

Engineering a resilient and sustainable future

The National Engineering Policy Centre's submission to the 2020 Spending Review

September 2020

The 2020 Spending Review is perhaps the most important in a generation. Against the backdrop of the COVID-19 pandemic it represents an opportunity to kick-start a recovery in which everyone can participate, powered by science, engineering and innovation; one that marries economic renewal with social goals of spreading opportunity and skilled employment more evenly across the nation and reducing our net carbon emissions to zero.

As engineers, we are problem-solvers and innovators, with a unique perspective on the world. Engineers build and maintain the national infrastructure, built environment and the supporting systems on which society and the economy depend, including in digital, mobility and healthcare. Engineers have a vital role to play in creating systems and solutions to address the climate crisis and support sustainable use and management of natural resources. Engineers innovate, design and create new products and services to improve quality of life, and they protect the safety, security, health and wellbeing of the public.

The actions we propose come from that practical perspective, and will enable the UK to make investment decisions that create more jobs and prosperity across the nation; meeting future societal needs at pace and with greater efficiency, sustainability and resilience. Engineers and the professional engineering institutions to which we belong stand ready to support delivery of these goals.

Here the National Engineering Policy Centre sets out actions to support two of the key priorities outlined in the UK government's 2020 Spending Review: **economic recovery – prioritising jobs and skills** and **levelling-up by investing in infrastructure and innovation**. The 18 evidence based actions are grouped under four areas:



National Engineering Policy Centre

We are a unified voice for **43 professional engineering organisations**, representing **450,000** engineers, a partnership led by the Royal Academy of Engineering.

We offer a range of suggested concrete actions in four areas, grouped under net zero, education and skills, infrastructure, and innovation, but with many interdependencies and overlaps between them. We set out how they especially support two priorities of the Spending Review – **Economic Recovery – prioritising jobs & skills** and **Levelling-up by investing in infrastructure and innovation**. However, the actions are relevant to all the priorities.



Net zero

Achieving a thriving, low-carbon economy and reaching the 2050 net zero target will involve rapid, co-ordinated and large-scale systemic change. It requires simultaneous transformation of several vital, interconnected infrastructure systems, with an urgent step-change needed now in policies, practices and behaviours, coupled with reduction in energy demand. Deployment and integration of existing low-carbon technologies, combined with ongoing innovation, could position the UK as a market leader.



Innovation

We support the ambition for the UK to be a science superpower and would go further: as a science, engineering and innovation superpower, the UK would be best placed to deliver the maximum economic and social returns from its investment in science. Most innovation is funded and carried out by businesses, and incentives should be focused on encouraging businesses to deliver more innovation. Support for innovation should inform all aspects of the Spending Review, especially the aims of net zero, infrastructure and digitalisation.



Education and Skills

The UK's ambitions on net zero, infrastructure and digitalisation are threatened if we do not have the number and diversity of people with engineering and technical skills needed to deliver them [see Diversity and Inclusion box]. The pandemic has exacerbated inequalities in school age education, hugely disrupted further and higher education, and risks reducing the diversity of young people going into engineering. The UK must now plan for its long-term engineering and technical skills need with an education system fit for the future and an ambitious plan for training, upskilling and reskilling.



Infrastructure

High-performing infrastructure is a central pillar of any world-class economy, and investing in infrastructure improves productivity, collective wellbeing, social inclusivity, healthy lifestyle choices, and safety, security and resilience. Careful and considered decisions made about infrastructure now will drive economic recovery and provide skilled jobs, as well as delivering on longer-term targets, while protecting the environment. The ability to achieve net zero is dependent on a resilient infrastructure system – the net zero and resilience agendas must be achieved together.

Systems-led approaches

Each priority policy area outlined in this document is complex in its own right and there is further complexity in the interactions and interdependencies between them. To achieve these outcomes together requires a systems approach to enable a big picture view. A systems approach captures the complexities involved, interdependencies and points of failure, maps key relationships and manages uncertainties. Systems thinking must also be applied to the institutional structures, roles and responsibilities of government, institutions, businesses and people whose response to these challenges must align.

