

The role of public and non-profit research organisations in the UK research and innovation landscape

The Government has committed to increase public investment in research and development (R&D) to £22 billion per year by 2024 – 25. This is part of the longer-term target to achieve 2.4% of GDP investment in R&D by 2027^{1,2}.

Achieving this target will require more R&D to take place. As the government develops strategies to achieve this, it is important to look at all the component parts of the UK’s research and innovation landscape and understand how they interact to ensure that the UK can scale up R&D sustainably and at pace to deliver the target by 2027.

Research takes place in many different places including universities, institutes and in businesses. Public and non-profit research organisations are an important but often overlooked part of the UK’s research and innovation landscape. They include Public Sector Research Establishments (PSREs), Research Council institutes and private non-profit organisations such as charities. Together, these organisations deliver substantial benefits to government, the economy and wider society.

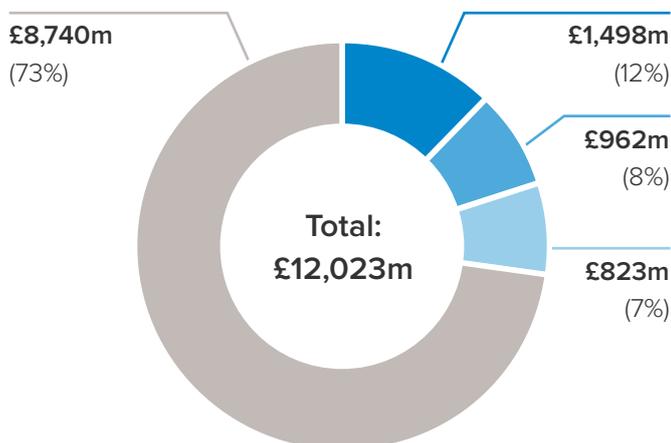
In 2018, Government departments, UKRI and private non-profit organisations spent nearly £3.3 billion on performing R&D in public and non-profit research organisations. These organisations have played a vital role during the COVID-19 pandemic and will be an essential part of the UK’s recovery.

However, as a result of many factors including policy and governance changes, cuts to R&D budgets and the shift to more short-term project-based funding, there are an unusually low number of public and non-profit research organisations in the UK compared to some other countries and there remain significant challenges with regard to their long-term financial stability. In addition, the strategic rationale for research organisations in some research areas and not others, is not always clear.

This document explains their distinct role and the policy challenges that must be overcome to maximise their economic and societal contribution. It sets out what public and non-profit research organisations are, where they are located, their background, their functions and how they are funded.

FIGURE 1

How much is spent on R&D performed by public and non-profit research organisations?³



Nearly £3.3 billion was spent by the Government, UKRI (Research Councils and Innovate UK) and private non-profit organisations on performing R&D in 2018. R&D in these sectors is carried out through government-managed research institutes and laboratories, Research Council facilities and infrastructure, or through charities and trusts mainly specialising in health and medical R&D. Business expenditure on R&D (not included in the chart) was approximately £25 billion in 2018.

KEY

- Government
- UKRI (not incl. RE)
- Private non-profit
- Higher education

What are public and non-profit research organisations?

There are many different types of public and non-profit research organisations in the UK and there is no general consensus on the terminology used to describe them or how they are categorised. In this document the following definition from the UK government report on Research and Innovation Organisations (2015) is used to capture all public and non-profit research organisations in the UK⁴ (right).

The boxes that follow contain typical terminology and information about the different types of public and non-profit research organisations that exist in the UK.

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“...non-profit organisations that perform research and innovation support as their main activity, whose existence depends on a significant degree of public funding, and whose work serves some public policy purpose.”

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Public Sector Research Establishments (PSREs)

The Government Office for Science (GO Science) 2019 Review of Government Science Capability uses the following definition for PSREs:

“PSREs are a diverse collection of public bodies carrying out research. This research supports a wide range of government objectives, including informing policy making, statutory and regulatory functions and providing a national strategic resource in key areas of scientific research. They can also provide emergency response services. They interact with businesses around a wide array of innovation-related functions⁵.”

