

Statement of policy intent

Purpose of this statement

This statement describes the rationale and intended purpose for the Advanced Research and Invention Agency (ARIA). This document accompanies others specifically covering the ARIA Bill. For more information on the Bill, please see The ARIA Bill Explanatory Notes.

Background

The Government has set out an ambition to cement the UK's position as a science superpower with a series of new commitments. The creation of ARIA will complement the work of UK Research and Innovation (UKRI) while building on the government's ambitious R&D Roadmap published in July 2020.

In November 2020, the Spending Review set out the government's plan to invest £14.6bn in R&D in 2021/22, building towards the government's target of 2.4% of GDP being spent on R&D across the UK economy by 2027, the current OECD average. Achieving this ambition will drive long-term economic growth, support the UK's position as a global force in science and innovation, and create wider benefits for society.

There is substantial evidence that investment in R&D increases productivity and that the spill over benefits from both public and private investment in R&D are significant. To retain and extend the UK's position of strength in science, action needs to be taken on several fronts.

We need to maintain the quality of our excellent research base, whilst ensuring that this excellence is seen broadly across the whole of the UK.

We also need to ensure that we can connect pure research with new inventions and commercial products effectively, ensuring good ideas

can be nurtured to create world-leading UK companies. This Government is taking a multi-faceted strategic approach, planning, and looking at how we can use innovative methods of investment to create industries of the future, and remain at the centre of global scientific collaboration. This policy is one of many targeted at this overarching objective.

The UK's Coronavirus response, for instance our Vaccines Taskforce and Rapid Response Funds, have illustrated the importance of agility in funding and decision-making. This policy is one of many across the landscape of public science funding which will learn lessons from those successes.

The March 2020 Budget confirmed the Government's commitment to an £800m investment in the creation of a new research funding body, based on the principles of the US Advanced Research Projects Agency (ARPA) now renamed DARPA (Defense Advanced Research Projects Agency).

Since the 1950s, ARPA / DARPA has focussed solely on transformative science and technological research programmes, with a lean structure and a high risk tolerance. This approach has yielded remarkable results. ARPA played a vital role in the creation of ARPANET, forming the basis for the Internet. It also funded a precursor to the Global Positioning System (GPS), and the world's first Weather Satellite: TIROS 1. More recently, it has been behind inventions like voice recognition technology, as used in Apple's SIRI.

There have been more recent attempts in the US to emulate DARPA's success in other Government Departments: ARPA-E (for energy), HSARPA (for homeland security) and IARPA (for intelligence computing). Other countries have also created bodies inspired by ARPA, including Japan's 'Moonshot R&D' and Germany's SPRIN-D.

Design Principles

There is much variety in the activities undertaken by bodies under the 'ARPA umbrella' since 1958, and even more variety in approaches taken by these other emulating bodies. But extensive engagement with the scientific community has helped the Government identify a

set of intrinsic features of the model which we intend to incorporate in the design of ARIA. Many of these features are already exhibited in certain parts of the current UK system, but the combination of them will be unique. These features are:

- ***High-risk research focus:*** ARIA will exclusively focus on projects with potential to produce transformative technological change, or a paradigm-shift in an area of science. While it is anticipated that most programmes may fail in achieving their ambitious aims, those which succeed will have profound and positive impact on society.
- ***Strategic, scientific, and cultural autonomy:*** ARIA will have maximum autonomy over its research and project choice; its procedures; and its institutional culture. Decisions on the programme portfolio will be set by ARIA, not ministers, and allocation of funding to research projects will be decided by those with relevant technical expertise.
- ***Investing in the judgement of talented people:*** The ARIA model will give freedom and control to a small number of the highest-calibre researchers, from public and private spheres. These individuals, filling the 'Programme Manager' position, will be empowered to dynamically channel funding, shift project objectives and milestones, and manage risks, to keep their overall research programme focussed around a coherent but evolving vision.
- ***Financial flexibility and operational freedom:*** Government is committed more widely to taking action to address unnecessary research bureaucracy, for instance, through UKRI's 'Reforming our Business' programme, and within that, the 'Better Funding Service' Programme. The research community have been clear that extra layers of approvals and review in the funding system, while well intentioned, can stifle the creativity and dynamism of scientists. ARIA will be a flagship of this agenda, minimising hurdles across a typical project lifecycle to create an agile and efficient funding body. ARIA will use a range of innovative approaches to funding researchers, which is likely to include the