Government Spending Review Priority: Economic recovery – prioritising jobs and skills

- Establish a strategic workforce planning function across government** to ensure the supply of key skills for the nation's future outside the EU.¹



Why?

The government's ambitious rebuilding programme for the economy and increased focus on innovation, computing and science will highlight fundamental gaps in the UK's future domestic skills capabilities in these domains. Cross-departmental strategic workforce planning would prioritise and incentivise education and training in key skills to support the whole economy.

- Establish a new STEM education strategy with large-scale funding across the whole of the UK** informed by strategic workforce planning and evidence of what works. This must address teacher shortages, teacher professional development, STEM careers education, outreach, diversity and progression to post-16 academic and technical qualifications.



Why?

Many of the most deprived regions of the country struggle to find STEM specialists.² Females and students from low socio-economic backgrounds are under-represented in post-16 physical sciences, computing and mathematics. There is a lack of opportunities for STEM engagement in schools and understanding of employment prospects in STEM careers among young people.³

- Maintain pre-pandemic commitment to uplift further education funding** and take a strategic subject-based approach to further and higher education, ensuring sufficient capital investment and funding for high-cost wealth-creating subjects such as science, engineering and technology.



Why?

While supporting the government's ambition to increase investment in further education and focus on higher-technical skills, we are concerned that post-18 reforms will have a deleterious effect on high-cost laboratory-based subjects in higher education.

- Continue funding incentives for employers to take on apprentices and look to expand the offer** including:
 - increasing the amount paid to employers to take on apprentices
 - reducing co-investment in training costs
 - giving employers greater flexibility on spending in the Apprenticeship Levy for 'off the job' costs, upskilling and reskilling of existing workforce, and pre-apprenticeships programmes to encourage disadvantaged groups into apprenticeships.



Why?

The number of people starting apprenticeships has been falling⁴ and this trend has been further exacerbated by the pandemic.⁵

Government Spending Review Priority: Economic recovery – prioritising jobs and skills

Deliver measures that encourage businesses to invest in R&D in the UK and take their prototypes through to commercial application, ultimately delivering new products and services, as well as wider socio-economic benefits for people from all parts of the UK.

- **Boost support for late-stage R&D and demonstration** including through funding mechanisms, joint ventures between government and industry, and strengthening the existing infrastructure for testing and demonstration including public sector research establishment (PSREs) and Catapult Centres.
- **Strengthen and stimulate partnerships and collaborations** across industry, academia, and research and technology organisations with public funding.
- **Make innovation a key component of the public procurement process** to bring best value for money to the public purse.⁶
- **Maintain the UK's competitive package of tax incentives** for companies to innovate such as R&D tax credits, the Enterprise Investment Scheme (EIS) and the Seed Enterprise Investment Scheme (SEIS).



Why?

Most R&D funding comes from the business community. Companies make global decisions about where to invest in R&D. Businesses find the UK tax incentives for R&D internationally competitive, but support for late-stage R&D and public procurement processes are poor compared to our competitor countries.⁷

Provide targeted support for the development, commercialisation and adoption of digital technologies where the value can be clearly demonstrated and there is potential to develop a strong and vibrant market.



Why?

Organisations in many sectors are unclear about the benefits of digital technologies for their businesses and how to adopt them.⁸ Digital sectors are estimated to create jobs 2x faster than the rest of the economy.⁹

Support difficult to decarbonise sectors in their transition to the low-carbon and resource-efficient world, accelerating efforts where the UK can pioneer sustainable industries and accelerate technology development, such as alternative fuels for aviation and demonstrating low-carbon technologies in maritime transport.



Why?

Net zero means that no sector is exempt from deep decarbonisation, and we cannot rely on passive technological change. Supporting industries to innovate and de-risk new business models could give the UK a first-mover advantage and significant export opportunities.^{10,11}

Develop a net zero skills plan to ensure the UK has the capability to deploy the required infrastructure, digitalisation, and technology installation and decommissioning for the transition to net zero to be delivered.



Why?