The term ‘Public Laboratory’ is sometimes used instead of PSRE, particularly when referring to a laboratory-based organisation. Research Council institutes are a subset of PSREs and are discussed separately in this explainer⁶.

There are around 50 PSREs in the UK that are associated with a government department. PSREs vary largely in size, history and function. Some of the larger establishments, for example Public Health England and the Atomic Weapons Establishment both employ over 5,000 members of staff. Smaller PSREs, such as Centre for Environment, Fisheries and Aquaculture Science and the National Nuclear Laboratory employ between 500 and 1,000 members of staff.

Research Council institutes (RCIs)

RCIs are research organisations for which one of the seven Research Councils have established a long-term investment as major funder or in some cases, a Research Council owns the organisation⁷. RCIs are also often known as ‘UKRI institutes’ or ‘Strategically funded institutes’⁸. RCIs are eligible for grant funding from all Research Councils. More information about Research Councils can be found in the National Academies’ UKRI explainer⁹.

There are around 30 RCIs in the UK¹⁰. They range in size and function. While some institutes are associated with universities like the Institute of Biological, Environmental and Rural Sciences, others have an independent governance model, but these models are very diverse. Some are corporate partnerships with Research Councils, while others are fully independent.

Some RCIs form part of a group of research organisations often known as a Research or Science Park, or a Centre. For example, the Harwell Centre in Oxfordshire is made up of the Rutherford Appleton Laboratory, Diamond Light Source, and the ISIS Neutron & Muon Source.

Medical Research Council (MRC) units

In addition to institutes, the MRC funds several units which are more focused and tend to exist for as long as needed to support a scientific need and/or deliver a research vision. Many are embedded in a university and are of the scale of an institute such as the MRC Population Health Research Unit at University of Oxford.

Catapult centres

Catapult centres are a physical network of technology organisations that provide businesses access to technical capabilities, equipment and other resources by connecting them with expertise from the UK's research and academic communities. The centres were set up in 2011 as not-for-profit, independent organisations run by Innovate UK, one of the Councils of UKRI.

There are nine Catapult centres spread across over 30 locations around the UK. Each specialises in a different area such as cell and gene therapy, satellite applications and offshore renewable energy. While some provide specialist equipment, others act as a knowledge base connecting businesses with technical expertise. Typically, Catapults employ up to 250 members of staff, however the High Value Manufacturing Catapult is the largest with nearly 3,000 employees.

Private non-profit research organisations

Private non-profit research organisations can include research institutes, charities and Research and Technology Organisations (RTOs).

Some of the largest charitable research institutes tend to specialise in health and medical research. These include the Wellcome Sanger Institute and the Cancer Research UK Cambridge Institute.

Many RTOs are members of the Association for Innovation, Research and Technology Organisations (AIRTO) which is a membership body for organisations operating in the UK's innovation, research and technology sector¹¹. Examples of RTOs include the BRE Group which used to be a national laboratory before being privatised in 1997.

Independent Research Organisations (IROs)

IROs are a subset of research organisations that satisfy a list of conditions set by UKRI which allow them to access UKRI funding. To qualify, they must have "in-house capacity to carry out research that materially extends and enhances the UK research base and they must be able to demonstrate an independent capability to undertake and lead research programmes". They must also not be owned, established or receive more than 50% of their funding from business or certain public sector establishments¹².