ability to run prizes; take equity stakes; and issue small grants rapidly without lengthy open competitions.

Underpinned by these broad principles, we outline below some key operational detail for ARIA, though we caveat that this broad intent is tempered with a desire that the organisation's independent leadership are given freedom to experiment with new methods and structures.

Programme Manager Led Funding

The exact sub-board level organisational structure and responsibilities will be for the CEO to determine. We expect ARIA to run a 'programme manager' model, sharing similarities with the approach through which DARPA has found success in the US.

The Programme Manager, in this context, is a highly unique role requiring visionary technical expertise, leadership, and project management skills. Programme Managers are expected to apply to work for ARIA for a fixed 3–5-year tenure, as the leaders of a single multi-million-pound research programme designed around their own scientific or technological vision. Within their overarching programme, Programme Managers will distribute funding across a range of projects of their choosing. Individual projects might vary in size, length, scientific discipline, and each may be conducted by different institutions or collaborative groups.

Projects are not 'standalone', but rather, must contribute to the overall aims of the programme, with the Programme Manager ensuring the outputs of projects align and cohere. So, while ARIA is a funding agency, and not likely to be conducting much scientific research in-house, the Programme Manager will be expected to be intimately involved in the projects they fund, visiting sites on a weekly or monthly basis. This makes the role akin to that of a 'product manager' in an industrial R&D setting, who elicits and draws together different sets of technical expertise in development of a single product.

ARIA will design its own decision-making processes, which will highly likely grant significant autonomy for the Programme Managers to make investments. A Programme Manager's specific clearance arrangements may or may not include peer review, this will be a decision of the incoming ARIA leadership.

ARIA will likely use small, quick ‘seed-grants’ to support prospective Programme Managers and their fundees to make strong initial proposals. As well as starting projects quickly, Programme Managers will also have the means to stop projects quickly and re-allocate funding and resource to the changing demands of a research endeavour. A regular, hands-on relationship between the Programme Manager and the researchers they fund allows for this agile objective-setting.

Programme-Manager-Led Funding – A Worked Example

A prospective Programme Manager with a background in industrial engineering applies to ARIA with a vision for a flying personal transport device, with potential commercial, military, and/or home security applications. Within weeks of her application, she is paid £50k to support a more substantive 3-month research proposal. This proposal is assessed, and once successful, she is employed by ARIA and given a budget of £20m over 5 years.

With only two approvals needed for each decision (from her technical office Director and CEO), she quickly begins to commission basic and applied research. She commissions new lightweight materials research from leading universities Glasgow, Oxford, and M.I.T; fuel engineering projects involving mixed academic and commercial consortia; and procures consultants to understand the landscape of the transport market in 2050 and where this new invention could fit in. She can start and stop new projects at will as new evidence emerges.

At the end of the 5-year programme, she will have forged a community of interested parties around an emerging technology, rooted firmly in the UK, and other dedicated staff in ARIA will be already supporting her in thinking about next steps, for instance, transferring the Intellectual Property to interested commercial partners; co-investing in firms involved in the projects; or spinning out new ventures.

Research Focus

The primary concern in the establishment of ARIA is *how* research is funded, rather than the precise area, industry, or technology. ARIA will not have its research focus set by Ministers. Like many other research funding agencies, ARIA will not be tied to a single research focus, industry, or government department ‘customer’.

