



Rt. Hon George Freeman FRSA MP, Chair, Parliamentary & Scientific Committee (All-Party Parliamentary Group)

Welcome to this our Winter 2024-25 SIP publication.

It's been a busy last few months as the Parliamentary & Scientific Committee gets established in the new Parliament, the new Government set out its first Budget and new Industrial Strategy with important implications for science & the R+D economy, and the new Select Committee for Science Technology and Innovation - on which I am delighted to have been elected as Deputy Chair - takes office.

The Budget on Nov 2nd set out a major change to the fiscal rules governing the definition of public sector borrowing to allow c £70bn of additional public sector borrowing alongside £40bn of tax rises to fund a major increase in public expenditure focussed on the NHS & infrastructure, to help the Government's mission to boost growth. (Even after this major stimulus package the OBR

forecasts for growth remain stubbornly low at c1.5% with inflation and interest rates looking set to remain stubbornly high too). All of which serves to highlight the importance of the R+D Innovation Economy as the only part of the economy capable of delivering higher productivity and sustainably high Growth.

Whilst many Departments and areas of spend received below inflation settlements, the Chancellor announced she would stick to the previous Governments pledge (which I and then Chancellor Rishi Sunak announced in October 2021) to increase public R+D expenditure to £20bn p/a by 2025.

Within that the Department of Science, Innovation and Technology is the largest Departmental R+D budget with the Department of Health and Social Care, Ministry of Defence, Department of Environment, Food and Rural Affairs, Department of Energy Security and Net Zero & Department of Transport in the next tranche well head of the others.

Much devil will be in the detail of Departmental allocations announced in the Spring Statement, including in particular - the extent to which the reclassification of DSIT as the digital department means a cut in science spending, whether the Industrial Strategy focus on green transition means a cut in non-Net Zero science & innovation, and whether the £2bn Quantum &

£2pm Engineering Biology Industrial Strategies announced (by me last year) survive or are cut.

The Committee has kicked off its programme of events in the new Parliament with a series of fascinating Presentations and Roundtable Discussions on **'In the next Parliament and beyond, how can engineers contribute to achieving a more sustainable world?'**, in partnership with the Institution of Chemical Engineers; **'Reuse, Replace or Repair'** in cooperation with the Institute of Corrosion; **'Can an app deliver positive nutrition and health outcomes?'** in partnership with The Nutrition Society; and **'How to tackle Contaminants or Emerging Concern (CEC's) in water'**, in cooperation with the Royal Society of Chemistry.

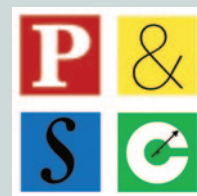
On November 5th we had our annual SiP lunch with my old friend and stalwart friend of Science David (Lord) Willetts as our guest speaker, and a lovely opportunity to thank my predecessor and our former Chair Stephen Metcalfe for his great service.

Each SiP publication I thought I would share a scientist quote. Here's my first. A reminder that Great science is not the cold dry empiricism so often portrayed but a great engine of enlightenment values driven by the imagination of new possibilities.

Ralph Waldo Emerson:
"Science does not know its debt to imagination".



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.

Editor's Note:

We are very pleased to welcome a number of new P&SC members:

Parliamentary: Graham Leadbitter MP; Lee Dillon MP; Steve Race MP; Chris McDonald MP; Lord Foulkes of Cumnock and Lord Griffiths of Burry Port

Scientific and Technical Organisations: CPI; The Pandemic Institute and Health Innovation Network South London

Individual: Doris-Ann Williams MBE, Yousef Alzidan and Vernon Hunte Leigh

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TRANSFORMING ORGANISATIONAL CULTURE: NAVIGATING INNOVATION IN DOCTRINAL AND REGULATED ENVIRONMENTS



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Organisational culture – the collective values, beliefs, and behaviours that shape how work is performed – serves as the foundation for collaboration, innovation, and adaptability. In doctrinal organisations such as NATO, as well as regulated industrial entities like MBDA, the challenge lies in transforming traditional, hierarchical systems into adaptive, innovative ecosystems whilst adhering to established operational frameworks. This article explores the interplay between culture change, innovation, and adaptation within such structures and emphasises leadership’s pivotal role in fostering innovation.

UNDERSTANDING ORGANISATIONAL CULTURE

Organisational culture can be defined as “how we do things around here,” encompassing shared values, behaviours, and assumptions. It manifests in every interaction, decision, and policy, shaping how organisations respond to challenges and opportunities^{1,2}. In doctrinal organisations and regulated businesses, culture often reflects rigid structures, strict adherence to protocols, and a ‘cautious’ approach to risk. While these features ensure consistency and safety, they can hinder innovation and adaptability in a rapidly changing and digitally-driven global landscape.

Cultural stagnation, in particular, poses significant challenges^{3,4}. As technological advances and geopolitical shifts accelerate, organisations must evolve their culture to remain relevant. For NATO and MBDA, this means

embedding innovation not as an auxiliary function but as a core principle.

THE INNOVATION IMPERATIVE

Both doctrinal organisations and regulated industries face disruptive forces^{5,6}, including technological advancements (e.g., artificial intelligence, hypersonics, and quantum computing) and external challenges such as geopolitical tensions, climate change, and economic instability. These entities cannot afford to remain static; they must innovate to maintain strategic and operational advantage.

Innovation is not merely about introducing new technologies; it involves rethinking strategies, operational models, and reformatting culture. For example, NATO’s initiatives to counter hybrid warfare and integrate AI^{7,8} into decision-making exemplify how innovation addresses complex

challenges. Similarly, MBDA’s efforts to develop sustainable practices⁹, predictive analytics, and advanced missile systems reflect the critical role of innovation in meeting industry and regulatory demands.

Rear Admiral Placido Torresi, Deputy Chief of Staff for Joint Force Development at NATO’s Allied Command Transformation, stated, “*In an era defined by rapid technological evolution and complex threats, adaptive capacity and innovation are no longer optional; they are the cornerstones of maintaining our operational advantage and securing collective defence.*” This perspective, articulated in the Warfare Development Agenda, underscores the critical need for doctrinal organisations to embed flexibility and innovation within their cultural frameworks.

LEADERSHIP'S ROLE IN CULTURAL TRANSFORMATION

Leaders in doctrinal and regulated organisations serve as catalysts for change. Their vision and commitment to fostering innovation create a ripple effect throughout the organisation. Key leadership strategies include:

1. Setting the Vision for Innovation

Leaders must articulate a clear vision of the value innovation brings to the organisation. For instance, NATO's long-term strategic planning has embraced emerging disruptive technologies such as cyber defence and autonomous systems, aligning these advancements with its broader mission.

technologies without the fear of missteps derailing progress.

3. Enabling Cross-Functional Collaboration

By breaking down silos, leaders can foster ecosystems where departments and external partners collaborate to co-create solutions. MBDA's partnerships with academic institutions and NATO's joint initiatives with member states exemplify this approach, facilitating the exchange of ideas and resources to drive innovation.

4. Role Modelling Adaptive Behaviours

Adaptive leaders demonstrate openness to change, data-driven decision-making, and resilience in uncertain conditions. This inspires their teams to embrace similar

barrier to agility and creativity. The DOTMLPF-I framework (Doctrine, Organisation, Training, Materiel, Leadership and Education, Personnel, Facilities and Interoperability), widely used by NATO, provides a lens through which the influence of doctrine on digital transformation efforts can be assessed. Doctrine is both an enabler and a potential constraint, influencing military organisation's ability to adapt to the rapid technological changes:

• Facilitating Innovation:

Doctrine provides a common framework and language, enabling coordinated efforts and efficient communication. It ensures alignment with organisational goals and can serve as a foundation for building innovative ideas. For

may prevent the adoption of new approaches that deviate from traditional methods. This is particularly challenging in environments requiring agility and rapid adaptation to unforeseen threats.

Balancing adherence to doctrine with the need for innovation requires^{14,15} a dynamic approach, where doctrine evolves in response to emerging challenges and opportunities.

CULTURAL STRATEGIES FOR TRANSFORMATION

In hierarchical and regulated contexts, cultural transformation is a complex process full of uncertainty. Strategic interventions can help nudge organisations towards innovation. Actionable approaches include:

1. Redefining Metrics of Success

Shift from traditional key performance indicators to metrics that measure innovation impact, such as the number of experiments conducted, speed to market and deployment, or the adoption rates of new technologies. Here, tools such as Objectives and Key Results (OKRs) – a goal-setting framework used by individuals, teams, and organisations to define measurable goals and track their outcomes – can operate better, particularly, when managing uncertainty.

2. Flattening Hierarchies

Empower teams to make decisions by adopting more agile, 'decentralised governance' structures. This fosters faster innovation cycles and aligns with modern operational needs. NATO's decentralised and federated interoperability initiatives^{8,9} and MBDA's lean management practices are prime examples of this strategy.



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2. Promoting Psychological Safety

Cultures of innovation thrive on psychological safety – the belief that individuals can share ideas without fear of reprisal. Leaders can encourage experimentation and learning from failure to build confidence in teams. At MBDA, fostering a safe environment for innovation has allowed the company to explore cutting-edge

mindsets, creating a culture that is both dynamic and forward-thinking.

DOCTRINE: A DOUBLE-EDGED SWORD

Doctrine – the set of fundamental principles that guide organisational actions^{10,11} – plays a crucial role in shaping behaviour and decision-making. It provides the foundation for consistency and operational alignment but can also act as a

example, NATO's doctrine on collective defence^{12,13} underpins its efforts to integrate emerging technologies like AI and machine learning into its operations.

• Hindering Innovation:

Conversely, rigid adherence to established doctrine can stifle creativity and discourage experimentation. When doctrine becomes inflexible, it

Denis Gardin, MBDA's Director of Innovation and Future Technologies, remarked, *"Innovation thrives at the intersection of collaboration and vision. By integrating advanced technologies with strategic partnerships, we are redefining defence capabilities to ensure adaptability and effectiveness in the face of evolving challenges."* This perspective highlights MBDA's dedication to cultivating a culture of innovation that delivers groundbreaking solutions, shaping the future of defence capabilities.

3. Leveraging Capability-Value Frameworks

Build organisational innovation stacks to enhance adaptive capacity. Assign roles to champion, enable, and scale innovations. Such Capability-Value Frameworks can help identify gaps and prioritise interventions effectively.

4. Utilising Storytelling

Communicate innovation successes through compelling narratives and use cases that resonate with employees and stakeholders. This reinforces the organisation's commitment to change and ensures buy-in from all levels.

5. Building Safe Experimentation Spaces

Create innovation labs or protected environments^{13,16} where teams can explore new ideas without the pressure of immediate results. NATO's innovation hubs and MBDA's advanced simulation centres demonstrate the efficacy of such spaces.

SIMILARITIES BETWEEN MILITARY ORGANISATIONS AND HIGHLY REGULATED BUSINESSES

Military organisations and highly regulated businesses share several characteristics:

1. Structured Hierarchies: Both operate within well-defined hierarchical frameworks that delineate authority and responsibility. This structure ensures accountability but can also limit flexibility.

2. Standardised Practices: Emphasis on standard operating practices ensures consistency and compliance with regulations or directives. While essential for operational safety, it can slow down decision-making in dynamically evolving environments.

3. Risk Aversion: A cautious approach to risk is prevalent, given the potential consequences of failure in both contexts. This culture can discourage experimentation, even when it is necessary for innovation.

4. Regulatory Compliance: Adherence to external regulations or internal doctrines is paramount to maintain legitimacy and operational effectiveness. Both NATO and MBDA illustrate how compliance intersects with innovation, balancing safety and progress.

INNOVATION IN PRACTICE: EXAMPLES

1. NATO

NATO's adaptation to hybrid warfare technologies and the use of scenario planning for emerging threats highlight how doctrinal organisations integrate innovation into their strategies. Tools like PESTLE and SWOT supported by AI analyses aid in understanding disruptive trends and shape interventions.

2. MBDA

MBDA's focus on sustainable practices, predictive analytics, and smart materials exemplifies how regulated businesses balance innovation with compliance

and operational rigour. Their ecosystem mapping methodology underscores the importance of collaboration with partners and academia.

THE PATH FORWARD

Transforming culture in doctrinal and regulated entities requires ongoing commitment and strategic leadership. To sustain change:

- **Institutionalise Innovation Practices:** Embed innovation processes into the organisational DNA through systematic approaches such as applying ISO 56001: 2024 and 56002: 2019 for innovation management.

- **Develop Leadership at All Levels:** Equip leaders with the skills to drive cultural change, including training in lean-agile methodologies, distributed decision making and design thinking.

- **Monitor Progress and Adapt:** Continuously assess cultural interventions and refine strategies based on feedback and results. Innovation is not static; it requires iterative improvement to remain impactful yielding the desired value for the organisation and the sectors it serves.

By leveraging leadership's influence to prioritise culture change, doctrinal and regulated organisations like NATO and MBDA can enhance their adaptive capacity and capability, ensuring resilience and sustained relevance in an ever-evolving global landscape.

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MENTORING THE NEXT GENERATION TOWARDS BETTER CORROSION PREVENTION



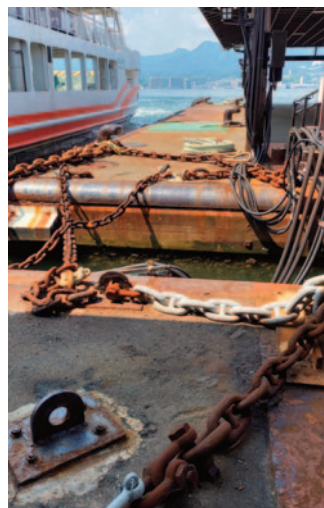
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Izabela is a Corrosion Engineer at Intertek CAPCIS with a master's degree in chemical technology from Poznań University of Technology. She is a Professional Member of the Institute of Corrosion (ICorr), an Associate Member of the Energy Institute, and serves as Vice Chair of ICorr Northwest. A past winner of the ICorr Young Engineer Programme (YEP), she is currently the organiser of the 2024-2025 YEP. Izabela is committed to achieving Chartered Engineer status and making a global impact in the field of corrosion.

Corrosion – the deterioration of materials, usually metals, is due to chemical reactions with their environment and is one of industry's costliest problems. Corrosion can occur in offshore wind farms, mineral extraction, chemical and petrochemical process plants, and public infrastructure such as bridges, buildings and may also pose a real threat to public health and the environment.

FINANCIAL, SAFETY & ENVIRONMENTAL IMPACTS OF CORROSION

According to the US Association for Materials Protection and Performance (AMPP), corrosion costs the global economy \$2.5 trillion per year, or approximately 3.4% of global GDP¹. In 2023, the GDP in the United Kingdom (UK) was £2.27 trillion², and assuming 3 to 3.4% of this corresponds to the annual cost of corrosion in the country, corrosion costs the UK up to approximately £90 billion annually.



Shiny and corroded metal chains
(source: private collection)

to approximately £850. In this context, it is also worth mentioning that the economic losses from corrosion in the UK each year are comparable to the annual education spending, as shown in Figure 1⁴.

Corrosion also has significant impact on both society and the environment. For example, it poses a serious safety threat, as evidenced by major accidents such as the 1985 Swiss swimming pool collapse, where the concrete roof, supported by stainless steel rods, collapsed

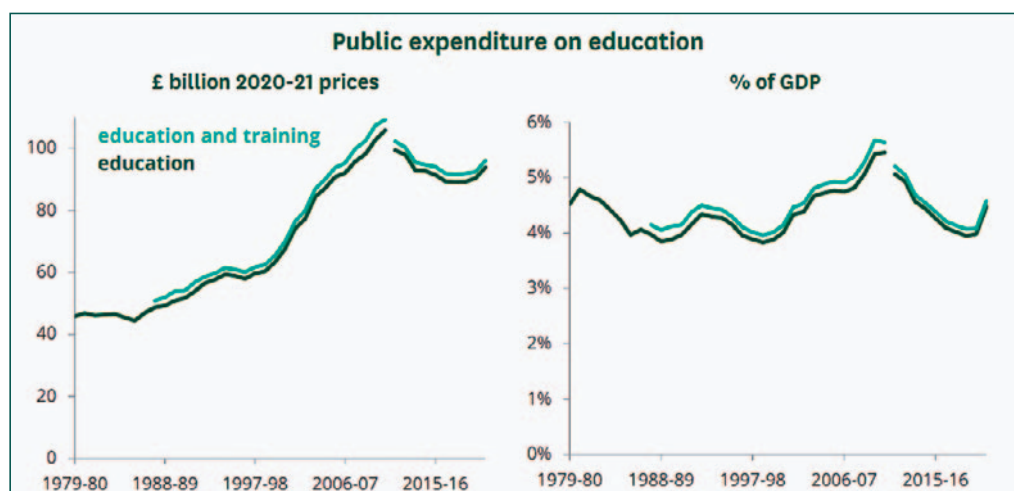


Figure 1. UK education and training costs over the years⁴

In addition, the AMPP estimates that up to 35% of these costs could be avoided¹, and given that in 2022 the UK's

average income was £39,328³, the annual corrosion costs per the average UK household could be reduced from around £1,300

after just 13 years of service due to Chloride Stress Corrosion Cracking, killing 12 people⁵.

Alongside the threat to public safety, corrosion can lead to environmental pollution through leaks and spills of hazardous chemicals into both water and the atmosphere. A spill from a pipeline transporting crude oil led to 4200 m³ of polluted water in the Kalamazoo River in 2010 in Michigan, USA⁶. Corrosion was also considered one of the main causes of the China Donghuang oil pipeline leak and explosion tragedy in 2013, where 63 people lost their lives, 156 people were injured and environmental pollution was extensive. This accident also caused a direct economic loss of 750 million yuan⁷.

An investigation into a railway safety incident in Berkshire, UK,⁸ in 2014 established that a signal post fell onto railway lines due to corrosion at its base, causing a passenger train travelling at 110 mph (177 km/h) to collide with it. Fortunately, the train remained on track, but the Rail Accident Investigation Branch (RAIB) emphasised that the potential for a more serious outcome was considerable. This incident underscores the critical need for ongoing infrastructure maintenance and inspection to ensure passenger safety.

In addition, it has been estimated that steel replacement due to corrosion could account for as much as 4.1 to 9.1% of global carbon dioxide (CO₂) emissions by 2030 if no action is taken⁹, contributing to a significant sustainability challenge.

IMPORTANCE OF EFFECTIVE CORROSION PREVENTION

Much can be done to mitigate the effects of corrosion. Optimised prevention practices can:

- (i) Improve safety, and prevent major accidents;

- (ii) Improve environmental protection;
- (iii) Reduce costs;
- (iv) Reduce inconvenience to the public, including:
 - Minimising water and gas leaks;
 - Ensuring more reliable travel through well-maintained roadside and trackside infrastructure, and;
 - Extending the life of public assets.

