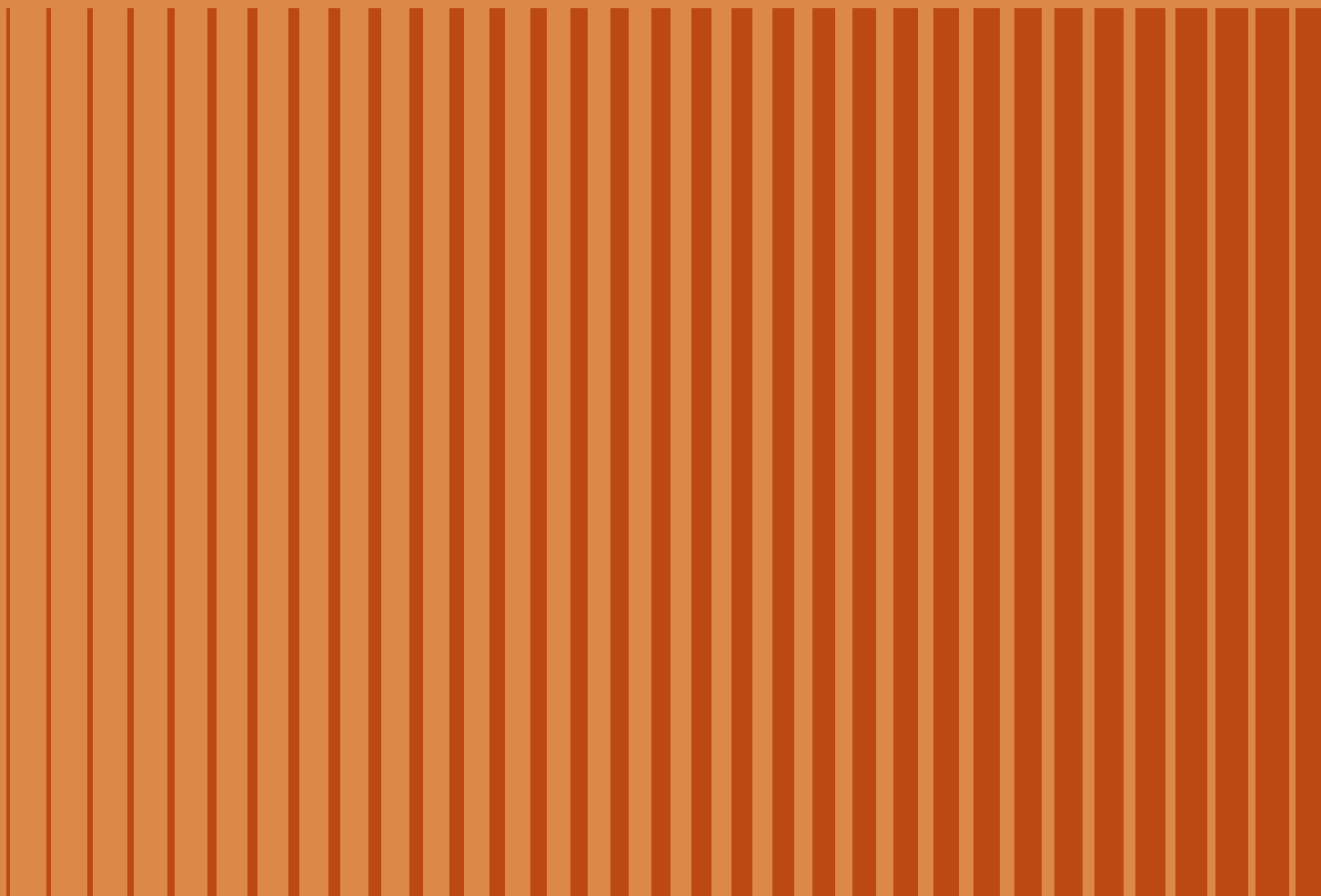
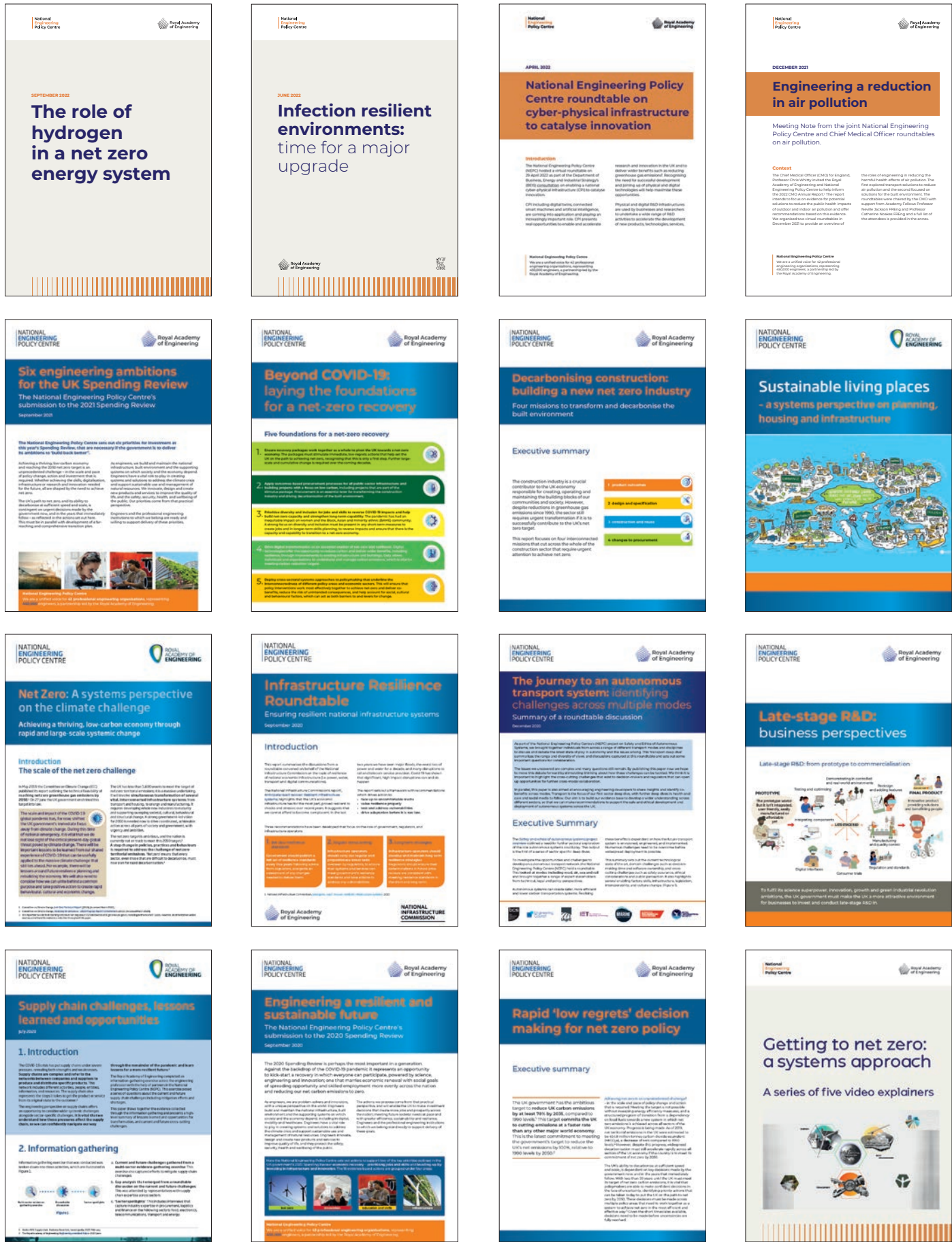


