



**National Physical Laboratory**

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## Response to the future frameworks for international collaboration on research and innovation call for evidence

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The National Physical Laboratory (NPL) is the UK's National Metrology Institute and is at the heart of the National Measurement System that provides the measurement infrastructure that underpins the UK's prosperity and quality of life. Along with partners, BSI and UKAS, it provides the UK Quality Infrastructure (UKQI). NPL conducts measurement research across a wide range of areas to support established and emerging technologies and industries.

NPL is part of the global network of National Metrology Institutes and other bodies around the world, working together to provide the measurement and standards infrastructure required to support research and innovation, underpin global business and trade, improve the quality of life and sustain the global environment. NPL is a highly influential member of this community and is globally recognised for its world class and world leading measurement science capability.

### **1. Methods by which new funding arrangements can:**

- **support research discovery of outstanding quality in all disciplines through international partnerships;**
  - **attract to the UK researchers of outstanding capability from around the world; and**
  - **attract further R&D investment to the UK, thereby contributing to the Government's 2.4% agenda**
1. The UK is recognised as having world-class universities and this attracts individuals and organisations that require access to this component of the R&D landscape. Protecting this excellent academic reputation (including its openness to international collaboration) is critical. However, one way to further grow the scale and broaden the range of organisations investing in R&D in the UK, is to build on and promote the UKs "translational" research sector (PSREs, Catapults, RTOs etc.). Providing access to skills and facilities to support this expensive stage of the R&D cycle would make the UK an even more attractive place for R&D intensive organisations.
  2. Global academic collaborations such as CERN have demonstrated the value to the UK (and industry) of such activities. Other challenge/application led activities such as UK fusion (e.g. JET) have also been successful in bringing European R&D to the UK. Government may want to explore the possibility of more bilateral arrangements for the joint hosting of research and development institutes, offering shared space and facilities and the opportunity to work collaboratively on areas of shared interest.
  3. There are other areas where international collaborations or networks exist, and it would be valuable for the UK to explore how to maximise the benefit of these (e.g. the wider UKQI network, Nuclear R&D, Weather and climate via the Met Office).

4. NPL is part of a global network of National Metrology Institutes (NMIs). The redefinition of four of the units in the International System of Units of Measurement (SI), which came into effect on May 20<sup>th</sup> this year represents decades of collaborative research and is the most significant change to the SI since its creation. The SI is a globally adopted system, used by scientists and industry to support trade all over the world, ensuring comparability and traceability of standards. The changes to the SI have helped to future proof the system. NPL played a major role in this and other NMI activities.
5. NPL's scientific excellence and influence attracts researchers from other NMIs, provides opportunities to supply instrumentation to other NMIs (with direct benefits for industry – for example the Kibble Balance to enable realisation of the Kilogram, the antenna testing range for the National Institute of Metrology in China), and enables us to influence the focus of international collaborations in measurement science. Seed funding to increase the scale or capitalise on opportunities in these areas would make a significant difference.
6. It will not be possible to meet the Government's target of increasing research and development spending to 2.4% GDP without greatly increasing the size of the UK research workforce. It is essential that the UK has enough researchers at all stages of their careers and **with skills appropriate to all parts of the R&D landscape**. We must support the development of UK research talent but also actively recruit excellent researchers from outside of the UK. The latter requires a sufficiently flexible and open visa system, and both require a career infrastructure which incentivises good researchers to establish their careers here.
7. Support should be available to enable high quality post graduate students to spend time in UK universities, in industry and in "translational" research institutes such as NPL.
8. NPL's Postgraduate Institute for Measurement Science is focussed not only on ensuring excellent science and engineering, but also on ensuring the individuals are "industry ready".
9. For experienced researchers, Fellowships should be made available that will enable them to spend time in teams and use the wide range of specialised facilities available at UK research institutes, universities, within industry and in "translational" research organisations. For example, at NPL researchers can participate in collaborations aimed at directly addressing national and international challenges (e.g. productivity, climate change, ageing population) in collaboration with world-class universities and industry (large and small).
10. It is also important for researchers to understand the regulatory landscape and how standards can promote innovation – opportunities for engagement with the organisations that support the UK Quality Infrastructure are valuable in enhancing their value (and attractiveness) to employers.
11. For the last 1.5 years NPL has run an International Measurement Fellowship scheme, funded by the National Productivity Investment Fund (NPIF). This scheme aims to attract and retain world class capability to the UK in the area of measurement science, in fields where there is a particular skills shortage (Data Science and Quantum Technology). Putting this funding alongside university fellowship schemes creates the opportunity for collaborative research and attractive career pathways for ambitious talent in both academic and "translational" parts of the R&D landscape.

