologies' (NATs). These include different ways to conduct medical research without involving

animals. This pack sets out background and includes links to further reading and recent PQs.

Debate on hormone pregnancy tests

Published Wednesday, 30 August, 2023, CDP 2023/0173

A debate pack published ahead of a debate on hormone pregnancy tests on 7 September in the Commons Chamber. The subject for the debate was chosen by the Backbench Business Committee. Drugs containing synthetic versions of the hormones progesterone and oestrogen were taken as a form of pregnancy test from the late 1950s until 1970s. Primodos was the most commonly used of these medications in the UK. Studies in the UK and elsewhere from the late 1960s to early 1970s suggested a link between the use of hormone pregnancy tests (HPTs) and a wide range of serious congenital abnormalities. HPTs were withdrawn from use in the late 1970s. This pack sets out background and includes recent Parliamentary and news items, as well as useful links.

Debate on Pediatric Acute-onset Neuropsychiatric Syndrome and Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal infections

Published Friday, 08 September, 2023, CDP 2023/0174

A debate pack published ahead of a debate on 12 September. Some children develop a range of behavioural, emotional and physical symptoms following an infection. These can include symptoms of obsessive compulsive disorder, restricted eating and tics. Paediatric Acute-Onset Neuropsychiatric Syndrome (PANS) and Paediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infections (PANDAS) are diagnoses that have been proposed to explain the sudden development of these symptoms.

Currently, there is no overall medical consensus about the definition of these conditions and cause of these symptoms in children. Diagnostic criteria and treatment options for PANS and PANDAS have been proposed by researchers and clinicians, but are based on limited evidence and many have called for more research. This pack sets out background.

Debate on football and dementia

Published Wednesday, 13 September, 2023, CDP 2023/0185

A debate pack published ahead of a debate on football and dementia on 14 September in the Commons Chamber. The subject for the debate was chosen by the Backbench Business Committee. Emerging research evidence suggests that there is a potential link between playing contact sports and the development of neurodegenerative diseases, like dementia, later in life. Some research suggests that the repetitive head impacts that result from heading the ball are to blame. This pack sets out background to this, and includes parliamentary and news items.

The regulation of e-cigarettes

Published Tuesday, 27 June, 2023, CBP 8114

This briefing paper provides an overview of the regulation, health, and product safety aspects, of e-cigarettes.

Debate on Artificial Intelligence

Published Wednesday, 28 June, 2023, CDP 2023/0152

A debate pack published ahead of a debate on Thursday 29 June on Artificial Intelligence. The subject for the debate was chosen by the Backbench Business Committee.

There is no single, universally-agreed definition of artificial intelligence (AI). It can broadly be thought of as technologies that enable computers to simulate elements of human intelligence, such as perception, learning and reasoning. To achieve this, AI systems rely upon large data sets from which they can decipher patterns and correlations, thereby enabling the system to 'learn' how to anticipate future events. It does this by relying upon/creating rules – algorithms – based on the dataset, which it can use to interpret new data.

The debate pack provides further information on different types of AI, where it is being used, concerns that have been raised about its application, as well as Government policy in this area.

Debate on funding for the prevention of fibrodysplasia ossificans progressiva

Published Monday, 04 September, 2023, CDP 2023/0172

A debate pack published ahead of a debate on funding for the prevention of fibrodysplasia ossificans progressiva on 7 September 2023 in the Commons Chamber,

Fibrodysplasia Ossificans Progressiva (FOP) is a rare, genetic condition whereby soft connective tissues in the body, such as tendons and ligaments, are gradually replaced by new bone (they are 'ossified'). It is caused by a fault (mutation) in the ACVR1 gene. The condition means that bone develops outside of the skeleton. If this occurs near joints, it can restrict the person's movement and, over time, will cause a progressive loss of mobility. Information about FOP, its symptoms, Government policy on rare diseases and funding research into rare diseases can be found in the Commons Library debate pack on E-petition on research into Fibrodysplasia Ossificans Progressiva (November 2021).

Support for cancer in England

Published Wednesday, 06 September, 2023, CBP 9766

House of Commons Library briefing on Government and NHS policy on cancer in England and cancer research.

Cancer is the cause of just over a quarter of all deaths in England in a typical year. The most common cancers are breast, lung, prostate and bowel cancer.

In 2021, 134,802 people died from cancer in England. The number of deaths has increased by 6% since 2001. But after accounting for the fact that England's population is both growing and ageing, the

rate of cancer deaths has fallen by 23% among men and 16% among women.

The Library briefing Cancer statistics for England (updated February 2023) provides an overview of cancer statistics for England. It covers detailed information on cancer diagnoses up to 2020 and deaths up to 2021, as well as statistics on NHS screening and treatment.

Debate on the HIV Action Plan Annual Update, 2022-23

Published Monday, 17 July, 2023, CBP 2023/0167

A debate pack published ahead of a Westminster Hall debate on Tuesday 18 July on the HIV Action Plan Annual Update 2022-23.

Human immunodeficiency virus (HIV) damages cells in the immune system and weakens a person's ability to fight everyday infections and disease. HIV is distinct from acquired immune deficiency syndrome (AIDS) – a term used to describe a range of infections and illnesses which can result from a weakened immune system caused by HIV. If HIV is left untreated, it can lead to AIDS.

On 7 June 2023, the DHSC published the first of its annual updates to Parliament on progress made towards the HIV Action Plan, which highlights key achievements under each of the Plan's objectives.

It reports a 32% reduction in the number of new HIV diagnoses made in England, between 2019 and 2021. In the same period, the number of people diagnosed with AIDS fell by 21%.

Community pharmacy in England

Published Tuesday, 12 September, 2023, CBP 9854

This briefing provides information on community pharmacy services in England. In particular, it focuses on funding, services, workforce and pharmacy closures.

Clean Air Zones, Low Emission Zones and the London ULEZ

Published Friday, 11 August, 2023, CBP 9856

Road user charging zones are intended to reduce air pollution in cities, by charging drivers of older, more polluting vehicles to enter them.

