

31 May 2019

Royal Society submission to the Sir Adrian Smith call for evidence on future frameworks for international collaboration on research and innovation

Executive summary

- Excellent research and innovation is increasingly international and the UK has strong relationships around the world, which it needs to preserve and extend.
- Internationally excellent collaboration requires three essential ingredients – mobility (of people in and out of the UK), money (that can move across national borders within projects) and common mechanisms (so that collaborations can embrace several countries at once).
- These principles should underpin the UK's future international research and innovation strategy.
- In the short-term, **seeking full association with the next EU Framework Programme – Horizon Europe – is by far the best option** to maintain strong international collaborations in Europe and beyond and to instil confidence in our international partners.
- The evidence supports this conclusion. Analysis undertaken for this submission finds that 33.5% of UK research papers are co-authored with other EU and associated countries in the Horizon 2020 bloc, compared with 17.6% with the USA. The rate of UK scientific co-authorship with the Horizon 2020 bloc is also increasing faster than with the USA.
- The UK government should commit money now to fund the closest possible association to Horizon Europe, ensuring that excellent research and innovation receives at least the same support as it does through the current programme Horizon 2020
- If association to Horizon Europe is not possible, it is important to develop UK funding mechanisms that replace those operated from the EU.
- The European Research Council (ERC), which funds investigator-led discovery research would be a major loss. The UK should develop an alternative approach to supporting this activity along with the Marie Skłodowska-Curie Actions (MSCA) programme, shaped by the principles of independence and excellence, and underpinned by a protected budget providing certainty and stability.
- Steps must also be taken to replace the EU SME Instrument and ensure that the UK can buy into Framework Programme funding which is open to third country participation.

Introduction

1. The Royal Society is the national academy of science for the UK and Commonwealth. A self-governing Fellowship of many of the world's most distinguished scientists, it draws on the expertise of Fellows and Foreign Members to provide independent and authoritative scientific advice to UK, European and international decision-makers. It is a funder of research across the UK and the rest of the world.
2. The Society welcomes the opportunity to respond to Sir Adrian Smith's review on the design of future UK funding schemes for international collaboration, innovation and curiosity-driven blue-skies research and would be happy to discuss any of the issues raised in this submission. It is also willing to support the development of any outputs from the commission's work.
3. In the sections below, EU member states and countries associated to Horizon 2020 – the EU Framework Programme for research and innovation – are referred to in shorthand as the 'Horizon 2020 bloc'. We refer to 'curiosity-driven blue skies research' as 'investigator-led discovery research'.

The importance of international collaboration to UK research and innovation

4. Scientific research and innovation is essential for UK jobs, health and wellbeing, and improving quality of life for us and people around the world. It also plays a role in shaping our relationship with other countries.
5. World-leading UK science is not produced in isolation. Research constantly builds on the body of knowledge developed through the work of researchers across the world, progressing it further and in new directions. That often means collaborating with scientists, and using facilities, outside the UK.
6. The UK government has recognised the importance of research and innovation in securing our future prosperity as a country. If the UK is going to achieve the target set out in the Industrial Strategy of investing 2.4% of GDP in R&D by 2027, we must maintain and grow our international scientific research through collaborations with Europe and beyond and attract R&D intensive businesses to locate in the UK.
7. To achieve this, we need the following:
 - a. **Highly-skilled researchers continuing to move to the UK for study and work.** At present, 30% of academic researchers based in the UK are from overseas with a larger proportion in engineering and technology (43%) and biological, mathematical and physical sciences (39%)¹. Overseas nationals comprise more than half of postgraduates across all disciplines.²
 - b. **Strong partnerships to support and grow the sharing of ideas and collaborations with talented researchers around the world.**
 - c. **A strong research and innovation base with a diversity of funding sources** supporting a mix of activities from discovery research to innovation and appropriate infrastructure.

