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# ADVICE PAPER

April 2022 | *NO: 22-07*

## HOUSE OF LORDS SCIENCE AND TECHNOLOGY COMMITTEE INQUIRY: DELIVERING A SCIENCE AND TECHNOLOGY STRATEGY FOR THE UK

## Summary

The UK can already be classed as a science superpower by many measures. Where it falters is in its ability to translate research into commercial applications, economic productivity and anticipatory policy or regulation. Where such translation does take place, it is often slow and hindered by unnecessary bureaucracy and a complex funding landscape.

Historically, science and technology companies have been hugely underrepresented in domestic markets, which in turn has driven many promising start-ups to relocate abroad where conditions are more favourable. The UK needs to recognise the value of these companies from the outset and either incentivise them to continue operating or incentivise business to become early adopters in the UK.

Funding remains a key barrier to the UK meeting its full potential as a science and technology superpower. The UK is poor at leveraging additional private investment into science and technology, which would help bridge the chasm between early and late-stage research that stalls many projects. Funding to universities, colleges and institutes has also been reduced and the funding that is available can be concentrated across a small pool of regular recipients, preserving the status quo and stifling both creative thinking and productivity. There is also comparatively little funding earmarked for research to inform the development of public policy and services.

Being a science superpower also necessitates a strong element of public engagement and awareness-building.

Current funding structures and academic progression pathways do not adequately recognise or reward interdisciplinarity, cross sector working or innovation, particularly those that are predicated on cumbersome panel review processes. If the UK is to become a more nimble and modern science superpower, it must find ways of streamlining the innovation pipeline, doing away with unnecessary bureaucracy and outdated metrics while still preserving its reputation for high-quality research.

While the Haldane principle is vital in ensuring the quality of scientific outputs, there could be scope to consider how present modes of funding might be diversified to allow a wider range of projects at different levels of maturity and complexity to be supported and which are not subject to the same peer review standards.

## Summary

Greater fluidity between academia and industry should be actively encouraged to facilitate the reciprocal exchange of key skill sets and support the commercialisation of academic research.

Fundamentally, the UK must precipitate a culture change that minimises the risks associated with failure. Successful innovation is by its nature built on multiple cycles of trial and error.

The UK has traditionally had close associations with the global scientific community, attracting high-calibre foreign students and staff and, likewise, exporting domestic talent to forge and strengthen collaborations abroad. However, recruitment of international graduate students, post-doctoral researchers and independent academics has suffered in the wake of Brexit due to higher fees, concerns around immigration requirements and career progression, and a heightened atmosphere of xenophobia. The UK has long enjoyed positive working relationships along the North/South axis. Regrettably, funding cuts to Official Development Assistance have undermined this relationship and the UK should make an effort to identify alternative means of supporting these important collaborations.


## Introduction

1 The Royal Society of Edinburgh (RSE), Scotland's National Academy, welcomes the opportunity to respond to the House of Lords Science and Technology Committee's inquiry into delivering a science and technology strategy for the UK. Given its status as a national academy representing the sciences and other disciplines, the RSE is inherently interested in the delivery and application of science and research, particularly in promoting national resilience, tackling complex challenges such as climate change and biodiversity collapse, and in improving the lives of individuals.

The RSE is supportive of UK Government's commitment to prioritising science and innovation and improving its impact and looks forward to following and contributing to this agenda as it develops. The working group preparing this paper was comprised of RSE Fellows, all of whom have significant knowledge of the science, research and innovation space and occupy various leadership roles across academia and business. We would be pleased to discuss this response further with the House of Lords Science and Technology Committee should they consider this useful.

