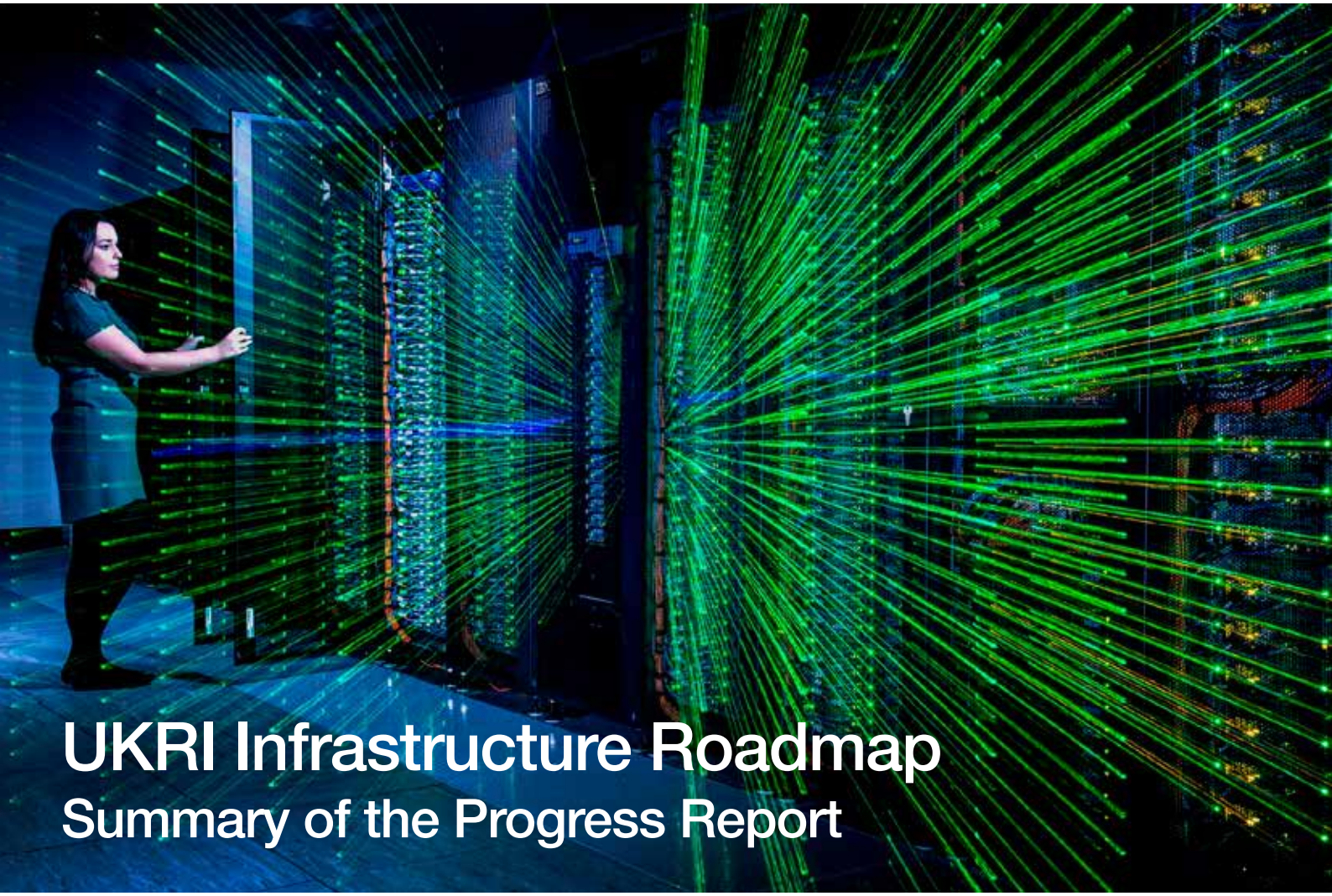
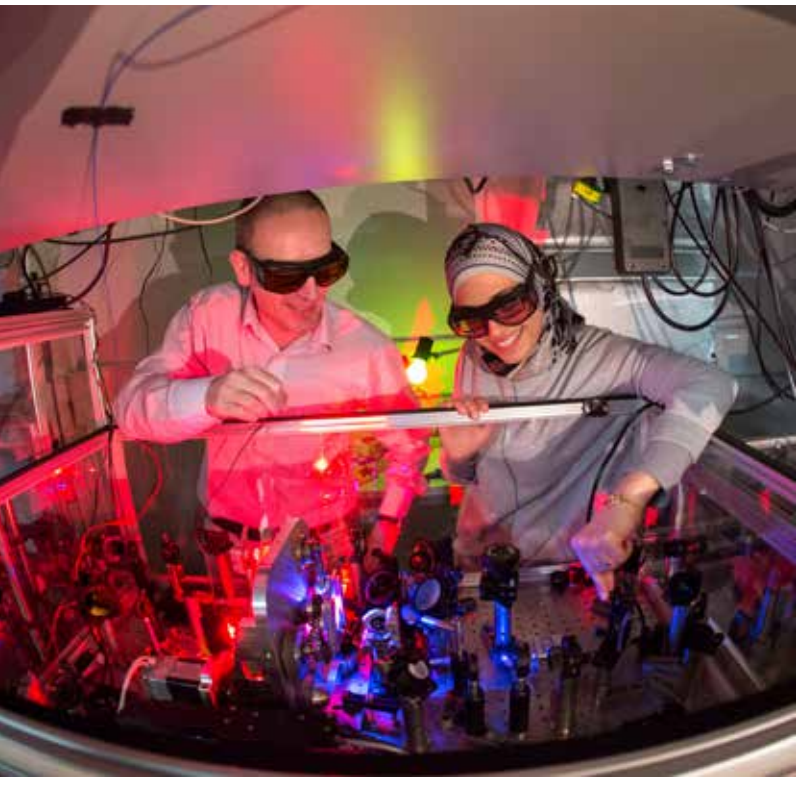