The amount spent on restoration of public structures can be substantial; corrosion of the cables of the Forth Road Bridge, Scotland (Figure 3), led to expensive repairs and eventually to the need to construct a replacement bridge at a cost of approximately £1.4 billion due to the weight limit imposed on the old road bridge^{10, 11, 12}. Another example is the Tay Bridge in Dundee, Scotland, the longest rail structure in the UK, where the cost of restoration is estimated to £130 million¹³.



Forth Road Bridge, Scotland (private collection)

SOLUTIONS TO CORROSION PROBLEMS

Potential solutions to corrosion problems include:

- (i) Safe, sustainable design through cost-effective material selection to match the asset's life cycle, thereby improving safety and structural reliability;
- (ii) Effective corrosion risk assessment to better forecast corrosion failures, thus extending the service life of structures;

- (iii) Collaboration between corrosion experts, government bodies, and communities to facilitate the provision of corrosion control expertise;
- (iv) Promoting knowledge transfer through education, training, and mentoring to enhance competency and raise corrosion awareness.

Corrosion professionals are needed in a variety of industry sectors, including:

- (i) Fundamental Research;
- (ii) Development of Products (e.g. alloys, coatings, corrosion inhibitors);
- (iii) Design;
- (iv) Engineering;
- (v) Asset Integrity Management;
- (vi) Health and Safety Compliance – COMAH regulations and Safety Cases;
- (vii) Plant & Equipment Engineering, Inspection & Safety.

*EngineeringUK*¹⁶ has tracked the annual demand for engineers and technicians needed to keep up with UK demand for infrastructure and other engineering projects and estimate the shortfall to be between 37,000 and 59,000.

Knowledge transfer is particularly important when more experienced staff approach retirement, as the loss of knowledge can be substantial with consequential risks to the business. While the UK's universities are training students from around the world, many of them supported by their governments, the UK is losing expertise due to an ageing population. It is vital to encourage more UK students to pursue Corrosion Science and Engineering to make up our shortfall. A good example to mention here is the Institute of Corrosion's (ICorr) 5-year funding for six student scholarships at the University of Manchester. STEM (Science Technology Engineering Mathematics) learning also has great potential for transferring corrosion engineering knowledge.

Because corrosion and degradation can affect most structures, other subject specialists such as mechanical, civil, structural, and electrical engineers, as well as architects, need to understand corrosion and corrosion prevention fundamentals in order to mitigate corrosion problems.

MENTORING AS A KNOWLEDGE TRANSFER STRATEGY

Over the years, many strategies and tools for knowledge transfer have been documented in knowledge and project management literature. Knowledge can be gained and communicated in many ways, including:

- (i) Work experience;

- (ii) Mentoring sessions;
- (iii) Encouraging familiarisation with standards and technical books relevant to the job position and performed activities;
- (iv) Training courses;
- (v) E-learning;
- (vi) Site visits;
- (vii) Technical meetings, webinars and conferences.

A popular learning model¹⁷ developed in the mid-1990s by McCall, Eichinger, and Lombardo (Figure 2) suggests that 70% of skill development comes from learning in the workplace, 20% from social (informal) learning (e.g., mentoring), and that structured (formal) learning (e.g., training courses and technical meetings) constitutes 10% of the above-mentioned model.

Effective KT requires a good planning, addressing:

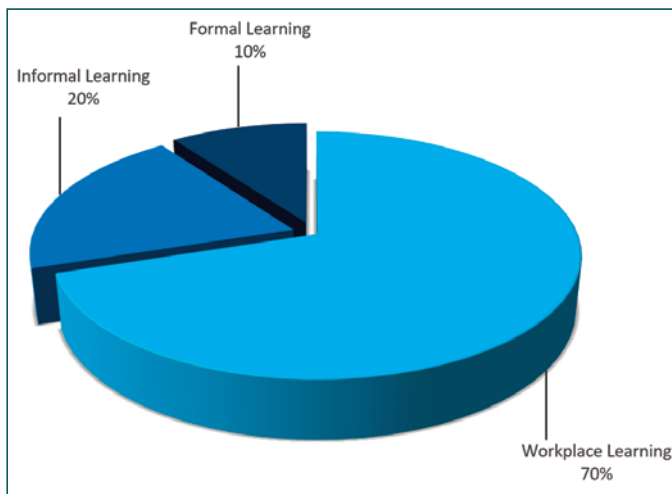


Figure 2. 70:20:10 Model for Learning and Development¹⁷

- (i) What knowledge is to be transferred;
- (ii) What the available methods of sharing knowledge are, and;
- (iii) How an employee's knowledge acquisition can be measured.

Consequently, mentoring the next generation of corrosion specialists is critical to successful corrosion management. Mentors should be matched with

mentees' goals and development needs, with a clearly defined schedule in place. Sessions can include presentations on fundamentals, problem-solving discussions, and site-based learning. A customised subject-based curriculum can be a great mentoring tool. Sharing knowledge from personal work experience is very important. Mentors should also provide support and opportunities to discuss issues related to ongoing projects. Presentations on agreed mentoring subjects, given to the company's staff, as well as tests or exams, can help assess mentoring effectiveness.

CONCLUSIONS

Corrosion presents serious safety and environmental challenges, significantly increases costs, and can indirectly raise the tax burden. In the UK alone,

properly addressing corrosion could lead to annual savings of up to £32 billion. However, while competent specialists are essential for effectively managing corrosion and degradation issues, the UK faces a shortage of skilled corrosion professionals, compounded by limited educational training programmes in this field.

To combat this issue, it is important to build a bridge between young corrosion

researchers and engineers, and senior experts to facilitate knowledge communication. Therefore, mentoring the next generation of corrosion professionals combined with fundamental academic research and development is critical for tackling corrosion and will, ultimately, lead to improved safety, significant cost savings, and enhanced sustainability. In conclusion, effective corrosion management extends beyond infrastructure, playing a crucial role in enhancing the durability and lifespan of vehicles as well. This progress not only supports environmental sustainability but also leads to meaningful cost savings for households, reflecting the widespread impact of innovations in corrosion control.

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PARLIAMENT NEEDS TO PRIORITISE ENGINEERING EDUCATION AND TRAINING AT ALL LEVELS IF WE ARE TO ENGINEER A SUSTAINABLE WORLD



Maddie Dinwoodie, Director of Engagement Programmes, EngineeringUK

Almost a fifth (19.2%) of the UK workforce works in engineering and technology, yet employers have been reporting skills shortages and recruitment challenges for some time, and the situation is getting ever more urgent, with jobs in engineering and tech predicted to grow faster than any other occupation between now and 2030.

The Climate Change Committee (A Net Zero Workforce) identified up to 725K new jobs needed by 2030 to support the transition to net zero, and we know a significant proportion of these are jobs that will rely on engineering skills in areas such as decarbonisation, building retrofitting, renewable energy and manufacturing of electric vehicles, where there is a need for engineers from across disciplines. If government's ambition to make Britain a clean energy superpower and drive economic growth is to be realised, we need to ensure that the UK has the skills to match.

challenges, and for the government to support the sector and lay the foundations for change. It will require a true partnership between government, the education sector and business not only to attract more people into the sector, but to ensure that they can acquire the skills required to deal with an ever-changing environment and technological advances.

This urgency has undoubtedly been understood. Not only are the skills shortages in the engineering sector recognised in the recently announced

the recently established Skills England as well as several Committee inquiries. Given the urgency and focus on improving the skills base in the UK, organisations such as EngineeringUK are working hard to identify solutions that would help move the dial.

It's imperative we change perceptions and misconceptions of what engineering is. In the eyes of too many young people, engineering is still associated with factories and building sites and for too many it's seen as a job best suited to men. As a result, the sector has been unable to move the dial on women in the engineering workforce. Most recent data shows a decline in the number and proportion of women working in engineering, to only 15.7% (from 16.5% the previous year). This is problematic because it has an impact on the number of young people moving into the sector and it limits diversity of thought and therefore innovation in it.

EngineeringUK works hard to challenge these myths. Our remit is to enable more young people from all backgrounds to be inspired, informed and



Increasing the number of skilled engineers in the UK will require the engineering sector to face up to a number of

Migration Advisory Committee review, they are also central to the discussions around the forthcoming Industrial Strategy,

progress into engineering and technology. We do this by working with businesses and schools around the country to bring insights into engineering and technology careers closer to young people through our programmes such as the Big Bang programme, including the annual UK Young Scientists & Engineers Fair, which sees 10s of thousands of young people visit the NEC in Birmingham where they get the opportunity to see and interact with hands on STEM activities and shows as well as chat to STEM employers. And our Climate Schools Programme makes the links between curriculum subjects and real-world careers, giving teachers the resources to empower their students to explore innovative solutions to tackling climate change and stimulate debate and interest.

Young people who participate in STEM activities and outreach are more likely to be interested in engineering and technology careers. Pupils who attended any (one or more) STEM careers activity in the last 12 months are 3.5 times more likely than those who did not to know about what people working in engineering do. They are also 3.4 times more likely to consider a career in engineering than those who hadn't attended a STEM careers activity.

EngineeringUK's recent report 'Advancing STEM careers provision in England' looks at how STEM careers provision is delivered in schools and colleges around England and what more needs to happen to ensure that more young people can benefit from it. Almost 200 teachers and others in career-related roles in schools were surveyed. Time constraints and funding were highlighted as very real issues. Over a third (36%) said the lack of funding meant that they were unable to support STEM work

experience in their school, while 33% cited a lack of capacity to engage more with STEM employers. Worryingly, the report also shows a quarter of Careers Leaders are being allocated less than one day a week to fulfil their roles and that just 15% of work-experience-aged young people had STEM related work experience. The insights from this report can help us to address the weak spots. It clearly identifies that collaboration with STEM employers is an area that can improved on and that greater involvements with those employers via outreach and careers hubs could make an impact and really help young people better understand the sector and the opportunities available.

Employers have a key role here. We know teachers are pushed for time, so the report recommends STEM employers up their engagement with schools and career hubs and consider engaging in careers fairs, assemblies and other programmes to showcase their work or offer work experience opportunities. Beyond their role in attracting more young people into the engineering community, employers also have a responsibility to develop clear and comprehensive training strategies to enable more young people to join the engineering and technology workforce.

At EngineeringUK, we work with employers through mechanisms such as the Tomorrow's Engineers Code to improve engagement by engineering and technology employers with young people across the UK. We also work with employers to identify what they are doing to broaden their intake of young people. We ask them to consider what more they could be doing and how they could work with government and other

organisations to achieve that, and how they could better support the further education sector to deliver this training. This is why we asked employers in

2023 survey included questions about engineering. It found some sobering stats particularly around girls' interest in STEM.

KEY FINDINGS

- Only 12% of girls say being an engineer fits well with who they are
- Just 16% of girls think engineering is suitable for them
- Interest in science has declined and a gender gap has opened up
- 36% of girls say science is not for them

our recent report on engineering and technology apprenticeships for young people to work more closely with training providers in their area to support teaching quality through releasing more staff to teach apprenticeships courses in the sector. We also asked them to rise to the challenge of skilling the next generation of engineers and technicians and offer more apprenticeship opportunities to young people,

However, employers and education organisations will not be able to resolve STEM workforce challenges alone. There are systemic issues in our education system, that can only be resolved by government. There are questions around funding and the behaviours that government decisions on apprenticeships, for example, drive and there is also the big question as to how we address the worrying signs relating to young people's interest in STEM subjects in schools.

The Science Education Tracker 2023 is the third in a series of studies which track evidence of more than 7,200 young people's experiences of and attitudes towards STEM education and careers. For the first time the

The research also found that there has been a marked decline in the offer of practical hands-on learning in science lessons, with only a quarter (26%) of GCSE students now doing practical work at least every fortnight compared to 44% in 2016. This is especially worrying give another finding, that practical science is a motivator for young people to study science, particularly girls and less engaged students.

The independent Curriculum and Assessment Review and the work that will follow provides an opportunity for government to address these issues and to ensure that we have an education system that delivers for young people as well as employers and the wider economy.

It is now time for employers, government, education providers and STEM education organisations like EngineeringUK to come together to tackle the barriers in the way of more young people enjoying STEM and having the opportunity to be part of the STEM workforce in the UK. ■

ADVANCED CORROSION MANAGEMENT TECHNIQUES TO REDUCE COST AND RISK IN OUR BUILT ENVIRONMENT



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Manager CPT

According to UK government data from 2022, 15% of all carbon emissions can be accounted for by just the production of the construction materials of steel and cement¹ Furthermore, 60% of waste in the UK is from the construction sector. It is important that, if emission targets are to be met, the world shifts from a mindset of demolition and new build to one of repair and conservation. In addition to the environmental cost, the monetary cost to the UK taxpayer of replacing essential infrastructure is usually far higher than the cost of preserving existing assets².

The main structural element of many buildings around us is reinforced concrete and one of the major factors limiting its life and safety is corrosion of the embedded steel³. If left unchecked corrosion can accelerate, spread and will reduce structural integrity and serviceability until demolition is the only option⁴. In some extreme cases, without intervention, disaster can strike, and a structure collapses.

ROUTINE COSTS OF REPAIR AND REPLACEMENT

The remediation of concrete infrastructure commonly comprises localised patch repairs. However, such repairs can accelerate corrosion in the surrounding steel, the incipient anode effect, and cause substantial deterioration in the neighbouring concrete within 5 years⁵. This results in continued repairs and the chasing of corrosion through a structure. Many repairs, such as those required by the spalling of



Cracking and spalling due to corrosion of the reinforcement (CPT)

concrete surrounding half-joints in bridges, have become routine, necessitating road closures and replacement routes often in 4-6 year cycles. This is not uncommon in the UK, which has around 60,000 bridges where concrete is the main structural element and a further 40,000 other highway structures where concrete plays a major role⁶. Many of these structures are especially vulnerable due to their age and the annual exposure to aggressive de-icing salts.

The cost of a concrete repair to a readily accessible bridge structure is approximately £11,000 per cubic metre, or

around £1,000-£2,000 per square metre, as of April 2024 and is forecast to increase. Access and traffic management at many sites can be as much, or even more, than the cost of repair. Given the continued degradation of structures left unprotected, corrosion management systems, which often cost a fraction of the repair⁵, remain an underutilised tool in limiting life-cycle expenditure and increasing the service life of buildings and infrastructure.

CORROSION SURVEYING

Most surveys in the UK are not undertaken by personnel with

dedicated training in corrosion. However, corrosion surveying is well understood within the UK, with many of the leaders in corrosion surveying, management and technology working domestically and internationally to assess and protect structures.

Corrosion surveying looks beneath the surface of structures and enables problems to be found early before issues such as substantial cracking can accelerate and become much more expensive to repair. A localised, tailored approach to corrosion management can be formulated that reduces further, more costly, issues and risk.

CORROSION MANAGEMENT

Over the last 20 years, there has been significant progress in corrosion management, much of which has been led by UK-based research and development. Modern corrosion management systems need not be intrusive, complex, or have expensive maintenance. Long-term monitoring data gathered in the real world has given us confidence in the effectiveness of these systems⁷. Should this technology be more widely adopted, significant savings could be made in maintenance, repair, and replacement.

Galvanic and hybrid systems, both invented and produced within the UK, protect against corrosion by introducing zinc anodes that are attached to the steel. Like a battery, the zinc anodes corrode sacrificially, passing a current to the reinforcement. This current protects the steel from corrosion electrochemically by the charge held in the steel itself and the generation of alkaline ions on its surface⁸. Galvanic anodes have been used for 200 years since Humphrey Davey first applied zinc and iron anodes to the

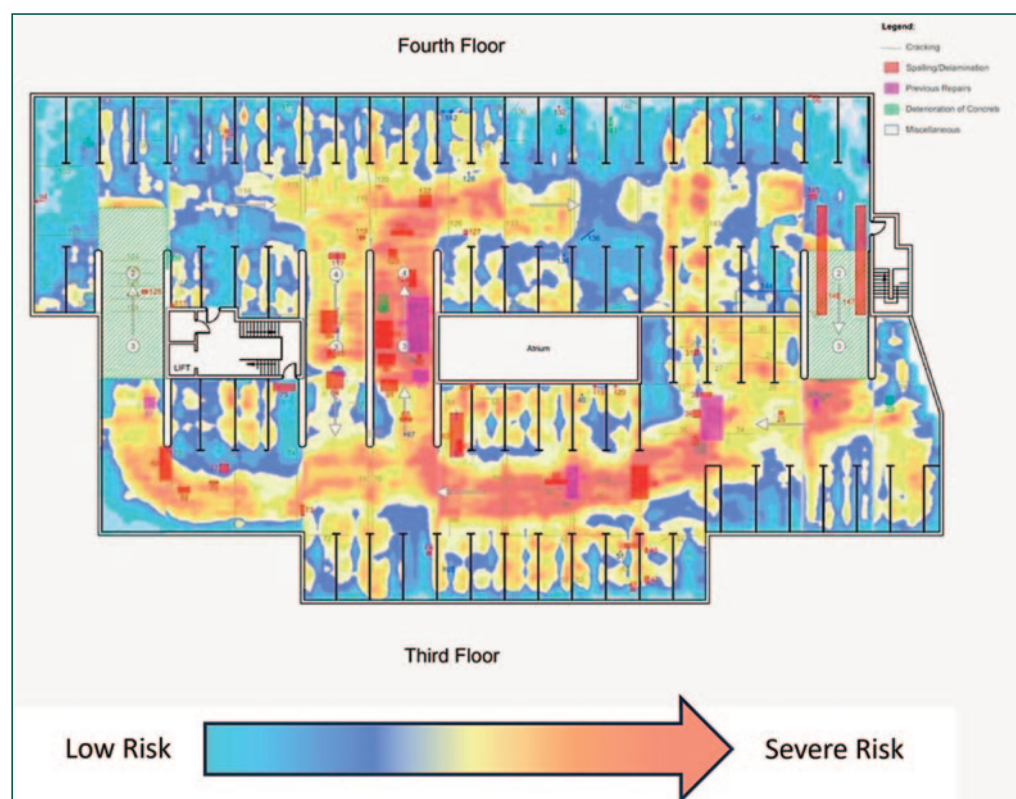


Figure 1: Half-cell potential map of car-park deck indicating areas of increased corrosion risk, adapted from an image by McFarland Consulting

copper hulls of Naval vessels. In infrastructure zinc anodes were originally used to protect and extend the life of patch repairs but as the technology progressed, they are now used to protect areas from small patches to whole structures⁷. Hybrid anodes use similar sacrificial technology but are suited to more severe corrosion risk, halting all ongoing corrosion in around 1 week⁹.