SEPTEMBER 2022

National Engineering Policy Centre

Policy advice, influence,
and impact





The work of the National Engineering Policy Centre

The National Engineering Policy Centre (NEPC) is a partnership of 42 professional engineering organisations that cover the breadth and depth of our profession, led by the Royal Academy of Engineering. Together we provide insights, advice and practical policy recommendations on complex national and global challenges. Through this work, the NEPC has helped shape critical policy decisions that have made a difference to people's lives and the economy.

This document highlights the work and impact of the NEPC from its launch in 2019 until September 2022. The NEPC has addressed a wide range of issues, including:

Sustainability and net zero

Since influencing the Prime Minister's Council for Science and Technology (CST) report on achieving net zero through a whole systems approach in 2020, the NEPC has supported government departments and industries tackling the net zero challenge. The work focuses on three areas: applying engineering principles to decision-making; applying systems approaches to the net zero transition whole sectors; and giving technical engineering insight on the role of individual technologies. Through policy reports, briefings, roundtables, and consultation responses, the NEPC has provided expert insight on issues from net zero governance to decarbonising aviation, and has engaged the public on the net zero transition through videos and events.

COVID 19

The NEPC provided advice to government at the height of the COVID-19 pandemic on immediate crisis response and progressed to looking at future risks and long-term recovery. The network of expertise and breadth of knowledge built during this project allowed the NEPC to be agile in responding to consultations, work with government in policy development, and take timely opportunities to engage the public and engineering profession. The contribution of engineering to the pandemic led to NEPC representation on expert groups in government.