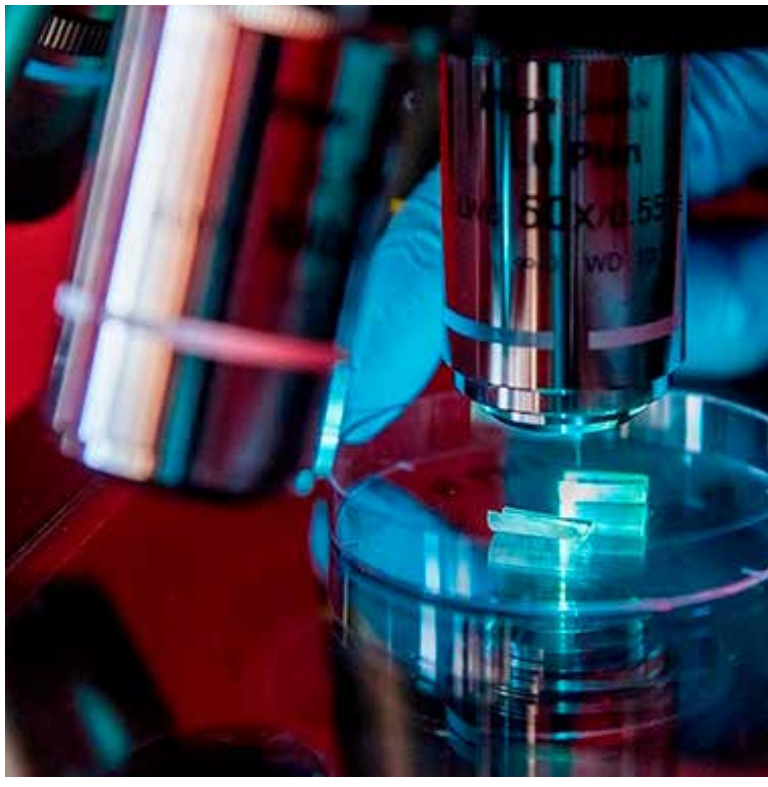
UK Research and Innovation



