

# ENGINEERING TOMORROW'S WORLD

## Why Britain must Invest in Infrastructure Research



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**A society's infrastructure, like an ecosystem, is complex and interlinked. It has components developed over time, as well as more dynamic elements which are constantly renewed.**

Much of the UK's physical infrastructure, roads, railways and utilities, has been built up over the last two centuries. These were built to last. However, the country has grown and changed; investment in the skeleton that supports our economy is now overdue. The Government's National Infrastructure Plan, which sets out the priority infrastructure investments, is beginning to address this issue and the research community has a key

role to play, injecting new ideas and technologies that will both shape and inform choices.

Infrastructure is not just the visible structures like highways, it has many layers – communications networks, energy production, storage and transmission, knowledge transfer and learning and skills development, to name just a few. Like the systems of a human body, these perform their own tasks, but are interdependent and act collectively to form the whole. Understanding these relationships is a key challenge for researchers, planners and government.

There are demands for greener energy; better building design; smarter, faster communications and better skills in our workforce, how can we meet these? As science and research bring about new discoveries, how will they affect the texture and fabric of our society and infrastructure? We know things will look very different in 30 years' time, so how can we engineer tomorrow's world?

The scale and potential longevity of these structures is such that we have to look beyond the short term, we have to plan properly and, as we plan, we must look to several possible futures.

A successful example of this approach to research is the

Mapping the Underworld project, a 10-year multidisciplinary research programme, that the Engineering and Physical Sciences Research Council (EPSRC) began funding in 2005. The initial four projects emerged from an intensive workshop that drew on academic and industry knowledge. These investigated both the use of multisensory tools to locate underground utilities, and whether accurate 3D maps could be created to aid developers. The results of the research have attracted international interest and are helping to determine new standards of training for utility mapping.

How will our infrastructure integrate with the rest of the world and how do we model this? We must ask planners, developers, engineers, builders – and the general public – what they want and need, factor in realistic timescales for financing, building and realising returns and take account of the needs of future generations. Different models will take account of variables and how society may be structured both physically and economically. We have to future-proof.

Lord Deighton, Commercial Secretary to the Treasury, recently announced two new research centres that will shape the way the UK's infrastructure is planned and implemented, with

funding of £7 million from two of the UK's research councils, the Engineering and Physical Sciences Research Council (EPSRC) and the Economic and Social Research Council (ESRC).

Developing new infrastructure presents opportunities to stimulate growth and create jobs domestically, but it also gives UK academia and industry the chance to demonstrate their innovative thinking, leadership and skills to global markets. The UK has an outstanding academic research base strongly linked to industry and providing world-leading expertise in infrastructure development, planning and construction. Companies such as Arup, Laing O'Rourke, and CH2M HILL are exporting skills and generating wealth. Likewise, we have first-class skills in the development of the digital economy that has become pervasive. The Digital City Exchange, at Imperial College London, is researching how to digitally link utilities and services within a city, creating new technical and business opportunities.

To continue this trend we must fund world leading research. EPSRC supports around 350 research projects, worth more than £350 million, that relate to infrastructure across the engineering and physical sciences, from fundamental research to applied activities.

EPSRC also funds research in clean energy generation and its more efficient use, and in guarding our vital ICT services and systems through innovations in cyber security.

A case in point is the £39 million investment by EPSRC, ESRC and industry in five End Use Energy Demand (EUED) research centres to look into the complexities of energy use across society – and a further £6 million has been set aside for research into how to apply digital technologies to reduce energy demand in buildings.

Information technology has become ubiquitous and has revolutionised the way society runs. This reliance also creates vulnerabilities for our services and businesses. That is why EPSRC has, in partnership with

the security services and government, invested in a new Research Institute for Cyber Security that will advise how to secure systems and safely exploit the possibilities the virtual world offers.

Just as we all need regular medical checkups, the Innovation and Knowledge Centre (IKC) on Smart Infrastructure and Construction at Cambridge, which is funded by EPSRC, the Technology Strategy Board (TSB), and industry, is using research into sensors and data management to monitor how infrastructure like London's Underground system is ageing. Using innovative manufacturing processes, the project aims to bring more efficient, sustainable and economic construction to new infrastructure.

By definition, infrastructure is a long term challenge, requiring highly-skilled experts in their respective fields. EPSRC invests over £250 million a year in developing the infrastructure leaders of tomorrow – from PhD training centres to tailored Fellowship packages for senior researchers. They will focus on addressing the complex demands of the future. An example is the EPSRC sponsored Centre for Doctoral Training in Urban Sustainability and Resilience at University College London, which is training the researchers we need to stay in front of many of the issues facing us.

The latest call for the next round of Centres for Doctoral Training includes priorities for National Infrastructure Systems and other related themes such

as Energy Use in Buildings and Transport, Energy Storage and Water.

In tough times some might say that investing in infrastructure is something we could delay until economic conditions improve. I disagree; we have to gear our economy to compete with others, some of whom are already dedicating time and effort to improving their infrastructure.

We also have an obligation to the current generation and our descendants, so that they will have the resources they need to tackle future challenges. We have to play our part in the global infrastructure and produce scientific and engineering solutions that will bring benefits to Tomorrow's World.

## EPSRC-SUPPORTED INFRASTRUCTURE RESEARCH

The EPSRC supports research towards a reliable, safe and resilient infrastructure that supplies the water, energy, transport, waste and communications systems essential to our society. This is crucial in facing our changing environmental, demographic and economic conditions and requires innovative solutions to ensure a healthy, productive and sustainable society that is able to support economic growth.

- Integrated project planning is vital for complex infrastructure networks, and EPSRC-funded projects such as Urban Futures, one of the activities under the £45 million Sustainable Urban Environment Programme (SUE), and Liveable Cities, a collaboration between four universities, are looking at how cities can be constructed and planned, taking a long term view of sustainability, managing natural resources and reducing carbon use.
- The Infrastructure Transitions Research Consortium (ITRC) is a partnership between seven UK universities that supports analysis and planning of national infrastructure systems. Its research addresses the major challenges facing the energy, transport, water, waste and ICT systems sectors.
- The LANCS Initiative, a collaboration of four universities, Lancaster, Nottingham, Cardiff and Southampton, is developing understanding of complex systems, including those in the transport and logistics sector.
- Researchers at the University of Cambridge have been working with industrial and academic partners to tackle some of the uncertainties associated with air traffic and the risks these pose to heavily loaded airports. They have also developed award winning technology that uses radio tags to track baggage as it passes through the airport system.

Further information about these projects and more can be found by visiting:

<http://www.epsrc.ac.uk/Pages/default.aspx>

## Who are the EPSRC?

The Engineering and Physical Sciences Research Council is the UK's main agency for funding research and training in the engineering and physical sciences. The EPSRC invests roughly £800m a year in research and postgraduate training to help the nation handle the next generation of technological change. The areas covered range from information technology to structural engineering, and mathematics to materials science. This research forms the basis for future economic development in the UK and improvements to everyone's health, lifestyle and culture.

**Infrastructure Business Model Centres: EPSRC and the Economic and Social Research Council (ESRC) are co-investing £7 million in two Infrastructure Business Model Centres at Newcastle and University College London.**