The principles that make for 'excellent' collaboration

8. Internationally excellent collaboration between researchers in different countries requires three essential ingredients: mobility, money and common mechanisms.
9. Any decisions on the UK's international research and innovation strategy must effectively address all three:
 - a. **Mobility** | Researchers need to be able to move frequently across borders for short and long-term project work, sometimes at short notice. Mechanisms that allow for movement without bureaucratic hindrance are a competitive advantage.
 - b. **Money** | In order to facilitate excellent collaboration, research teams need the ability to move funding across country borders.
 - c. **Common mechanisms** | Effective collaboration requires partners from several countries. Bilateral agreements do not deliver the necessary common mechanisms.
10. This is the right moment for a critical review of our future ambitions for international collaboration on research and innovation, and how we best deliver them. However, such an exercise should not start from a blank slate, and must identify where the UK could build on existing networks and relationships, and foster new ones. In shaping our future, we must guard against the erosion of existing strengths.

¹ Universities UK (2018), 'Higher education in facts and figures 2018'

² Higher Education Statistics Agency (2019), 'Higher Education Student Statistics: UK, 2016/17 – Where students come from and go to study'

Why association to Horizon Europe can deliver the UK's future ambitions for international collaboration on research and innovation

11. **Securing association to the next EU Framework Programme – Horizon Europe – is by far the best option for the UK to maintain strong international collaborations in the EU and around the world and to instil confidence in our international partners.**
12. This option effectively addresses the three principles above in the following ways.
13. The EU Framework Programmes offer clear solutions on:
 - a. **Mobility** | Within projects researchers can move between countries with no barriers of administration.
 - b. **Money** | EU funded collaborative research projects deploy their budgets to maximise value for money. This may involve redistributing funds across borders during the lifetime of the project and EU Framework Programmes provide the legal mechanisms for this to happen.
 - c. **Common Mechanisms** | Horizon 2020 and its predecessors have provided an established, well-respected and unique multilateral platform for engaging that permits collaborations across multiple countries in any given project through the EU's 'open to the world' strategy³.
14. The Framework Programmes have also leveraged inward investment to the UK of €9.6 billion and helped generate a total of €16.6 billion in R&D expenditure in 2007-2016.⁴
15. Association offers a number of advantages that could not be delivered through individual bilateral agreements. These include:
 - a. **Access to international peer reviewers** | High quality peer review requires a large pool of deep expertise to provide assessors who are independent of applicants. Large international programmes which can attract overseas reviewers and incentivise them to take part is required to ensure peer review is of the highest standard.
 - b. **Facilitating access to international markets** | Access to international markets influences companies' decisions over whether to invest in the UK. A Technopolis report for the National Academies in 2017 found that more than half of firms that participated in Framework Programme 7 reported improved access to other European markets as a result.⁵
 - c. **Diversity of funding sources beyond those available in a single country** | Access to EU Framework Programmes creates a plurality of funding sources across all fields.
16. The EU Framework Programmes have had demonstrable impact in growing UK collaborations with European partners. New analysis contained in this submission finds that:
 - a. **Collaborations with researchers from the Horizon 2020 bloc** account for **33.5%** of UK research papers. In certain fields, the proportion is even higher (41.2% in natural sciences).
 - b. **Collaborations with the USA** – the UK's most frequent individual country partner – account for **17.6%** of UK papers, with five EU member states and Switzerland among the UK's top ten strongest individual country collaborators.

³ http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm [accessed 10 May 2019]

⁴ J Haskel et al (2014), 'The economic significance of the UK science base: a report for the Campaign for Science and Engineering'

⁵ Technopolis (2017), 'The role of EU funding in UK research and innovation'