Infection resilient environments

In March 2020, the NEPC was commissioned by Government Chief Scientific Adviser Sir Patrick Vallance FRS FMedSci to identify the interventions needed in the UK's built environment and transport systems to reduce infection transmission. Two key reports have been produced through this project, investigating how we can design and manage buildings and transport to create healthier, more sustainable and infection resilient environments for those who use them. The Cabinet Office has taken steps to implement the recommendations of the first report, improving the ventilation guidance and public information campaigns, and establishing a ventilation Technical Advisory Group with strong engineering representation. The phase two report was anticipated in the government's 'Living with COVID-19' plan, and has received extensive media coverage including the BBC, the *Guardian*, *The Times* and *The Engineer*.



Safety and ethics of autonomous systems


This project seeks to understand the risks and benefits associated with autonomous systems across sectors and how they should be designed, developed and deployed to ensure benefits are widely distributed and no one is disadvantaged. Through this work, the NEPC has provided engineering insight to policymakers through input to the letter from the Prime Minister's CST on harnessing technology for the long-term sustainability of the UK's healthcare system, alongside consultations, conferences and public engagement events such as workshops and an installation at a Science Museum Late exhibition.

Late-stage R&D: business perspectives

Many businesses choose global locations for high-value late-stage R&D activities, from multinationals to mobile innovative SMEs with growth ambitions. But existing UK support for late-stage R&D is not meeting businesses' needs and is considered poor compared to competitor countries. This work focused on understanding late-stage R&D and making recommendations to government on actions to ensure more late-stage R&D takes place in the UK. Interviews with engineering businesses identified five key common resources essential for conducting and managing the risks associated with late-stage R&D, alongside the policy levers to enable them and illustrated by a series of case studies. At the Spending Review and Autumn Budget 2021, Rt Hon Rishi Sunak MP, then Chancellor of the Exchequer, highlighted both an increased understanding of late-stage R&D in government and fulfilled one of the recommendations to increase Innovate UK's budget. These insights informed the CST's letter on innovation to the Prime Minister and Chancellor of the Exchequer in June 2021.

Through this work, the NEPC has helped shape critical policy decisions that have made a difference to people's lives and the economy.

For more information about our existing work or how to work with us, visit www.nepc.raeng.org.uk or contact nepc@raeng.org.uk

Key
Click on [] to access our work online.



Sustainability and net zero

Addressing climate change is a major challenge of the 21st century, with the UK aiming to achieve net zero by 2050.

Since its inception in January 2020, the NEPC's net zero project has explored three areas where engineers can contribute key insights to achieving net zero:



- Applying engineering principles to decision-making.
- Applying systems approaches to the net zero transition across whole sectors, giving technical engineering insight on the role of individual technologies

Applying engineering principles to decision-making

The UK's ability to rapidly decarbonise at scale depends on key decisions made by the government now and in the years that immediately follow. With less than 30 years until the UK must achieve net zero, policymakers must be able to make confident decisions in the face of uncertainty. This project applies systems approaches that are informed by engineering principles to help decision-makers reach these urgent decisions and to shape the governance structures needed to achieve net zero.

- **Beyond COVID-19: laying the foundations for a net zero recovery** , which offers five foundations accompanied by actions for government, industry and the engineering

profession to help enable positive change and set the UK on a decisive pathway to net zero territorial emissions.

- **Rapid 'low regrets' decision-making for net zero policy** , which introduces a framework that can be used to identify urgent, 'low regrets' decisions that can be made now to have a significant impact on decarbonisation while unlocking pathways towards the net zero target.
- **BEIS committee enquiry net zero governance consultation response**  in which the NEPC gave an engineering perspective to the leadership and co-ordination that will be needed by government to deliver net zero by 2050.

Applying a systems approach to the net zero challenge facing key sectors

Achieving net zero by 2050 requires a rapid transformation of many vital and interconnected sectors. It is crucial that policies and actions are co-ordinated so that infrastructure and technology work together in a cost-efficient way, whilst also achieving zero emissions and the best outcomes for the population.

We have applied a systems approach to better understand the net zero challenge across several different sectors:

- **Net zero: a systems perspective on the climate challenge** [↗](#) introduces the value of taking a systems approach to the net zero challenge while achieving a thriving, low-carbon economy.
- **Decarbonising construction: building a new net zero industry** [↗](#) uses systems thinking to identify what is needed from government, industry and the engineering profession to decarbonise the construction sector and wider built environment.
- ‘Decarbonising aviation’ workshop held with the Department for Transport (DfT) to explore the systemic challenges of decarbonising the aviation sector, focusing on the impact of ‘fuel switching’ on wider energy, transport and environmental systems.
- **‘Getting to net zero’ video explainer series** [↗](#) shows why reaching net zero by 2050 requires whole-systems transformation across energy, transport and the built environment, explores the interconnections between the actions needed in one sector and the implications for the others and what this means for how we get to net zero.
- As part of the NEPC’s wider work on sustainability, we also published our **sustainable living places** [↗](#) report, which provides a systems perspective on planning housing and infrastructure to identify points of intervention that promote sustainable, happy, low-carbon places.