Like all circuits, the current produced by the anodes depends on the resistivity of the material in which it flows, the concrete. Therefore, when corrosion risk increases, due to the concrete becoming wet, hot or full of aggressive ions, the path between the anodes and the steel becomes more conductive and larger protective currents flow to the steel. This electrochemical responsive

behaviour of zinc anodes allows the corrosion management system to give protection proportional to the corrosion risk without the risk of overprotection seen in externally powered systems⁷.

Similarly, more recent advances allow vulnerable bridge half-joints to be protected using anodes inserted directly into the expansion joints¹⁰. These anodes are designed to work

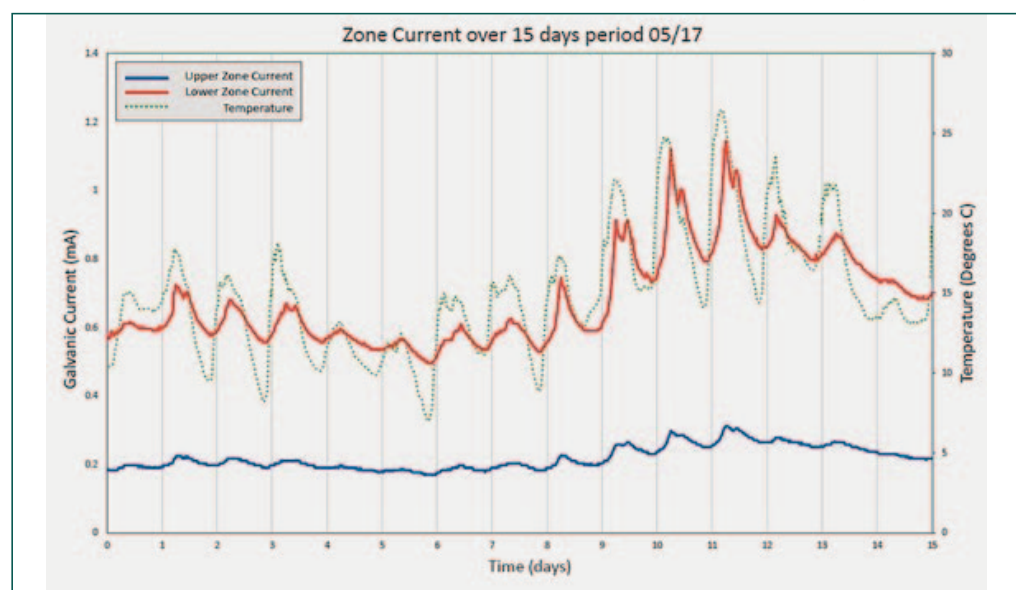
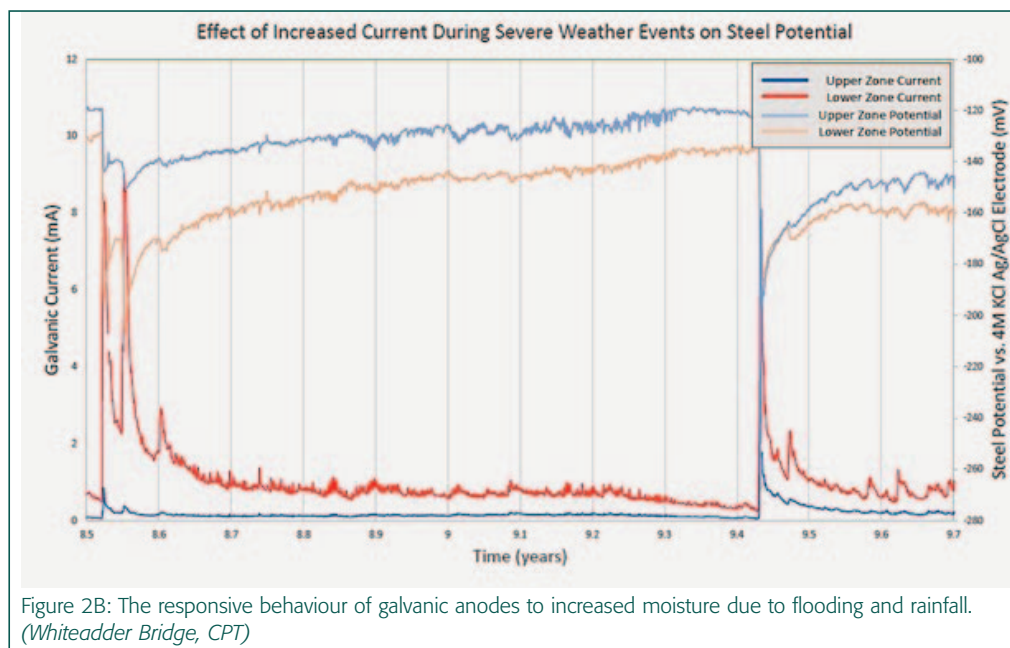


Figure 2A: The responsive behaviour of galvanic anodes changes in temperature. (Whiteadder Bridge, CPT)



concrete is of significant concern^{16,17,18}.

RAAC relies heavily on a coating applied to the reinforcement during manufacture to control corrosion. The aerated concrete acts like a sponge, able to stably retain around half its mass in moisture, so the impermeability of the coating is crucial. This coating however is susceptible to degradation and cracking, becoming more porous¹⁹.

As a result of extensive UK research, RAAC-specific survey techniques and corrosion control technologies are now available and bespoke corrosion management systems are being installed within vulnerable elements in the NHS estate. These systems can extend the life of these structures using a bespoke development of the same galvanic principles²⁰.

FURTHER THOUGHTS

There is always more work to be done, however, we now have a clear understanding of the effectiveness of corrosion prevention techniques and the role that they can play in reducing costs and protecting our built environment well into the future.

Much of our infrastructure is built using reinforced concrete and managed by local authorities which struggle with limited budgets to undertake the required work. However, without appropriate repair and corrosion management, the issues will accelerate and spread, the costs skyrocket, and the risk to the public become ever greater.

We hope that these technologies will be embraced more widely by an industry that can be slow to change and that the UK will continue to lead the world in corrosion management, infrastructure resilience and safety. Investment in corrosion management does take some

with the joint and move with the expansion and contraction of the concrete. The placement of these anodes within the joint void minimises future repairs, extends the life of the structure and reduces disruption and carbon emissions. Though sacrificial anodes have a limited design lifetime, an estimated 20-30 years, site monitoring has suggested that many anodes are projected to exceed this by many years. When insufficient anode remains, these systems can be replaced with fresh anodes and the service life is further extended.

Zinc-based anodes are therefore especially well suited to the changing environment we and our structures are now subject to. An analysis by the think tank 'Bright Blue' states that the increase in flooding due to the climate emergency requires us to improve the resilience of our infrastructure¹¹. One of the major drivers of corrosion in infrastructure is moisture ingress; extreme cycles of moisture and heat are becoming commonplace. Galvanic, self-powered, self-regulating systems are maintenance-free, require no power source and are proven effective during extreme weather events.

One such structure protected by zinc anodes is Whiteadder Bridge near Berwick-upon-Tweed. The bridge, which is prone to frequent flooding, has been protected for almost 18 years. During this time over 10 million data points have been collected to monitor the corrosion rate of the steel in the structure and the performance of the anodes. The reinforcement has remained passive during the many floods and, despite the levels of aggressive ions present in the concrete, there has been no need for further maintenance and repair. It is currently on track to exceed its design life despite these events^{10,12}.

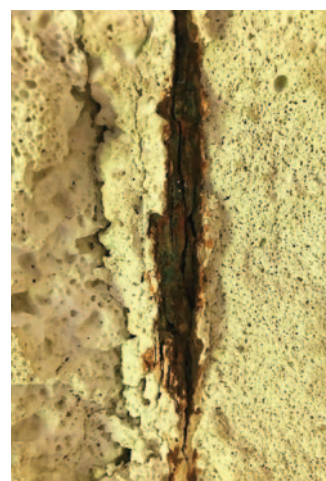
Externally powered, impressed current systems are also widely available and are well suited to some structures. Though these systems sometimes have lower initial costs, they can be vulnerable to vandalism of their expensive power supply and management system; they require frequent maintenance, costly to run and are often found unpowered within a few years of installation. Once unpowered the structure is no longer protected¹³.

Impressed current systems are

externally controlled rather than naturally responsive, leading to less flexibility to changes in climate or moisture. During extreme climate events, these systems may under-protect or potentially over-protect the steel within the concrete leading to acid buildup at the anodes and dangerous embrittlement of the reinforcement^{14,15}.

CORROSION IN RAAC

Issues of corrosion in UK infrastructure are not limited to traditional reinforced concrete. The BRE, SCOSS, IStructE and Loughborough University, amongst others, have concluded that corrosion within RAAC



Corrosion in RAAC seen after a spill due to probable moisture ingress due to a humid internal environment (CPT)

initial funding, but over time pays great dividends in both structural safety, cost, and the environment.

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OLD DRUG, NEW TRICKS?

How Losartan and Nanomedicines Could Transform Cancer Treatment



Kyle Greenland, Doctoral Researcher, Imperial College London

Cancer. It's a word none of us ever wants to hear. Yet, Cancer Research UK reports that 1 in 2 people in the UK will get cancer in their lifetime. A cancer diagnosis can often turn life upside down, but alongside this daunting challenge, there is hope. Advances in medicine and technology are creating more intelligent, kinder ways to treat the disease. One of the most promising areas is the use of nanomedicines, which uses incredibly tiny tools to deliver treatments exactly where needed.

Moreover, an unexpected partner has recently emerged in the field of oncology: Losartan, a drug usually prescribed to manage high blood pressure. Strange as it sounds, this everyday medicine is helping to make cancer treatments work better, faster, and with fewer side effects. Together, nanomedicines and Losartan could open a new chapter in cancer care.

WHAT ARE NANOMEDICINES?

Nanomedicine refers to the application of nanotechnology for medical purposes; in this context, scientists are utilising nanoparticles to deliver cancer medicines specifically to tumours. To put the scale we're talking about into perspective, a nanometre is one billionth of a metre. Picture a single speck of dust – now shrink that down by

another 100,000 times. At this level, scientists can create nanoparticles, which are essentially tiny carriers designed to deliver drugs directly to diseased cells.

Why does this matter? Well, traditional cancer treatments, like chemotherapy, often affect the entire body. This is frequently akin to the use of a blunt hammer. While they do attack cancer cells, they also harm

healthy ones, which is why side effects like hair loss, nausea, and fatigue are so common. Nanoparticles, however, act like highly trained messengers. They carry medicine straight to the tumour, leaving the surrounding healthy tissue largely untouched. This enables treatment not just to be effective but also far more precise.

WHY IS CANCER SO HARD TO TREAT?

If precision medicine is the goal, why haven't we solved cancer already? The answer lies in the complexity of tumours themselves. Often, cancer is thought of as one disease, but cancer is a family of diseases that can occur almost anywhere in the body. For example, cancers that develop from the skin or the tissues lining internal organs are called carcinomas. In contrast, sarcomas are called cancers that spawn from bones, muscles, or other connective tissues.

Many solid tumours are surrounded by a thick layer of connective tissue called the stroma. You can think of the stroma as armour – a rigid barrier that shields the tumour and makes it harder for medicines to reach their target. Additionally, this armour squeezes the tumour's blood vessels, limiting blood flow. With poor circulation, even the most advanced drugs struggle to penetrate deep into the tumour.

It's a frustrating obstacle for doctors and researchers. After all, what is the use of a highly effective medicine if it cannot get to where it is needed most?

LOSARTAN: OLD-DOG, NEW TRICKS

Losartan is an FDA-approved antihypertensive drug that has been used for decades to lower blood pressure. However,

emerging research suggests that it may have a surprising secondary effect. Researchers have discovered that it can help relax the stroma around a tumour.

Losartan softens the dense connective tissue around a tumour, improving blood flow. It's like weakening the armour around a fortress – once the defences are loosened, the gates open, allowing the cavalry to charge in. In the case of a tumour, this means that cancer-fighting medicines – whether delivered through traditional drugs or nanoparticles – can finally penetrate and target the cancer cells effectively.

The idea is deceptively simple but incredibly powerful. By combining Losartan with advanced treatments like nanomedicine, researchers are seeing significantly better results in pre-clinical studies and early trials.

HOW NANOMEDICINE AND LOSARTAN WORK TOGETHER

Nanoparticles and Losartan make a natural team. Nanoparticles are brilliant at precision – they can carry chemotherapy drugs or other treatments directly to cancer cells, minimising harm to the rest of the body. In parallel, Losartan clears the path for these particles, allowing them to penetrate even the most stubborn tumours.

The outcome? Tumours respond more effectively to treatment, and doctors can administer lower doses of chemotherapy. This approach is not just about better results – it's also about reducing the strain of treatment. For patients enduring the harsh side effects of chemotherapy or radiation, using lower doses can make a massive difference in improving their overall experience and well-being.

The true excitement of this approach lies in its flexibility. Nanomedicines can be designed to carry a variety of treatments, making it possible to adapt this method to address different types of cancer – and even other disease areas. This adaptability represents an innovative strategy with immense potential for the future of stratified medicine.

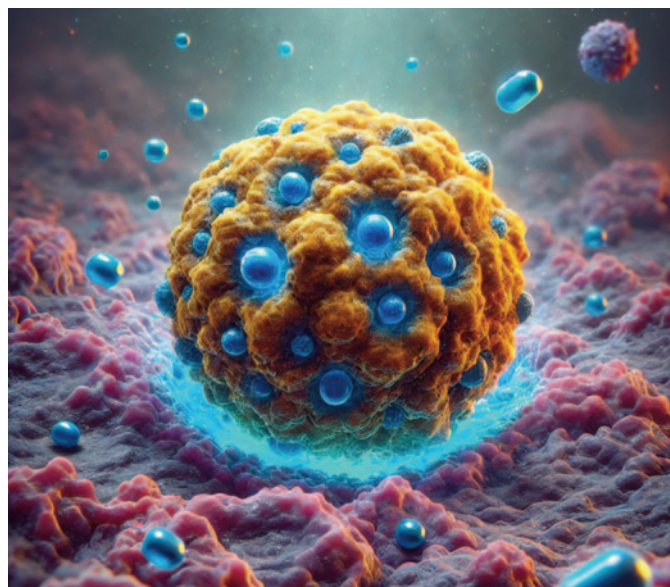
PAVING THE PATH: CHALLENGES AND OPPORTUNITIES

The pairing of Losartan with a targeted drug delivery system such as nanomedicines holds incredible promise. Imagine a future where cancer treatments are faster, more effective, and far gentler on the body. For many

larger scale requires consistent quality and effectiveness, which will require careful refinement and innovative solutions.

Even after development, these treatments undergo rigorous testing before they can be approved for clinical use. Specialised tools and techniques must be created to assess their safety and ensure they work as intended in the body. The long-term effects must also be investigated to identify any unforeseen risks, particularly given the technology's novel nature.

The question of cost is also likely to be a barrier to novel nanomedical technologies. Advanced treatments like these



patients, that could mean better quality of life and, crucially, better survival rates.

While full of potential, the path forward is anything but simple. Developing nanoparticles is a complex and expensive endeavour that takes years of research. These tiny carriers are highly specialised, and even the smallest variation in their size or surface properties can change how they behave in the body. Once they are designed, scaling up production to make them widely available is another major challenge. Manufacturing on a

often come with a high price tag, raising accessibility concerns. The question then becomes how to make them accessible to as many people as possible. This issue of affordability is especially crucial in low and middle-income countries, where cancer treatment is already an ongoing issue. How do we ensure that patients everywhere—not just in wealthy countries—can benefit from the advancements we see in cancer care? This is a critical question that will need to be addressed if these promising therapies are to make a

meaningful impact on a global scale.

THE ROAD AHEAD

Aside from the complexities, combining Losartan with nanomedicines offers hope for a

brighter future in cancer care. It also paves the way for repurposing other treatments that were initially approved for different diseases to make an impact in oncology. By making treatments smarter and more

targeted, we can improve outcomes and lessen the burden on patients.

Of course, no single solution will ever “cure” cancer—it’s a profoundly complex disease. However, we are moving closer

to a world where cancer is less of a life sentence and more of a challenge that can be managed.

It is a future worth striving for, and with continued investment in research and collaboration, it feels increasingly within reach. ■

WHY INVESTING IN R&D AND TECHNOLOGY DEPLOYMENT IS KEY FOR A SUCCESSFUL UK INDUSTRIAL STRATEGY



Daphne Vlastari, Head of Communications and Government Relations, BASF UK and Ireland.

The UK Government consultation on the Green Paper for an Industrial Strategy may have just closed but discussions across businesses, scientists, academics, policymakers and parliamentarians are only beginning. It is clear that ongoing dialogue is needed to create a successful new UK Industrial Strategy with a 2035 investment perspective.

At BASF, as one of the largest chemical companies in the world with a presence in the UK since the 1880s, the introduction of an Industrial Strategy offers the opportunity to refocus expectations for our sector and its path to net zero while also creating a compelling business case for investing in the UK.

The chemicals industry needs to be recognised as a foundational industry which can support the Strategy’s growth driving sectors, including advanced manufacturing, life sciences and clean energy technologies. The Government has acknowledged the need to better understand dependencies on foundational industries like chemicals and to develop value chain analysis to feed into their approach to the sectors that will be prioritised as part of the Strategy’s sector plans. This is

very positive, and it is critically important that the chemicals sector is able to feed into these discussions as it can advise on where onshoring of manufacturing might be possible and under which circumstances as well as how security of supply to address dependencies and vulnerabilities might be a preferred route.

But there is a further aspect that we cannot afford to ignore: the role of innovation and R&D

deployment for growth. For BASF, with a broad portfolio of solutions that supports most sectors of the economy, from agricultural solutions and nutrition to advanced materials and industrial applications, innovation has always been at the heart of what we do. We invest over €2billion in R&D and file approximately 1,000 new patents each year. In 2023, we generated sales of around €10 billion with products launched



Steam cracker at BASF's Ludwigshafen site

on the market in the past five years that stemmed from research and development activities.

Our ambition is to be the preferred chemical company to enable our customers' green transformation and to achieve this we aim to further increase sales and earnings with new and improved products – especially with products that make a positive sustainability contribution in the value chain. At the same time, we are investing in solutions that will support our own journey towards net zero. BASF aims to reach net zero by 2050 with our flagship site in Ludwigshafen in Germany aiming to be net zero already in 2045. As the largest integrated chemicals site in the world and a key supplier to the European market,

companies. One way in which we do this is through our global Academic Research Alliances, where we set up R&D focus areas with universities known for their exceptional research capabilities. In 2023, we launched the British Alliance for Research and Innovation (BARI), one of eight global BASF Academic Research Alliances. This is a testament to the UK's world class innovation ecosystem which makes the UK a particularly attractive hub for R&D in sustainable solutions. BARI's focus areas are Chemical Engineering (particularly Flow Chemistry) and Digitalisation including AI for optimising chemicals manufacturing. These are important technologies that can help meet BASF's sustainability commitments and enhance the sector's resilience

reaching net zero. In 2019, the UK chemicals sector spent on innovation was over £5.4 billion which is equivalent to more than 20% of the UK's R&D expenditure. A clear plan for R&D deployment in a foundational sector such as the chemicals industry will be important for capitalising on emerging technologies that can support

be supported from a government point of view.