In recent years the following road user charging zones have been introduced in parts of the UK:

- London's low emission zone (LEZ) and ultra low emission zone (ULEZ),
- England's clean air zones (CAZ), and
- Scotland's low emission zones (LEZ).

These zones are intended to reduce air pollution in cities by charging drivers of older, more polluting vehicles to enter them.

Climate change "Loss and Damage" fund

Published Tuesday, 29 August, 2023, CBP 9848

In 2022 countries created a committee on loss and damage for climate change. What is loss and damage, how might it be funded, and what has the UK response been?

Debate on the import and sale of fur

Published Friday, 23 June, 2023, CDP 2023/0140

A debate pack published ahead of a Westminster Hall debate on Tuesday 27 June on the import and sale of fur. The subject for the debate was chosen by the Backbench Business Committee,

A number of animal welfare charities, including Four Paws, the Humane Society International (UK) and Peta UK, are running a Fur Free Britain campaign calling for a ban on the import and sale of fur in the UK.

According to the British Fur Trade Association, London is one of the major international trading centres for fur pelts, the majority of which are sold through auction houses.

This pack sets out information on the UK trade in fur, campaigns to ban fur, current UK legislation on fur and proposals for change. It also includes recent PQs and some useful links.

Debate on the fishing industry

Published Wednesday, 28 June, 2023, CDP 2023/0144

A debate pack published ahead of a debate in the Commons Chamber on 29 June on the fishing industry. The subject for the debate was chosen by the Backbench Business Committee.

Further information is provided on the following topics in this pack, as well as recent Parliamentary and news material.

fisheries post brexit, including the review of fisheries post 2026, included in the UK and EU Trade and Co-operation agreement

new medical certificate requirements for inshore fishers

changes to visa requirements for foreign inshore fishing crews

concerns about how the competing uses of the marine environment affect the fishing industry (the spatial squeeze).

Debate on e-petition 626737 relating to swift bricks

Published Friday, 07 July, 2023, CDP 2023/0126

Information for a debate on e-petition 626737 which called on the government to make swift bricks compulsory for new housing.

Swifts are migratory species of bird that usually arrives to breed in the UK in late April. They typically nest in the eaves of tall older buildings entering through gaps in timber and brickwork.

There is a continuing long-term decline in breeding swift numbers in the UK. Swifts were placed on the UK Red List for birds in 2021 by British Trust for Ornithology (BTO) "due to worsening declines in the breeding population".

A 'swift brick' provides a nesting box for swifts that is fitted into the walls of a building.

Energy Bill [HL] 2022-23 Committee stage report

Published Friday, 01 September, 2023, CBP 9853

The remaining stages of the Energy Bill [HL] 2022-23 in the House of Commons took place on 5 September 2023. This paper is a

summary of what happened at committee stage and how the Bill has changed as a result.

Gigabit broadband in the UK: Government targets, policy, and funding

Published Monday, 03 July, 2023, CBP 8392

This briefing paper provides information on the Government's targets for rolling out gigabit broadband, its policies to support the roll-out by industry, and its public funding programme, Project Gigabit.

Digital telephone switchover

Published Friday, 07 July, 2023, CBP 9471

This briefing addresses frequently asked questions about the switch of landline phones to digital, Voice over Internet Protocol (VOIP) services.

Over the next few years, landline telephone services will switch to a fully digital network. This means phone calls will be carried over the internet.

Gigabit broadband FAQs

Constituency casework

Published Wednesday, 02 August, 2023

This article addresses some frequently asked questions about the rollout of gigabit broadband in the UK.

Access to broadband

Published Friday, 01 September, 2023, CDP 2023/0176

A debate pack published ahead of a Westminster Hall debate on Wednesday 6 September on access to broadband.

Ofcom's 2023 Technology Tracker estimates that 7% of UK households did not have internet access at home. This is down from around 11% in 2020 and 24% in 2011. The prevalence of digital exclusion varies greatly depending on age and socio-economic status. For example, 18% of households in socio-economic band DE say they don't have internet access, as well as 18% of people aged over 65 years.

Proposed merger between Three UK and Vodafone

Published Friday, 15 September, 2023, CDP 2023/0187

A debate pack published ahead of a debate on Tuesday 19 September 2023 in Westminster Hall on the proposed merger between Three UK and Vodafone.

Mobile networks (including masts, antenna, and so on) are built by telecoms companies called mobile network operators (MNOs). Since 2010, when T-Mobile and Orange merged to become EE, there have been four MNOs in the UK. They are: Vodafone, Three, O2, and EE.

Each of the MNOs offers mobile services to customers. MNOs also act as wholesalers, selling network access to other telecoms companies who do not have their own network infrastructure. These

companies, called mobile virtual network operators (MVNOs), use MNOs' networks to provide services to customers. MVNOs include Tesco Mobile and GiffGaff.

Mobile roaming in the EU after Brexit

Published Tuesday, 19 September, 2023, CBP 8649

This page provides information about mobile roaming charges for UK customers after the end of the Brexit transition period.

Since the end of the Brexit transition period (1 January 2021), there has been no obligation on UK mobile operators to guarantee surcharge-free roaming across the European Economic Area (EEA). Other protections, including a daily limit on roaming costs, expired on 30 June 2022. Consumers travelling to the EU will need to check the roaming policies of their mobile operator before they go abroad.

Debate on the implementation of ECO4 and ECO+

Published Monday, 26 June, 2023, CDP 2023/0141

A debate pack published ahead of a Westminster Hall debate on Tuesday 27 June on the implementation of ECO4 and ECO+.

The Energy Company Obligation (ECO) is an obligation placed on energy suppliers with over 150,000 customers to deliver energy efficiency and heating measures to domestic premises. It focuses primarily on support for low income and vulnerable households. The current iteration of the scheme (ECO4) will run until March 2026.