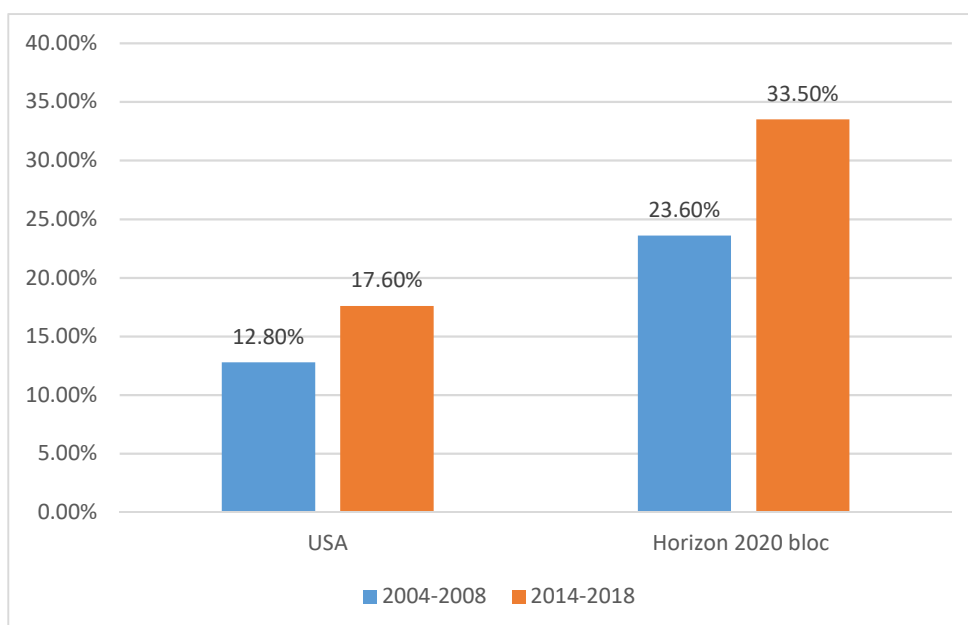
- c. **While the trend is for greater international collaboration overall, the UK's international collaboration with the Horizon 2020 bloc is rising faster than with the USA.**
- i. Comparing two four year periods, 2004-2008 and 2014-2018, **the percentage of UK papers co-authored with the USA increased by 4.8 percentage points** (from 12.8% to 17.6%).
 - ii. Over the same time period, **the percentage of UK papers co-authored with the Horizon 2020 bloc increased by 9.9 percentage points** (from 23.6% to 33.5%).

Figure 1: Comparing the UK's largest collaborators across all research fields 2014-2018

	Total number of papers published by country/bloc (2014-2018)	Number of papers co-authored between the UK and the partner country/bloc (2014-2018)	Percentage of UK papers co-authored with the partner country/bloc (2014-2018) UK total = 682,414
Horizon 2020 bloc	2,783,573	228,773	33.5%
USA	2,225,226	120,406	17.6%

Source: Clarivate Analytics findings for the Royal Society (May 2019)

Figure 2: Change in the percentage of UK papers co-authored with the USA and Horizon 2020 bloc (2004-2008 compared with 2014-2018)



Source: Clarivate Analytics findings for the Royal Society (May 2019)

17. These data show the growing value of international collaboration to UK research and innovation generally and the particular value of working closely with European partners. Further detail is appended in Annex 1.

Actions the UK government should take now

18. While it is not possible to confirm the UK's relationship with Horizon Europe until the text has been formally agreed, the UK government can provide certainty by earmarking additional public

funds in the forthcoming Spending Review to enable association. This funding should match the level of support that the UK currently receives from Horizon 2020 (see Annex 2).

19. Any break in funding would immediately erode the UK's existing international relationships and must be avoided.
20. Alongside the Spending Review, the UK government should:
 - a. create an internationally competitive visas and immigration offer which recognises the importance of all roles within the research system, attracts and retains exceptional talent (for example, by affording a Tier 1 visa to any researcher in receipt of ERC or equivalent grant funding), is low cost and low burden, delivers reciprocal arrangements with other countries on short-term outward mobility, offers ease of access to close family members, and streamlines visa processes for visitors.
 - b. publish a 2.4% roadmap, including public spending commitments up to 2027, to provide certainty to the research and innovation community and confidence to those investing in UK R&D.
 - c. establish an independent oversight board to offer expert advice on international research and innovation.