For example, BASF is currently leading alongside Imperial a 5-year industry consortium, the Innovative Continuous Manufacturing of Industrial Chemicals consortium, to develop modern chemical manufacturing methods. The partners are working to help



R&D labs and teams working on catalysts for an improved carbon management performance.



Centre for Rapid Online Analysis of Reactions (ROAR) in the Molecular Sciences Research Hub, Imperial's new home for chemistry research in London's White City. Photo Credit: Thomas Angus, Imperial College London

Ludwigshafen's transition will require investment across a number of new technologies including the procurement of significant amounts of renewable electricity, clean hydrogen, CCS, the installation of industrial heat pumps as well as sourcing alternative raw materials to substitute virgin fossil fuels.

We know that partnership is key to achieving this. This is why we work closely with universities, research institutes and partner

as well as enable an accelerated transition to net zero for our society as a whole.

It was therefore encouraging that the Green Paper sought feedback on the barriers to R&D commercialisation and how the UK government could address those. This is particularly significant for the chemicals sector which is heavily investing in R&D to optimise production processes but also develop the technologies needed for

not only the UK Government's growth mission but to position the UK as competitive in the key industries of tomorrow.

In this respect, the UK Government should consider how R&D grants can support projects of particular value through longer-term funding cycles as well as provide support and expertise for resolving the regulatory and investment barriers that companies and consortia face in the R&D phase. Very often these are identified early by the relevant organisations and the UK Government approach to R&D should be able to not only support further research in a specific area if this is deemed important, but to also bring relevant policy and regulatory stakeholders to identify how the business environment can be improved in practical ways to give participating organisations confidence that the commercialisation of an R&D technology is possible and will

grow a high-tech sustainable chemical sector in the UK and worldwide by demonstrating how innovative processes for the production of high-value chemicals, including agrochemicals and pharmaceuticals, can be transferred from the R&D lab into industrial practice. In line with the Industrial Strategy ambition such manufacturing technologies can create onshoring opportunities that would deliver growth and jobs as well as enhance supply chain resilience.

To capitalise on these opportunities for R&D deployment, it is important that early discussions take place with UK Government to analyse the results of such work and the barriers and opportunities for investment that companies seeking to deploy such technologies in the UK would face. Early engagement and discussion with a view to identifying the areas where an

improved regulatory and investment environment would support the business case for deployment would be very helpful for the businesses already engaged and investing in such R&D work.

Another example of an R&D project is Flue2Chem where through Innovate UK funding, a consortium of global product manufacturers, chemical companies, academics and others have come together to explore how an alternative source of carbon – captured carbon – can be used instead of

virgin fossil fuel for manufacturing consumer products. The consortium is hoping to successfully demonstrate the capture of CO₂, its conversion into new chemical building blocks and then downstream products to showcase how value chains of the future will work and how they can be integrated into our existing manufacturing systems. R&D projects such as these hold significant growth potential, but their deployment would depend on the Industrial Strategy providing a vision for the future

of such technologies in the UK. In the case of Flue2Chem, it means looking at how carbon capture and utilisation policies will be developed, access to clean hydrogen as well as broader business investment considerations.

Missing out on the opportunity to develop a clear vision for the chemicals sector as part of the Industrial Strategy would also mean missing out on the deployment of new technologies as described above – and by extension the growth opportunities they provide –

which both the UK government and businesses have supported in recent years.

As chemical value chains provide solutions for the majority of the identified growth sectors including advanced manufacturing, clean energy technologies, life sciences and defence, it is hard to imagine how we can develop a meaningful Industrial Strategy and sector plans without a vision for chemicals and relevant chemical value chains that will matter for UK growth. ■

RAISING AWARENESS OF CORROSION FOR A MORE SUSTAINABLE WORLD



Professor Gareth Hinds FREng FIMMM FNACE FICorr, National Physical Laboratory, President, World Corrosion Organization and Past President, Institute of Corrosion

Corrosion, the phenomenon whereby metallic components and structures lose their functionality due to the interaction with oxygen, water and salt in the surrounding environment, is something that most people think about very rarely, if at all. This is only natural as, unless for example they happen to own a boat, the average person going about their everyday business won't tend to experience its impact.

At least not directly. The fact is that corrosion affects every single one of us far more than we realise. A range of detailed studies has shown that the average cost of corrosion to the global economy is around 3.4% of GDP¹, which is associated primarily with increased maintenance and inspection costs, replacement of failed components and unplanned operational downtime².

For the UK, this translates to a total cost of around £90 billion per year. This huge financial drain is passed on to all of us in the form of higher prices for goods

and services, not to mention the added inconvenience of transport delays, supply interruptions, environmental pollution and safety hazards.

It's not all bad news. It's estimated that up to 35% of these costs could be saved by the application of existing corrosion control practices¹. This would save the UK £32 billion every year. It's noteworthy that these potential savings are comparable in magnitude to the black hole in public finances recently cited by incoming Chancellor of the Exchequer Rachel Reeves³.

So why is there such reluctance in both the public and private sectors to grasp these enormous savings?

Firstly, there's a general lack of public awareness of the major economic impact of corrosion and the importance of sound corrosion management strategies. More often than not, those asset owners who are aware of the issue tend to view corrosion protection as an unavoidable cost rather than an investment.

Secondly, there is the trade-off between short-term and long-term thinking. Major infrastructure

projects tend to be divided into capital and operational teams. The former are incentivised to build the asset on time and as cheaply as possible, leaving the latter to struggle with the ensuing maintenance issues once the asset is in use. This often results in whole lifecycle costs that are significantly higher than would have been the case if an appropriate corrosion management strategy had been incorporated at the design stage.

Thirdly, most corrosion professionals tend to operate at a technical level in their organisation and are not

Corrosion awareness is a global issue and as such it needs to be tackled at international level. One of the ways ICorr is approaching this is through its membership of the World Corrosion Organization (WCO)⁵. From a personal perspective, I have been serving as President of the WCO since April 2022.

The WCO is a non-governmental organisation of the United Nations, a non-profit charitable body whose mission is to promote education and best practice in corrosion control for the benefit of society, ensuring conservation of resources and



Site of the Union Carbide disaster in Bhopal, India, considered by many to be the world's worst ever industrial tragedy. Corrosion was a significant contributing factor to an explosion at this insecticide plant in October 1984, which led to the release of a large cloud of toxic gas. The final death toll was estimated to be between 15,000 and 20,000.

effectively connected to broader financial and management systems. This disconnect means that senior management tends to have limited visibility of the direct benefits of implementing corrosion management strategies and little opportunity or incentive to make related business decisions.

The first step towards addressing this issue is to raise general awareness, which is one of the reasons that the Institute of Corrosion (ICorr)⁴ chose to table a discussion with the Parliamentary & Scientific Committee on this topic. I think it's fair to say that all those who attended were struck not only by the magnitude of the economic impact of corrosion, but by the fact that so many people are completely unaware of it.

protection of the environment. This mission is particularly relevant in the light of global challenges such as climate change, scarcity of natural resources and environmental pollution.

The membership of the WCO is made up of organisations from all over the world with an interest in corrosion, including professional societies such as ICorr, research institutes working on related technologies and companies from a range of industrial sectors.

The WCO has three main objectives:

- To communicate how the United Nations Sustainable Development Goals (SDGs)⁶ can be advanced through best practice in corrosion protection.

- To enhance public awareness of the importance of corrosion control via the annual World Corrosion Awareness Day, held every year on April 24th, and through other activities.

- To facilitate influencing of policy makers with respect to consideration of sustainable use of materials in a circular economy.

The 17 United Nations SDGs represent a core part of the 2030 Agenda for Sustainable Development⁷, which was adopted by all UN Member States in 2015. Corrosion protection will play a key role in achieving a number of these, in particular the following:

SDG 6: Clean Water & Sanitation

SDG 7: Affordable & Clean Energy

SDG 9: Industry, Innovation & Infrastructure

SDG 11: Sustainable Cities & Communities

SDG 12: Responsible Consumption & Production

SDG 13: Climate Action

For example, extension of asset lifetime via implementation of best practice in corrosion management can significantly reduce greenhouse gas emissions associated with material processing and component manufacturing, cut demand for critical raw materials, decrease the need for human intervention throughout asset life and ensure uninterrupted supply of clean water and energy. In this way, sustainability and corrosion protection are inextricably linked.

The WCO is strongly connected to the United Nations through its UN Youth Representatives⁸ who are based at Lehigh University in Pennsylvania, USA. These dedicated ambassadors help to advocate for best practice in corrosion control and to promote awareness of corrosion at the

global level. The WCO is currently working on the publication of a UN White Paper on corrosion to support these objectives, with the participation of ICorr members.

Another key component of the WCO's mission is World Corrosion Awareness Day, which is an international UN-affiliated day celebrated annually on 24th April. To mark World Corrosion Awareness Day in 2024, the WCO, together with the Association for Materials Protection & Performance (AMPP)⁹ and the European Federation of Corrosion (EFC)¹⁰, coordinated a highly successful 24 hour 'round the world' social media campaign on 24th April.

Starting in New Zealand and ending in Hawaii, member societies from across the globe posted about corrosion on social media at 8am in their local time zone. There was a general theme of iconic structures, and the use of related images was encouraged but people were free to post about anything related to corrosion. The posts were linked with the hashtag *#CorrosionAroundTheClock* and shared to boost publicity for World Corrosion Awareness Day, resulting in over 8 million social media impressions.

The aim of these activities is to take the message of the importance of corrosion protection outside of the traditional corrosion community and more towards the general public. Plans are already being discussed for an even bigger campaign for 2025 World Corrosion Awareness Day, this time including traditional media such as TV and newspapers.

Increasing general awareness of the importance of corrosion can play a role in shifting the mindset in infrastructure projects away from CAPEX and OPEX towards whole lifecycle costs. This would be timely as the world moves towards a circular economy in response to

challenges with supply of raw materials, the greenhouse gas emissions associated with their processing and manufacturing, and the pressures of waste management. Incorporating corrosion protection more effectively at the design stage would lead to substantial savings over the lifetime of the asset.

From a practical perspective, this shift could be encouraged by incorporating best practice in

range of practically oriented training programmes, e.g. for coating applicators, coating inspectors and cathodic protection engineers, there remains a gap in the UK's third level education offering. Corrosion has historically suffered from not being a stand-alone discipline, typically sitting somewhere in between chemistry, physics, materials science, and civil, structural or mechanical engineering.



Collapse of the Carola Bridge on the River Elbe in Dresden, Germany, in September 2024. There were no fatalities but significant disruption occurred, including the loss of hot water supply for the entire city and halting of shipping on the river. A formal investigation is ongoing but local authorities have stated that corrosion of steel reinforcement due to ingress of salt is likely to have been the cause of the failure.

corrosion protection more effectively into industry codes and standards. Options include, for example, specifying the implementation of whole lifecycle corrosion management strategies in building codes and mandating formal training and accreditation of coating applicators and cathodic protection engineers working on infrastructure projects.

Another critical issue is skills. The UK is a world leader in corrosion engineering, with a 200-year pedigree dating back to the pioneering work of Humphry Davy and Michael Faraday and more recently built on expertise developed during the exploitation of North Sea oil and gas. In order to maintain this position, there is an urgent need to attract more young people into the profession.

While ICorr offers a broad

due to the fact that it is a volunteer organisation with limited resources. It would perhaps be beneficial for the Institute to partner with experienced practitioners in this area to bridge this important gap.

Looking forward, the importance of corrosion protection is set to increase even further in the coming decades as it plays a significant role in the energy transition. Corrosion is a key lifetime-limiting factor for many clean technologies, such as wind turbines, solar panels, batteries, water electrolyzers and CO₂ pipelines, where degradation mechanisms are not as well understood and managed as those in conventional fossil fuel technologies. Understanding and mitigating these degradation modes will facilitate cost reductions, accelerating the widespread deployment of these technologies.

The Institute of Corrosion would like to thank the Parliamentary & Scientific Committee for the opportunity to discuss this important topic with parliamentarians and others with an interest in the subject. We hope that the next time you stroll under a bridge, you'll be far more likely to cast an eye over the structure to check for the tell-tale signs of corrosion!

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- 2 It should be noted that additional costs arising from environmental clean-up and financial compensation are typically not included so this should be regarded as a minimum cost.
- 3 Reuters <https://www.reuters.com/world/uk/uk-public-finance-show-22-billion-pound-spending-hole-new-finance-minister-2024-07-29>
- 4 Institute of Corrosion <https://www.icorr.org>
- 5 World Corrosion Organization <https://corrosion.org>
- 6 United Nations Sustainable Development Goals <https://sdgs.un.org/goals>
- 7 United Nations 2030 Agenda for Sustainable Development <https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981>
- 8 Lehigh University UN Youth Representatives <https://global.lehigh.edu/un-partnership/youth-representative-program/current>
- 9 Association for Materials Protection & Performance <https://www.ampp.org>
- 10 European Federation of Corrosion <https://efcw.org>

Changes to university curricula are required to ensure a sufficient supply of graduate corrosion engineers in the future.

Outreach in schools is another vital activity; this is something that ICorr has not really attempted in the past, mainly



Institute of Corrosion attendees at the Parliamentary & Scientific Committee discussion meeting 'Reuse, Renew or Replace?' on 15th October 2024. Left to right: Yunnan Gao (ICorr Vice President), George Freeman MP (Past Minister of State in the Department for Science, Innovation and Technology), Gareth Hinds (Past ICorr President/Speaker), Christian Stone (ICorr Speaker), Stephen Tate (ICorr President/Speaker), Stephen Benn (3rd Viscount Stansgate), Izabela Gajewska (ICorr Speaker), David Parker (ICorr Speaker), David Mobbs (Coatings Specialist), Douglas Mills (Past ICorr Technical Secretary).

LEVERAGING DIGITAL TECHNOLOGY TO PREVENT CHILDHOOD OBESITY BY SUPPORTING INFANT FEEDING AMONG UNDER-SERVED GROUPS



Professor Clare Llewellyn (Professor of Psychology & Epidemiology, University College London)



Dr Andrea Smith (Senior Research Associate, University of Cambridge)



Dr Kristiane Tommerup (Research Associate, University College London)



Professor Ken Ong (Professor of Paediatric Epidemiology, University of Cambridge)

Childhood obesity is a major public health challenge that begins in early life

Childhood obesity is one of the greatest public health challenges of our time, and risk of obesity has its origins in very early in life. Rapid weight gain (upward crossing of one or more centile spaces on a child's growth chart – **Figure 1**) in the first two years of life is a major risk factor for later obesity.¹ It is most common among formula-fed babies – with up to 40% experiencing it – and the likely reason is unintentional overfeeding.² Formula-feeding is highly prevalent in England; by 6-8 weeks of age, half of all babies are exclusively formula-fed, and two thirds receive some formula milk.³ Just as there are stark inequalities in childhood obesity, rapid weight gain is much more common among babies born into families from disadvantaged backgrounds, with higher rates of formula feeding being the likely reason.⁴ The foundations for lifelong inequalities in obesity are therefore laid in early infancy, with infant feeding playing a key,

but modifiable, role.

Public health challenges in supporting formula-feeding best practices

Supporting breastfeeding is a public health priority. However, supporting formula-feeding best practices is also essential, but very challenging to implement. Providing detailed information about formula-feeding, which is publicly available, runs the risk of inadvertently undermining breastfeeding support and violating the WHO International Code of Marketing of Breast-milk Substitutes. Healthcare professionals can provide formula-feeding support on an individual basis, for families who need it, but this is challenging too, as:

- 1) healthcare professionals worry about appearing to promote formula-feeding, thereby violating the WHO Code;
- 2) healthcare services are already under immense pressure;
- 3) parents need access to information outside of healthcare appointments, which don't

always coincide with immediate needs; and

- 4) families who would benefit most from formula-feeding support are often less likely to use existing healthcare services.

Parents are avid information-seekers; in the absence of information from healthcare providers, they use non-evidence-based sources (e.g. formula milk company websites, or social media).⁵

Smartphone apps can provide personalised support for formula-feeding at scale

Digital apps can be leveraged to support formula-feeding best practices and overcome some of the challenges. Personalisation features allow information on formula-feeding to be available only to families who already report using formula, and not to families who are breastfeeding – reducing the risk of undermining breastfeeding. Apps can provide immediate formula-feeding support at scale, which complements existing healthcare provision, and takes pressure off

NHS services. Certain apps can reach families from disadvantaged communities who may be less likely to use conventional healthcare services.

BRIGHT: Baby Responsive Intervention for Growth and Health Tracking

With funding from UKRI Medical Research Council, researchers from University College London and Cambridge University leveraged this digital opportunity, in a project called BRIGHT (Baby Responsive Intervention for Growth and Health Tracking). The aim of BRIGHT was to develop a digital intervention prototype to support parents and caregivers to follow formula-feeding best practices, and thereby reduce overfeeding and prevent rapid weight gain during the first two years of life. The academic team partnered with the UK charity Best Beginnings, who host Baby Buddy - an established and widely used (~500,000 users) pregnancy and parenting app.⁶ The Baby Buddy app was created using the principle of

proportionate universalism; while available to anyone in the UK, it is designed to be particularly relevant to, and engaging for, families from disadvantaged communities. To enable accessibility, its content has a reading age of nine, predominantly uses video content and short articles, and is free to use. It is one of only a few apps that has succeeded in being disproportionately used by families from disadvantaged backgrounds: 26% in low-income households (<£25,000/year); 43% from

minority ethnic backgrounds; 20% non-native English speakers; 17% not in paid employment. Importantly, Baby Buddy is free from commercial interest (no adverts), which is particularly important for public health interventions that aim to support infant feeding. It provides only evidence-informed/based content and aligns with UK recommendations and guidelines. It is endorsed by eight Royal Colleges and professional organisations and is used extensively within the NHS.