This pack sets out background information about ECO, measures delivered under ECO and challenges to delivering ECO4. It also includes PQs and useful links.

Debate on football and dementia

Published Wednesday, 13 September, 2023, CDP 2023/0185

A debate pack published ahead of a debate on a motion on football and dementia on 14 September in the Commons Chamber. The subject for the debate was chosen by the Backbench Business Committee.

Emerging research evidence suggests that there is a potential link between playing contact sports and the development of neurodegenerative diseases, like dementia, later in life. Some research suggests that the repetitive head impacts that result from heading the ball are to blame.

Estimates Day debate on the spending of the Department for Energy Security and Net Zero on energy infrastructure

Published Friday, 30 June, 2023, CDP 2023/0157

A debate pack published ahead of an Estimates Day debate in the Commons Chamber on Wednesday 5 July on the spending of the Department for Energy Security and Net Zero on energy infrastructure.

The Department for Energy Security and Net Zero (DESNZ) is responsible for:

- delivering security of energy supply
- ensuring properly functioning energy markets
- encouraging greater energy efficiency
- seizing the opportunities of net zero to lead the world in new green industries.

The department works with 14 agencies and public bodies.



General debate on building safety and social housing, to mark six years since the Grenfell Tower tragedy

Published Monday, 03 July, 2023, CDP 2023/0152

Information for a debate on 6 July 2023 on building safety and social housing to mark six years since the Grenfell Tower fire.

Planning and solar farms

Published Tuesday, 18 July, 2023, CDP 2023/0168

A debate pack published ahead of a Westminster Hall debate on planning and solar farms *on Wednesday 19 July 2023.

Installing solar farms usually requires planning permission. Depending on their size, solar farms will either require planning permission from the local planning authority (LPA) or from the Secretary of State for Department for Energy Security and Net Zero (DESNZ):

Solar farms with a generating capacity below 50 megawatts (MW) fall under the remit of the LPA and require planning permission.

Solar farms with a generating capacity above 50 megawatts (MW) are considered 'nationally significant infrastructure projects' (NSIPs) and require development consent from the Secretary of State for DESNZ.

Fire safety in houses and blocks of flats

Published Friday, 30 June, 2023, CBP 9770

This briefing discusses fire safety requirements for houses and blocks of flats, the 'stay put' strategy and the government response to the Grenfell Tower fire.

The fire safety of houses and blocks of flats is governed by different regimes at different points:

The fire safety measures that houses and blocks of flats must include at the point of construction (or some refurbishments) are governed by the Building Regulations 2010.

The building owner or manager is responsible for the fire safety of blocks of flats during occupation, under the Fire Safety Order 2005. As the 'responsible person', they must regularly carry out fire risk

assessments and, if necessary, put in place and maintain fire safety measures.

The Fire Safety Order 2005 only applies to communal areas in shared blocks of flats, not to individual flats or houses.

Building regulations and fire safety are devolved matters. This briefing focuses on England, with section 7 covering the devolved administrations.

This briefing focuses on the fire safety of blocks of flats and houses. It does not cover how the fire safety of other buildings, such as hospitals or care homes, is regulated.

Influencing the planning process (England)

Constituency casework

Published Thursday, 31 August, 2023

This article gives information on how constituents can get involved in the planning process at various stages, including how to object to planning applications.

Overview of the planning system (England)

Constituency casework

Published Thursday, 31 August, 2023

This article gives information on the planning system in England, including how applications are decided and whether permission can be overturned.

The use and development of all land and buildings in England are governed by the planning system. Most planning matters are the responsibility of local planning authorities (LPAs). Usually that function is taken on by the district council.

The Energy Bill and households: FAQs

Published Friday, 29 September, 2023, CBP 9865

This briefing answers frequently asked questions about what the Energy Bill would do if it became an Act in its current form. It covers energy performance regulations, energy smart appliances, smart metering and hydrogen heating. ■



Dr Douglas Naysmith

DR DOUG NAYSMITH – AN APPRECIATION BY SUE WHARTON

At the 1997 election several career scientists were elected as MPs. These included Dr Doug Naysmith, Dr Brian Iddon, and Dr Ian Gibson who were all members of the Parliamentary and Scientific Committee over the years. They determined to educate their colleagues, mostly non-scientists, about the world of science and technology by promoting STEM, and were enthusiastic sponsors of many Westminster events.

As an immunologist Doug was very interested in both health and science, being a member of the relevant Select Committees for much of the time he was in Parliament. When the SET for BRITAIN events for early-stage researchers ceased in 2007 on the death of Dr Eric Wharton, it was felt that they had been so valuable they should continue, albeit in a slightly different format, under the umbrella of the Parliamentary and Scientific Committee. As Doug was then the Committee Chair it is largely due to his enthusiasm and drive that the first new annual format event took place in March 2009, and now renamed STEM for BRITAIN, it has continued successfully every year since.

SCIENCE DIRECTORY

UK Research and Innovation

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Big challenges demand big thinkers - those who can unlock the answers and further our understanding of the important issues of our time. Our work encompasses everything from the physical, biological and social sciences, to innovation, engineering, medicine, the environment and the cultural impact of the arts and humanities. In all of these areas, our role is to bring together the people who can innovate and change the world for the better. We work with the government to invest over £7 billion a year in research and innovation by partnering with academia and industry to make the impossible, possible. Through the UK's nine leading academic and industrial funding councils, we create knowledge with impact.



Website: www.ahrc.ukri.org

AHRC funds outstanding original research across the whole range of the arts and humanities. This research provides economic, social and cultural benefits to the UK, and contributes to the culture and welfare of societies around the globe.



Website: www.bbsrc.ukri.org

BBSRC invests in world-class bioscience research and training. This research is helping society to meet major challenges, including food security, green energy and healthier, longer lives and underpinning important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.



Website: www.esrc.ukri.org

ESRC is the UK's largest funder of research on the social and economic questions facing us today. This research shapes public policy and contributes to making the economy more competitive, as well as giving people a better understanding of 21st century society.