## 1 What would it mean for the UK to be a "science superpower?"

- *What would a "science superpower" look like?*
- *What measures should determine whether the UK has become a "science superpower"?*

**2** The UK can already be classed as a science superpower by many measures. For example, by global standards, the UK excels in producing a high volume of impactful primary research relative to its population size, sometimes described as 'punching above its weight.' Where it falters is in its ability to translate research into commercial applications, economic productivity and anticipatory policy or regulation. Where such translation does take place, it is often slow and hindered by unnecessary bureaucracy and a complex funding landscape. This protracted timeline of innovation is at odds with the urgent solutions demanded by the climate emergency, the biodiversity crisis and other modern threats such as COVID-19, as well as seizing opportunities presented by artificial intelligence and its use in public and private sector data capture and analysis. Delivering the UN Sustainable Development Goals will also require immediate and cross-cutting scientific and technological solutions hinged on global partnerships. Unfortunately, as discussed in our response to question 7, the UK has become more isolated from the international scientific community post-Brexit and as a result of cuts to Official Development Assistance. A true science superpower would be agile in its ability to respond rapidly to current and emerging needs, translating research into operational realities at pace whilst also encouraging more speculative and visionary research.

**3** Historically, science and technology companies have been hugely underrepresented in domestic markets, which in turn has driven many promising start-ups to relocate abroad where conditions are more favourable. The UK needs to recognise the value of these companies from the outset and either incentivise them to continue operating or incentivise business to become early adopters in the UK. Failure to address these challenges will mean the continued risk of losing talent and innovation to foreign markets.

**4** Although translating science into concrete solutions is critical, a science superpower must also appropriately endorse curiosity-driven inquiry whose eventual application may not be immediately obvious but which nonetheless serves to broaden the existing knowledge base and could lead to transformational discoveries down the line.

**5** Funding remains a key barrier to the UK meeting its full potential as a science and technology superpower. The UK is poor at leveraging additional private investment into science and technology, which would help bridge the chasm between early and late-stage research that stalls many projects. Industry is often poorly motivated to collaborate with researchers (particularly those engaged in more speculative blue skies research) due to the perceived financial risks and long-term nature of the research and the pace of its delivery. Funding to universities, colleges and institutes has also been reduced and the funding that is available can be concentrated across a small pool of regular recipients, preserving the status quo and stifling both creative thinking and productivity. By contrast, other countries have explicit measures in place to prevent this from happening. There is also comparatively little funding earmarked for research to inform the development of public policy and services.

**6** Being a science superpower also necessitates a strong element of public engagement and awareness-building. Even the most ambitious policy measures will be hindered if met by a scientifically illiterate citizenry who fail to see the benefits of building a strong science and innovation base and who are themselves unwilling to engage with science. The rapid development and deployment of vaccines, at-home COVID tests and personal protective equipment (PPE) during the pandemic was made easier by extensive (though not universal) public buy-in. Regular citizens saw the need to implement rapid scientific solutions to combat the pandemic and were willing to embrace these in their daily lives. Policymakers should now look to redirect this renewed public appreciation for science towards enduring issues such as improving societal physical and mental health, addressing climate challenges and halting biodiversity loss.

- *Are the Office for Science and Technology Strategy's four scientific and technological priorities the right ones for the UK?*

**7** We are broadly in favour of the four scientific and technological priorities that have been identified but believe these could be refined in order to make them more impactful. For example, we would like to see a focus on circular economy and behavioural science as these are central to building a sustainable net zero society. There is also the question of whether the UK wishes to build on existing successes through continued investment or whether it wants to pump-prime new areas. We also see benefit in broadening the definition of science to also encompass social science, economics, and related fields in the interests of promoting more interdisciplinary research that reflects the nature of pressing societal challenges like climate change, an ageing population and delivering a safe and just society.

## 2 Are the right structures in place in Government to implement a science and technology strategy?

- *How should the Government coordinate science policy across different departments, with different strategic priorities such as levelling up? What role could the National Science and Technology Council play?*
- *How should the National Science and Technology Council and the Office for Science and Technology Strategy interact with existing bodies like the UKRI Council and the Council for Science and Technology?*

**8** The UK research and innovation landscape is exceedingly complex. Introducing new entities to this system like the National Science and Technology Council (NSTC) and the Office for Science and Technology (OST) could further clutter this policy space unless relationships between existing bodies are better defined. In this sense, a science and technology strategy would ideally improve the coherence of the current science policy and funding landscape by presenting a more rationalised framework for how its constituent bodies interact with one another and by clearly delineating the role of the NSTC and OST with respect to these other bodies.