There are many UK publicly funded research bodies and programmes with a specific topic focus set by ministers. For instance, we have UKRI’s Strategic Priorities Fund, investing £830m to support government priorities across 34 multi and inter-multidisciplinary research themes. We also fund research through specialist organisations like the Faraday Institution, which is set up solely to look at the future of battery technologies. For ARIA, however, we aim for a less prescriptive approach.

Like US DARPA, ARIA will operate across the R&D life cycle from funding at the intersection of pure science and applied science; towards early technological development; and then exploring different avenues to commercial success. It is important to note that breakthroughs earlier along this R&D life cycle do not correspond to only a single final commercial product. Early stage scientific and technological research can generate many types of technological possibilities. So-called ‘general purpose technologies’, for instance, A.I., quantum computing, and robotics; are applicable in a range of industries, and in tackling a range of societal problems.

DARPA pursues a range of technological advances, but all broadly tied to the objectives of the US Department of Defense. In this regard, ARIA will depart from the DARPA model, but align with other ARPA-inspired bodies around the world such as Germany’s SPRIN-D and Japan’s Moonshot R&D. We want to leave the door open to ARIA to forge links with multiple government department customers, unlocking new ways to tackle a range of societal problems, and boosting UK industry in a range of sectors.

While the organisation as a whole has an open scope, individual programmes will have a clearly defined scientific or technological ‘mission’. As explained above, the programmes will be selected on the basis of the coherence of their vision, and it will be the Programme Manager’s entire role to bring that to fruition. We do not intend for ARIA to fund a mixed selection of individual projects which provide no

contribution to a wider programmatic aim. ARIA's leadership will need to strike a balance in its programme portfolio between breadth and depth within its allocated budget.

Relationship to Central Government

ARIA will be a public body and the Department for Business, Energy, and Industrial Strategy will be its central Government departmental sponsor. Noting the operational freedoms and minimal bureaucracy fundamental to ARIA, it will be important to ensure the distance between the entities strikes an appropriate balance.

R&D, and in particular transformational R&D, is an inherently dynamic, uncertain, and unpredictable endeavour. Research programmes can perform better when they possess the means to quickly capitalise on new discoveries.

This inherent uncertainty does not naturally suit the system of Government budgeting, controls, and project clearance processes, which standardly apply to all programmes (R&D and otherwise). Government generally requires budgets for its large capital projects and programmes to be clearly specified, objectives to be rigidly set, and economic impacts forecasted and calculated, all well in advance.

While such processes are often prudent and sometimes essential, for some transformational R&D projects, they may constitute a bureaucratic burden which is not sufficiently outweighed by the value or assurance they aim to provide. Thus, we will give ARIA operational freedom, cutting bureaucracy where it is inappropriate.

The Government will deliver some such operational freedom in legislation. For instance, it seeks to exempt ARIA from public procurement regulations, allowing Programme Managers to quickly access suppliers such as those producing new scientific equipment. Noting that ARIA will be a small body with minimal administrative capacity, we will remove the burden of processing Freedom of Information requests. This said, ARIA will be an outward facing body which will proactively provide information about its activities to encourage coalescence around its programmatic goals.

In addition to the ARIA Bill, non-legislative processes and arrangements between Central Government and ARIA will be

stipulated in a forthcoming framework document, to be agreed between BEIS and ARIA's leadership.

While ARIA will have day-to-day operational independence, our legislation takes steps to ensure the body is subject to Government oversight in the interest of national security. ARIA may spawn technologies of interest to hostile parties and the Secretary of State must be given direction-making powers to halt or prevent ARIA activities which pose a threat to the UK's national interests. We will also ensure that ARIA has the critical infrastructure it requires to reduce cyber-attacks.