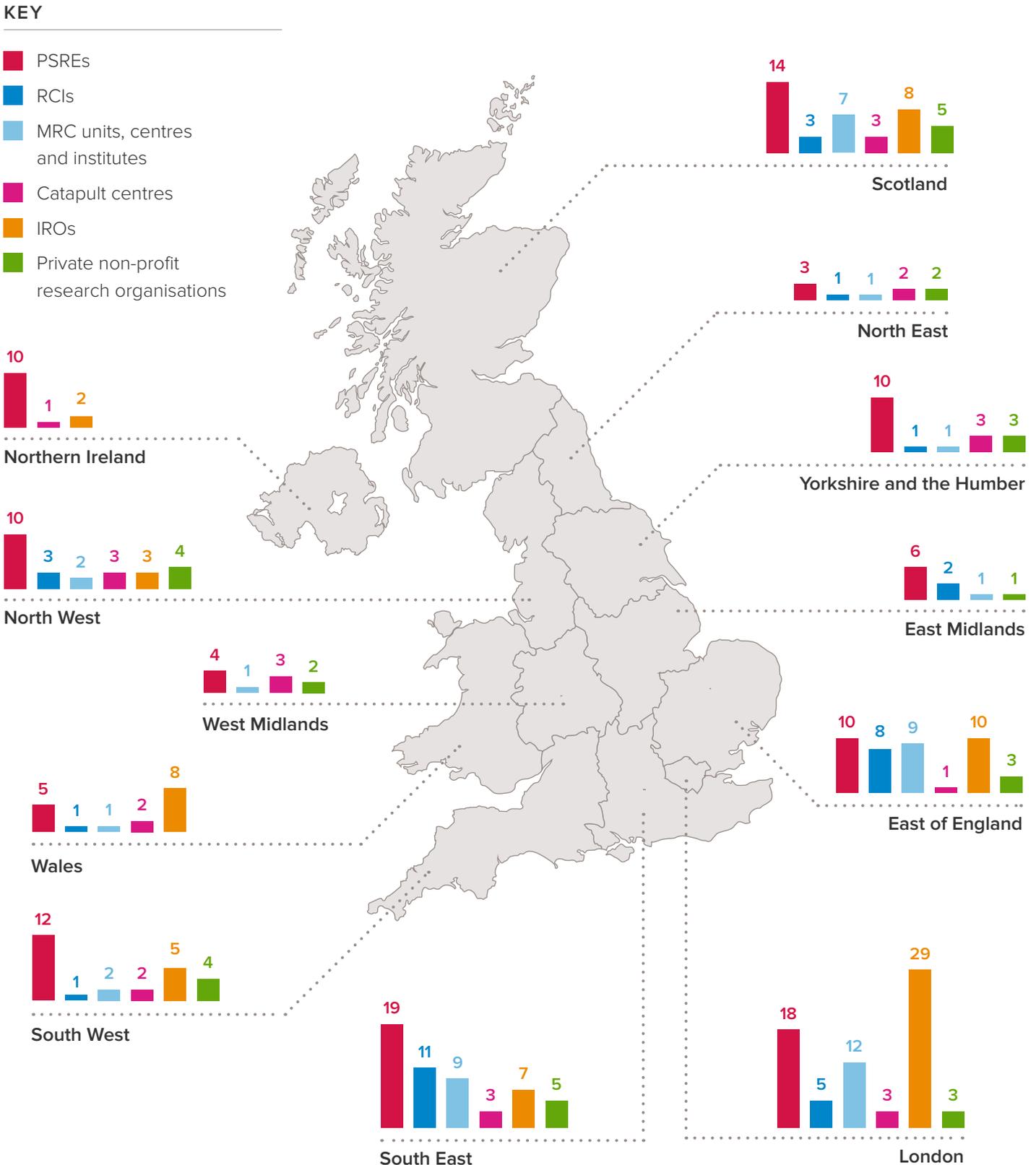
Examples include the National Oceanography Centre, the Rosalind Franklin Institute and some museums and galleries such as the Science Museum Group and the Tate galleries. The latter form the Independent Research Organisation Consortium, which is a network of IROs recognised by the Arts and Humanities Research Council.

The UK also contributes and has access to the joint EU and international research organisations such as the European Synchrotron Radiation Facility and CERN.

Where are public and non-profit research organisations located?

FIGURE 2

Locations of public and non-profit research organisations in the UK, by region.