How can we ensure that there is no erosion of UK research and innovation if association to Horizon Europe is not possible

21. If associating to Horizon Europe is not possible, it is important to consider the most appropriate course of action. Given the established benefits of participating in EU Framework Programmes, and the short-term imperative to maintain collaborations and instil confidence in UK research and innovation, the priority in this scenario should be to:
 - a. underwrite UK access to EU programmes open to third countries; and
 - b. develop domestic alternatives to those which are open to EU member states and associated countries only
22. In the longer-term, the UK should retain the ability to adapt to changing global circumstances as part of an evolving international research and innovation strategy.

Priority a) | Buy into collaborative programmes open to third country participation

23. Once the UK leaves the EU, it can participate in the EU Framework Programmes as a third country, providing access to the majority of the collaborative elements of Horizon Europe on a 'pay to play' basis. These schemes currently provide close to €1 billion for UK research and innovation annually (see Annex 2) and the UK government should seek to match this to ensure that UK researchers can continue to apply.
24. One approach would be for UK Research and Innovation (UKRI) to allocate funds to support this activity as a cross-cutting programme, similar to the Global Challenges Research Fund and Newton Fund.
25. **The funding should be governed by the principle that UK-based researchers should be able to participate in all funding calls that they believe to be appropriate and valuable.**
26. The UK government should be confident in EU grant allocation processes rather than risk a process of 'double jeopardy' where proposals are subject to both UK and EU scrutiny. This would prove highly draining of resources and be inefficient without adding any value.

Priority b) | Replace investigator-led discovery research and innovation programmes not open to third country participation

27. As a third country, UK-based researchers would not be able to access monobeneficiary schemes under Horizon Europe including the European Research Council (ERC), some Marie

Skłodowska Curie Actions (MSCA) grants, or the SME Instrument. These schemes bring in around €500 million of research and innovation funding to the UK annually (see Annex 2).

28. Particularly important to UK science are the individual grants for investigator-led discovery research provided by the ERC and support for travel and exchanges afforded through MSCA.⁶ Taken together, these two schemes alone have accounted for around half of the total value of fellowships and investigator awards for UK researchers⁷ and have also played a critical role in building partnerships.
29. Analysis for the Royal Society by Thomson Reuters found that while ERC does not require international collaboration, 58% of ERC funded research between 2005 and 2014 had co-authors based in other countries – a higher proportion than that supported by the UK Research Councils during the same period.⁸
30. **Loss of access to these programmes would have a significant impact on the diversity of the UK's research and innovation system, particularly support for valuable discovery research, which would erode its strength and its ability to build international collaborations.**

Future Fund (replacing ERC and MSCA)

31. If association to Horizon Europe is not possible, the UK government should establish a Future Fund specifically focused on supporting excellent discovery research to take place in the UK – effectively replacing the valuable schemes operated by ERC and MSCAs across two separate streams.
32. The operation of the Future Fund should be underpinned by three key principles:
 - a. **Independence** | The Fund should be overseen by an independent board of leading UK and international researchers chosen on the basis of their expertise who set the organisation's strategic direction under the Haldane principle and oversee its operation.
 - b. **Excellence** | The Fund should be allocated on the basis of excellence – defined as “ground-breaking nature, ambition and feasibility of the research project and the intellectual capacity, creativity and commitment of the Principal Investigator” – and open to talented people from around the world who would like to come and work in the UK.
 - i. The Fund should be split into two separate streams – mirroring ERC and MSCA – which support researchers at different career stages to work with excellent people, wherever they are. This will ensure funding that gives heavy weighting to track record (ERC's prominent criterion for selecting grants) as well as schemes designed to support post-docs and PhD students (akin to MSCA).
 - ii. It should be ambitious to develop a world-class reputation and should support international collaborations and collaborations with EU research funding programmes where appropriate
 - iii. Funding decisions should be transparent with clear operational aims and accountability from the outset.
 - c. **A protected budget providing certainty and stability** | The funding should be ring fenced and index linked to the UK's overall R&D budget to prevent support being allocated to other priorities and be governed by the Haldane principle.

