R&D infrastructures

The physical and digital infrastructures needed to test, certify and develop new products, processes, services and technologies safely and effectively

Where and how can we access the R&D infrastructures needed?

Public R&D infrastructures, their availability, accessibility and strategic focus

Regulators and their openness and availabilty to engage in innovation

Data for development and its accessibility

Finance, planning rules and processes to build new R&D infrastructures

Local government and public sector organisations such as the NHS, accessibility and engagement in test beds and living labs

Physical and digital R&D infrastructures are used by businesses to undertake a wide range of late-stage R&D activities to accelerate the development of a new product, technology, service or process[14,15,16].
R&D infrastructures are used to:

- **test new products in use in real environments**, for example testing an AI traffic monitoring system in the streets of Milton Keynes.
  ▶Vivacity Labs

- **solve technical challenges, including manufacturing at commercial scale**, for example accessing and developing the manufacturing line to increase production volume from 60 to over 1000 ventilators per week.
  ▶Ventilator Challenge UK

- **meet regulatory requirements**, for example validating a new transformer for safe and reliable use before integrating it into the electric grid.

- **demonstrate an innovative solution to potential customers**, for example building a first hydrogen refuelling station in the UK and proving a roll-out model attracting investment from a leading global engineering company.
  ▶ITM Power

R&D infrastructure can be internal to the business, or a shared external facility, such as public facilities like the National Physical Laboratory or the Catapult Centres, or private, for example incubators or specialist testing facilities. In some cases, establishing new R&D infrastructures is part of the late-stage R&D process, for example building a new energy demonstrator plant or a new manufacturing centre.
Shared R&D infrastructure plays a crucial enabling role by providing:

- **access to specialist equipment, knowledge, data that would otherwise be unaffordable or inaccessible to companies**

- **engagement with real users, regulators, local authorities or potential customers.**

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Without access to R&D infrastructures, and more importantly certainty of access, the risk of conducting late-stage R&D increases rapidly for businesses with the introduction of delays or additional cost in securing the right skills and facilities. Challenges in accessing existing R&D infrastructures include: time delays; lack of awareness or prohibitive costs; the absence of needed R&D infrastructures; and the costs associated with building new infrastructures, which can be insurmountable barriers to pursuing late-stage R&D. Conversely, the availability of R&D infrastructures can provide a huge draw for companies within and beyond the UK, especially if they offer unique expertise and capabilities.

Where can the UK government play a role?

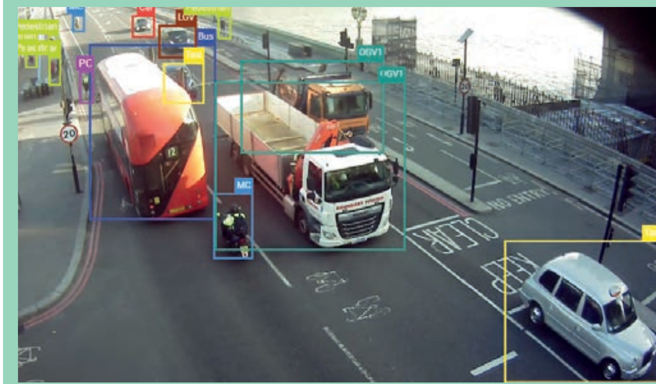
Access to shared and world class public R&D infrastructures, as well as a cooperative and innovation-friendly regulatory and public sector environment, can support companies to demonstrate new products in use, helping generate investment and providing risk mitigation and certainty.

The government should utilise infrastructure more creatively across the whole of the UK to test innovations, but also to support innovation more widely including through skills development, regulation and public engagement.

For public R&D infrastructures, the government should promote and support strategic late-stage R&D and innovation infrastructure, such as the NPL and Catapult Centres, treating them as national innovation assets, with an uplift in public investment to enable them to step change their offer and engagement with innovative businesses and strengthen and scale their innovation ecosystems.

CASE STUDY

VIVACITY LABS: DEVELOPING AN AI TRAFFIC MANAGEMENT SYSTEM ON THE STREETS OF MILTON KEYNES AND MANCHESTER



Photos used with permission from Vivacity Labs

Vivacity Labs is a London-based startup that combines artificial intelligence (AI) and the Internet-of-Things to improve transport networks. With Innovate UK funding, it opened a first-of-a-kind manufacturing facility in Bletchley in 2017 to build, test and produce sensors. These sensors were then deployed in a real-world environment, across Milton Keynes, where they delivered up-to-the-minute city-wide transport data as well as a testbed for further AI development. Following this demonstration project, Vivacity Labs have won contracts with multiple clients both in the UK and internationally.

Its current focus is in developing an artificial intelligence traffic light optimisation system in a living lab in Manchester where they are now managing traffic lights in the real world and already demonstrating 30% reductions in traffic delays compared to existing systems. The company adapted its technology to help anonymously analyse social distancing behaviour for the Department for Transport in response to COVID-19.