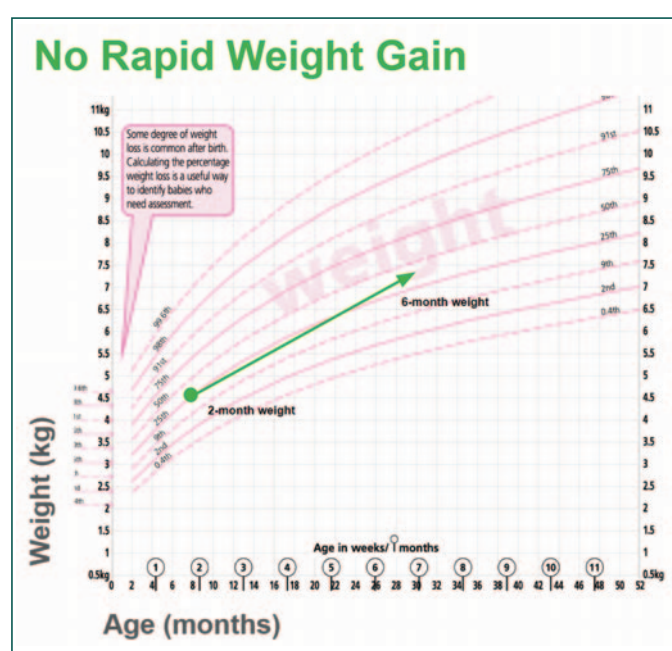
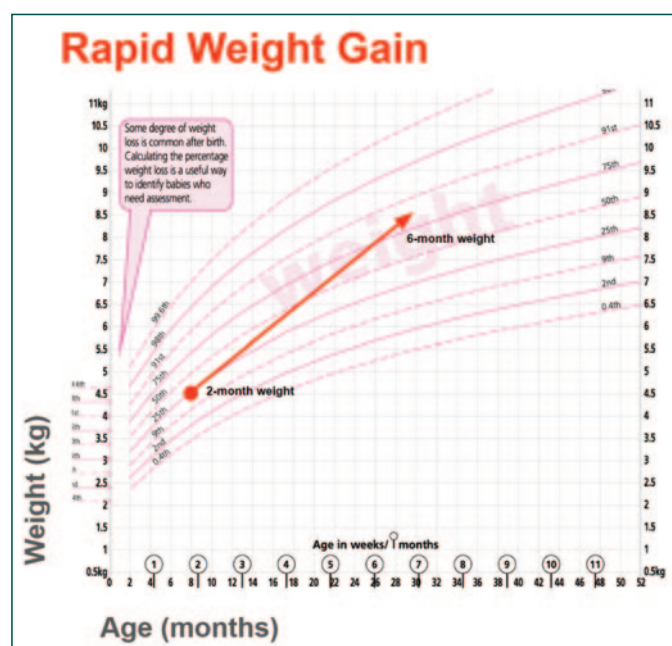


Figure 1: Examples of rapid weight gain (figure top) and healthy weight gain (figure bottom) in infancy, plotted on the UK-WHO growth chart

To develop BRIGHT, we digitalised two existing face-to-face, behaviour change interventions that had succeeded in optimising caregiver formula-feeding practices², and feeding practices during introduction to solid food.⁷ We used the Person-Based Approach, which is a behavioural science method for developing effective behavioural health interventions that successfully engage target users and support better health outcomes.⁸ It involves iterative in-depth research and co-production with target users and stakeholders, to shape all aspects of the intervention. It aims to develop interventions that users (and stakeholders) need, value, and will engage with, by gaining a deep understanding of them and how they interact with key intervention features. Incorporating perspectives of stakeholders, including healthcare professionals, was particularly important for BRIGHT, to ensure it is applicable nationally across the UK, can be embedded into established care pathways, and that parents would be signposted to it.

Addressing challenges for digital infant feeding support

We identified several challenges that needed to be addressed by BRIGHT. Caregivers need access to detailed support for formula-feeding at any time of the day – it must be useful, easy to find and understand, and quick to access. Caregivers who formula-feed their babies feel stigmatised, so it is essential that content uses appropriate language and framing. Overfeeding may happen for many reasons: to manage sleep problems and excessive crying; some parents and healthcare professionals view rapid weight gain as healthy or advantageous;

and some infants have large appetites and are highly demanding for feeds. Individual differences between infants mean parents face differing challenges, so tailored support is more helpful than ‘one size fits all’ advice. A key priority for stakeholders was to position BRIGHT appropriately alongside existing healthcare provision – neither replacing professional support, nor encouraging caregivers to seek professional support unnecessarily.

BRIGHT was developed to address these challenges. The new app content includes six core modules, covering: formula-feeding best practices; understanding healthy growth; managing sleep problems; coping with excessive crying; feeding babies with different appetites; how to introduce solid foods (Figure 2). It includes >60 short articles and nine short videos, and features the UK’s first healthcare professional-endorsed video of a parent formula-feeding their baby, to demonstrate best practice (Figure 3). A personalised notification pathway guides users to content most relevant to them. Parents receive

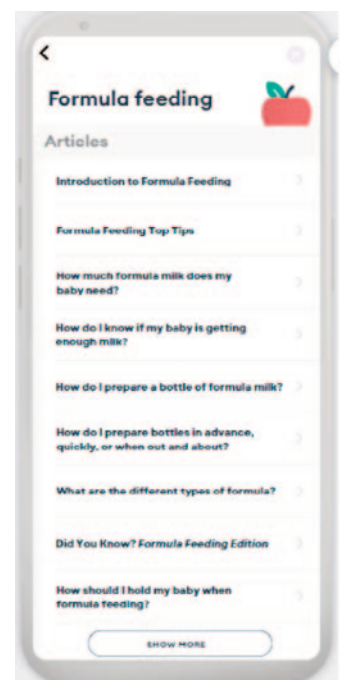


Figure 2: BRIGHT formula-feeding landing page

personalised feeding support tailored to their baby's appetite and growth pattern, highlighted as particularly important.

User-testing of the intervention with Baby Buddy parents indicated that BRIGHT was highly valued and engaging, and that it met an important need for this underserved group of families (see quotes from parents in **Box 1**). However, with an unprecedented number of parenting apps available, families and healthcare professionals need to know which ones are safe and effective. The academic team are therefore working with Best Beginnings to develop an evidence base for BRIGHT across the UK.

Opportunities and challenges in using apps to support infant feeding among under-served groups

In the largely digital age, smartphone apps offer a platform for providing personalized care at scale that can be used alongside existing healthcare services. Most parents and caregivers use apps; these can deliver public health interventions to groups who would benefit most but may be less likely to engage with healthcare professionals. As such, apps can support two of the three 'big shifts' needed to reform the NHS: making better use of technology in health and care; focusing on preventing sickness, not just treating it.⁹ However, alongside these opportunities are major challenges. The greatest public health challenge in the UK is to narrow inequalities in health. Such inequalities begin in early life and the digital health revolution must include and accommodate the needs of families from disadvantaged backgrounds; otherwise, it will widen inequalities. Most parenting apps are commercially supported (requiring payment and/or have adverts) and have a

BOX 1 - USER-TESTER RESPONSES TO BRIGHT

"I've kind of been overfeeding... That was... a learning curve for me. I've noticed that it's really worked. So, it's helped me. It's helped him as well"

"Having this information in Baby Buddy would have saved me probably a solid week's worth of research that I did on my own"

[BRIGHT was] "as good as sort of speaking to... your health visitor or something"



Figure 3: UK's first video demonstrating responsive formula-feeding, created by BRIGHT

relatively affluent user base. Furthermore, they do not always provide evidence-based content that aligns to public health guidance. To truly leverage digital technology to improve the health of the public, the UK government needs to invest in schemes/tech innovation incubators (e.g. the Obesity Mission, <https://www.gov.uk/government/publications/life-sciences-vision-missions/obesity-mission>) that support the development and robust evaluation of digital apps that are

free to use, are free from commercial interests, can be embedded alongside resources provided in Family Hubs, and include evidence-based content that is accessible to everyone. Digital apps like BRIGHT have enormous potential to support individual behaviour change, especially when combined with policies that address the broader structural determinants of health and wellbeing.

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BOX 2: KEY TAKEAWAY MESSAGES

1. Prioritise tackling early-life inequalities to effectively prevent childhood obesity

Childhood obesity risk begins in infancy; rapid weight gain during the first two years of life is a key predictor. Supporting formula-feeding best practices for families from disadvantaged communities who choose not to exclusively breastfeed is critical for breaking the inter-generational cycle of health inequalities.

2. Invest in innovative evidence-based, accessible digital health solutions

Sustained financial investment is essential to provide under-served groups with apps that are free to access and use, have no commercial interest, and include evidence-informed content.

3. Use co-development with patients/target users to overcome the digital divide

Frameworks from behavioural science (e.g. the Person-Based Approach) allow for proactive inclusion of families from disadvantaged communities in development of digital health interventions. These frameworks emphasise equity, reduce barriers to access, and focus on the real needs of under-served communities, ensuring interventions are accessible, relevant, and effective for those who will benefit the most.

VALUE RETENTION PROCESSES – VALUABLE CONTRIBUTORS TO PRODUCT LONGEVITY, NET ZERO AND THE CIRCULAR ECONOMY



David Parker, Director of Technical Projects, Metsims Sustainability Consulting (UK)

A CASE FOR VALUE RETENTION PROCESSES (VRPS)

VRPs aim to fulfil and extend product lifespan through a spectrum of processes ranging from simple re-use, through repair and refurbishment, to the most engineering-led approach – remanufacturing. VRPs should be contrasted with recycling, which reduces whole products to component materials with a consequent loss of the majority of labour, energy, time and materials invested. A simple statement of the rationale for VRPs is encapsulated in this statement.

Recycling an iPhone generates \$5 of material value; refurbishing and reselling it generates \$500.

As a proposition, VRPs offer benefits (over new manufacture) of: very large virgin material and carbon footprint reductions (70-90% typically); higher skill levels (such as diagnostic and remedial); lower dependence on critical raw materials; and potential for re-shoring by fostering domestic skill centres. In addition, manual input is higher per unit of GDP, thus boosting employment.

Studies of economic benefits suggest that the economic leverages of GDP per kg output are 50% higher for VRPs than manufacturing in general. GDP per kg and per person are orders of magnitude higher than for recycling.

The potential of remanufacturing alone is indicated by consideration of an expansion from the current 2% (average) to 20% - a level seen in aerospace. This would result in around a further £70bn in GDP and carbon avoidance equivalent to around 13% of the industrial emissions reduction target under the 2050 commitment.

WHAT ARE THE CHARACTERISTICS OF DIFFERENT VRPS?

The following graphic visually differentiates the various approaches.

In summary, to the right is reuse; reuse is simple, requires little input and has the major benefit of ensuring a full and productive **first life** of a product. If a product fails, repair may be possible, so some investment may again assist in achieving a full life. To the left, on the other hand, after terminal failure, remanufacturing can completely rejuvenate certain products back into **one or more cycles of reuse**, without compromising performance or guarantee. Remanufacturing is a high engineering, moderate input process but yields substantial whole-life energy and material benefits.

WHAT IS THE SCALE AND RELEVANCE OF VRPS?

A study of VRPs on behalf of Innovate UK in 2022 by the author et al. found that (Parker, D. & Waugh, R. et al., 2022):

- VRP activity in the UK in 2020 is estimated to have generated over **£75 billion in revenue** and supported over **500 thousand jobs**.

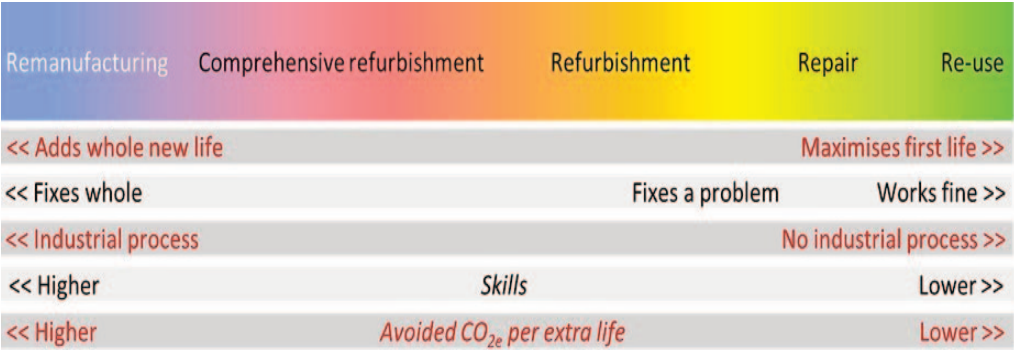


Figure 1. Various approaches to VRP's

- VRP activities in the UK in 2020 are estimated to have prevented at least **620 kt of waste** and avoided at least **4.7 Mt CO₂e**.

The figure below from the report shows roughly the prevalence of VRPs in the UK economy across 10 sectors ¹. This mirrors similar benefits found in a prior study for the Canadian Government (Waugh, R. & Parker, D. et al., 2021); this also found that plastics savings tonnages were 25% of all plastics recycling with significantly higher value.

In both economies, remanufacturing represented only around 2% of all manufacturing GDP, but reduced industrial emissions by more than 2%, highlighting significant room for expansion.

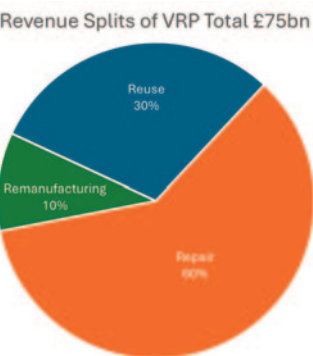


Figure 2. Revenue Splits of VRP's

HOW ARE VRPS SPREAD ACROSS SECTORS?

VRPs are much more prevalent in some sectors, with a different focus in the spectrum of reuse. This has implications for which sectors and activities might be targeted to maintain or boost.

The two-part graphic above-right illustrates:

- The scale and VRP splits for each sector examined.
- The current level of remanufacturing in the sector and the gap to a putative 20% level.

It can be seen that VRP actively is widely different across sectors, and at a broad range of scales.

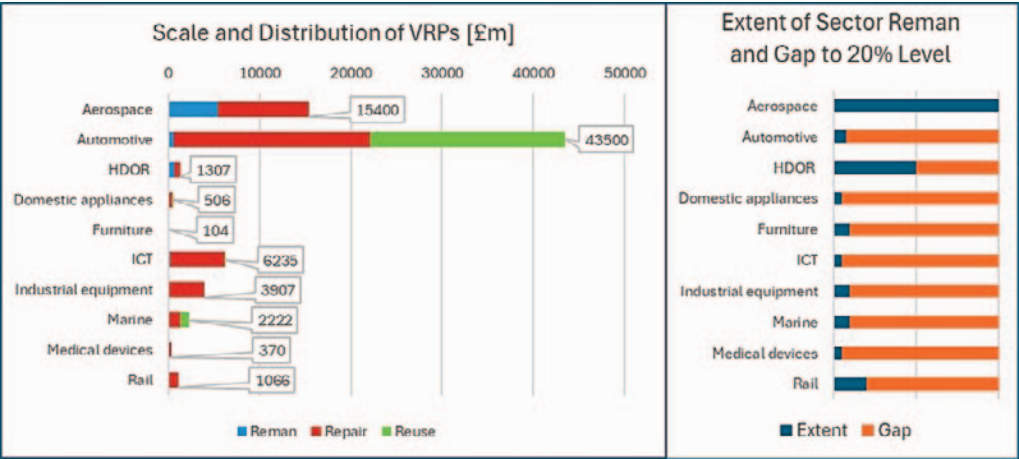


Figure 3. Scale and Distribution of VRP's

WHERE ARE VRP PROMOTIONAL EFFORTS BEST PLACED?

There are numerous potential targets for consolidating or increasing the uptake of VRPs. However, with limited resources to intervene, efforts are better focused on certain VRP approaches within particular sectors. The following figure summarises selected targets for promotion and, importantly, which objective they can help to achieve (economic, competitive or carbon reduction).

For example, large environmental impacts (carbon) can be achieved by promoting reuse, repair and refurbishment activities in domestic goods and IT, simply to maximise the intended life of these products, or somewhat rejuvenate them. This prevents unnecessary purchase of new products with all their burdens.

The 'heavy' engineering sectors fall more into the business-to-business service domain, are more amenable to remanufacturing for multiple use

lives, and are proven money spinners. Note, this is not to say they don't have carbon benefits: they do and are large, but there is a clear profit motive in these sectors compared to 'domestic' sectors.

WHAT ARE THE BARRIERS TO EXPANSION?

A recent report for Innovate UK into VRPs (Parker, D. & Waugh, R. et al., 2022) identified the following sectoral issues hampering expansion or uptake. These are presented under broad categorisations of technical, economic, social and legislative. *See Figure 5.*

WHAT STEPS WOULD ASSIST UPTAKE?

In common, previous studies indicate 5 core clusters comprising 10 priority actions. These are more or less appropriate depending on the jurisdiction under examination.

1. Overall strategy, coordinate approaches.
 2. Sector focus groups.
 3. Terminology & standards.
 4. Rebalance EoL and purchasing tariffs.
 5. Update NAO metrics/reporting.
 6. Embed right to repair.
 7. Use public purchasing.
- See Figure 6.*

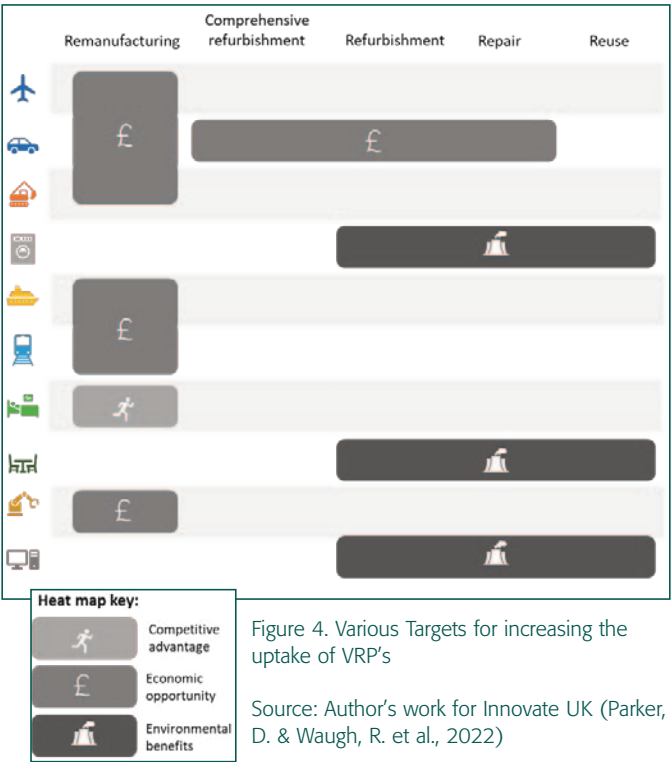


Figure 4. Various Targets for increasing the uptake of VRP's

Source: Author's work for Innovate UK (Parker, D. & Waugh, R. et al., 2022)

	 Technical	 Economic	 Social	 Legislative
Aerospace	MRO only for mechanical components			Limitations on the recycled content allowed in aircraft components
Automotive	Lack of access to software, original specifications, and tolerances (non-OEM)	Economics and logistics of core recovery. Low-cost 'copy' parts	Increased labour costs. Lack of skills in dealing with electrical components	Obtaining core from other European countries
Domestic appliances	Non-authorized repairs	Often cheaper to replace than repair/refurbish	Predicted skills shortage in the end of the decade	
ICT	Lack of access to software, original specifications, and tolerances	Economics and logistics of core recovery	Consumer perception on purchasing new	
HDOR	Limited component availability	Sale of single life tyres		
Industrial equipment	Limited information / original component drawings		Skills shortage in dealing with electrical components	
Furniture	Lack of understanding of material composition (independent actors)	Procurement processes favours new products	Consumer perception on what is in style and on trend	
Marine	Older ports do not have the right technology to retrofit shipping vessels	High cost for recertification of refurbished boats	Skills shortage for retrofitting large ships	
Medical devices	Accessing software and core (independent actors)	NHS procurement process favours new products		
Rail	Electrifying existing infrastructure	Low-cost financing options favour the purchasing of new stock		
Barriers across different sectors	Understanding software and material composition of components	Making value retention products economically competitive against low-cost imports	Training and upskilling programs	Importing of core

Figure 5. Barriers to Expansion Source: Innovate UK (Parker, D. & Waugh, R. et al., 2022)

8. Community reuse and repair.
9. Public messaging and trust building.
10. International VRP recognition protocols.
- More detail on sector opportunities and high priority



Figure 6. Sector Opportunities

Reuse, however, does not cross-national accounting boundaries, only corporate ones, and there is no specific obligation to classify and report incomes and flows apart from a few NACE codes targeting e.g. vehicle repair.