Background

While many public and non-profit research organisations were established in the last century, the origins of some organisations date back as far as the 1600s. During this time policies, funding and governance structures have undergone significant changes, leading to the disparate research organisation landscape we see today.

Why were they created?

Although many public and non-profit research organisations were created to address military or strategic needs like the Atomic Weapons Establishment or Defence Science and Technology Laboratory (Dstl), both of which are sponsored by the Ministry of Defence (MOD), others were founded to address standardisation or regulatory needs. For example, the Health and Safety Executive is the UK's independent health and safety regulator. Many research organisations were initiated in response to specific scientific needs and opportunities such as the emergence of, for example, particle physics or artificial intelligence. Some organisations were set up in response to public health crises. Others were initially established by charities which had a specific interest in a particular area, but have since evolved into centres they are now, based on perceived national need – examples include the Research Council institutes, Rothamsted, established by the Lawes Trust and the John Innes Centre, founded by the John Innes Foundation.

How many are there?

As a result of government policy and individual decision-making, many public and non-profit research organisations have closed or merged in recent decades. This has left the UK with an unusually low number compared to other countries with a similar level of research intensity. Germany, for example, is well known for having a large number of research institutes including 86 Max Planck, 72 Fraunhofer and 96 Leibniz Institutes.

The UK's decisions have also led to some areas of strategic research being under-funded and under-resourced. One such area is forensic science. In 2012, the government-owned Forensic Science Service closed leaving forensic science to be contracted out to the private sector¹³. In 2019, the House of Lords Science and Technology Committee held an inquiry on forensic science. It found that there are still little funds for, or coordination of, forensic science in the UK, and urged UKRI to substantially increase its funding for both technological advances and foundational research in forensic science¹⁴.

R&D budget cuts have had a disproportionate impact on public and non-profit research organisations

Public spend on applied R&D has suffered from multiple cuts as government departments and Research Councils have tried to make savings over recent decades. The 2019 GO Science review of Government Science Capability found that spend on R&D by some government departments is at a fraction of 1% of the total spend¹⁵. Pressures on applied R&D budgets has meant that the available funding for research organisations has shifted away from longer-term core funding to shorter-term project-based funding. This imbalance in funding was recently explained in more detail in David Willett's *The road to 2.4%*. It states, "There is a funding gap – we have dedicated funding for universities as institutions but not for non-university research institutes". The UK devotes a significantly smaller amount of public funds to non-university R&D compared to other countries.

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In 2018, the UK spent 0.10% of GDP on Government R&D (GovERD), which is less than half the OECD average of 0.24% and less than a quarter of what Germany spent on government R&D (0.42% of GDP)¹⁶.

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Public and non-profit research organisations have a range of functions

Public and non-profit research organisations fulfil a number of different and important functions and roles within the UK research system. Some institutes have very specific functions, for example the Research Council institute, Diamond Light Source hosts the UK's national synchrotron. Others have a much broader remit, for example, Dstl has many functions including carrying out research, managing risk and supporting policy development. Some Research Council institutes will carry out a significant amount of discovery science in common with universities. Some PSREs have a role in international government-to-government partnerships. For example, NPL is the UK's National Metrology Institute (NMI) (the science of measurement) which means in addition to developing and maintaining the national primary measurement standards for the UK, it represents the nation when liaising with international metrology and standards organisations and NMIs from other countries.

The box to the right includes a non-exhaustive list of common functions. More detailed analysis of the functions of research organisations is included in the government's 2015 report on Research and Innovation Organisations in the UK.

Public and non-profit research organisations' functions

- To perform research
- To innovate
- To gather and distribute scientific information
- To develop high-level skills
- Manage strategic risk
- Support the development of policy
- Underpin business and public sector operations
- Develop standards, test and regulate
- Provide and maintain infrastructure and specialist equipment
- Training and teaching (PhD students or apprenticeship training, but generally on a smaller scale compared to universities)
- Stewardship of national collections (for example, core samples or artistic collections)

CASE STUDY 1

Defence Science and Technology Laboratory (Dstl)

Dstl was formed in 2001, although its origins can be traced back through a number of organisations to 1664. Dstl and its predecessors have undergone numerous governance changes, mergers and splits¹⁷.