While we wish to cut inappropriate bureaucracy, ARIA will still be a partner organisation – it will have to produce accounts to be consolidated within BEIS', and it will need to monitor and report transparently on the funding it is given to show that it is acting responsibly. ARIA will be required to provide a statement of accounts and an annual report on the exercise of its functions, which will be laid before Parliament by the Secretary of State. To ensure robust scrutiny on financial matters, ARIA will also be audited on an annual basis by the National Audit Office. This audit will be an opportunity to ensure public scrutiny, and that staff are only exercising their freedoms in the public interest, and in pursuit of ARIA's aims.

Personnel

We will soon begin the recruitment process to find the first Chief Executive Officer and Chair of ARIA. Recruitment for other positions will follow in due course, subject to the ARIA Bill successfully gaining Parliamentary Approval.

In shaping the research, culture, and setup of ARIA, the first CEO will have a significant effect on the technological and strategic capabilities of the UK over the course of generations. They will establish the philosophies, working styles, and cultural norms that make ARIA effective and distinct. They will recruit the first cohort of Programme Managers (or equivalent positions), enable them to launch the first programmes, sign the first research partnerships, and help define the strategic advantages the programmes aim for. They will position ARIA as a distinctive part of the UK's research funding landscape that complements and expands the UK's funding capability.

The process for both roles will be conducted on the basis of open and fair competition. We expect the successful CEO candidate to be a dynamic and visionary leader with experience in either academic or industrial high-risk R&D. We will complement this CEO with a Chair who has significant board experience, a good understanding of governance issues facing publicly funded organisations, and the ability to remain objective in scrutinising ARIA's executive and holding it to account on behalf of the Government.

Innovative Funding Approaches

Each approach to funding research creates different incentives among researchers. ARIA's high-calibre programme managers will wield a range of funding methods. A measure of funding mechanism diversity has been integral to US ARPA's success, but we will encourage ARIA to experiment perhaps even more.

Below, we outline some innovative funding mechanisms ARIA's Programme Managers may have at their disposal alongside traditional grant-making powers:

- ***Inducement Prizes***: An emerging body of academic and anecdotal evidence suggests inducement prizes can provide significant returns and galvanise the research communities. Competitions prove popular from those not usually seeking government grants. This includes companies looking for prestige, or the large community of 'casual coders' who have talent and time, but little knowledge of the administration side of grant applications. The US Ansari X Prize (AXP) – a \$10 million winner-takes-all final product prize for building and launching a spacecraft – leveraged over \$100 million investment, and the \$2m Northrop Grumman Lunar Lander Challenge (NGLLC), in association with NASA, spurred \$20 million total investment.

Nesta's 2018 report *Funding Innovation* notes that the best conditions for prize challenges are when research objectives are well-defined with clear success criteria. Issues arise when challenges are vaguely specified; when challenges are set in areas already too well funded to the point of saturation; or where

there are not enough potential entrants for a proper competition. ARIA will take note of all these lessons, but the small size of the UK researcher market in some disciplines makes the last point particularly pertinent. ARIA will need to consider the extent to which prizes are open to international researchers, which might be a case-by-case decision.

- **Grant/Prize Hybrids:** We would like ARIA to consider how prizes can be combined with grants to, for instance, pay researchers a minimal grant or contractor salary to carry out research they could not otherwise afford to do up front, but incentivise high performance with a prize for a winning team; or increase a funding pot incrementally for different competitors qualifying through different stages of a research programme. These hybrid options allow myriad different incentive structures to tailor to the unique qualities of particular research markets.
- **Seed Grants:** US ARPA bodies differentiate themselves from typical US R&D with maximum flexibility on scale and time of their grants. They tend to issue small grants (\$50,000-\$1m for 3–9-month delivery) as quickly as possible with minimal assessment criteria, following up on only a small fraction of the most promising seeds with further larger-scale investments in pursuit of the larger aims of a Programme. Seed grants are also used to support prospective programme managers to develop theses upon which programmes are selected and then subsequently funded.