Website: www.epsrc.ukri.org

EPSRC invests in world-leading research and postgraduate training across the engineering and physical sciences. This research builds the knowledge and skills base needed to address scientific and technological challenges and provides a platform for future UK prosperity by contributing to a healthy, connected, resilient, productive nation.



Website: www.ukri.org/councils/innovate-uk/

Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas, including those from the UK's world-class research base. They connect businesses to the partners, customers and investors that can help them turn these ideas into commercially successful products and services, and business growth.



Website: www.mrc.ukri.org

MRC is at the forefront of scientific discovery to improve human health. Its scientists tackle some of the greatest health problems facing humanity in the 21st century, from the rising tide of chronic diseases associated with ageing to the threats posed by rapidly mutating micro-organisms.



Website: www.nerc.ukri.org

NERC is the driving force of investment in environmental science. Its leading research, skills and infrastructure help solve major issues and bring benefits to the UK, such as affordable clean energy, air pollution, and resilience of our infrastructure.



Website: www.re.ukri.org

Research England creates and sustains the conditions for a healthy and dynamic research and knowledge exchange system in English universities. Working to understand their strategies, capabilities and capacity; supporting and challenging universities to create new knowledge, strengthen the economy, and enrich society.



Website: www.stfc.ukri.org

STFC is a world-leading multi-disciplinary science organisation. Its research seeks to understand the Universe from the largest astronomical scales to the tiniest constituents of matter, and creates impact on a very tangible, human scale.

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AIRTO, the Association of Innovation, Research and Technology Organisations, comprises approximately sixty principal organisations operating in the UK's Innovation, Research and Technology (IRT) sector. The IRT sector has a combined turnover of £6.9Bn, employs over 57,000 people and contributes £34Bn to UK GVA. AIRTO's members work at the interface between academia and industry, for both private and public sector clients. Members include independent Research and Technology Organisations, Catapult Centres, Public Sector Research Establishments, National Laboratories, some university Technology Transfer Offices and some privately held innovation companies.

Applied Microbiology International

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Applied Microbiology International believes that global challenges need to be solved by global, interdisciplinary experts who apply their diverse experience and unique voices to achieve a common goal. Because of this, we're a truly inclusive, international organisation. With a strong focus on influencing international policy, we are organised around seven goals which align with core UN Sustainable Development Goals and encourage partnership between industry and academia to increase our impact. At Applied Microbiology International we publish the leading industry magazine, *The Microbiologist*, and in partnership with Wiley and Oxford University Press, we publish six internationally acclaimed journals.



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For over 70 years, AWE has supported the UK Government's nuclear defence strategy and Continuous At Sea Deterrence. On behalf of the Ministry of Defence, AWE manufactures, maintains and develops the UK's nuclear warheads, and applies its unique expertise to support nuclear threat reduction and to protect national security. The company provides guidance to UK military and police counter-terrorism teams, as well as emergency response in the event of nuclear or radiological incidents.



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The Biochemical Society works to promote the molecular biosciences; facilitating the sharing of expertise, supporting the advancement of biochemistry and molecular biology and raising awareness of their importance in addressing societal grand challenges. We achieve our mission by :

- bringing together molecular bioscientists;
- supporting the next generation of biochemists;
- promoting and sharing knowledge and
- promoting the importance of our discipline.



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The British Ecological Society is an independent, authoritative learned society, and the voice of the UK's ecological community. Working with our members, we gather and communicate the best available ecological evidence to inform decision making. We offer a source of unbiased, objective ecological knowledge, and promote an evidence-informed approach to finding the right solutions to environmental questions.

British In Vitro Diagnostics Association (BIVDA)

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BIVDA is the UK industry association representing companies who manufacture and/or distribute the diagnostics tests and equipment to diagnose, monitor and manage disease largely through the NHS pathology services. Increasingly diagnostics are used outside the laboratory in community settings and also to identify those patients who would benefit from specific drug treatment particularly for cancer.



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The British Pharmacological Society is a charity with a mission to promote and advance the whole spectrum of pharmacology. It is the primary UK learned society concerned with drugs and the way they work, and leads the way in the research and application of pharmacology around the world.

Founded in 1931, the Society champions pharmacology in all its forms, across academia, industry, regulatory agencies and the health service. With over 3,500 members from over 60 countries worldwide, the Society is a friendly and collaborative community. Enquiries about the discovery, development and application of drugs are welcome.



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BSAC is a learned society whose members are among the world's leading infectious disease physicians, pharmacists, microbiologists, and nurses.

With more than 45 years of leadership in antibiotic research and education, BSAC is dedicated to saving lives by fighting infection. It does this by supporting a global network of experts via workshops, conferences, evidence-based guidelines, e-learning courses, and its own high-impact international journal.

BSAC also provides national surveillance and susceptibility testing programmes, an outpatient parenteral antimicrobial therapy (OPAT) initiative, research and development grants, and the secretariat for the All-Party Parliamentary Group on Antibiotics.

BSAC has members in 40 nations and active learners in more than 135 countries.



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The British Society for Immunology is the leading UK charity organisation representing scientists and clinicians who study the immune system in humans or animals. As a membership organisation, we act as a focal hub for the immunology community, supporting and empowering immunologists working in academic, industry and clinical settings to drive forward scientific discovery and application together.

SCIENCE DIRECTORY



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The British Society of Animal Science (BSAS), the principal body for animal science in the UK, was established in 1944. We work globally with members and partners to shape the future of animal science, supporting the advancement of responsible, environmentally and economically sustainable animal production, addressing issues such as the role of animal science in resolving the world's food crisis. BSAS disseminates research findings to ensure practical and beneficial application of positive outcomes to include livestock, animal health and welfare, the care of equine, companion, and zoo animals.



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The British Society of Soil Science (BSSS) was founded in 1947 and is an established international membership organisation and charity committed to the study of soil in its widest aspects. The society brings together those working within academia, practitioners implementing soil science in industry and all those working with, or with an interest in soils.