Today, Dstl is an executive agency (see Annex A for the definition) of the MOD and one of the principal government organisations dedicated to science and technology in the defence and security field. It employs over 4,000 members of staff and has a turnover of around £630 million. Dstl is responsible for the delivery of the MOD science and technology programme. It brings together industry, academia, wider Government and international partners to provide sensitive and specialist services to the MOD and wider Government. Dstl only undertakes work in-house for reasons of national security or political sensitivity¹⁸.

Dstl was formed in 2001 following the split of the MOD's Defence Evaluation and Research Agency (DERA). It was created as a Trading Fund (see Annex A) of the MOD but became an executive agency in 2016. The other, larger part of DERA became a company called QinetiQ¹⁹. QinetiQ was initially a government owned company before privatisation in 2006. QinetiQ is now owned by a US-based company and provides research, testing and evaluation services to the MOD, as well as international and industry customers. More recently in 2018, the Home Office's Centre for Applied Science and Technology (CAST) was integrated with Dstl to more effectively deliver expert advice, innovation and frontline support to the Home Office²⁰.

The Norwich Research Park

The Norwich Research Park (NRP) is an example of a research park or centre. It is based in East Anglia and officially opened in 1992, although many of its organisations were already established on the site. It is the home to several research organisations, the Norfolk and Norwich University Hospital (NNUH), the University of East Anglia (UEA) and over 75 businesses – see Table 1 for detail on some of the institutions based at the NRP. The NRP is internationally renowned for its plant, food and health research.

The history of the research organisations based at the NRP is complex²¹. The John Innes Horticultural Institution, whose origins date back to 1910, moved to Norwich in 1967 to form an association with the UEA. Its move and partnership with the UEA proved pivotal in subsequent investments.

The Sainsbury Laboratory (TSL) joined the site in 1987 as a joint venture between the Gatsby Charitable Foundation, the John Innes Foundation, the UEA and the Agricultural and Food Research Council (now BBSRC). In 1994, the John Innes Centre was formed by merging the Cambridge Laboratory, and the Nitrogen Fixation Laboratory, fulfilling the Agriculture and Food Research Council's policy of creating larger interdisciplinary centres. In 2009, the Earlham Institute (then known as The Genome Analysis Centre) opened. Most recently in 2019, the Quadram Institute opened bringing together research teams from the Institute of Food Research (IFR), originally established in 1922, with researchers from UEA and the NNUH. The research park is managed by Anglia Innovation Partnership which aims to deliver inward investment and regional growth, based on translation of scientific discoveries across the NRP²².

TABLE 1

Research organisations and institutions at Norwich Research Park

	Year established	Type of organisation	Research area
John Innes Centre	The John Innes Horticultural Institution was founded in 1910, moved to the Norwich in 1967 and became the John Innes Centre in 1994.	Research Council institute	Plant science, genetics and microbiology.
Norfolk and Norwich University Hospital (NNUH)	The university hospital opened in 2001 replacing the Norfolk and Norwich Hospital which was established in 1771.	Hospital	NNUH is an NHS academic teaching hospital.
University of East Anglia (UEA)	UEA was established in 1963.	University	The UEA has strong collaborative research links across Norwich Research Park.
The Sainsbury Laboratory (TSL)	TSL was founded in 1987 and opened at the NRP in 1989.	Non-profit research institute	Plant-microbe interactions.
Quadram Institute	The Institute of Food Research (IFR) was created in 1986, but its origins date back to the 1920s. The Quadram Institute was opened in 2019 bringing together the IFR with researchers from UEA and NNUH.	Research Council institute	Food and health research.
Earlham Institute	The Genome Analysis Centre was established in 2009 and became the Earlham institute in 2016.	Research Council institute	Biological systems in plants, animals and microbes.