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CASE STUDY

SIEMENS: LIVING LABS FOR THE INTEGRATED ENERGY SYSTEMS OF THE FUTURE

Photo © Tyseley Energy Park

Siemens is developing new technologies and services for future global distributed energy systems. Siemens has found that the use of living laboratories can offer opportunities to evaluate new business models, customer acceptance in real environments and accelerate their market introduction. Siemens has a number of collaborations across Europe, including: Aspern, Vienna; Project Triangulum in Manchester; and Project Ruggedised in Glasgow.

More recently, Siemens has started to partner with several UK universities to test technologies across their campuses, facilities and student accommodation, while supporting them to reduce energy costs and carbon footprint. The data and learning from the projects are also being shared with the universities for use in teaching. Deploying the technology in different types of accommodation, new and old, that is representative of the housing stock is essential to developing a technology that can work globally.

"The High Value Manufacturing Catapult supported 4,646 innovation projects in 2019/2020 across its seventeen locations[25] and £518 million of industry R&D was linked to catapult activity."

MANUFACTURING AT SCALE

Producing a novel product at scale, efficiently and reliably is the next challenge after producing prototypes in a laboratory. ▶Ventilator Challenge UK. **Manufacturing processes may need to be developed or require custom and specialist machinery.**

Centres such as the Cell and Gene Therapy Catapult, High Value Manufacturing Catapult or the Offshore Renewable Energy Catapult provide access to specialist equipment and expertise for companies to develop and validate processes before investing in new costly equipment or manufacturing facilities themselves[23,24]. This shared infrastructure supports risk management by providing a venue and supportive expertise to try out innovative processes before investing the full cost of new equipment.

MEETING SAFETY, REGULATORY NORMS AND STANDARDS

Regulatory procedures, including access to specialist testing facilities may be required to certify safety and reliability norms and standards. In the case of highly innovative products, the time to develop new regulation can introduce delay or uncertainty during the product development ▶ITM Power.

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CASE STUDY

ITM POWER: WORKING WITH REGULATORS TO SAFELY ROLL OUT NEW HYDROGEN REFUELLING STATIONS

Photo used with permission from ITM Power

ITM Power is a Sheffield-based company manufacturing electrolysers for enabling green hydrogen solutions, including fuel stations for zero emissions transport. ITM built its first prototype hydrogen refuelling station in 2007, and the first public facing station in 2014 with support from the UK government's Hydrogen Transport Fund.

ITM Power worked closely with local authorities, BCGA, the Energy Institute and Ofgem to develop a code of practice for deploying this new technology. With a proven roll out model, ITM Power has since built ten more public-facing stations in the UK, Europe and North America. The first station helped put them on the radar of Linde, a global engineering company that has since acquired a minority stake and established a joint venture to deploy large-scale electrolysers in industrial processes.

Solving the great global challenges: 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. Deployment and integration of existing low-carbon technologies, combined with ongoing innovation, could position the UK as a market leader.

Delivering on the UK's ambitious climate change goals will require investing in large-scale late-stage R&D projects to deploy, at scale, all credible known and developing clean technologies.

As outlined in the Prime Minister's *Ten point plan for a green industrial revolution*[28], there is a real opportunity to harness, leading the world by example and developing, demonstrating and commercialising the technologies necessary to respond to the climate crisis.

REAL-WORLD ENVIRONMENTS FOR REGULATED TESTING

Test beds, living labs and regulatory sandboxes provide real world conditions, physical or digital, for new products to be tested and demonstrated in use with real customers ▶Siemens, ▶Vivacity Labs[17,18,19,20]. They bring together the public and private sector and provide:

- **Safe spaces to conduct live experiments** and maximise performance and benefits from new products and technologies.
- **Collaboration**, with for example:
  - **Real users** engaging with the new product to highlight any problems that might emerge.
  - **Engagement on regulation**[21,22] helping companies understand regulatory considerations, potentially reducing time to market and helping regulators ensure their frameworks are fit for the future.

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CLINICAL TRIALS

In the pharmaceutical and biomedical engineering sector, clinical trials[27] are a crucial step prior to regulatory approval, licensing and commercialisation of new medical devices, therapeutics and vaccines. They:

- **demonstrate safety** and identify potential side effects
- **validate effectiveness** in treating a condition.

These often last several years, involve the regulator and healthcare organisations and large numbers of people, sometimes across different countries.

"The National Physical Laboratory supports UK industry with the latest advances in measurement science and technology to gain a competitive edge. For one SME, Anglia CNC Engineering, the product verification work they conducted with NPL has resulted in more than £50,000 in savings per year[26]"

FIRST OF A KIND AND DEMONSTRATORS

'First of a kind' is a term often used in the context of infrastructure projects or large-scale manufacturing. An innovative first will often need to be built with a degree of uncertainty remaining and the associated risk can be a barrier to private investment.

The first of a kind validates the performance or potential of the technology, providing reassurance and interest from investors. It is also an opportunity to **learn lessons to improve the efficiency of subsequent builds**. In some sectors, such as the energy sector, a first of its kind may also require close involvement of regulators to ensure safety. ▶ITM Power.

Public sector backing for this type of R&D infrastructure is often essential due to the regulatory element, high cost and risk associated to the investment.