We promote research and education, both academically and in practice, and build collaborative partnerships to help safeguard our soil for the future. This includes hosting the World Congress of Soil Science 2022 in Glasgow, where those with an interest in soil science can meet to discuss the critical global issues relating to soil.



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Brunel University London is an international research active university with 3 leading research institutes:

Institute of Energy Futures: Led by Professor Savvas Tassou, the main themes of the Institute are *Advanced Engines and Biofuels, Energy Efficient and Sustainable Technologies, Smart Power Networks, and Resource Efficient Future Cities.*

Institute of Materials and Manufacturing: The main themes of research are *Design for Sustainable Manufacturing, Liquid Metal Engineering, Materials Characterisation and Processing, Micro-Nano Manufacturing, and Structural Integrity.* The Institute is led by Professor Luiz Wrobel.

Institute of Environment, Health and Societies: Professor Susan Jobling leads this pioneering research institute whose themes are *Health and Environment, Healthy Ageing, Health Economics Synthetic Biology, Biomedical Engineering and Healthcare Technologies, and Social Sciences and Health.*

Brunel University London offers a wide range of expertise and knowledge, and prides itself on having academic excellence at the core of its offer, and was ranked in the recent REF as 33rd in the UK for Research Power (average quality rating by number of submissions) and described by The Times Higher Education as one of the real winners of the REF 2014.



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The Cavendish Laboratory houses the Department of Physics of the University of Cambridge.

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Biological Universe: Physics of medicine, biological systems and soft matter

The Laboratory has world-wide collaborations with other universities and industry



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Our vision is integrated design to improve life, wellbeing and performance through science, engineering, technology and psychology. The Institute is one of the largest in the world representing the discipline and profession of Human Factors and Ergonomics. We have sector groups in most industries from defence to aviation and pharmaceuticals that provide expert advice to industry and government. We accredit university courses and consultancy practices and work closely with allied learned societies.



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CTPA is the UK trade association representing manufacturers of cosmetic products and suppliers to the cosmetic products industry. 'Cosmetic products' are legally defined and subject to stringent EU safety laws. CTPA is the authoritative public voice of a vibrant and responsible UK industry trusted to act for the consumer; ensuring the science behind cosmetics is fully understood.



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The Council for the Mathematical Sciences is an authoritative and objective body that works to develop, influence and respond to UK policy issues affecting mathematical sciences in higher education and research, and therefore the UK economy and society by:

- providing expert advice;
- engaging with government, funding agencies and other decision makers;
- raising public awareness; and
- facilitating communication between the mathematical sciences community and other stakeholders



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The Francis Crick Institute is an independent charity, established to be a UK flagship for discovery research in biomedicine.

The Crick's mission is discovery without boundaries. We don't limit the direction our research takes. We want to understand more about how living things work to help improve treatment, diagnosis and prevention of human disease, and generate economic opportunities for the UK.

In our institute more than 2,000 staff and students use their wide-ranging knowledge and expertise to work across disciplines and explore biology at all levels, from molecules through cells to entire organisms.

SCIENCE DIRECTORY



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Founded in 1992 in memory of the UK's first female Professor of Physics, the Trust is the UK's leading charity dedicated to realising the potential of scientists and engineers returning to research after career breaks for family, caring and health reasons. Recently, we have expanded our remit to incorporate the social sciences and arts & humanities. Our Fellowship programme, working in partnership with universities, UKRI, charities, learned societies and industry, enables individuals to undertake part-time research in universities and research institutes. Fellowships comprise a research project alongside an individually tailored retraining programme, with additional mentoring and support, enabling recipients to re-establish their research credentials, update skills and redevelop confidence, in a suitably supportive environment.



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EngineeringUK is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. EngineeringUK partners business and industry, Government and the wider science and technology community: producing evidence on the state of engineering; sharing knowledge within engineering, and inspiring young people to choose a career in engineering, matching employers' demand for skills.



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Fera provides expert analytical and professional services to governments, agricultural companies, food retailers, manufacturers and farmers to facilitate safety, productivity and quality across the agrifood supply chain in a sustainable and environmentally compatible way.

Fera uses its world leading scientific expertise to provide robust evidence, rigorous analysis and professional advice to governments, international bodies and companies worldwide. Our food integrity, plant health, agri-tech and agri-informatics services ensure that our customers have access to leading edge science, technology and expertise.



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GAMBICA is the voice of the laboratory technology, instrumentation, control and automation industries, providing influence, knowledge and community. We offer members a common platform for voicing their opinions and representing their common interests to a range of stakeholders. GAMBICA seeks to spread best-practice and be thought leaders in our sectors.



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The Geological Society of London is the UK's national society for geoscience, providing support to 12,000 Fellows (members) worldwide.

The Fellowship encompasses those working in industry, academia and government, with a wide range of expertise on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.

The Society aims to be an inclusive and thriving Earth science community advancing knowledge, addressing global challenges, and inspiring future generations.



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Advancing knowledge and setting standards in biomedical science

With over 20,000 members in 61 countries, the Institute of Biomedical Science (IBMS) is the leading professional body for scientists, support staff and students in the field of biomedical science.

Since 1912 we have been dedicated to the promotion, development and delivery of excellence in biomedical science within all aspects of healthcare, and to providing the highest standards of service to patients and the public.

By supporting our members in their practice, we set quality standards for the profession through training, education, assessments, examinations and continuous professional development.



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We are the UK's leading professional body for those involved in all aspects of food science and technology. We are an internationally respected independent membership body, supporting food professionals through knowledge sharing and professional recognition.

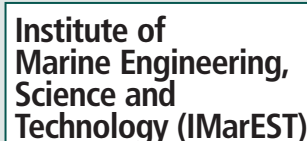
Our core aim is the advancement of food science and technology based on impartial science and knowledge sharing.