National Laboratory Alliance

The National Laboratory Alliance (NLA) are a group of 10 PSREs whose purpose is to provide:

- Business continuity, for example if an instrument breaks at one establishment, another can provide support;
- Independent science and technology advice to government particularly in times of emergency e.g. to the government's Science Advisory Group in Emergencies (SAGE).

Collectively, the NLA group employs around 18,000 members of staff and have a revenue of approximately £1.8 billion²³.

TABLE 2

Members of the National Laboratory Alliance

	Year established	Location
Met Office	1854	Exeter
National Physical Laboratory (NPL)	1900	Teddington, Huddersfield, Surrey, Cambridge, Glasgow.
National Nuclear Laboratory (NNL)	The NNL was founded in 2007, but its origins date back to 1940.	Workington, Preston, Sellafield, Warrington, Stonehouse, Culham.
Animal and Plant Health Agency (APHA)	APHA was launched in 2014 after merging the former Animal Health and Veterinary Laboratories Agency (AHVLA) with parts of the Food and Environment Research Agency (FERA) responsible for plant and bee health.	Weybridge
Public Health England (PHE)	PHE was established in 2013 to bring together public health specialists from more than 70 organisations into a single public health service.	Each of the nine regions in England have a local centre which provide services, expertise, response and advice to the local NHS, local authorities and other partners.
Centre for Environment, Fisheries and Aquaculture Science (Cefas)	Cefas' origins date back to 1902.	Lowestoft, Weymouth.
Fera Science Limited (Fera) (formally the 'Food and Environment Research Agency')	Fera was launched in 2009, but became Fera Science Limited in 2015.	York
Defence Science and Technology Laboratory (Dstl)	Dstl was established in 2001, but its origins can be traced back to 1664 through a number of former organisations.	Porton Down, Portsdown West, Fort Halstead, Alverstoke, Langhurst.
Atomic Weapons Establishment (AWE)	AWE's predecessor, Atomic Weapons Research Establishment was set up in 1950. AWE was formed in 1987 by merging with two Royal Ordnance Factories.	Aldermaston, Burghfield, Blacknest, Coulport.
Health and Safety Executive (HSE)	HSE was founded in 1975 following the Health and Safety at work Act of 1974.	Buxton

How are public and non-profit research organisations funded?

Public and non-profit research organisations are funded via many different types of mechanisms. The boxes below provide a brief overview of how the different types of research organisations are funded. More detail on public R&D funding can be found in the National Academies' How does the UK government invest in R&D explainer²⁴. Although universities are beyond the scope of this explainer, a brief description of how they are funded is included to help understand the research and innovation landscape.

PSREs

Generally, PSREs receive a large part of their funding from the government department that they are sponsored by, but this varies by department and function. Some also receive funding from other sources, such as competitively won project-based funding from UKRI Councils or through private commercial contracts.

Research Council institutes

Typically, Research Council institutes receive some form of long-term core capability funding from one of the UKRI Research Councils. Some funding for national capabilities is also available.

Research Council institutes also receive funding through competitively allocated grants. In addition, they can leverage external funding from academic, commercial or charitable partners, including additional UKRI resources such as another Research Council.

Private non-profit research organisations

Private non-profit research organisations are often funded through a mixture of charitable, commercial, public or university funding mechanisms. They may receive funding from UKRI Councils and many are eligible to apply for competitively allocated grants.

Catapult centres

Catapult centres are funded through a mix of core Innovate UK investment and competitively earned commercial funding, deriving broadly from three sources:

- Business-funded or independently funded R&D contracts.
- Collaborative applied R&D projects, funded jointly by the public and private sectors, won competitively.
- Core public underpinning funding for long-term investment to support infrastructure, expertise and skills development²⁵.

University funding mechanisms

Research at universities is primarily funded through the dual support system. Funding is allocated in two ways: firstly, Research Council funding which tends to be for projects and programmes, and secondly, funding from higher education institution funding bodies for universities known as 'block grants' or quality-related research funding (QR). Research England funds QR in England based on performance in the Research Excellence Framework (REF). This also informs the different formulas used in Scotland, Wales and Northern Ireland. Some research organisations that are embedded within universities, like a number of MRC's Units, can also receive QR funding²⁶.