In speaking with US counterparts, they noted how the speed of seed grant issuance allow a new type of stakeholder engagement work. Rather than stakeholder events merely being opportunities to advertise funding application opportunities, Programme Managers are empowered to attend academic and technology conferences; network and identify talent; and make a provisional funding offer during the conference, incentivising a researcher to invest time in a thesis of much higher quality than a standard funding application document.

- ***Taking Equity Stakes:*** The ARIA Bill gives ARIA the potential to take equity stakes in companies, for instance, start-up ventures for developing and exploiting scientific research. Through the forthcoming framework document, we will specify the parameters for these types of activities.
- ***Attracting Private Co-financing:*** Garnering private sector finance to support particular ARIA programmes would bring greater funding totals, a lower financial exposure, and can create a clear pathway for commercialisation of technology. Firms will also have significant market expertise which will be crucial for ARIA to draw upon. ARIA would need to be careful only to co-finance programmes where the private partner would not otherwise fund a similar activity completely themselves, thus avoid displacing and ‘crowding out’ other private investment. Again, through the forthcoming framework document, we will specify the parameters for these types of activities.
- ***Academic and Entrepreneurial Fellowships:*** ARIA may offer fellowships for talented early and mid-career individuals with a specific emphasis on working with Programme Managers to explore routes to commercialisation of ARIA research and technology in the UK.

We will ensure that ARIA documents and publishes what is working well and not so well when experimenting with funding methods. Even perceived failures in this regard may serve a hugely valuable public benefit, as lessons are shared with the wider UK research community.

Relationship with UKRI

UK Research and Innovation is the umbrella body for UK public funded research, covering the seven research councils, Research England, and Innovate UK. It funds c.£8bn of research, innovation, skills, infrastructure, and partnerships per year. UKRI is the foundation of public R&D in the UK, supporting 54,006 researchers and innovators across 3,942 universities, businesses, and other organisations.

A key consideration in the development of ARIA has been whether it ought to be established inside or outside UKRI. UKRI holds significant expertise, the economies of scale of an existing large organisation, and an avenue for coordinating spending with their other programmes.

However, ARIA is intended to fund science in new and innovative ways beyond those permitted by UKRI's governance arrangements. As noted above, ARIA will benefit from a light-touch approach to project clearances for it to be able to operate with autonomy from central Government and at speed, which requires a specific and unique set of allocation and finance arrangements. ARIA will be a small organisation, with a flat structure and a distinct cultural identity.

We will establish ARIA as an independent body, outside UKRI, but ensure, through multiple open communication channels, that ARIA will be a complementary part of the UK R&D landscape.

The ability of ARIA to invest in high risk and novel funding approaches has the potential to complement the work of UKRI. A strong partnership between the two agencies will ensure, the UK can benefit from the unique role of both organisations in the funding landscape and enable UKRI to fulfil its key role as the steward of a vibrant and inclusive research and innovation system that maximises the benefits of investing in R&I for the whole country. We will ensure that particular attention is given to ARIA's relationship with Innovate UK, considering the key role Innovate UK plays in investing public funding to help businesses scale-up and commercialise technology.

Location

ARIA will be a small organisation with few employees and its headquarters will occupy a very small physical footprint. ARIA will be expected to fund individuals, institutes, universities, and businesses across the UK. The benefits of ARIA's funding will thus not be restricted to a single location.

No decision has been taken on the initial location of any office(s) for the new agency.

Conclusion

When it comes to finding the best way to fund R&D, it is clear and perhaps inevitable, that the world is still experimenting. That said, we have learned from historical successes and failures in the UK and around the world that certain organisational characteristics lend themselves well to high-risk, high-reward research.

This Government believes our proposals for an Advanced Research and Invention Agency meaningfully diversify the current public R&D portfolio in a way which will place the UK at the epicentre of a new generation of transformational technologies.

Alongside the multitude of science and R&D spending this Government is undertaking, ARIA will be key to establishing a competitive advantage for the UK as a global science superpower, creating meaningful jobs and economic growth for generations to come.