⁶ The Royal Society (2018), 'Position paper on Framework Programme 9'

⁷ Technopolis (2017) 'The role of EU funding in UK research and innovation and European Commission'

⁸ Royal Society (2016) 'UK research and the European Union: The role of the EU in international research collaboration and researcher mobility'

- i. Delivery partners should be provided with specific allocations for existing and new programmes that support activity.
 - ii. The current EU research programmes provide funding over seven-year periods. This certainty and stability is very valuable and the UK government should seek to replicate it.
 - iii. The fund should be provided with sufficient budget to ensure that UK research and innovation receives at least the same support as it currently does through Horizon 2020 and should increase in proportion with overall UK public investment in R&D.
33. To fulfil these principles, the new Fund must have the maximum independence in terms of governance and its ability to distribute funding. The governance model for securing this outcome must be subject to detailed discussion between the UK government and the research and innovation community.
34. Annex 3 sets out the principles that should specifically govern the operation of the Future Fund as agreed by the National Academies.

Innovation Fund (replacing *SME Instrument/European Innovation Council*)

35. Whilst EU funding makes up for a small proportion of total UK business expenditure on research & development (R&D), EU sources comprise 17% of the R&D for UK SMEs, which received over £650 million between 2007 and 2013⁹. This support has facilitated improved access to other European markets and brought a range of non-monetary benefits including strategic collaboration, competitor monitoring, agenda setting and market appraisal.¹⁰
36. It is important that monobeneficiary funding provided by the EU is replaced in the event that the UK loses access. The governance model should recognise the following principles for exploiting new ideas and market making:
- a. **Reflect UK strengths** | The UK has one of the best environments for starting new knowledge-based businesses. It is important that in the context of the creation of the European Innovation Council, it does not lose this advantage. The founders of the best start-ups will already have many reasons to base their business in the EU (including access to a larger market, deeper talent pool) and it is important to look at the system from their perspective, and to make the UK a most attractive offer. It is vital the UK continues to make the most of its strong research base, financial environment and liberal approach to regulation for small businesses.
 - b. **Focus on high potential businesses** | We must be willing to focus support on the businesses with highest potential in the manner of the EU's SME Instrument to maintain a competitive environment, but there is no need to replicate closely EU models.
37. These recommendations aim to replicate some of the benefits of the current EU Framework Programmes. However, we emphasise that any alternative would fall far short of full association to Horizon Europe which is by far the best option.

For further information, please contact the Royal Society's public affairs team on public.affairs@royalsociety.org

⁹ Technopolis (2017), 'The role of EU funding in UK research and innovation'

¹⁰ Technopolis (2017), 'The role of EU funding in UK research and innovation'

Annex 1 – Summary of Clarivate Analytics findings produced for the Royal Society

- Horizon 2020 bloc = aggregate of EU member states and associated countries
- Co-authorship figures are for the period 2014-2018 (2004-2018 used as the basis for comparison in categories 9 and 11)