Giving technical engineering insight on the role of individual technologies

Engineers from every discipline will design, build, retrofit, operate, and make safe the infrastructure and technologies that will help us achieve net zero. This project draws expertise from a wide range of engineering disciplines to provide technical insight on the role of individual technologies and what is needed for these to be realised.

- **The role of hydrogen in a net zero energy system** [↗](#), which provides an overview of

hydrogen’s value as an energy vector, its potential role in a net zero energy system and the risks and dependencies associated with low-carbon hydrogen production.

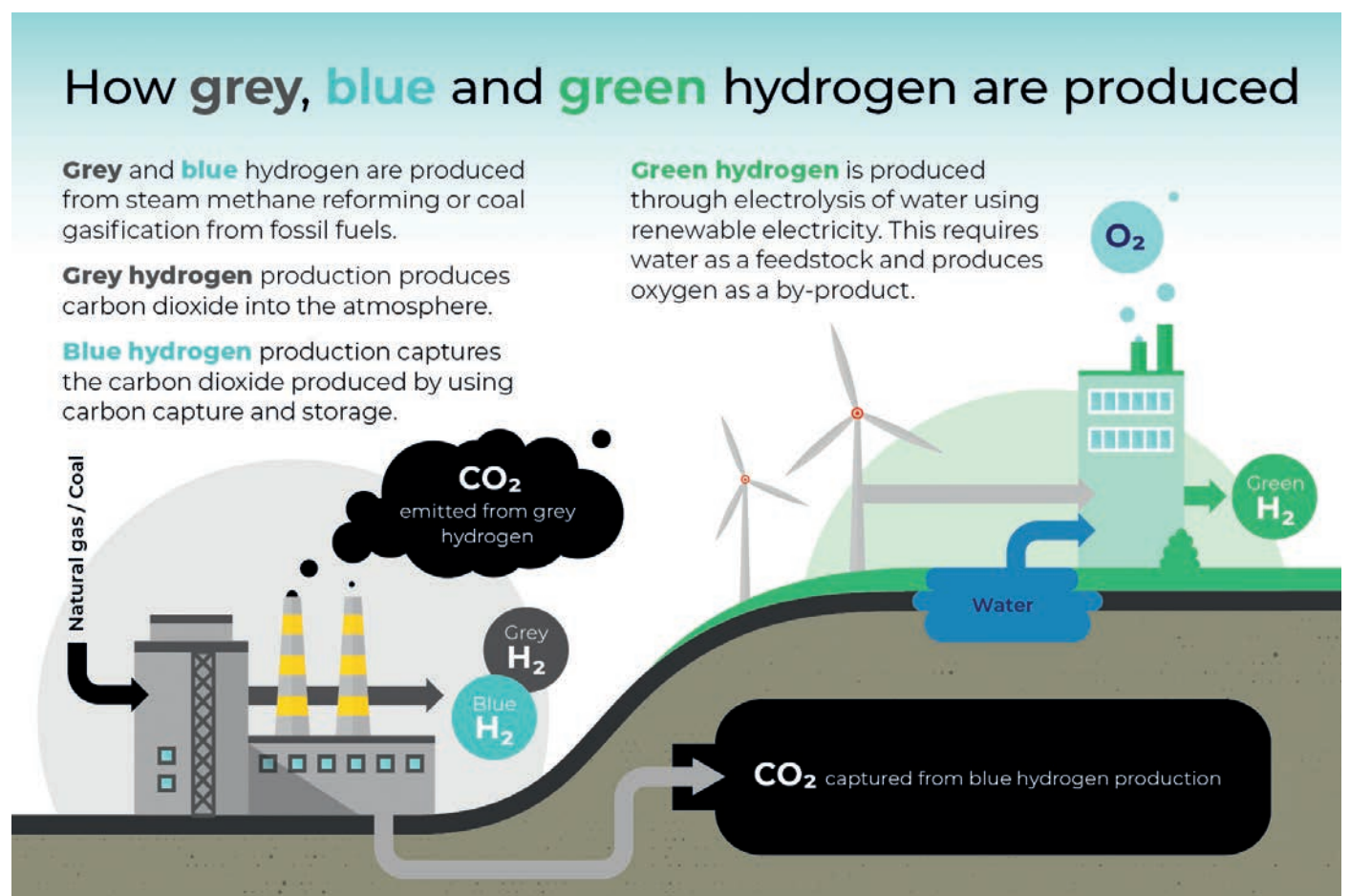
Impact

The NEPC:

- informed the Prime Minister’s Council for Science and Technology (CST) report on **achieving net zero through a whole systems approach** [↗](#) in January 2020
- supported CST’s briefing workshops for Kwasi Kwarteng, Secretary of State for the Department for Business, Energy and Industrial Strategy (BEIS), on decarbonising homes and on hydrogen
- collaborated with the Department for Transport to run expert workshops on the role of hydrogen in a net zero transport system and decarbonising the aviation sector
- provided expert engineering insight through government consultations including the House of Commons Science and Technology Committee inquiry into **the role of hydrogen in achieving net zero** [↗](#) and the BEIS Select Committee inquiry into **net zero governance** [↗](#)
- presented our work through several events including:
 - a **Royal Academy of Engineering critical conversation on net zero** [↗](#)
 - a Foundation for Science and Technology event on **the importance of systems thinking for achieving net zero** [↗](#)
 - a joint lecture with the Royal Society of Edinburgh on engineering in the climate emergency
 - a joint event with the Prospect Union on skills for net zero and a webinar on achieving **sustainability in shipping** [↗](#) with BAE Systems
 - a presentation on a systems approach to net zero at the Council of Academies of Engineering and Technological Sciences annual conference 2021.

Professor Paul Monks, Chief Scientific Adviser of BEIS said:

“Now is the time the world needs to go further and faster to tackle climate change. Prioritising low-regrets actions is a crucial component of our net zero strategy to build back greener. The Prime Minister introduced the strategy by warning against panicked, short-term or self-destructive measures that will hinder future efforts, and this framework will assist us with identifying the routes that will deliver not only the transition to net zero, but a healthier, happier, more equal society.”



Grey, blue, and green hydrogen production methods. The role of hydrogen in a net zero energy system, Report 2022

COVID-19

The COVID-19 pandemic presented a major risk to the health and wellbeing of individuals and communities; to business continuity and the wider economy; and to national security. This public health crisis raised several challenges where engineering advice could make a positive difference.

By surveying the engineering community, we determined the contributions needed from engineers during and after the pandemic, from manufacturing ventilators to maintaining critical national infrastructure. We set this out across different timeframes in **Engineering a resilient future**, laying the foundations to help government identify engineering advice and expertise.

Having mobilised the engineering community around the goal of minimising the impact of COVID-19, the NEPC rapidly responded to the changing demands of policymakers. Initially, this involved collating evidence from across the partnership to answer immediate questions from the Scientific Advice Group for Emergencies (SAGE), which supported the Chief Scientific Adviser and Chief Medical Officer in providing evidence for decision-makers. As the pandemic progressed, our focus transitioned into forward-thinking, preparatory advice, looking at future risks and long-term recovery. The outputs are outlined below:

Immediate crisis response advice

- Written evidence for SAGE on Ventilation in the Nightingale hospital.
- A rapid overview of **engineering solutions to limit nosocomial infection** for the SAGE hospital acquired infection subgroup.
- A summary of the considerations for improving **Public transport ventilation** for the Department for Transport.
- A rapid summary of *Manufacturing methods for medical consumables* for NHS England. Identification of volunteers to support the nightingale hospitals and NHS England.

Short-term forward thinking: ‘what are the risks of the next winter?’

- A cross-sector roundtable to identify emerging risks: **Winter is coming: risks for interdependent infrastructure**.
- A commentary on: **Considerations for PPE reprocessing based on international practices**, to explore how personal protective equipment (PPE) shortages might be managed.
- A focus group for DfT to inform future transport scenarios.
- Expert review for the Rail Safety and Standards Board transmission risk model.