- *Are the right levers and mechanisms in place for the delivery of a science and technology strategy?*

**9** Government could consider the creative application of regulatory levers as a means of driving innovation. As an example, the introduction of ubiquitous standards for environmental protection produced an immediate market demand which spurred the rapid development of associated pollution control technologies. Regulated businesses can also subsequently benefit from increased productivity.[1]

**10** One element that is often conspicuously absent from existing structures is the role of people in delivering successful science and innovation. Even if there is funding or support in place to allow a specific project to progress, it can be difficult to facilitate the movement of staff from one stage to the next, meaning that valuable knowledge and expertise is often lost from the innovation pipeline.

- *Who should be accountable for the delivery of a science and technology strategy?*
- *What ministerial representation should science and technology have?*

**11** We would advise against assigning responsibility for the delivery of a science and technology strategy to a minister, given the short-termism that often characterises the political cycle. We are, however, supportive of responsibility resting with a single appointed individual with the requisite background, experience and level of authority so that responsibility for the strategy is not diluted across a large department which could make it difficult to ensure accountability.

1 Office for Product Safety and Standards (formerly Regulatory Delivery). (2012). *Regulation and growth.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/262631/12-688-regulation-and-growth.pdf

## 3 Does the introduction of a science and technology strategy challenge the Haldane principle and UKRI's commitment to fund outstanding research?

- *Should the Government take further steps to preserve and enhance the Haldane principle?*
- *How should the Government balance support for bottom up, curiosity-driven research with support for research focused on its strategic priorities?*

**12** The Haldane principle is fundamentally important. We do not believe that a science and technology strategy would challenge this principle; rather, a well-designed and well-implemented strategy would ideally reduce some of the bureaucratic burden associated with the peer review process while still honouring its role in ensuring research excellence.

## 4 Is the UK realising the potential of its research investment?

- *Do bureaucratic processes hinder research and development in the UK? Are there examples of where these could be removed without compromising oversight?*
- *Could the bureaucracy reducing principles of the Advanced Research and Invention Agency (ARIA) be extended to other public sector research establishments?*

**13** The introduction of the ARIA has been a welcome step change in terms of reducing bureaucracy as well as encouraging interdisciplinary and mission-led approaches by aggregating talent around identified problems (and potentially outstanding and talented individuals). While we see merit in embedding these principles across other public sector research establishments, concerns have been raised about the ARIA's potential lack of transparency and so we would advise that, were any bureaucracy reducing principles to be replicated, these should be coupled with appropriate transparency measures to ensure that science and innovation are not fast-tracked at the expense of public trust.

- *How can the Government better incentivise and support interdisciplinary research and innovation?*
- *Does the Government's strategic direction and the current allocation of research funding align with the UK's scientific and economic strengths?*

**14** While we are supportive of UKRI's commitment to developing a Future Research Assessment Programme as a potentially improved way of conceptualising research performance, we would emphasise that any attempts to reimagine the current research paradigm must be coupled with corresponding changes to the structures that uphold it. Current funding structures and academic progression pathways do not adequately recognise or reward interdisciplinarity, cross sector working or innovation, particularly those that are predicated on cumbersome panel review processes. If the UK is to become a more nimble and modern science superpower, it must find ways of streamlining the innovation pipeline, doing away with unnecessary bureaucracy and outdated metrics while still preserving its reputation for high-quality research. A useful first step could be to diversify review panels by bringing in industry and other external voices to ground the assessment of research proposals within a real-world context and dismantle traditional siloed thinking. There are also potentially valuable lessons to be learned from the ARIA, subject to the caveats we specify above. Lastly, we welcome the independent review of research bureaucracy by Professor Adam Tickell whose findings should serve to improve existing research processes.[2]

## 5 How should state funding for research and development be allocated between different organisations, who should make that decision and by what criteria?