The UK's energy sector needs hundreds of thousands of people to fill 400,000 roles in the net zero energy workforce. Of this, 260,000 will be in new roles, while 140,000 will be replacing those who have left the workforce.¹²

Government Spending Review Priority: Levelling-up by investing in infrastructure and innovation

- Deliver on the recommendations of the National Infrastructure Assessment¹³**, and subsequent work on resilience¹⁴, regulation¹⁵, renewables, and net zero¹⁶ from the National Infrastructure Commission, or set out alternative plans to meet the UK's long-term infrastructure needs.



Why?

The National Infrastructure Commission was established in 2015 to provide independent, strategic thinking, analysis and advice to address the UK's long-term infrastructure needs. For each £1 spent on infrastructure, there is an additional £1.50 to £2.70 of demand due to multiplier effects.¹⁷

- Incentivise the uptake of off-site manufacturing** to deliver better infrastructure and drive productivity through procurement, regulation and R&D funding, building on the Construction Sector Deal.



Why?

There was a 20% reduction in delivery schedule in the construction of the Royal Victoria Building, Western General Hospital in Edinburgh, through the offsite production of 55% of building components.¹⁸

- Establish subnational infrastructure bodies to create integrated infrastructure strategies** that set out evidenced-based infrastructure need across the different English regions.



Why?

To ensure the strategic coordination of infrastructure prioritisation at multiple geographic levels and to provide the basis for the government's 'levelling-up' agenda to come to fruition.¹⁹ (Scotland and Wales have their own infrastructure commissions, and Northern Ireland is looking at creating one).

- Drive the establishment of world-class digital connectivity and infrastructure** that is fast, secure and resilient across both urban and rural areas of the UK, through investments such as the National Productivity Investment Fund.



Why?

Connectivity is an essential prerequisite for an advanced digital economy and ensuring UK competitiveness, since the fast, resilient and secure transfer of data is required for many data-driven systems. Conversely, broadband outages are estimated to cost business over £12 billion per year.²⁰

- Increase Innovate UK's budget and autonomy to boost support for business innovation** and the 'D' of R&D to increase productivity.



Why?

Only 6% of Innovate UK's 2017/18 budget was allocated to open programmes, limiting its ability to rapidly respond to business needs and a market pull in any area of the economy.²¹ Innovate UK support, both financial and non-financial, is invaluable to innovative companies.²² With additional funds and autonomy, Innovate UK could better support companies across the country and maximise return on tax payer investment.

Government Spending Review Priority: Levelling-up by investing in infrastructure and innovation

- | **Expand the Made Smarter pilot** beyond the North West to support SMEs to adapt and thrive by rapid uptake and upskilling of digital technologies.



Why?

SMEs are typically embedded in their communities, and engineering SMEs offer routes to good jobs right across the country. Made Smarter provides advice from specialist technology experts to help identify and implement the right digital tools to deliver everyday improvements to SMEs.

- | **Establish a net zero delivery body to drive and coordinate progress across government and industry, provide systems-level analysis**, share learnings about what works, and build a clear, evidence-based vision for a net zero UK.^{23,24}



Why?

The net zero target is ambitious, and the nation is currently not on track to meet this 2050 target.²⁵ Moving to net zero is an opportunity to renew our infrastructure and to build cleaner, healthier, more prosperous places. It will require clear vision, good governance, and a rigorous systems approach to implementation to realise these ambitions and ensure that costs and benefits distributed equitably and avoid any unintended consequences.

- | **Roll out of charging infrastructure for electric vehicles in urban and rural areas** to encourage their uptake and meet consumer demand, subsidising where the private sector is less likely to deliver.



Why?

Transport emissions fell by only 2% between 1990–2017, compared to a 60% drop in emissions for the electricity supply.²⁶

- | **Prioritise low-carbon retrofit and refurbishment of the existing building stock** broadening out from the Green Homes Grant scheme to develop the supply chain, and set up a programme of training and competence in retrofit, low-carbon heat to deliver safe, healthy and energy-efficient buildings and significant carbon reductions.²⁷



Why?