## 2. The optimum balance of emphasis for any new funding arrangements in each of the following dimensions:

- **European collaboration, Overseas Development Assistance and global collaboration;**
  - **support for: outstanding individuals; blue-skies research; business innovation and research impact; and research facilities and infrastructure; and**
  - **research and innovation domains (research disciplines, business sectors etc).**
12. Within Europe the Framework Programmes, such as Horizon 2020, and the European Metrology Research Programmes EMRP & EMPIR have been very successful mechanisms for encouraging collaborative research. In the past NPL has played a leading role in shaping the metrology programmes to ensure they are focussed and built around the impact they aim to deliver (e.g. to healthcare, energy and the environment) rather than scientific discipline. The next stage of the evolution of these programmes is creating European networks of research in particular application areas. Having a major, and ideally a leading role in such activities will naturally create a centre of gravity in the UK for this work in Europe, with the opportunity to influence the direction and attract R&D to the UK in application areas of interest and value to the UK. It is important therefore that the UK is able to participate as fully as possible in these future programmes.
13. Alongside these important EU collaborations we see opportunities for greater collaboration with our counterparts in other parts of the world. NIST, in the USA, clearly has a strong track record, including 5 Nobel prizes. China and Singapore offer opportunities to work in areas of significant growth and there is potential for overseas development assistance with partners in Africa.
14. For international research to achieve maximum impact and to ensure UK industry can be best positioned to benefit it is essential that the appropriate Quality Infrastructure is considered as early as possible. Engaging the Measurement, Standards and Accreditation communities (e.g. UKQI) is essential to ensure that the applications and outputs of research either meet required standards, can undergo conformity assessment and be accredited, and that new international standards are shaped so as to support rather than disadvantage UK industry.
15. It is important to note that as funding arrangements have differing purposes, they also have differing criteria for demonstrating their success. For ODA funding, focusing on the innovative use of and the development of research with a range of applications including education and training can be very impactful.
16. Recently much ODA funding has been targeted primarily on conducting new research, e.g. “The Global Challenges Research Fund (GCRF) is a £1.5 billion fund... to support cutting-edge research that addresses the challenges faced by developing countries”<sup>1</sup>. Excluding the applications of new research (e.g. excluding translational activities) can seriously limit the impact of the research and the ODA funding. The innovative development, applications, training and other outputs of existing research and knowledge could be better utilised for positive impact, ensuring that the most benefit is derived from research.
17. Within the UK the Industrial Strategy, global challenges are the primary drivers of where NPL are targeting its research. Internationally the drivers will be different across each

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<sup>1</sup> <https://www.ukri.org/research/global-challenges-research-fund/>

country depending upon its areas of focus. For ODA related activities the UK could consider how to better align research and innovation activity with the UN Sustainable Development Goals<sup>2</sup>.

### **3. Methods and timescales for introducing any new funding arrangements for international collaboration, including those that**

- **reflect the ambitions of small and large businesses**
- **foster new systems of international peer review and funding**

18. Any system involving funding from multiple countries requires flexibility as funding cycles and speed of decision making will differ. Use of in-kind funding mechanisms can be easier to agree than cash-based mechanisms when dealing with government owned or funded organisations but need appropriate audit.
19. As described above, NPL's scientific excellence and influence provides opportunities to supply instrumentation to other NMIs. In nations with emerging or rapidly developing Measurement Systems this provides the opportunity to introduce UK technology/knowhow into the flagship institution (NMI) which can be a showcase as the wider infrastructure in the country is built up. The German Government has been very successful with its programme. PTB, NPL's German counterpart, has a Department funded by the German Agency for International Cooperation which operates to establish and support the quality infrastructure in developing countries in Africa, Asia and Latin America as well as supporting the Accession States of the European Union. The Department also works closely with the World Bank and UNIDO. This has been successful in showcasing and promoting German technology. NPL has only been able to do this on a very limited scale providing training to the Georgian National Agency for Standards and Metrology (GEOSTM), and the Standards Organisation and Weights and Measures Department, of the Federal Ministry of Industry, Trade and Investment Nigeria. It would be valuable to explore how more could be made of this.
20. For businesses wanting to move onto the international stage, it will be important to build their skills and capability within an international context. There are opportunities to exploit the international infrastructure that exists within the global network of National Metrology Institutes, UK Universities that have an overseas campus and other research organisations that have international sites to support UK business.

### **4. The roles of Government, UKRI, National Academies and other organisations in defining the agenda for European and international collaboration and administering any new funding arrangements for such activities.**

21. Mechanisms such as the Newton Fund have made use of a range of delivery partners, but it would be good to further broaden the stakeholders involved in defining the agenda to include other Government funded research institutes and partner organisations, as well as representation from organisations that provide the quality infrastructure required to deliver research and innovation. In addition, we would wider representation from industry in such programmes.
22. NPL would welcome an opportunity to be more involved in administering activities, NPL has significant experience of delivering the administration of the EMRP/EMPIR programmes

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<sup>2</sup> <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

under contract to the European Association of National Metrology Institutes (EURAMET). These programmes, based on Article 185 of the Lisbon Treaty, are implemented by EURAMET under a delegation agreement between the European Commission and EURAMET. The budget is 400 M€ and 600 M€ respectively and they involve participants from over 23 countries. The Management Support Unit, at NPL, which manages them is ring fenced to ensure its independence from the research performing part of NPL and receives excellent feedback from EURAMET and the Commission.

#### **5. Existing evidence on the efficiency and effectiveness of funding for international collaborations.**

23. The European Association of National Metrology Institutes (EURAMET) has a wide range of published evidence demonstrating the impact of collaborative European metrology research programmes<sup>3</sup>.

#### **6. Any other issues relating to this work that you wish to bring to our attention**

24. It is important that the UK continues to engage in strategic dialogues to identify joint areas of interest and where collaboration would be beneficial to drive research forward.
25. The UK has world leading quality infrastructure, more could be done to capitalise upon the reputation and relationships that have already been built internationally.

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<sup>3</sup> <https://www.euramet.org/research-innovation/>