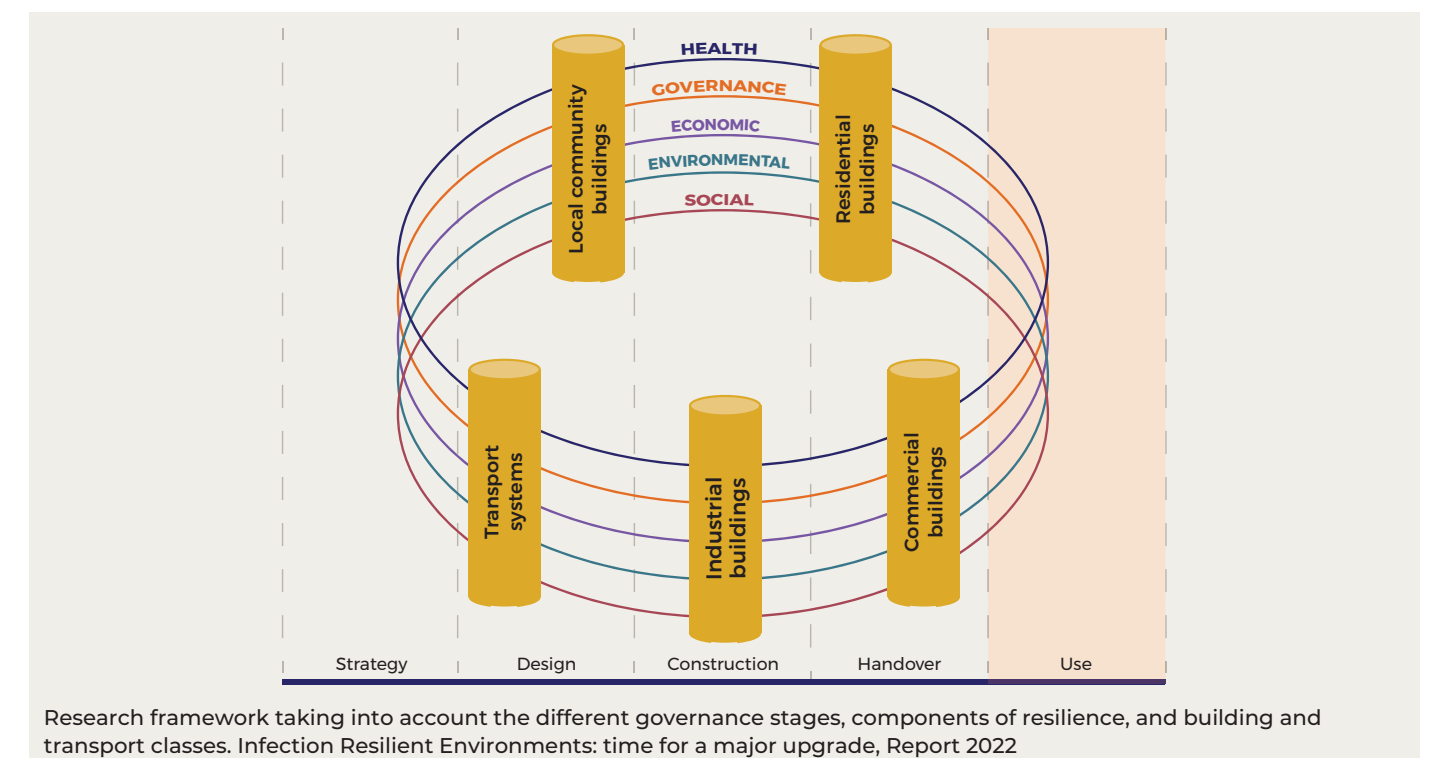
Looking toward the future: ‘what are the lessons we have learned and how can we build greater resilience?’

- A report: **Supply chain challenges, lessons learned and opportunities** considered how our supply chains could be more resilient.
- A roundtable on **infrastructure resilience**, on behalf of the National Infrastructure Commission, making longer-term recommendations to encourage adaptation.
- A response to the Cabinet Office consultation on the National Resilience Strategy.
- A briefing for Westminster Hall debate on the role of colleges in a skills-led recovery from the COVID-19 outbreak.

Impact

The network of expertise and breadth of knowledge built during this project allowed the NEPC to be agile in responding to consultations, work with government in policy development, and take timely opportunities to engage the public and engineering profession.

- The work ensured a breadth of engineering evidence could inform policy decisions on pertinent topics such as ventilation or reopening public transport.
- The contribution of engineering to the pandemic response was recognised through NEPC representation on the SAGE Environmental and Modelling subgroup, Department for Business Energy and Industrial Strategy supply chain expert group and NEPC involvement in the National Security Risk Assessment methodology review.
- The NEPC received a direct commission from the Government Chief Scientific Adviser on changes needed to make environments safe ahead of winter (see the Infection resilient environments project below).
- The role of engineering in public health has also been recognised by Chief Medical Officer, Professor Sir Chris Whitty FMedSci who has drawn on NEPC expertise for his 2022 Annual Report on air pollution.



Infection resilient environments



Creating indoor environments that are infection resilient is essential to minimising the risks of disease transmission and support public health during and beyond the pandemic. In early 2021, the Government Chief Scientific Adviser Sir Patrick Vallance FRS FMedSci asked the NEPC to explore the interventions needed across the UK's built environment and transport systems to reduce COVID-19 transmission.