The observant will note that VRPs comprise a core 'circular' activity. At the national level, there is widespread interest in measures of circularity. As described above, the effects of waste, recycling, stock-building and material pass-through can be measured and accounted for. Therefore, the only existing national measure of VRP impact is its overall effect on reducing need for raw materials (per unit of GDP) and overall GWP reduction (per unit of GDP).

More detail on this topic can be found in the Zero Waste Scotland report on circular economy indicators (Parker, D. et al., 2023).

WHAT IS THE LINKAGE TO UK POLICY IN CARBON AND MANUFACTURING?

VRPs are core the delivery of the Circular economy. Specific policy vehicles where they are identified or supportive include: **The Climate Change Act 2008 (2050 Target Amendment) Order 2019** (H.M. Government, 2019); **Build Back Better – our plan for growth** (HM Treasury, 2021); **Ten point plan for a Green Industrial Revolution** (HM Government, 2020); **Industrial Decarbonisation Challenge** (HM Government, 2021); **Energy-Related Products Policy Framework** (Department for Business, Energy & Industrial Strategy, 2021); **UK Innovation Strategy** (Department for Business, Energy & Industrial Strategy, 2021); **Net-Zero Research and Innovation Framework** (HM Government, 2021).

actions indicated in the figure can be found in the Environment and Climate Change Canada (ECCC) report (Waugh, R. & Parker, D. et al., 2021) Sections 13, 14 and 16; and Innovate UK report (Parker, D. & Waugh, R. et al., 2022)

A particularly persistent issue is that of Point 5, namely that there are no substantive national metrics to monitor reuse activity at a material or economic level. Without measurement, control is impossible, but measurement is problematic. Recycling is easy to monitor because wastes cross a notional material accounting boundary, namely waste consignment, collection and treatment coordinated through a limited number of operators.

HOW CREDIBLE ARE THESE RESULTS?

This article draws from work carried out by the author and colleagues for the EU, UK, Canadian and Malaysian governments, various trade bodies and during industrial assistance supported historically by DEFRA. The benefits, barriers, potentials and possible actions are remarkably consistent across time, geography and within sectors. This suggests there is universal learning on offer.

In terms of coverage, studies harmonised on 10 sectors evaluated, estimating that these covered around 70% of potential activity with a more detailed examination covering around 50% of potential activity (in 6 sectors).

References

- 1 Aerospace, automotive, heavy duty & off-road vehicles, ICT, furniture, home appliances, rail, marine, medical and industrial equipment.

Department for Business, Energy & Industrial Strategy. (2021, November). *Energy-Related Products Policy Framework*. Retrieved December 22, 2021, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034456/energy-related-products-policy-framework.pdf

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- Waugh, R., & Parker, D. et al. (2021). *Socio-economic and environmental study of the Canadian remanufacturing sector and other value-retention processes in the context of a circular economy*. Oakdene Hollins & Dillon. Environment & Climate Change Canada. Retrieved November 2024, from <https://static1.squarespace.com/static/5a60c3cc9f07f58443081f58/t/60e47a2350aefc23482ea9b4/1625586223488/EC-CC+VRP+Project+Published+Report.pdf> ■

DISCUSSION MEETINGS

P&SC Discussion In Partnership with The Institute of Chemical Engineers Tuesday 10th September



L-R: **Sam Carling MP** (Vice-Chair, P&SC); **Dr Rachel Bibby**, Director of Member Experience & Professional Learning, IChemE; **Mark Aspsey MBE**, President, IChemE; **Viscount Stansgate**, President, P&SC; **Maddie Dinwoodie**, Director of Engagement Programmes, Engineering UK; **Baroness Pauline Neville-Jones DCMG**, House of Lords Science and Technology Committee; **Duncan Lugton**, Head of Policy and Impact, IChemE; **Professor Raffaella Ocone OBE**, Deputy President, IChemE; **Andrew Foster**, Director for Strategic Partnerships and Impact, IChemE

November Discussion Event with The Nutrition Society

Our meeting, held on the 12th November, in partnership with The Nutrition Society, discussed the theme of:

‘Can an App deliver positive nutrition or health outcomes?’



L-R: **Mark Hollingsworth**, CEO, The Nutrition Society; **Professor Clare Llewellyn**, Associate Professor of Obesity, Research Department of Behavioural Science and Health, University College London; **Professor Philip Calder**, Head of Human Development & Health and Professor of Nutritional Immunology within Medicine, University of Southampton; **Viscount Stansgate**, President, P&SC; **Professor Sarah Berry**, Department of Nutrition Sciences, King's College London, and Chief Scientist at Zoe.

Credit: Roger Brown

You can read a report of the meeting at www.scienceinparliament.org.uk

ANNUAL LUNCHEON

Tuesday 5th November 2024



Lord Willetts addresses the Annual Lunch





George Freeman MP thanks his predecessor Stephen Metcalfe for his tremendous service as P&SC Chair.



FUTURE-PROOFING LONDON: THE THAMES ESTUARY 2100 TIDAL DEFENCE STRATEGY



Tim Reeder BSc, CSci, FCIWEM is a Senior Consultant at Climate Sense. He is an adjunct Fellow of Southampton University. He advises the London Climate Ready Partnership which he helped to set up and was the Project Scientist for Thames Estuary 2100 leading the development of climate change adaptation.



Professor Jason A. Lowe OBE is a Principal Fellow and Head of Climate Services for Government at the Met Office, and Chair in Interdisciplinary Climate Research, Priestley Centre, University of Leeds.

Jason has over 20 years of experience as a climate researcher and research leader, contributing to scientific journal publications on a diverse range of subjects relevant to both climate mitigation and adaptation. He leads the UKCP project, which developed innovative new climate scenarios for the UK that were used extensively in the most recent UK Climate Change Risk Assessment and are being used in the 3rd National Adaptation Programme. Internationally, Jason has contributed to all three working groups of the Intergovernmental Panel on Climate Change, and many UN climate reports. He regularly provides advice to Government and other stakeholders on climate variability and change.

A recent focus has been to provide information and guidance on climate change to the finance sector, including to the adaptation working group of the Climate Financial Risk Forum (CFRF) in 2024.



Prof Chris Rapley CBE MAE is Professor of Climate Science at UCL and a Fellow of St Edmund's College Cambridge. He Chairs the UCL Climate Action Unit and the European Science Foundation's European Space Sciences Committee, is Patron of the Surrey Climate Commission and is a Board Member of the UK Clean Growth Fund.

The Thames Estuary is a vital artery for our nation's capital, and safeguarding it against the growing threat of tidal flooding is a matter of national importance. In 2002, the Environment Agency embarked on the Thames Estuary 2100 (TE2100) Project—a forward-thinking initiative designed to tackle the escalating challenges posed by aging flood defences, increasing development pressures on the floodplain, and, crucially, the uncertain impacts of climate change.

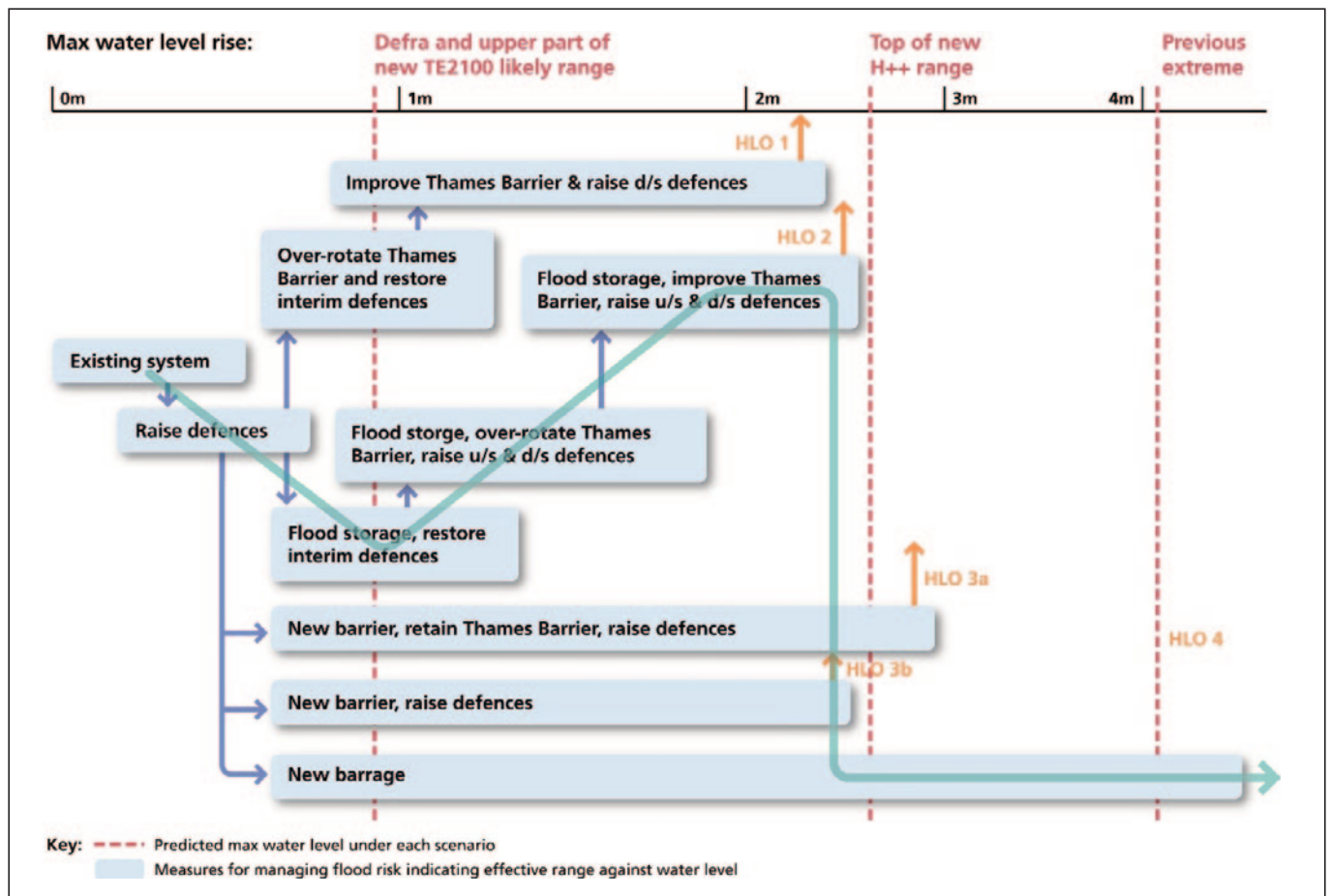
The project aimed to assess the effects of climate change on sea level rise, storm surges, and high river flows along the Thames, which pose increasing risks to the Tidal Defence System. This system includes 330 kilometres of walls and dykes, along with seven tidal gates, and including the iconic Thames Barrier, all working together to protect London and the Thames Estuary from tidal surges and flooding. The Barrier was constructed following the 1953 floods that led to 300 fatalities along the East Coast, including Canvey Island and was officially opened in 1984.

Whilst we knew it was virtually certain that in a warming world sea levels will rise, there was considerable uncertainty how fast and how large climate change impacts would be, including the magnitude and frequency of storm surges. To address this, a twin-tracked approach was adopted. Firstly, a Decision Testing framework was developed to facilitate decision-making in an uncertain future. This was supported by the EU ESPACE project, which

collaborated with partners in Holland and Germany facing similar challenges. This collaboration allowed the project to develop an innovative approach to climate change impacts.

Instead of planning for a single future scenario, the project assessed the flood risk management system against a range of scenarios, from current sea / storm surge levels to the most extreme plausible / reasonable worst case change scenario (High++). The focus was on identifying key thresholds beyond which the existing system would fail and determining adaptation measures that could be implemented, along with their effectiveness thresholds, up to a four metre increase. Adaptation measures were then combined into Adaptation Pathways, depicting various possible future routes. This was a new approach to optimise decision making under deep climate uncertainty.

These pathways, shown in Fig 1, could handle extreme water level event increases of 2.5 to 3



High Level Options. The dark blue path shows a possible future adaptation route (or pathway) in the event of extreme change. The vertical dashed lines show the new TE2100 scenarios.

metres. Coping with increases beyond this would necessitate constructing a barrage to prevent most tidal movements, requiring locks for shipping. Fig 1 also indicates that an initial planning scenario of a 90 cm increase by 2100 was appropriate, with a revised plausible extreme scenario of around 2.7 meters. This confirmed that all pathways could manage the revised extreme scenario. A phased plan, the TE2100 plan, was developed, outlining how measures such as raising defences would be implemented throughout the 21st century. For instance, a new or updated Thames Barrier will be needed by 2070 assuming the 90 cm planning scenario. Using this technique the Plan ensures that investment in maintenance and development of flood defence assets makes the best use of existing

infrastructure and ensures that improvements and additions are made in the context of the full range of possible climate change impacts.

Approved in 2012, the plan has led to a coordinated approach to maintaining and investing in the tidal defence system, working with stakeholders to enhance riverside strategies and improve community resilience in the defended floodplain. A key component of the plan is the ongoing review of indicators such as sea level rise rates and defence conditions. The TE2100 project was the first to embed this monitoring into the final plan, pioneering the concept of Adaptation Pathways, which has since been widely adopted in climate change adaptation and has been followed as a key example in setting adaptation standards.

The second part of the twin-track approach involved initiating research projects with the Met Office Hadley Centre (MOHC), Proudman Oceanographic Centre, Centre for Ecology and Hydrology and others. Early in the TE2100 project, it was anticipated that major investments in the Thames Barrier and associated defences would be required within the century. Hence, reducing or better quantifying the uncertainty in future climate change and flood risk was crucial to optimise expenditure. At the project's outset, UKCIP02 scenarios projected an increase of up to 1.3m in storm surge at the Thames mouth by the 2080s, while other models projected a decrease. This uncertainty range could significantly compromise future flood risk management planning and associated costs.

To address this new research was commissioned to better quantify uncertainties around storm surges, relative sea level rise, and river flows consistently. This work, conducted alongside MOHC research for UKCP09 scenarios, provided valuable output on mean and extreme sea levels relevant to the entire UK, contributing significantly to the UKCP09 marine projections. Close collaboration with the scientific community was invaluable. For example, the decision to devise the High++ scenario addressed emerging evidence of Antarctic ice sheet melt presented at the Dangerous Climate Change Conference in 2005¹. This scenario, derived from expert opinion on plausible worst-case changes, ensured future planning took place within an envelope that could cope with the most unlikely extreme

change. It was reduced from an initial 4 metres to 2.7 through looking at the latest science at the time provided by paleo climate evidence, model studies and limiting physical arguments. An important feature of the analysis was being transparent on where there were limitations to current understanding.

The TE2100 plan, approved in 2012, has undergone a major ten-year review and update, adopting a higher planning figure for sea level rise over the 21st century of 1.15 metres². Consequently, some adaptation actions, such as raising defences, have been advanced, along with the deadline for deciding on an end-of-century option like a new or updated Thames Barrier. The plan has stood the test of time, with the review emphasizing the plan's benefits, clarifying roles

and responsibilities, and setting stronger sustainability and resilience ambitions. There is also a call for the plan to get statutory backing from Parliament with respect to spatial planning. In addition the recent London Resilience review carried out for the Mayor of London has called for climate adaptation and resilience to be led by a cabinet level Minister.

In summary, the TE2100 project developed a novel approach to climate change adaptation by creating Adaptation Pathways, offering various routes to address climate uncertainties and showing that uncertainty in climate projections does not need to be a barrier to adaptation decision making. This approach has been widely adopted globally for example in New York, New Zealand and

Australia and has provided an adaptable plan for London's and the Thames Estuary's future tidal flood risk management. It is being more widely used by the Environment Agency and will help with adapting communities and infrastructure to the full scale of the challenge that climate change presents.

Now, more than ever, the consequences of climate change are hitting home - from record-breaking floods to heatwaves and extreme events that disrupt daily life and economic stability. The TE2100 project has set a global standard for how to tackle these realities head-on, using science and wisdom to guide the timing and scope of investments that keep our communities and infrastructure safe. It demonstrated that even where there remains uncertainty

in the science there is typically enough information to make effective decisions to improve resilience. But as we look to the future, the plan's success relies on continuous support and commitment. Parliament has a pivotal role to play in ensuring the statutory backing for TE2100, aligning our spatial planning and resilience strategies to the escalating climate risks. Decisions made according to the Plan will shape not just the safety of London and the Thames Estuary, but also set a benchmark for climate leadership for others to follow.

References

- 1 [https://en.wikipedia.org/wiki/Avoiding_Dangerous_Climate_Change_\(2005_conference\)](https://en.wikipedia.org/wiki/Avoiding_Dangerous_Climate_Change_(2005_conference))
- 2 Major updates to Thames Estuary 2100 from 2012 to 2023 - GOV.UK

SCIENCE IN THE NEW PARLIAMENT

A new hub is launched for excellence in science, digital and technology research and policy analysis.