- *Should Government departments commission and fund more research and development directly?*
- *What role should public sector research establishments play?*
- *What role should universities play?*
- *How should state funding be used to leverage private sector funding?*

2 Celtic Academies Alliance. (2021). *A response from the Celtic Academies Alliance to the Independent Review of Research Bureaucracy.* https://rse.org.uk/wp-content/uploads/2021/10/Research-Bureaucracy-3.pdf

**15** Large capital investments beget continued investment in a region, a fact which the current levelling up agenda has underscored. For example, considerable capital investment in scientific facilities and infrastructure has been directed to southeast England, perpetuating a cycle of continued investment. The development of regional city deals in Scotland and Northern Ireland co-funded by the devolved administrations is particularly welcome. While the announcement of innovation accelerators in areas with significant deprivation like Glasgow and Clackmannanshire is a positive development, we would like to see more detail on how the national levelling up commitment will disperse opportunity across the whole of the UK, including Scotland.

**16** As mentioned in our response to question 1, much of the available funding for science and research is presently distributed by a few main channels and tends to be concentrated across a few repeated recipients. Not only does this restrict the range of research that could be funded, it also tends to be a heavily bureaucratic process driven by onerous peer review. While the Haldane principle is vital in ensuring the quality of scientific outputs (as discussed in our answer to question 3), there could be scope to consider how present modes of funding might be diversified to allow a wider range of projects at different levels of maturity and complexity to be supported and which are not subject to the same peer review standards. For example, smaller and simpler projects could benefit from receiving modest grants through a lottery process. Charitable trusts are also emerging as a key alternative funder of scientific research, such as the ten disruptive research centres funded by the Leverhulme Trust and funding that is available through the Nuffield Foundation.

## 6 What more should be done to encourage private-sector investment in research and development in the UK?

- *What policies could incentivise private sector research spending in the UK? Are there international examples the UK could learn from?*
- *What more could be done to incentivise collaborations between academics and industry? Are there barriers preventing this collaboration that could be removed?*
- *What can be learnt from local innovation ecosystems, such as the Cambridge Science Park?*
- *What stage of the pipeline, from innovation to industry, is presenting the most significant problems for commercialising discoveries in the UK?*
- *What contribution should public procurement make to achieving the aims of the science and technology strategy?*

**17** Currently, there are few mechanisms in place to encourage private-sector investment in research and development. For example, Innovate UK's innovation loan pilot has placed a greater financial obligation on potential investors that has arguably dissuaded some organisations from getting involved. The UK research and innovation base could benefit from having a closer association with industry, such as by co-housing industry within academic research centres and encouraging the Higher Education Funding Council for England (HEFCE), Scottish Funding Council (SFC) and other funding bodies to increase funding dedicated to the commercialisation of innovation and the intellectual property of academic research outputs. However, this relationship with industry will need to be properly balanced against other obligations and priorities to prevent vested interests from dominating research agendas.

**18** Ultimately, there needs to be a more symbiotic relationship between industry and academia. Within the UK, academics are generally hesitant to leave academia to explore entrepreneurial ventures as academic career success and progression are still heavily predicated on research outputs and Research Excellence Framework (REF) performance which remains fixed along traditional and often siloed Units of Assessment. Further, PhD students are often funnelled towards academic trajectories that may be at odds with their talents and interests, which could lie outside academia and instead within policy and industry. Greater fluidity between academia and industry should be actively encouraged to facilitate the reciprocal exchange of key skill sets and support the commercialisation of academic research. The following examples illustrate a number of models of successful academia-industry partnership working and co-development that are currently active in Scotland.

- *The SEFARI network of research institutes deliver the Scottish Government-funded Strategic Research Programme (SRP), which addresses key mid- to longer-term challenges for Scotland's environment, agriculture, land use, food and rural communities.*[3] *More generally, the SEFARI network serves as a model for how government funding can be elevated by private funding to support multiple streams of rapid response, medium-term and long-term research priorities.*
- *Through its association, the Scottish whisky sector declared a non-competitive zone around sustainability and environmental performance, with members sharing their knowledge and technologies to support collective industry advancement.*[4] *Additionally, the industry funds its own research institute.*[5] *Beyond these zones, the individual members remain fiercely competitive. This could be a valuable model to propose for other industry sectors.*
- *The Leverhulme Trust's*[6] *investment in forensic science research in Dundee attracted further funding through the Tay Cities Regional Deal to create an institute of innovation for this area, bringing interdisciplinary professional practice, industry, research and public engagement together to create an agile and responsive new economic cluster supporting the use of science in the justice space.*[7]
- *Scottish Water's investment in the Scotland Hydro Nation Chair within Scotland's international Environment Centre will build an agile research and innovation community within Scotland to support the delivery of net zero across the water sector at pace, an initiative which has drawn significant interest from across the UK's water industry.*[8]