Our membership comprises individuals from a wide range of backgrounds, from students to experts, working across a wide range of disciplines within the sector.



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IKE is the UK's professional body for innovators. It accredits and certifies innovation practices. We influence the inter-relationship between education, business, and government through research and collaborative networks. Our Innovation Manifesto highlights our commitment to support the development of innovative people and organisations. IKE runs think-tanks, conducts research, develops new business models and tools and supports organisations to benchmark their innovation capabilities.



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Established in London in 1889, the IMarEST is a leading international membership body and learned society for marine professionals, with over 15,000 members worldwide. The IMarEST has an extensive marine network of 50 international branches, affiliations with major marine societies around the world, representation on the key marine technical committees and non-governmental status at the International Maritime Organization (IMO) as well as other intergovernmental organisations.

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Institute of Measurement and Control



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The Institute of Measurement and Control is a professional engineering institution and learned society dedicated to the science and application of measurement and control technology for the public benefit. The InstMC has a comprehensive range of membership grades for individuals engaged in both technical and non-technical occupations. Also, it is licensed by the Engineering Council to assess and register individuals as Chartered Engineers (CEng), Incorporated Engineers (IEng) and Engineering Technicians (EngTech).

The InstMC works to develop the knowledge and skills of individual engineers, fostering communication and advancing the science and practices within the industry.

IOP Institute of Physics

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The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland. The IOP's mission is to raise public awareness and understanding of physics, inspire people to develop their knowledge, understanding and enjoyment of physics and support the development of a diverse and inclusive physics community. As a charity, the IOP seeks to ensure that physics delivers on its exceptional potential to benefit society.

IPEM Institute of Physics and Engineering in Medicine

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Physicists, engineers and technologists play vital roles in delivering our healthcare. The Institute of Physics and Engineering in Medicine (IPEM) is the professional organisation that represents this diverse workforce. We are a charity with more than 4,600 members drawn from healthcare, academia and industry.

Our Mission is Improving Health through Physics and Engineering in Medicine. Our vision is one in which professionalism drives improvements in diagnosis, treatment and care, transforming the lives of patients.

Our members, the professional community of medical physicists, biomedical engineers and clinical technologists working in hospitals, academia and industry around the world are the people who make it happen. We work to support them through professional development, community and leadership services and initiatives. IPEM is licensed by the Science Council to award CSci, RSci and RSciTech, and by the Engineering Council to award CEng, IEng and EngTech.

IChemE ADVANCING CHEMICAL ENGINEERING WORLDWIDE

The Institution of Chemical Engineers

The Institution of Chemical Engineers (IChemE) advances chemical engineering's contribution worldwide for the benefit of society. We support our members in applying their expertise and experience to help address the Sustainable Development Goals.

We are the leading professional qualifying body for chemical, biochemical and process engineers, and are the only organisation worldwide to award Chartered Chemical Engineer status.

We support the development of chemical engineering professionals, and provide connections to a powerful network of over 29,000 members in more than 100 countries.

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IET The Institution of Engineering and Technology

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The IET is a world leading professional organisation, sharing and advancing knowledge to promote science, engineering and technology across the world. Dating back to 1871, the IET has over 163,000 members in 127 countries with offices in Europe, North America, and Asia-Pacific.



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LGC is a leading global life science tools company, providing genomics and quality assurance solutions into high growth application areas within human healthcare and applied market segments. Our core purpose is Science for a Safer World.

Our 180 years of scientific heritage, combined with a focus on innovation and value-enhancing acquisitions, has enabled us to build a highly valued product portfolio, and to closely collaborate with our customers, partners and the global scientific community.

As the UK Government Chemist www.gov.uk/government/organisations/government-chemist, LGC acts as the referee analyst and advises Government and the wider analytical community on analytical measurement matters for policy, standards and regulation.

LGC is also the UK's National Measurement Laboratory for chemical and bio-measurement, finding solutions to fundamental and emerging measurement challenges, driving innovation, productivity and economic growth.

L'ORÉAL UK AND IRELAND

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L'Oréal employs more than 3,800 researchers world-wide and dedicates over €877 million each year to research and innovation in the field of healthy skin and hair. The company supports women in science research through the L'Oréal UNESCO For Women In Science Programme and engages young people with science through the L'Oréal Young Scientist Centre at the Royal Institution. L'Oréal also collaborates with a vast number of institutions in the UK and globally.

The LINNEAN SOCIETY of London



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As the world's oldest active biological society, the Linnean Society is an essential forum and meeting point for those interested in the natural world. The Society holds regular public lectures and events, publishes three peer-reviewed journals, and promotes the study of the natural world with several educational initiatives. The Society is home to a world famous library and collection of natural history specimens. The Society's Fellows have a considerable range of biological expertise that can be harnessed to inform and advise on scientific and public policy issues.

A Forum for Natural History

Marine Biological Association



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Since 1884 the Marine Biological Association has been delivering its mission 'to promote scientific research into all aspects of life in the sea, including the environment on which it depends, and to disseminate to the public the knowledge gained.' The MBA represents its members in providing a clear independent voice to government on behalf of the marine biological community. It also has an extensive research programme and a long history as an expert provider of advice for the benefit of policy makers and wider society.

SCIENCE DIRECTORY



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The Institution provides politicians and civil servants with information, expertise and advice on a diverse range of subjects, focusing on manufacturing, energy, environment, transport and education policy. We regularly publish policy statements and host political briefings and policy events to establish a working relationship between the engineering profession and parliament.



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The Met Office doesn't just forecast the weather on television. Our forecasts and warnings protect UK communities and infrastructure from severe weather and environmental hazards every day – they save lives and money. Our Climate Programme delivers evidence to underpin Government policy through the Met Office Hadley Centre. Our Mobile Meteorological Unit supports the Armed Forces around the world. We build capacity overseas in support of international development. All of this built on world-class environmental science.