The first report, **Infection resilient environments: buildings that keep us healthy and safe** [↗](#) investigated what building and transport operators needed to improve the safety of our indoor environments for winter 2021/22. Within 12 weeks, it successfully highlighted gaps and current systemic weaknesses in UK buildings and set out an agenda for change.

A second phase, **Infection resilient environments: time for a major upgrade** [↗](#) published on 13 June 2022, looked more deeply at how we can design and manage buildings and transport to create healthier, more sustainable and infection resilient environments for those who use them. The project makes a case for major changes to improve the health of our built environment and transport systems, outlining the actions required across the lifetime of this infrastructure to successfully embed effective infection resilience.

Impact

- The initial NEPC report has been disseminated widely, and discussed with policymakers, industry and at committee inquiries such as the Scottish Parliament COVID-19 Recovery Committee on *Baseline health protection measures: preparing for winter and pathways to recovery*, attracting a significant amount of interest and engagement across government.
- The Cabinet Office acted on the first report's recommendations, by improving the ventilation guidance and public information campaigns, and establishing a ventilation Technical Advisory Group with strong engineering representation.
- Many government departments and devolved administrations actively engaged in the report's development, and major research funders have used its findings to explore gaps in research capability.
- The phase two report was highlighted as an anticipated source of evidence in the government's **'Living with COVID-19'** [↗](#) plan.
- The findings had significant media coverage including in the **BBC** [↗](#), the **Guardian** [↗](#), **The Times**, and **The Engineer** [↗](#).

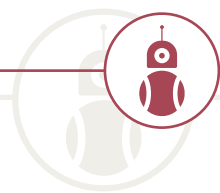
“The National Engineering Policy Centre's work exploring how the design, construction, and use of built environments and transport systems can remove or reduce the transmission of infections from one person to another is therefore both timely and important. Engineering and technological solutions, along with medical and behavioural interventions, are central for society to create environments that are resilient to both known and future infectious diseases.”

Professor Sir Chris Whitty KCB FMedSci, Chief Medical Officer for England

“The pandemic has highlighted the link between public health and our built environments. There are lessons we can learn from the transmission of coronavirus as we adapt and design the environment around us to promote good infection control and help reduce future transmission risks. There are good opportunities for us to combine this work with climate mitigation and adaptation action to help achieve greater resilience and improved environment and health outcomes for the future.”

Professor Chris Jones, Deputy Chief Medical Officer for Wales

Safety and ethics of autonomous systems



Autonomous systems have the potential to be transformative technologies. Ensuring that they are developed and deployed safely and ethically is a challenge on which engineering advice offers vital insights for policymakers and regulators. Understanding the challenge's complexity involves diverse expertise from engineering professions, law, ethics, philosophy and social sciences. Launched in 2019, this project embodies the future-focused and horizon scanning nature of the NEPC's work.

The [project overview](#) explored opportunities that arise across sectors through a cross-sectoral, multidisciplinary workshop. This examined how autonomous systems should be ethically and safely designed, developed, and deployed to ensure benefits are widely distributed and no one is disadvantaged, identifying some of the policy and professional levers to achieve that.

The [journey to an autonomous transport system: identifying challenges across multiple modes](#) sets out the current technological state of the art of autonomy across transport modes. This highlighted some specific modal challenges such as decision-making time and software ownership, and cross-cutting challenges such as safety assurance, ethical considerations and public perception. It also highlights several enabling factors: skills, infrastructure, legislation, interoperability, and culture change.

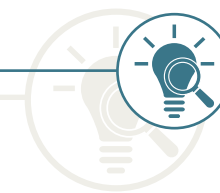
These will be followed by learning from a sector deep-dive into healthcare and a cross-sector workshop on the role that technical standards can play to inform emerging regulations, offering practical routes to ensuring safe and ethical systems and identifying potential gaps.

Impact

The NEPC:

- provided expert engineering insight through the [NEPC response](#) to the Law Commission of England and Wales and the Scottish Law Commission Consultation on a regulatory framework for automated vehicles
- presented the project's findings at conferences on maritime artificial intelligence, [transport safety](#) and [trustworthy autonomous systems](#)
- provided input to the letter from the Prime Minister's Council for Science and Technology (CST) on [Harnessing technology for the long-term sustainability of the UK's healthcare system](#)
- engaged the public through activities including an international workshop at the [Global Grand Challenges Summit](#), installation at the Science Museum Late exhibition [Driverless – Who is in Control?](#), press quotes, and [panel discussions about autonomous vehicles](#)

Late-stage R&D: business perspectives



The UK government has set a target for total investment in research and development (R&D) to reach 2.4% of GDP by the year 2027 and outlined wider ambitions to be a science and innovation superpower. The private sector contributes about two-thirds of R&D investment in the UK, meaning a considerable increase in business R&D is required to reach the target. Late-stage R&D is the majority of R&D that businesses do, taking a prototype or proof of concept to commercial application. Existing UK support for late-stage R&D is not meeting businesses' needs and is considered poor compared to competitor countries.