Dr Sarah Bunn

As we settle into the new parliamentary session, House staff from different teams are working on a wide range of science and technology subjects to support MPs and peers. This will involve supporting scrutiny on numerous cross-cutting topics from digital technologies, AI and cybersecurity to research infrastructure, gene therapies and biometrics.

Most parliamentarians do not have research or science backgrounds. But they are all faced with making decisions on subjects where research evidence can be complex, incomplete, and difficult to navigate. There are several teams across Parliament that support scrutiny of science and technology subjects, but cross-cutting issues require cross-cutting collaboration between teams with different specialisms.

To meet this need, we have established a new parliamentary hub for science, digital and technology, which will focus on deepening

parliamentary staff subject specialisms and building the capacity and resilience of the policy, research and analysis community in the House of Commons.

The Science, Digital and Technology Hub will provide a focus for enhanced collaboration and coordination across teams working in select committees, the Commons Library and the bicameral Parliamentary Office of Science and Technology (POST). The hub also welcomes Dr Varuna De Silva (Reader in Machine Intelligence and Digital Technologies,

Loughborough University), who will provide expert support across teams on digital and AI themes as a Thematic Research Lead, through a programme funded by UK Research and Innovation.

Varuna and I will be working closely with teams inside Parliament to achieve the hub's objectives to develop staff skills and experience, to anticipate and respond to parliamentarians' needs and to work effectively to harness knowledge and expertise.

WHO ARE THE SCIENCE TEAMS IN PARLIAMENT?

The hub will collaborate closely with the Science and Environment Section in the House of Commons Library, POST, the Science, Innovation and Technology Select Committee, and the Lords Science and Technology Committee, among others.

SCIENCE AND ENVIRONMENT SECTION

The Science and Environment Section (SES), led by Xameerah Malik, supports individual MPs through the Library's confidential request service. It also publishes impartial briefings on bills, debates and topical issues, all of which are available on the Commons Library website. MPs and their staff, including constituency staff, can request research and information by visiting the Members' Library in the Palace or by emailing commonslibrary@parliament.uk. Subscribe to alerts about new Library briefings at commonslibrary.parliament.uk/subscribe.

Since the general election, SES has been focused on briefing new and returning MPs and their staff on a wide range of topical issues.

A key focus area for us over the next year will be publishing briefings on legislation, including government bills and private members' bills. These include the Terminally Ill Adults (End of Life) Bill, Product Regulation and Metrology Bill and the cyber resilience and AI bills. We look forward to collaborating with the hub, committee teams and POST in briefing MPs on these, and other, important science issues.

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY

The Parliamentary Office of Science and Technology (POST), led by Oliver Bennett, ensures that the best available research evidence and information is accessible to Parliament. It produces briefings to synthesise research evidence on a topic, conducts horizon scanning to identify topics likely to be important in the future, arranges academic placements, and conducts knowledge exchange activities to link external experts to parliamentary specialists. To get involved, you can sign up to POST's mailing list, send in ideas for research, and respond to relevant aspects of POST's work programme.

POST looks forward to collaborating with the hub to ensure that research evidence can better inform and support the wider work of parliament.

For example, POST has recently concluded a major horizon scan, identifying key priorities for parliament over the next five years. Over 100 major issues were identified, from prison reform and tackling extremism, to trust in public institutions and preventing disease. Short articles have been published on our website on many of the issues to help parliament identify what action it may take. POST will prioritise research on many of these topics over the next year, and this work will also help the committees and library teams to anticipate and plan for this parliament.

COMMONS SCIENCE, INNOVATION AND TECHNOLOGY COMMITTEE

The Commons Science, Innovation and Technology Committee, with its secretariat led by Hannah Stone, has its new Chair, Chi Onwurah MP and a brand new membership. Committee staff will be supporting the committee as it shapes its priorities and inquiry programme for the year ahead.

The committee's role has evolved over the last two years: before the creation of the Department for Science, Innovation and Technology (DSIT) in 2023, the committee looked at science policy across government. It now has the role of scrutinising the department, as well as maintaining its cross-governmental remit. In July 2024, the government announced that the Central Digital and Data Office, the Government Digital Service and the Incubator for AI would move to DSIT. This expanded the committee's role further, bringing more data, digital and AI policy within its scope.

The committee recently launched its first inquiry, which will look into social media algorithms and the spread of mis/disinformation, and is likely to launch further inquiries soon into topics across its remit. It is also planning a public engagement exercise to get input into its programme from members of the public and stakeholders.

All committees will be announcing inquiries shortly, with written and oral evidence essential in informing their understanding of relevant issues. Readers can find more information on Parliament's website about current select committee inquiries and the passage of bills, as well as how to engage with committees.

LORDS SCIENCE AND TECHNOLOGY COMMITTEE

The House of Lords Science and Technology Committee is currently chaired by Baroness Brown of Cambridge. Its secretariat is led by John Turner.

The committee is currently reaching the end of its inquiry into engineering biology, with a report expected to be published in the new year. It has yet to agree its next inquiry.

To find out more about the work of the new hub, or other science teams, please contact Dr Sarah Bunn bunnsk@parliament.uk. You can also access a wide range of resources on academic engagement with Parliament and committees provided by the Knowledge Exchange Unit on keu@parliament.uk. ■



HOUSE OF COMMONS SELECT COMMITTEES

BUSINESS AND TRADE COMMITTEE

The Business and Trade Committee scrutinises the policy, spending and administration of the Department for Business and Trade and its public bodies. You can follow the Committee on X (@CommonsBTC).

Membership:

Rt Hon Liam Byrne MP, Labour (Chair)
Antonia Bance MP, Labour
John Cooper MP, Conservative
Sarah Edwards MP, Labour
Alison Griffiths MP, Conservative
Sonia Kumar MP, Labour
Charles Maynard MP, Liberal Democrat
Gregor Poynton MP, Labour
Joshua Reynolds MP, Liberal Democrat
Matt Western MP, Labour
Rosie Wrighting MP, Labour

Current Inquiries:

The Work of the Business and Trade Committee

Opened: 20th November 2024

Business and Trade Committee Priorities

Opened: 13th November 2024

Make Work Pay: Employment Rights Bill

Opened: 31st October 2024.

Deadline for written evidence: 6th December 2024

For further details:

Email: commonsbtc@parliament.uk

Phone: 020 7219 8586 (General enquiries) | 020 7219 4984 (media enquiries)

Address: Business and Trade Committee, House of Commons, London, SW1A 0AA

ENVIRONMENTAL AUDIT COMMITTEE

The Committee's remit 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.ou can follow the Committee on X @CommonsEAC.

Membership:

Toby Perkins MP, Labour (Chair)
Olivia Blake MP, Labour
Julia Buckley MP, Labour
Ellie Chowns MP, Green Party
Barry Gardiner MP, Labour
Anna Gelderd MP, Labour

Sarah Gibson MP, Liberal Democrat
Pippa Heylings MP, Liberal Democrat
Chris Hinchliff MP, Labour
Martin Rhodes MP, Labour
Blake Stephenson MP, Conservative
Alison Taylor MP, Labour
Cameron Thomas MP, Liberal Democrat
John Whitby MP, Labour

Current Inquiries:

Environmental Sustainability and housing growth.

Opened: 18th November 2024

Deadline for written evidence: 20th December 2024

For further details:

Email: eacom@parliament.uk

Phone: 020 7219 8890 (general enquiries) | 020 7219 1034 (media enquiries)

SCIENCE, INNOVATION AND TECHNOLOGY COMMITTEE

The Science, Innovation and Technology Select Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Department for Science, Innovation and Technology, and associated public bodies. It also exists to ensure that Government policies and decision-making across departments are based on solid scientific evidence and advice. You can follow the Committee on X @CommonsSITC.

Membership:

Chi Onwurah MP, Labour (Chair)
Emily Darlington MP, Labour
Rt Hon George Freeman MP, Conservative
Dr Allison Gardner MP, Labour
Tom Gordon MP, Liberal Democrat
Rt Hon Kit Malthouse MP, Conservative
Steve Race MP, Labour
Josh Simons MP, Labour
Dr Lauren Sullivan MP, Labour
Dr Adam Thompson MP, Labour
Martin Wrigley MP, Liberal Democrat

Current Inquiries:

Social media misinformation and harmful algorithms

Opened: 20th November 2024.

For further details: Email: commonssitc@parliament.uk Phone: 020 7219 5023 (general enquiries) | 020 7219 0731 (media enquiries). Address: Science, Innovation and Technology Committee, House of Commons, London, SW1A 0AA.

HEALTH AND SOCIAL CARE COMMITTEE

The Health and Social Care Committee. Its responsibility is to scrutinise the work of the Department of Health and Social Care and its associated public bodies. The Committee examine government policy, spending and administration on behalf of the electorate and the House of Commons.

You can follow the Committee on X @CommonsHealth

Membership:

Layla Moran MP, Liberal Democrat (Chair)
Danny Beales MP, Labour
Ben Coleman MP, Labour
Dr Beccy Cooper MP, Labour
Deirdre Costigan MP, Labour
Jen Craft MP, Labour
Josh Fenton-Cooper MP, Labour
Andrew George MP, Liberal Democrat
Paulette Hamilton MP, Labour
Joe Robertson MP, Conservative
Gregory Stafford MP

Current Inquiries:

The 10 Year Health Plan

Opened: 13th November 2024

Adult social care reform: the cost of inaction

Opened: 31st October 2024

Deadline for written evidence: 11th December 2024

For further details: Email: hscocom@parliament.uk
Phone: (general enquiries) 020 7219 6182 | 020 7219 3138 (media enquiries). Address: Health and Social Care Committee, House of Commons, London, SW1A 0AA

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.

You can follow the Committee on X @CommonsESNZ.

Membership:

Bill Esterson MP, Labour (Chair)
Polly Billington MP, Labour
Sir Christopher Chope MP, Conservative
Torcuil Crichton MP, Labour
Wera Hobhouse MP, Liberal Democrat
Josh MacAlister MP, Labour
Anneliese Midgley MP, Labour
Julie Minns MP, Labour
Luke Murphy MP, Labour
Bradley Thomas MP, Conservative
Claire Young MP, Labour

Current Inquiries:

Unlocking community energy at scale

Opened: 11th November 2024

Deadline for written evidence: 13th January 2025

Work of the Department of Energy and Net Zero

Opened: 11th November 2024

Workforce planning do deliver clean, secure energy

Opened: 11th November

Deadline for written evidence: 13th January 2025

For further details: Email: commonsesnzs@parliament.uk
Phone: Media: 020 7219 4984 / bridgespalmerj@parliament.uk
Address: Energy Security and Net Zero Committee, House of Commons, London SW1A 0AA

ENVIRONMENT, FOOD AND RURAL AFFAIRS COMMITTEE

Looking at issues from the air we breathe to the food on our plates, Parliament's Environment, Food and Rural Affairs Committee (EFRA) exists to scrutinise the administration, spending and policy of the Government's Department for Environment, Food and Rural Affairs. You can follow the Committee on X @CommonsEFRA

Membership:

Rt Hon Alistair Carmichael MP, Liberal Democrat (Chair)
Sarah Boot MP, Conservative
Charlie Dewhurst MP, Conservative
Helen Dollimore MP, Labour
Sarah Dyke MP, Liberal Democrat
Jayne Kirkham MP, Labour
Josh Newbury MP, Labour
Andrew Pakes MP, Labour
Jenny Riddell-Carpenter MP, Labour
Tim Roca MP, Labour
Henry Tufnell MP, Labour

Current Inquiries:

Work of the Department and its arm's-length bodies

Opened: 6th November 2024

For further details: Email: efracom@parliament.uk
Phone: Media enquiries: 020 7219 3138
Address: Environment, Food and Rural Affairs Committee, House of Commons, London, SW1A 0AA

EDUCATION COMMITTEE

The Education Committee scrutinises the work of the Department for Education, covering children's social care, schools, colleges, the early years and higher education. The Committee also holds regular hearings with DfE's arms-length bodies, including Ofsted, Ofqual and the Children's Commissioner. You can follow the Committee on X @CommonsEd

Membership:

Helen Hayes MP, Labour (Chair)
Jess Asato MP, Labour
Sureena Brackenridge MP, Labour
Dr Caroline Johnson MP, Labour
Amanda Martin MP, Labour
Darren Paffey MP, Labour
Manuela Perteghella MP, Liberal Democrat
Mark Sowards MP, Labour

Patrick Spencer MP, Conservative
Dr Marie Tidball MP, Labour
Caroline Voaden MP, Liberal Democrat
Current Inquiries:

There are no Inquiries at present.

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HOUSE OF LORDS SCIENCE AND TECHNOLOGY SELECT COMMITTEE

The Science and Technology Committee is appointed to consider science and technology. It does this principally through undertaking inquiries.

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The Lord Wei, Conservative
The Baroness Willis of Summertown CBE, Crossbench
The Baroness Young of Old Scone, Labour

Current Inquiries:

Engineering biology

Opened 28th March 2024

Long-duration energy storage.

Opened 26th July 2023.

Report published 13th March 2024. Government response published 16th May 2024,

For further details:

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Address: Science and Technology Committee, House of Lords, London SW1A 0PW



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.

The 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:

General Debate on building safety and resilience

Debate pack CDP 2024/0120, published 10 September, 2024.

A landing page published ahead of a debate on building safety and resilience in the House of Commons Chamber on 11 September 2024.

On 4 September 2024, the Grenfell Tower Inquiry published its final report into the fire that killed 72 people at Grenfell Tower in London on 14 June 2017. This public inquiry concluded that "the fire at Grenfell Tower was the culmination of decades of failure by central government and other bodies in positions of responsibility in the construction industry to look carefully into the danger of incorporating combustible materials into the external walls of high-rise residential buildings and to act on the information available to them". Since the fire, there have been various investigations, select committee inquiries and changes to legislation, including the Building Safety Act 2022. Relevant publications and Library briefings are listed on the page.

Environmental standards for new housing

Debate pack CDP 2024/0118, published 11 September, 2024

A landing page published ahead of a debate on environmental standards for new housing in Westminster Hall on 12 September 2024.

All new housing in England must adhere to building regulations, under the Building Act 1984 and the Building Regulations 2010. The statutory requirements set out in Schedule 1 to the Building Regulations 2010 include water efficiency (part G), drainage and

waste disposal (part H), combustion appliances and fuel storage systems (Part J), conservation of fuel and power (part L), overheating (part O) and infrastructure for the charging of electric vehicles (part S). This page summarises the requirements and includes recent Parliamentary material and press coverage.

The UK's plans and progress to reach net zero by 2050

Research Briefing CBP 9888, published 26 September, 2024

The UK is committed to reaching net zero by 2050. This means that the total greenhouse gas emissions would be equal to the emissions removed from the atmosphere, with the aim of limiting global warming and resultant climate change.

The UK Government has adopted a suite of policies in order to reach net zero, set out in two strategy publications: the Net Zero Strategy (2021) and Powering Up Britain: The Net Zero Growth Plan (2023).

This briefing provides an overview of the context for the net zero target, important UK net zero policies since 2020, and progress towards this goal. It covers how some key sectors are implementing net zero policies and includes stakeholder commentary on progress.

Debate on the Grenfell Tower Inquiry Phase 2 Report

Debate pack CDP 2024/0161, published 29 November, 2024

A debate pack published ahead of a general debate on the Grenfell Tower Inquiry Phase 2 Report on 2 December 2024 in the Commons Chamber.

This debate pack summarises the key conclusions and recommendations of the Phase 2 Report, responses from the organisations affected by the inquiry and some of the actions that the government has taken to improve the fire safety of buildings since the fire. It also includes recent press and parliamentary material.

Infected Blood Inquiry: compensation

Research Briefing CBP 10099, published 24 September, 2024

The Infected Blood Public Inquiry recommended that the government should set up a compensation scheme for those infected and affected by contaminated blood, blood products and tissue. The government accepted this recommendation and made regulations to establish the Infected Blood Compensation Scheme in August 2024.

Between the 1970s and early 1990s thousands of UK patients contracted HIV, hepatitis viruses, or both, after receiving contaminated blood, blood products and tissue as part of medical treatments and procedures, such as blood transfusions.

The Infected Blood Inquiry's primary recommendation was that the government should immediately establish a compensation scheme for those "infected and affected". Affected people are "those who have suffered the impacts of infected blood through their relationship with a living or deceased infected person".

This Library briefing on infected blood compensation examines the design and implementation of the compensation scheme. A separate Library briefing examines recommendations made by the inquiry that are focused on improving safety and patient care: Infected Blood Inquiry: recommendations for recognition, healthcare and patient safety.

Debate on the potential merits of a cancer strategy for England Debate pack CDP 2024/0141, published 24 October, 2024

A landing page published ahead of a Westminster Hall debate on 31 October on the potential merits of a cancer strategy for England.

England does not currently have a stand-alone cancer strategy.

The Conservative Government launched a consultation on a '10-Year Cancer Plan for England' in February 2022. Eleven months later, in January 2023, the government announced that the cancer plan would be incorporated into a 'Major Conditions Strategy' (MCS) covering six major conditions (cancer, heart disease, musculoskeletal disorders, mental ill-health, dementia and respiratory diseases).

The Health and Social Care Select Committee wrote to the government in May 2024 with the key findings of its 'Future Cancer' inquiry, ahead of the dissolution of Parliament. In the letter it argued that it was "a mistake to abandon the '10 Year Cancer Plan'" and went on to "call for commitment to the redevelopment and publication of a long-term strategy for cancer which has innovation at its core". A government response to this letter is expected.

The Labour Government is focused on creating a new 10 year health plan.

This page gives background and includes recent Parliamentary and press material.

Developments in dementia treatments

Research Briefing CBP 10117, published 06 November, 2024

This briefing focuses on two disease-modifying dementia drugs that are currently being appraised by the National Institute for Health and Care Excellence (NICE): lecanemab and donanemab.

There is currently no cure for dementia. There are medicines and treatments that can help manage, or temporarily reduce, some of the symptoms. However, these do not treat the cause of the underlying disease and therefore do not stop its progression.

There are some new 'disease-modifying' treatments in development that are aimed at people in the early stages of dementia, who have a mild cognitive impairment / mild dementia, due to Alzheimer's disease. These are drugs that slow (but do not stop) the progression of dementia.

This briefing focuses on two disease-modifying dementia drugs that are currently being appraised by the National Institute for Health and Care Excellence (NICE): lecanemab and donanemab.

The Terminally Ill Adults (End of Life) Bill 2024-25

Research Briefing CBP 10123, published 22 November, 2024

The Terminally Ill Adults (End of Life) Bill 2024-25 had its second reading on 29 November 2024. This Library briefing provides an overview of the bill and key areas of debate.