	CATEGORY	FINDINGS
1	Overview (across all fields in aggregate)	<ul style="list-style-type: none"> • The UK co-authors more papers with the USA than with any other individual country (n = 120,406) • The UK co-authors more papers with the Horizon 2020 bloc (n = 228,773) than with the USA • Collaborations with the Horizon 2020 bloc account for 33.5% of UK research papers. Collaborations with the USA account for 17.6%.
2	Natural sciences	<ul style="list-style-type: none"> • The UK has similar patterns of international co-authorship in the Natural Sciences to those observed for all fields in aggregate. • Collaborations with the Horizon 2020 bloc account for 41.2% of UK papers. Collaborations with the USA account for 21.8%.
3	Engineering and technology	<ul style="list-style-type: none"> • The UK co-authors more engineering and technology papers with China than any other country. In all other fields, the UK co-authors more papers with the USA than with other individual countries.
4	Medicine and health sciences	<ul style="list-style-type: none"> • The UK has similar patterns of international co-authorship in the medical and health sciences to those observed for all fields in aggregate. • The UK co-authors relatively few papers with China in this field.
5	Agricultural sciences	<ul style="list-style-type: none"> • Overall numbers of research papers are relatively low in this field • The UK has similar patterns of international co-authorship in the agricultural sciences to those observed for all fields in aggregate.
6	Social sciences	<ul style="list-style-type: none"> • The UK has similar patterns of international co-authorship in the social sciences to those observed for all fields in aggregate.
7	Humanities	<ul style="list-style-type: none"> • Rates of international co-authorship are generally low in the humanities.
8	Percentage of papers with international co-authors	<ul style="list-style-type: none"> • The percentage of UK research papers with international co-authors is higher in the sciences, engineering and technology than in the social sciences and humanities (e.g. natural sciences 68.9% v social sciences 39.7% v humanities 13.4%)
9	Changes in UK-international collaboration – 2004-2018 compared with 2014-2018	<ul style="list-style-type: none"> • The percentage of UK papers co-authored with the USA increased more rapidly between 2004-2008 and 2014-2018 than rates of co-authorship with any other individual country, from 12.8% in 2004-08 to 17.6% in 2014-18 – a 4.8 percentage point increase. • However, the percentage of UK papers with a the Horizon 2020 bloc has increased even more rapidly, from 23.6% in 2004-08 to 33.5% in 2014-18 – a 9.9 percentage point increase

10	Percentage of UK papers with international co-authors by Web of Science Journal Subject Category	<ul style="list-style-type: none"> The percentage of UK papers with at least one international co-author varies by discipline, but is generally higher in global health topics, certain areas of physics, earth sciences and space science.
11	Changes in UK-international collaboration by Web of Science Journal Subject – 2004-2018 compared with 2014-2018	<ul style="list-style-type: none"> In general the research areas where the percentage of UK research papers with an international co-author has increased most rapidly (2004-08 to 2014-18) tend to relate to engineering and technology subjects.

The UK's top collaborators across all research fields 2014-2018

Country/bloc	Total number of papers published by country/bloc (2014-2018)	Number of papers co-authored between the UK and the partner country/bloc (2014-2018)	Percentage of UK papers co-authored with the partner country/bloc (2014-2018) UK total = 682,414
Horizon 2020 bloc	2,783,573	228,773	33.5%
USA	2,225,226	120,406	17.6%
Germany	586,406	64,199	9.4%
France	398,716	45,452	6.7%
China	1,591,646	43,723	6.4%
Italy	367,438	43,474	6.4%
Australia	352,256	42,655	6.3%
Netherlands	219,229	37,286	5.5%
Spain	314,807	35,787	5.2%
Canada	374,297	31,028	4.5%
Switzerland	167,301	27,138	4.0%

Source: Clarivate Analytics data and analysis for the Royal Society (May 2019)