UKRI Infrastructure Roadmap

Summary of the Progress Report





The UK is globally recognised as a world leading knowledge economy. It is vital that we maintain and capitalise on this status at this time of global demographic, technological, and geopolitical change. Recognising these challenges, the Government has positioned research and innovation at the heart of its Industrial Strategy[1]. The Government has committed an additional £7 billion by 2021/22 and set an ambition to increase expenditure on research and development (R&D) to 2.4% of GDP by 2027.

Our Industrial Strategy sets out how we are building a Britain fit for the future. To achieve this, we must ensure every part of our country realises its full potential and makes the most of our strengths so that we can be at the forefront of emerging technologies and industries in the years ahead, boosting productivity and earning power across the country. Research and innovation infrastructures contribute significantly across the framework set out in our modern Industrial Strategy.

Figure 1: The Industrial Strategy sets the ambition for the UK to be the world's most innovative economy. Research and innovation infrastructures contribute across the strategy and to each of the Grand Challenges.

The UK's internationally-competitive research and innovation infrastructure already contributes significantly to the UK's world-leading performance in science, research and innovation. Its continued development will support the achievement of stretching commitments in this area to become the world's most innovative economy, including increasing the UK's total expenditure on research and development to 2.4% of GDP by 2027, 3% in the longer term. Achieving this ambition would realise a step-change in the UK's investment in R&D, the biggest increase since records began and it is vital that we capture the full range of economic, social and environmental benefits from this increase.

Our ability to innovate – to develop new ideas and deploy them – is one of Britain's great historic strengths, bringing significant benefit to the economy and society. The UK is the most productive science base in the G7 ranking first amongst comparable major research nations for Field Weighted Citations

1 Department for Business, Energy & Industrial Strategy, Industrial Strategy: building a Britain fit for the future (2017)

Impact (FWCI), a measure of research quality. The UK also has the most productive research base in the G7 in terms of papers and citations per unit of R&D expenditure and ranks within the top 4 of the Global Innovation Index. Every £1 spent on public R&D delivers approximately £7 of net economic benefit to the UK and unlocks £1.40 of private R&D investment. This includes investment from overseas helping to make the UK a location of choice for businesses at the cutting edge of innovation and technology; the UK attracts more overseas investment in R&D than many other countries.

ISIS Neutron and Muon Source delivers £1.4 billion economic benefit

STFC

The ISIS Neutron and Muon source is expected to deliver £1.4 billion of net economic benefit based on its work to 2014, a return on investment of at least 214% and a further £1.4 billion of economic benefit is predicted up to 2030. ISIS is the world's leading pulsed neutron and muon source, allowing scientists from across the world and research disciplines to study materials at the atomic level. Applications have been wide ranging, from cleft palate treatment development to solutions for waste water management. The infrastructure has long established industrial links with more than 100 companies, including Rolls-Royce, Unilever, Airbus and BP and plays an important role in nurturing scientific and technical talent for the wider economy.

The term 'research and innovation infrastructure' can cover a huge variety of different activities. It includes facilities such as the ISIS Neutron and Muon Source which explores the properties of materials at the atomic scale, the Royal Research Ship Discovery, or the fleet of scientific satellites collecting data about our planet's climate for the Met Office, researchers, businesses and government agencies. Crucially, it includes "knowledge-based resources" such as scientific, cultural or artistic collections such as the British Library's digitized and physical collections of manuscripts and vast quantities of data collected by studies such as Biobank which investigates the health and well-being of the population.

E-infrastructure (data and computing systems and communication networks) are increasingly important part of the infrastructure landscape. This includes the JANET national high-speed data network linking laboratories and universities, the Cambridge-headquartered ELIXIR bio-informatics network enabling data access to researchers from across Europe, and the Hartree Centre's high performance computers which are delivering productivity and sales improvements for UK business.