**19** Fundamentally, the UK must precipitate a culture change that minimises the risks associated with failure. Successful innovation is by its nature built on multiple cycles of trial and error. Unfortunately, failure is often regarded in absolute rather than relative terms, which can deter individuals who are otherwise inspired to undertake bold research to revert to safer alternatives. Academia and industry must make allowances for – if not explicitly encourage – failed attempts, recognising these are often the precursors to successful innovation.

## 7 How well does the UK collaborate on research with international partners and what can it learn from other countries?

- *In which areas of science and technology is collaboration, or negotiating access to existing projects, more appropriate than competition or seeking comparative advantage?*

**20** The UK has traditionally had close associations with the global scientific community, attracting high-calibre foreign students and staff and, likewise, exporting domestic talent to forge and strengthen collaborations abroad.

3 SEFARI. (n.d.). *Our work*. https://sefari.scot/research
4 Scotch Whisky Association. (n.d.) *Scotch whisky sustainability*. https://www.scotch-whisky.org.uk/insights/sustainability/
5 Scotch Whisky Research Institute. (n.d.) *About SWRI*. https://www.swri.co.uk/about-1.html
6 Leverhulme Research Centre for Forensic Science. (n.d.) *Leverhulme Research Centre for Forensic Science*. https://www.dundee.ac.uk/leverhulme/
7 University of Dundee. (2021). *University welcomes Tay Cities Deal*. https://www.dundee.ac.uk/stories/university-welcomes-tay-cities-deal
8 Hydro Nation Chair. (n.d.) *Hydro Nation Chair*. https://www.hydronationchair.scot/

**21** However, recruitment of international graduate students, post-doctoral researchers and independent academics has suffered in the wake of Brexit due to higher fees, concerns around immigration requirements and career progression, and a heightened atmosphere of xenophobia. This loss has also taken place in the other direction, with considerable numbers of established academics choosing to leave the UK for more secure futures overseas. The UK's withdrawal from the Erasmus+ programme has exacerbated these effects and the details of the replacement Turing Scheme have yet to be adequately established, prompting continued uncertainty about the future of academic exchange with Europe. Coupled with the fact that job creation is outpacing the number of qualified graduates in fields such as engineering, data science, and technology including aerospace, the UK is experiencing significant labour shortages in the very sectors it has identified as being central to its continued economic development and future prosperity.[9]

**22** Britain's continued access to European funding schemes has also been called into question and could compromise the sustainability of UK projects and international partnerships that rely heavily on this form of funding. Although the UK has stated its intention to remain formally associated with Horizon Europe, it is not yet clear how this would work in practice. The UK cannot afford further delays in clarifying its new relationship to Horizon Europe as researcher confidence has already suffered and the long-term viability of many research projects hangs in the balance.

**23** The UK has long enjoyed positive working relationships along the North/South axis. The advantages of these collaborations have been twofold in that researchers from developing countries could benefit from greater investment and resources, while developed countries such as the UK had a direct line to potentially global threats such as emerging pathogens and extreme weather events, increasing the likelihood these risks could be identified and mitigated at an early stage. Regrettably, funding cuts to Official Development Assistance have undermined this relationship and the UK should make an effort to identify alternative means of supporting these important collaborations. Strong North/South research associations will also be a key part of meeting the UN Sustainable Development Goals.

9 IET. (2021). *Addressing the STEM skills shortage challenge*. https://www.theiet.org/media/8186/addressing-the-stem-skill-s-shortage-challenge-report.pdf

## *Additional Information*

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Responses are published on the RSE website (https://www.rse.org.uk/)

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*Advice Paper (Royal Society of Edinburgh) ISSN 2024-2694*