Energy demand in homes and workplaces needs to be reduced to reduce the cost of zero carbon supply to an affordable level. Buildings are responsible for 19% of UK carbon dioxide emissions.²⁸ 27 million dwellings and two million commercial buildings use 698 TWh or 43% of delivered UK energy supply.²⁹

Government Spending Review Priority: Levelling-up by investing in infrastructure and innovation

Deliver on the UK's ambitious climate change goals by investing in large-scale projects for the deployment at scale of all credible known and developing clean technologies, in particular:



- **Low-carbon heat technologies** such as district heat networks, heat pumps and heat recovery.

Why?

85% of UK households and 65% of non-domestic buildings currently use fossil-fuel based natural gas.³⁰ Heating in buildings and industry account for 37% of UK total emissions.³¹

- **Carbon capture, usage and storage (CCUS) technologies** particularly in energy-intensive industries and the development of shared infrastructure, market frameworks and regulation.

Why?

CCUS is crucial for achieving net zero emissions and limiting global average temperature increases to 1.5°C, yet there are currently no large-scale CCUS pilots in the UK compared to 43 projects currently around the world.³²

- **Low-carbon hydrogen production, storage and use** in sectors including transport and industrial processes, including demonstration activities where needed.

Why?

A healthy hydrogen sector could unlock new pathways to net zero for many challenging high-emission sectors, including heating, transport, manufacture, and energy storage.³³

- **New nuclear generation capacity** fit for the future energy system.

Why?

Nuclear provides almost a fifth of the UK's electricity generation³⁴, but the majority of the UK's existing nuclear fleet is due to be offline by 2030, some as soon as 2023.³⁵ Nuclear can provide a supply of low carbon always on power to complement intermittent renewables.



Diversity and Inclusion

Each year, around **7,500 girls** take A-level physics, 2% and 3% of the female cohort. While for computing the figure is **1,400**, 0.5% of the female cohort.³⁶

Each year, typically **only 4%** of the mathematics A-level cohort are eligible for Free School Meals.³⁷

Only **8% of apprentices** in engineering and associated subjects are female. **Only 6.5%** are from Black, Asian and minority ethnic groups.³⁸

A survey of 11–19 year olds in the summer of 2020 found that the pandemic had made their **STEM career aspirations more gender stereotyped**.³⁹

Only 37% of Black engineering graduates enter engineering occupations after their studies **compared with 60%** of their white counterparts.⁴⁰

Around **12% of the engineering workforce are female** and **8% from Black, Asian and minority ethnic groups**.⁴¹

Increasing the diversity and inclusivity of engineering is a priority of the National Engineering Policy Centre and should be embedded in all of the actions set out here.

Engineers take a systems view and the priorities emphasised above are closely connected to the other stated objectives in the Spending Review.

Government Spending Review Priority:
The UK as a science, engineering and innovation superpower.

The UK's science and innovation capability can drive the delivery of the government's renewal agenda. For instance, building the infrastructure for net zero will involve combining and upscaling multiple existing technologies while reaching back into the UK's world-leading research base where new knowledge is needed. We have therefore recommended investments to grow our scientific excellence and increase the UK's innovation support.

Government Spending Review Priority:
The UK's place in the world.

Science, engineering and innovation are inherently collaborative activities that stretch across national boundaries. By maintaining and widening international research partnerships post-Brexit the

UK can protect its investments in research, and by strengthening support to late-stage development and innovation it can build whole new export industries.

Government Spending Review Priority:
Public Services.

COVID-19 has shown the vital role engineering plays in public services. The National Engineering Policy Centre has provided engineering-based advice to government on issues from safe ventilation in public transport and buildings, to options for rapid manufacture and reprocessing of PPE for public health. A well-structured systems approach to the management of public services, for instance in procurement, would make Spending Review investments go further, improving the quality of outcomes, and reducing the cost, time and risk related to delivery.



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National Engineering Policy Centre

We are a unified voice for 43 professional engineering organisations, representing 450,000 engineers, a partnership led by the Royal Academy of Engineering.

We give policymakers a single route to advice from across the engineering profession.

We inform and respond to policy issues of national importance, for the benefit of society.

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