This work focused on understanding late-stage R&D, explaining what late-stage R&D is to policymakers and made recommendations to government on actions to ensure more late-stage R&D takes place in the UK.

Drawing on interviews with engineering businesses, it identified five key common resources essential for conducting and managing the risks associated with late-stage R&D, alongside the relevant government policy levers.

- **R&D infrastructure:** the physical and digital infrastructures needed to test, certify and develop new products, processes, services, and technologies safely and effectively.
- **Investment:** the availability of funds and fiscal measures that enable businesses to allocate funding for late-stage R&D activities.

- **People:** access and availability of diverse people with the experience and expertise to deliver technical and challenging projects to market.
- **Partnerships:** the relationships, networks and collaborations that enable access to skills, infrastructure, investment, and customers, reducing the burden placed on a single company through sharing resources and expertise with others.
- **Market environment:** the policies and frameworks influencing and producing opportunity or challenge for businesses conducting late-stage R&D and commercialising innovation, including regulation, trade policy, intellectual property, and government strategies.

The report used [case studies](#) to bring late-stage R&D to life, which were also included with recommendations for government in our [Late stage R&D: business perspectives report](#).

Impact

- At the Spending Review and Autumn Budget 2021, the then Chancellor of the Exchequer, The Rt Hon Rishi Sunak MP, said “and strengthen our focus on late-stage innovation, increasing Innovate UK's annual core budget to £1bn [...], double what it was at the start of the Parliament.” – highlighting both an increased understanding of late-stage

R&D in government and fulfilling one of the recommendations to increase Innovate UK's budget.

- The report fed extensively into the Council for Science and Technology Innovation letter to the Prime Minister and Chancellor of the Exchequer in June 2021.
- Secretary of State The Rt Hon Kwasi Kwarteng MP requested a meeting with Academy President Professor Sir Jim McDonald FREng FRSE to discuss late-stage R&D following the report's publication.

- This work informed core messaging on increasing R&D investment and influencing activities during the development of the government's Innovation Strategy by the Royal Academy of Engineering across government departments and meetings with high-level stakeholders.



Professor Julia Sutcliffe FREng FRAeS, Chief Technologist and Head of Engineering Strategy, BAE Systems, panellist 'Boosting the 'D' of R&D: what do engineers need?', NEPC plenary 10 July 2019



Chi Onwurah MP, speaking at the NEPC partners' plenary on 10 July 2019 'I would like to see the National Engineering Policy Centre and the voice of engineering on a par with the other institutions that politicians go to for expert insight. It's up to you in this room to set out engineering policy options in a way that politicians and policymakers can engage with.'

Single point of access to external and independent expertise

The NEPC is a direct route for policymakers to tap into expertise from every facet of the profession. This means policymakers rapidly get the most useful experience, advice and solutions to help them respond more effectively to policy issues.

The NEPC submitted twice to the UK government's Spending Reviews in 2020 and 2021: [NEPC spending review submission \(2020\): Engineering a resilient and sustainable future](#), [NEPC Spending Review Submission \(2021\): Six engineering ambitions for the UK Spending Review](#), bringing the recommendations of over 40 engineering organisations – representing more than 450,000 UK engineers – to influence government spending in areas such as decarbonising the economy and creating a national workforce planning strategy.



Stephen Metcalfe MP, Chair of the Parliamentary and Scientific Committee, speaking at the NEPC partners' plenary on 30 January 2020 'Shaping and developing the way the world looks in 2120 will be engineers.'



Professor Nilay Shah OBE FREng FICHEME, Head of the Department of Chemical Engineering at Imperial College, Deputy chair of the NEPC's Net Zero Working Group

NATIONAL ENGINEERING POLICY CENTRE

The National Engineering Policy Centre brings engineering thinking to the heart of policymaking, creating positive impacts for society.

We are a partnership of 42 professional engineering organisations that cover the breadth and depth of our profession, led by the Royal Academy of Engineering. Together we provide insights, advice, and practical policy recommendations on complex national and global challenges.

THE ROYAL ACADEMY OF ENGINEERING

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public. Together we're working to tackle the greatest challenges of our age.

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