The Industrial Strategy sets out the importance of building innovation excellence across all parts of the UK, capitalising on our existing strengths and fostering local ecosystems that can support innovation and sustained growth. The development of this roadmap can inform localised planning work through a greater understanding of how this landscape might develop over time.

Research and innovation infrastructures act as magnets for talent and investment from both domestic and international businesses and provide critical infrastructure to support de-risking of innovative business ideas or to support wider policy objectives. They also contribute to their local and regional economies through employment, often at the heart of localised clusters of expertise, and play a vital role in the training and development of specialist skills.

Research and innovation infrastructures bring together talent from the public and private sectors and across disciplines to tackle society's most complex challenges and generate knowledge and capability

critical to UK policy, security and well-being. This includes the Grand Challenges set out in the Industrial Strategy: putting the UK at the forefront of the artificial intelligence and data revolution; maximising the advantages for UK industry from the global shift to clean growth; becoming a world leader in shaping the future of mobility; and harnessing the power of innovation to help meet the needs of an ageing society.

Recent investments through the £1.7bn Industrial Strategy Challenge Fund are creating nationally important infrastructures in support of these priority areas such as the UK Battery Industrialisation Centre in Warwickshire, Vaccines Manufacturing Innovation Centre in Oxford and National Satellite Test Facility at Harwell. The detailed chapters of this report also highlight where research and innovation infrastructures have the potential to contribute further to the Grand Challenges and Industrial Strategy Sector Deals.

Investing in the design, build and operation of world-class national-scale research and innovation infrastructure is expensive, and a long-term commitment. The Research and Innovation Infrastructure Roadmap programme will create a long-term (until approximately 2030) research and innovation infrastructure roadmap based on an understanding of existing UK infrastructure (and key international facilities in which the UK participates), future needs and resulting investment priorities. The Roadmap project is not a funding programme. It will instead provide expert advice and evidence to government and input to efforts to raise investment in research and development to 2.4% of GDP.

The Progress Report has been compiled using data collected from existing infrastructures, previous work in particular research subjects or business sectors and extensive stakeholder consultation. The report identifies emerging themes and areas of potential capability across research disciplines. It does not include specific proposals or seek to prioritise these.

The report also identifies common challenges for research and innovation infrastructure:

- Sustainability of operational funding (the "batteries not included" issue identified in previous government and parliamentary reports)
- Current availability and future provision of skilled staff especially "e-skills". A critical issue also identified in the Industrial Strategy. The extreme nature of many of the technological challenges faced in operating research infrastructures makes finding specialist staff and upskilling a growing challenge. In particular ensuring staff are equipped with the data analysis related skills is now at the core of most modern research techniques
- Responding to new technologies. The lab of the future will require fundamentally new techniques, new skills, new ways of working, and a change to the research culture in response to technical challenges or disruptors. Key challenges are the increasing volume of data, modelling and simulation, and the implications of AI – one of the Industrial Strategy Grand Challenges
- Improvements to e-infrastructure. All those consulted report it is vital to develop the UK's e-infrastructure in response to changes in technology and increasing demand. This includes networks, data infrastructure, access mechanisms, and development of both hardware and software

The Progress Report is an essential milestone in developing the final Roadmap and will provide the basis for a second round of highly targeted stakeholder engagement, including with major international partners with a view to "sense checking" the preliminary findings against the experience of other nations. It has been prepared by UK Research and Innovation (UKRI) with support and advice from: the MET Office, National Physical Laboratory, UK Atomic Energy Authority, UK Space Agency, National Nuclear Laboratory, Department for Business, Energy and Industrial Strategy, Higher Education Funding Council for Wales, Scottish Funding Council, Department for the Economy of Northern Ireland, the Royal Society, Universities UK and the Association for Innovation, Research and Technology Organisations.