On 16 October 2024, Kim Leadbeater (Labour) presented the Terminally Ill Adults (End of Life) Bill 2024-25 to Parliament, having

been drawn highest in the private members' bill ballot for the 2024-25 session.

The bill's long title states it would "allow adults who are terminally ill, subject to safeguards and protections, to request and be provided with assistance to end their own life".

The new alcohol duty system

Research Briefing CBP 9765, published 07 November, 2024

A new alcohol duty system was implemented on 1 August 2023. This briefing discusses the new duty regime, how it was developed, and how it compares to the former one.

The Finance (No. 2) Act 2023 implemented a major restructure of the taxation of alcohol. It took effect on 1 August 2023.

Broadly speaking, the change created a system of taxation of alcohol where drinks are taxed more the stronger they get.

Alongside changes to the structure of alcohol taxation, the government also increased the rates of duty in line with inflation. Although this is supposed to happen for all types of alcoholic drink each year, it was the first time it occurred since 2020. Certain drinks, such as beer, had not had a duty increase since 2017. This caused concern among sections of the industry, as expressed by the chief executive of the Wine and Spirit Trade Association (WSTA), Miles Beale, who said the increase in tax would cause "an extremely tough period for wine and spirit businesses".

Tobacco and Vapes Bill 2024-25

Research Briefing CBP 10150, published 22 November, 2024

The Tobacco and Vapes Bill 2024-25 will introduce a generational ban on the sale of tobacco, and further regulate vapes and vaping products.

The Tobacco and Vapes Bill 2024-25 (HC Bill 121) had its first reading on 5 November 2024, in the House of Commons. The bill's second reading took place on Tuesday 26 November 2024.

The bill aims to create the first "smoke-free generation" by ensuring children turning 15 this year or younger can never be legally sold tobacco.

The bill includes other provisions which focus on making vaping less attractive and accessible to children and young people, strengthening smoke-free restrictions, and strengthening enforcement around the sale of tobacco and vaping products.

The government has called the bill the "biggest public health intervention in a generation".

Provisions in this bill are similar to those proposed in the Tobacco and Vapes Bill 2023-24. The Conservative government introduced the previous bill in April 2024. It did not complete its parliamentary stages prior to the general election, and consequently fell when Parliament was dissolved.

Debate on waste crime in Staffordshire

Debate pack CDP 2024/0116, published 30 August, 2024

A debate pack published ahead of a Westminster Hall debate on 5 September on waste crime in Staffordshire.

There are many different waste offences. The Environment Agency, the environmental regulator for England, has published a list of offences and sanctions in a policy paper, Waste Offences, updated

28 June 2024. It includes, for example, the offence of “Depositing, knowingly causing or knowingly permitting the deposit of controlled waste or extractive waste on land without, or other than in accordance with, an environmental permit,” (section 33 of the Environmental Protection Act 1990, as amended) and which is the main offence used in fly tipping cases.

This pack describes the types of waste crime, measures to tackle it and future changes to tracking waste and registering waste carriers and dealers, as well as including recent Parliamentary and news items.

Holocaust Memorial Bill: Progress of the Bill

Research Briefing CBP 9741, published 01 October, 2024

The Holocaust Memorial Bill would remove restrictions on building a Holocaust Memorial in Victoria Tower Gardens. The bill is currently progressing through the House of Lords.

The Holocaust Memorial Bill 2022-23, 2023-24 and 2024-25 would remove restrictions on building a Holocaust Memorial and Learning Centre in Victoria Tower Gardens next to Parliament. The bill would also give the government powers to use public funds to build and operate the Holocaust Memorial and Learning Centre.

This briefing describes the background to the Bill and the stages it has already passed.

The bill will only return to the House of Commons (during ping pong) if the House of Lords returns the bill with amendments.

Flood risk management and funding

Research Briefing CBP 7514, published 05 November, 2024

This briefing paper provides an overview of flood and coastal risk management in the UK, including which bodies manage risk, current policy on flood risk management, and how flood funding works.

Several million properties in England are at risk of flooding.

There are different sources of flood risk. Flood risk can come from rainwater, rivers, the sea and coasts, and can include surface water flooding and groundwater flooding.

It is not possible to prevent all flooding or coastal erosion, but the impacts on communities can be reduced with effective flood and coastal erosion risk management (often referred to as FCERM).

Debate on a Motion to approve the Draft Environmental Protection (Single-Use Vapes) (England) Regulations 2024

Research Briefing CDP 2024/0165, published 06 November, 2024

A debate on a Motion to approve the Draft Environmental Protection (Single-Use Vapes) (England) Regulations 2024 took place in the Commons Chamber for 13 November 2024.

The regulations seek to ban the sale of single-use vapes. If approved, the regulations would come into force on 1 June 2025 and would apply to England only.

This page sets out the environmental impact of single-use vapes and what the Regulations would do, as well as recent Parliamentary material and news items.

The fishing industry

Debate pack CDP 2024/0160, published 27 November, 2024

A debate pack published ahead of a debate on the fishing industry in Westminster Hall on 28 November 2024.

This briefing covers a range of topical issues for the fishing industry, and includes recent Parliamentary material and media coverage.

Debate on the future of fishing after 2026

Debate pack 2024/0143, published 31 October, 2024

A debate pack published ahead of a debate on the future of fishing after 2026 on 5 November 2024 in Westminster Hall.

The UK-EU Trade and Cooperation Agreement (TCA) (PDF) covers fisheries and provides mutual access for UK and EU fishing vessels in each other's waters until June 2026. The agreement also sets out provisions for negotiations on access and share of stocks after that date. These could result in annual or multiannual agreements on fishing.

Following the general election and change of government in June 2024, there have been references to a reset of relations with the EU, although this has not included mention of fisheries specifically. Fishing organisations have raised concerns about any changes, should they result in increased EU fishing vessel access to UK waters after June 2026.

Help with energy bills

Research Briefing SN06163, published 30 September, 2024

This Library briefing sets out sources of financial and practical help for constituents with domestic energy bills. This briefing focuses on schemes that individuals can access via the government and local authorities, rather than those aimed at local authorities or housing associations. It covers targeted schemes and provides information on practical steps such as supplier switching, joining priority services registers, and making complaints. It also provides links to useful resources.

Great British Energy Bill 2024-25

Research Briefing CBP 10088, published 25 October, 2024

The Great British Energy Bill 2024-25 was introduced to the Commons on 25 July 2024. The second reading of the bill took place on 5 September 2024 and the committee stage of the bill took place between 8 and 15 October 2024. The report stage and third reading of the bill took place on 29 October 2024. The bill would create a new, publicly owned company, Great British Energy, designed to invest in and develop clean energy.

The bill includes provisions to create a new company, Great British Energy (GBE). GBE would be a publicly owned energy company designed to drive deployment of low-carbon, 'clean' energy (meaning energy not derived from fossil fuels).

GBE is part of the government's mission to make the UK a clean energy superpower and to decarbonise the electricity grid by 2030, which was included in its manifesto for the 2024 general election. The government also sees GBE as a means of increasing energy independence and reducing the UK's exposure to volatile international fossil fuel markets, and to return a profit for the benefit of UK taxpayers and communities.

The bill was not amended at committee stage.

Fuel poverty in the UK

Research Briefing CBP 8730, published 04 November, 2024

Record energy price rises have led to concern that more families will be drawn into ever deeper fuel poverty. This briefing at how fuel

poverty varies across the UK, policies to address fuel poverty, and stakeholder comment on the issue.

In general, fuel poverty relates to households that must spend a high proportion of their household income to keep their home at a reasonable temperature. Fuel poverty is affected by three key factors: a household's income, their fuel costs, and their energy consumption (which in turn can be affected by the energy efficiency of the dwelling).

The rapid increases in energy prices from late 2021 onwards led to higher energy debt, more customers on prepayment meters 'self-disconnecting' and others having to drastically cut their energy usage. This, along with wider cost of living pressures, have all led to heightened concerns about the extent and severity of fuel poverty and its impact on people.

Fuel poverty is a devolved policy area and is defined and measured differently in different parts of the UK.

Help with energy efficiency, heating and renewable energy in homes

Research Briefing CBP 9585, published 28 November, 2024

This briefing outlines the various financial support available across the UK for installing energy efficient measures, heating and renewable energy in homes.

Various support schemes are available to eligible households, to support domestic energy efficiency, heating and power generation. This briefing covers each of the schemes in further detail, including in which parts of the UK they are available, how to rectify problems, and links to sources for further information.

Debate on domestic production of critical minerals

Debate pack 2024/0164, published 28 November, 2024

A landing page published ahead of a debate on 3 December on domestic production of critical minerals.

In April 2024, the Library published a debate pack ahead of a debate on Supply of lithium and other critical minerals. The pack contains a useful overview of the issues. In addition, the attached documents include updated recent Parliamentary material and news items.

Since the April debate on Supply of lithium and other critical minerals there have been some industry updates, for example:

Cornish Lithium opened their hard-rock demonstration plant near Treviscoe in Cornwall which aims to produce lithium hydroxide for use in batteries.

Green Lithium (a lithium refiner) partnered with energy supplier EDF on using hydrogen as a feedstock for its lithium refinery in Teesside.

The Chancellor Rachel Reeves announced that UK Export Finance (the government's export credit agency) will offer support for overseas projects the supply critical minerals to the UK with the aim of increasing and diversifying the UK's access to critical minerals.

Customer protection in the mobile and broadband markets

Research Briefing CBP 9245, published 16 September, 2024

This briefing describes customer protections in the UK mobile and broadband markets. It discusses recent concerns expressed on behalf of telecoms consumers, and looks at reforms aimed at improving fairness and protection.

The government (through the Department for Science, Innovation and Technology) and Ofcom, the independent regulator, aim to encourage a competitive market for telecoms services in which consumers can make informed choices and shop around to get the best deals.

Telecoms markets are regulated by Ofcom under the Communications Act 2003, as amended. Under the Act, one of Ofcom's primary statutory duties is to further the interests of consumers, including where appropriate by promoting competition. In addition, Ofcom must act in accordance with the government's Statement of Strategic Priorities (SSP) for telecommunications.

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

Research Briefing CBP 8392, published 21 November, 2024

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.

The government's target is for next-generation, gigabit broadband to be available to 85% of the UK by 2025 and nationwide by 2030. This paper discusses the background to these targets and recent government policies and funding to support the rollout of gigabit broadband.

The UK Government has primary responsibility for broadband policy and coverage targets because telecommunications is a reserved power. However, the delivery of broadband infrastructure projects often involves local authorities or devolved responsibilities, such as building regulations, planning and business rates.

Delivery of electricity grid upgrades

Debate pack CDP 2024-0156, published 22 November, 2024

A debate pack published ahead of a Westminster Hall debate on Delivery of electricity grid upgrades on 26 November 2024.

The UK Climate Change Act 2008 (2050 Amendment) target to reach net zero in greenhouse gas emissions by 2050 will require significant increases in low carbon electricity generating infrastructure. The UK Government has ambitious targets relating to the development of offshore wind, solar energy and onshore wind, as well as a target to fully decarbonise the electricity grid by 2030.

NESO, the electricity system operator for Great Britain, carried out a review of the grid requirements needed to deliver the increase in offshore wind and other low carbon generation. This review reported in July 2022 with Pathway to 2030, which recommended a single, integrated network connecting new offshore wind farms and associated offshore and onshore transmission networks.

This briefing describes the current transmission network, demand on the system and planned upgrades. It also sets out the planning frameworks across GB and proposals to compensate those affected by developments.

Debate on community benefits from renewable energy projects

Debate pack CDP 2024/0127, published 11 October, 2024

A debate pack published ahead of a Westminster Hall debate on community benefits from renewable energy projects on 15 October.

Community benefits packages are financial payments made by developers of energy infrastructure, such as wind farms or electricity lines, made to local communities that will be impacted by the development. They are paid on a voluntary basis in the UK, with guidance provided by devolved administrations.

Debate on regeneration of city centres

Debate pack CDP 2024/0128, published 15 October, 2024

A debate pack published ahead of a Westminster Hall debate on regeneration of city centres on 16 October.

This pack contains information on the current economic conditions in town and city centres and measures which have been taken to regenerate them, as well as regeneration policies which have been used by previous governments and policy announcements by the new government.

Debate on regulation and financial stability of water companies

Debate pack 2024/0134, published 21 October, 2024

A debate pack published ahead of a Westminster Hall debate on 23 October on the regulation and financial stability of water companies.

Water is a devolved matter, and provision and regulation take place differently across different parts of the UK.

All water companies hold an appointment as a water undertaker (or sewerage undertaker), which is subject to conditions with which the companies must comply. This is also referred to as a licence.

Ofwat sets the price of water through price reviews.

Water company financial stability falls under the remit of Ofwat; its statutory duties include ensuring that water companies are able to finance their duties, as well as a wider resilience objective. Ofwat oversees the financial resilience of companies and can raise concerns or challenge a company to demonstrate how its financial practices allow it to maintain long-term financial viability.

Ofwat publishes an annual report on the financial resilience of water companies. In 2023, half of the seventeen companies assessed were below the “standard” rating, with four in the most serious “action required” category.

UK priorities for COP29

Debate pack 2024/0117, published 04 September, 2024

A debate pack published ahead of a Westminster Hall debate on UK priorities for COP29 on Tuesday 10th September 2024.

The United Nations Framework Convention on Climate Change (UNFCCC) conference on climate change is attended by signatory countries and other parties. It is also known as the conference of the parties (COP), and its aim is to review progress of these parties towards the overall goals of the UNFCCC. The COP meets every year, unless the parties decide otherwise.

The 29th Conference of the Parties, or COP29, was held from 11 to 22 November 2024 in Baku, Azerbaijan.

COP29: The 2024 United Nations Climate Change Conference

Research Briefing CBP 10083, published 15 October, 2024

The 2024 United Nations Climate Change Conference (COP29) is to be held from 11 to 22 November 2024 in Baku, Azerbaijan. This briefing covers the main themes of COP29.

Azerbaijan has outlined a framework for action for COP29, which comprises three main aims: limiting warming to below 1.5°C, “enhancing ambition and enabling action”, and ensuring an inclusive process.

Many stakeholders are referring to COP29 as ‘the finance COP’, with negotiations seen as critical to advance a range of financial tools and instruments to support actions to address climate change.

Antimicrobial resistance

Research Briefing CBP 8141, published 18 September, 2024

Antimicrobial resistance (AMR) is a significant threat to public health. This briefing provides information on the causes and implications of the development and spread of AMR and about UK and international action to address it.

Antimicrobial resistance (AMR) happens when antimicrobial medicines are no longer effective in killing or slowing the growth of microorganisms that cause disease. This makes infections harder to treat and increases the risk that diseases will spread.

Antimicrobial medicines include antibiotics, antivirals, antifungals and antiparasitics. AMR affects all four categories of antimicrobials.

AMR has been described as a ‘catastrophic threat’ to human and animal health. Bacterial AMR was linked to an estimated 4.95 million deaths and was directly responsible for 1.27 million deaths worldwide in 2019. Researchers have estimated that this figure could increase to 1.91 million by 2050.

“Netflix” for antimicrobials: The Antimicrobial Products Subscription Model

Library Insight, published 18 September, 2024

The NHS will pay a subscription fee to pharmaceutical companies, which will give it access to new antimicrobial drugs for drug-resistant infections.

The Antimicrobial Products Subscription Model is a new way for the NHS to purchase newly developed antibiotics to treat infections caused by drug-resistant bacteria. The payment model aims to encourage pharmaceutical companies to develop new antibiotic medicines and to prevent their overuse.

Coronavirus: Long covid

Research Briefing CBP 9112, published 31 October, 2024

Information about long covid, including guidance and services for long covid patients, statistics and the impact of long covid on healthcare, employment and education.

Some people who are infected by SARS-CoV-2, the virus that causes Covid-19, experience symptoms after the acute stage of the illness has passed. Long covid is a term used to describe ongoing symptoms of Covid-19, or new symptoms that develop after a Covid-19 infection. People with long covid can experience a wide range of symptoms affecting different parts of the body. Research exploring the causes of the condition and potential treatment options is ongoing.

Patients, charities and healthcare professionals have raised concerns about recognition and awareness of long covid, and difficulties in accessing appropriate medical assessments and support. ■

SCIENCE DIRECTORY

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SCIENCE DIRECTORY



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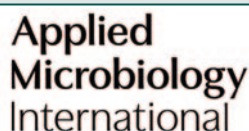


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The British Ecological Society is an independent, authoritative learned society, and the voice of the UK's ecological community. Working with our members, we gather and communicate the best available ecological evidence to inform decision making. We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



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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 representing scientists and clinicians who study the immune system in humans and 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. We aim to harness the knowledge generated by our membership to ensure society is aware of and can gain from the health benefits that immunology research can deliver.

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.

Cavendish Laboratory



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

The research programme covers the breadth of contemporary physics

Extreme Universe: Astrophysics, cosmology and high energy physics

Quantum Universe: Cold atoms, condensed matter theory, scientific computing, quantum matter and semiconductor physics

Materials Universe: Optoelectronics, nanophotonics, detector physics, thin film magnetism, surface physics and the Winton programme for the physics of sustainability

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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CIPA represents virtually all of the UK's 2,600 registered patent attorneys in industry and private practice. We are the UK's largest intellectual property organisation with over 4,700 members, including 1,100 trainee patent attorneys. It is our members that support British SMEs, universities and large companies in protecting their innovative technology worldwide. The reputation of the UK for IP advice draws work from around the world; only 11% of European patent applications by British representatives are for UK applicants. Consequently, the profession generates around £1 billion for the economy in gross value added and approaching £750 million in exports.



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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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We bring school students and their teachers

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 - Primary; our local **Meet-a-Medic Programme** since 2005
- Clifton Scientific Trust Ltd is registered charity in England and Wales 1086933



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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

SCIENCE DIRECTORY



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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.



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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.

SCIENCE DIRECTORY

Institute of Marine Engineering, Science and Technology (IMarEST)



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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.

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.



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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.



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The Institution of Chemical Engineers (IChemE) is the UK based and internationally recognised qualifying body and learned society for chemical, biochemical and process engineers.

We advance chemical engineering's contribution for the benefit of society, facilitate the development of chemical engineering professionals across a wide range of sectors including energy, water, food and health, and provide connections to a powerful network of 30,000 members in more than 100 countries.



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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.



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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.



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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

SCIENCE DIRECTORY

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.

Institution of MECHANICAL ENGINEERS

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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.



The University of Nottingham

UNITED KINGDOM • CHINA • MALAYSIA

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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.



The Nutrition Society

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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.

SCIENCE DIRECTORY



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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.



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



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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.

SCIENCE DIRECTORY

Society of Chemical Industry



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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

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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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.



The Welding Institute

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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.