Universities also receive revenue through other substantial streams, such as UK and overseas student tuition fees and commercial activities.

TABLE 3

A comparison between the main funding sources for universities and public and non-profit research organisations*

	PSREs	Research Council institutes	Catapult centres	Private non-profit research organisations	Universities
Government department funding	✓	✗	✗	✗	✗
Research Council long-term funding ⁱ	✗	✓	✗	✓	✗
Research Council project-based funding	✓	✓	✗	✓	✓
Innovate UK long-term funding	✗	✗	✓	✗	✗
Innovate UK project-based funding	✓	✓	✓	✓	✓
Commercial contracts	✓	✓	✓	✓	✓
Charitable funding	✓	✓	✗	✓	✓
Quality-related research funding ⁱⁱ	✗	✗	✗	✗	✓
Tuition fee income	✗	✗	✗	✗	✓

* This table provides a crude indication of the funding sources available to each type of research organisation to illustrate some of the main differences between how they are primarily funded. In reality, the landscape is more complex and it is likely that all types of research organisations receive all of the different types of funding to some extent. The table doesn't capture the different types of assurance and evaluation policies or mechanisms associated with the different funding sources.

ⁱ This does not include Research England or Innovate UK.

ⁱⁱ Funding of higher education institutions is a devolved matter and so QR funding is administered by the following bodies: Research England, Higher Education Funding Council for Wales (HEFCW), the Scottish Funding Council (SFC), and the Department for the Economy (Northern Ireland).

UKRI administers funding to other types of research organisations as well as universities and Research Council institutes. This funding is often project-based and is usually provided at 80% of the Full Economic Costing (FEC). Organisations must find other resources to fund the FEC of any funded project. This means that much of the funding for research organisations is project-based and short term. This can create challenges for the long-term financial stability and sustainability for research organisations, given the absence of a distinct QR-type funding stream.

What is FEC?

Full Economic Costing (FEC) is a methodology used by UK Higher Education institutions (HEIs) and research organisations for the production of consistent and transparent research project costs. It includes running costs of the research project, including consumables, travel costs, facility access, staff costs, estates, infrastructure costs and any other day-to-day project costs²⁷. FEC was introduced in 2005 and based on the level of additional funding that was made available to support the government's policy of maintaining research volumes at the time²⁸.

Research Councils can only provide grants up to 80% of FEC. Similarly charities often do not provide full economic costs²⁹. HEIs and research organisations are expected to fund the remaining 20% from their own resources. HEIs primarily use QR to fully fund the FEC of Research Council funded projects.

Annex A – Definitions of legal status

Executive agency

Delivers executive functions of government separately from – but within a policy and resources framework set by – a primarily policy-focused department. Although legally part of a government department, they are administratively and financially distinct. Staff are civil servants³⁰.

Executive non-departmental public bodies

Has a role in the processes of national government but are not government departments or part of one. They have a sponsor department with general oversight of its activity which are ultimately accountable to parliament. They operate to a greater or lesser extent at arm's length from ministers. Staff are public servants³¹.

Non-Ministerial Departments

Government departments, but they do not have their own minister. They are accountable to Parliament through their sponsoring ministers. A non-ministerial department is staffed by civil servants and usually have their own estimate and accounts³².

GOCO

Government Owned, Contractor Operated

GOGO

Government Owned, Government Operated

Joint Venture

Can describe a range of different commercial arrangements between two or more separate entities. Each party contributes resources to the venture and a new business is created in which the parties collaborate together and share the risks and benefits associated with the venture³³.

Company Limited by Guarantee (CLG)

Usually non-profit organisations which have guarantors rather than shareholders. Profits are invested back into the company³⁴.

Trading Funds

Public corporations which finance their operations from trading activity³⁵.

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