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The Microbiology Society is a membership charity for scientists interested in microbes, their effects and their practical uses. It has a worldwide membership based in universities, industry, hospitals, research institutes, schools, and other organisations.

Our members have a unique depth and breadth of knowledge about the discipline. The Society's role is to help unlock and harness the potential of that knowledge.

Our principal goal is to strengthen our culture of being a community-driven Society by amplifying our members' voices, wherever they are in the world, and empowering them to embed the benefits of microbiology within wider society.



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The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute, an internationally respected and independent centre of excellence in research, development and knowledge transfer in measurement and materials science. For more than a century, NPL has developed and maintained the nation's primary measurement standards - the heart of an infrastructure designed to ensure accuracy, consistency and innovation in physical measurement.



Advancing the science of nature

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We challenge the way people think about the natural world – its past, present and future

We use our unique collection and unrivalled expertise to tackle the biggest challenges facing the world today.

We are leaders in the scientific understanding of the origin of our planet, life on it and can predict the impact of future change.

We study the diversity of life and the delicate balance of ecosystems to ensure the survival of our planet.

We help enable food security, eradicate disease and manage resource scarcity.

We inspire people to engage with science to solve major societal challenges.



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The University of Northampton is an institution committed to science education through initial teacher training, a STEM Ambassador network which works within the community and teaching and research to doctoral level. We are an Ashoka U 'Changemaker Campus' status university recognising our commitment to social innovation and entrepreneurship.



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With 43,000 students and campuses in Nottingham, China and Malaysia, The University of Nottingham is 'the nearest Britain has to a truly global university'. With more than 97 per cent of research at the University recognised internationally according to the Research Excellence Framework 2014, the University is ranked in the top 1% of the world's universities by the QS World University Rankings.



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The Nutrition Society, formed in 1941, is a diverse community with the independence and courage to challenge, question and progress the field of nutrition. Through a progressive approach that champions collaboration and breaking down research silos, we welcome members from around the world, regardless of their level of expertise. They must however have a genuine interest in pushing forward the field of nutrition for the benefit of people, animals while balancing the health of our planet too.



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As the largest network of physiologists in Europe, with academic journals of global reach, we continue our 140-year tradition of being at the forefront of the life sciences.

We bring together scientists from over 60 countries, and our Members have included numerous Nobel Prize winners from Ivan Pavlov to John O'Keefe.

SCIENCE DIRECTORY



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Prospect is an independent, thriving and forward-looking trade union with over 120,000 members across the private and public sectors and a diverse range of occupations. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

Prospect's collective voice champions the interests of the engineering and scientific community to key opinion-formers and policy makers. With negotiating rights with over 300 employers, we seek to secure a better life at work by putting members' pay, conditions and careers first.

QUADRAM INSTITUTE



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The £75m Quadram Institute opened in 2019 and is focused on fundamental and translational research into the interfaces between the gut microbiome, food, and human health. The Quadram Institute combines leading-edge bioscience capabilities with NHS endoscopy, clinical trials and biobank facilities. The Quadram Institute is a partnership between the Norfolk and Norwich University Hospital, University of East Anglia, Quadram Institute Bioscience and BBSRC.



Royal Academy of Engineering

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As the UK's national academy for engineering, we bring together the most successful and talented engineers for a shared purpose: to advance and promote excellence in engineering. We have four strategic challenges: drive faster and more balanced economic growth; foster better education and skills; lead the profession; and promote engineering at the heart of society.



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RBG Kew is a centre of global scientific expertise in plant and fungal diversity, conservation, and sustainable use, housed in two world-class gardens. Our scientific vision is to document and understand global plant and fungal diversity and its uses, bringing authoritative expertise to bear on the critical challenges facing humanity today.

Kew's strategic priorities for science are:

1. To document and conduct research into global plant and fungal diversity and its uses for humanity.
2. To curate and provide data-rich evidence from Kew's unrivalled collections as a global asset for scientific research.
3. To disseminate our scientific knowledge of plants and fungi, maximising its impact in science, education, conservation policy and management.

These priorities enable us to curate, use, enhance, explore and share Kew's global resource, providing robust data and a strong evidence base for our UK and global stakeholders. Kew is a non-departmental government body with exempt charitable status, partially funded by Defra.



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The Royal Society is the academy of science in the UK and the Commonwealth comprising 1400 outstanding individuals representing the sciences, engineering and medicine. The Society has played a part in some of the most fundamental, significant and life-changing discoveries in scientific history and Royal Society scientists continue to make outstanding contributions to science across the wide breadth of research areas. Through its Fellowship and permanent staff, it seeks to ensure that its contribution to shaping the future of science in the UK and beyond has a deep and enduring impact, supporting excellence in science and encouraging the development and use of science for the benefit of humanity.



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The Royal Society of Biology is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policy makers – including funders of biological education and research – with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines. Our vision is of a world that understands the true value of biology and how it can contribute to improving life for all.



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The Royal Society of Chemistry is the world's leading chemistry community, advancing excellence in the chemical sciences. With over 50,000 members and a knowledge business that spans the globe, we are the UK's professional body for chemical scientists; a not-for-profit organisation with 170 years of history and an international vision of the future. We promote, support and celebrate chemistry. We work to shape the future of the chemical sciences – for the benefit of science and humanity.

Society for Underwater Technology



Society for Underwater Technology
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The SUT is a multidisciplinary learned society that brings together individuals and organisations with a common interest in underwater technology, ocean science, and offshore/subsea engineering. The society was founded in 1966 and has members from over 40 countries, including engineers, scientists, other professionals and students working in these areas.

Society of Chemical Industry

SCI: where science meets business

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Established by Royal Charter in 1881, SCI is a unique multi-disciplinary community. Set up by a prominent group of forward thinking scientists, inventors and entrepreneurs, SCI continues to be a multi-science and industry network based around chemistry and related sciences. Our charitable objective is to promote links between science and industry for the benefit of society. Our passion is invention and creation.

We deliver our charitable objective by:

- Supporting the commercial application of science into industry
- Tackling global challenges across Agrifood, Energy, Environment, Health and Materials

SCIENCE DIRECTORY

Society of Cosmetic Scientists



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Advancing the science of cosmetics is the primary objective of the SCS. Cosmetic science covers a wide range of disciplines from organic and physical chemistry to biology and photo-biology, dermatology, microbiology, physical sciences and psychology.

Members are scientists and the SCS helps them progress their careers and the science of cosmetics ethically and responsibly. Services include publications, educational courses and scientific meetings.



THE SOCIETY FOR RADIOLOGICAL PROTECTION

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The Society for Radiological Protection is the principal independent professional body for radiation protection in the UK. Its members operate in the fields of medicine, the nuclear power cycle and other industries, research, and teaching. We offer a profession-wide view to regulators and are involved in training and educational outreach. We ensure that professional standards are maintained at the highest levels.



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The **UK Innovation & Science Seed Fund** is a leading patient capital investor with more than £330 million private investment leveraged to date. The Fund works to build technology companies from the earliest stage by working closely with its partners led by STFC, BBSRC, NERC and Dstl, with the National Research and Innovation Campuses they support, and with entrepreneurial science-led teams. UK Innovation & Science Seed Fund is also closely aligned with the Catapults and InnovateUK, helping to commercialise key technological advances in industrial biotech, agricultural technology, healthcare, medicine, clean energy, materials, artificial intelligence, software and space.



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Understanding Animal Research is a not-for-profit organisation that explains why animals are used in medical, veterinary, environmental and other scientific research. We aim to achieve a broad understanding of the humane use of animals in medical, veterinary, scientific and environmental research in the UK. We work closely with policymakers to ensure regulation is effective and are a trusted source of information for the national and international media. We are funded by our members who include universities, professional societies, trade unions, industry and charities.



University of Essex

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Established in 1964, the University of Essex is ranked as one of the Top 20 universities in the Research Excellence Framework and is awarded Gold in the Teaching Excellence Framework. It is home to world-leading expertise in analytics and data science, with research peaks spanning the social sciences, sciences, and humanities. Pioneers of quantitative methods and artificial intelligence techniques, Essex is also in the UK top 10 for Knowledge Transfer Partnerships, and works with businesses to embed innovation into operations, through KTPs, knowledge exchange and contract research.

Universities Federation for Animal Welfare



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Registered in England Charity No: 207996

The Universities Federation for Animal Welfare (UFAW) is an international independent scientific and educational animal welfare charity and membership society.

UFAW's vision is a world where the welfare of all animals affected by humans is maximised through a scientific understanding of their needs and how to meet them. We promote an evidence-based approach to animal welfare by funding scientific research, helping develop the next generation of animal welfare scientists and sharing animal welfare science knowledge with both experts and the wider public.



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The Welding Institute is the leading institution providing engineering solutions and knowledge transfer in all aspects of manufacturing, fabrication and whole-life integrity management.

Industrial membership provides access to innovative problem-solving from one of the world's foremost independent research and technology organisations.

Non-Corporate services include membership and registration, education, training and certification for internationally recognised professional development and personnel competence assurance.

TWI provides Members and stakeholders with authoritative and impartial expert advice, knowhow and safety assurance through engineering, materials and joining technologies.

SCIENCE DIARY

PARLIAMENTARY AND SCIENTIFIC COMMITTEE – ALL-PARTY PARLIAMENTARY GROUP

Email: office@scienceinparliament.org.uk
www.scienceinparliament.org.uk
follow us on Twitter @ParlSciCom

FORTHCOMING DISCUSSION AND OTHER MEETINGS

Monday 20th November 2023

Discussion Meeting on 'The impact of extreme heat on vulnerable populations'

In partnership with The Physiological Society
5.15pm to 6.45pm
Chairman's Reception 6.50pm to 7.30pm

Monday 15th January 2024

Discussion Meeting on 'Healthy safe and sustainable indoor environment managing trade-offs for indoor air quality and net zero goals'

In partnership with the Institution of Mechanical Engineers
5.15pm to 6.45pm, Palace of Westminster
Chairman's Reception 6.50pm to 7.30pm

ROYAL SOCIETY OF BIOLOGY

For further details please contact
Karen Patel: events@rsb.org

ROYAL SOCIETY OF CHEMISTRY

For further details please contact
events@rsc.org

ROYAL SOCIETY

Details of all events can be found on the events calendar at events@royalsociety.org
For scientific meetings queries:
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The Parliamentary & Scientific Committee's STEM for BRITAIN 2024 takes place on Monday 4th March

in the Attlee Suite, Portcullis House,
House of Commons.

Applications are now open from early-career research scientists, engineers, technologists and mathematicians who wish to exhibit posters in one of the following areas:

- Biological and Biomedical Sciences
- Chemistry
- Engineering
- Mathematics
- Physics

The closing date for applications is Monday 27th November 2023.

A wide range of important scientific, engineering and mathematics institutions and organisations are lending their support to this event, including the Royal Society of Biology, the Institute of Physics, The Physiological Society, the Royal Society of Chemistry, the Royal Academy of Engineering, the Council for the Mathematical Sciences, Dyson, the Institute of Biomedical Science, the Clay Mathematics Institute, the Nutrition Society, British In Vitro Diagnostics Association, the Heilbronn Institute, United Kingdom Research and Innovation, the Biochemical Society, AWE, and the Society of Chemical Industry.

This reflects the importance we all attach to the encouragement of researchers at this stage in their careers.

Prizes will be awarded for the posters presented in each discipline which best communicates high level science, engineering or mathematics to a lay audience.

The Westminster Medal in memory of the late Dr Eric Wharton, who did so much to establish SET for Britain as a regular event in the Parliamentary calendar, will be awarded at a P&SC event in Parliament in April 2023, following online judging.

Full details of the competition and exhibition including the application form will be on the STEM for Britain website: www.stemforbritain.org.uk