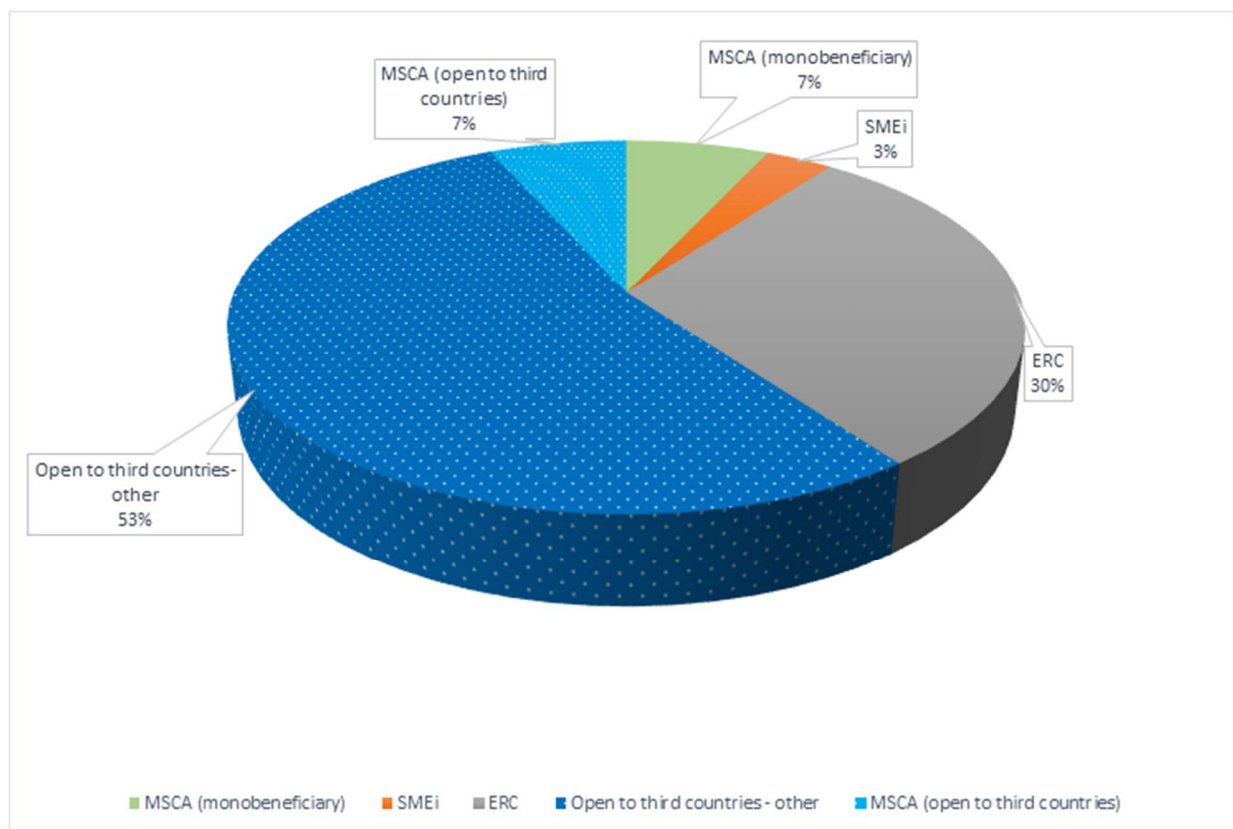
Annex 2 – The value of EU Framework Funding (Horizon 2020) to the UK

Net EU contribution to the UK (2015-2017) by Horizon 2020 programme

Programme	€2015-17	€2015	€2016	€2017
MSCA (monobeneficiary)	273,071,215	112,180,221	87,819,215	73,071,780
SME Instrument	127,040,316	58,373,945	47,996,127	20,670,245
ERC	1,168,785,174	380,847,895	422,571,539	364,335,741
Monobeneficiary – total	1,568,896,705	551,402,061	558,386,881	458,077,766
Other H2020	2,099,584,202	848,888,701	691,841,982	559,883,515
MSCA (open to third countries)	261,844,139	88,397,995	96,050,224	77,395,920
Open to third country – total	2,361,428,341	937,286,696	787,892,206	637,279,435
Total value € 2015-2017	3,930,325,046	1,488,688,757	1,346,279,087	1,095,357,201

Source: European Commission Webgate portal (accessed 28 May 2019)¹¹

Note: Monobeneficiary programmes are open to EU member states and associated countries only.
 MSCA = Marie Skłodowska-Curie Actions / ERC = European Research Council / SMEi = SME Instrument



¹¹ <https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/PbZJnb/state/analysis> [accessed 28 May 2019]

Annex 3 – Principles for the funding of investigator-led discovery research (Future Fund)

- a) **Support excellent investigator driven discovery research** | The funding should be awarded purely on the basis of the excellence of the research using high quality international peer review. Funded researchers should have the flexibility to change direction and follow their curiosity, given the flexibility to do so based on their track record.
- b) **Be awarded through open competition** | Funding should only be allocated through programmes which have a very broad disciplinary remit and which are not limited by thematic priorities (bottom up funding). The programme should reflect the full breadth of the disciplinary remit of the delivering organisation and should encourage transversal and plural disciplinary approaches.
- c) **Support disciplinary and inter/multi-disciplinary research** | As well as providing support for research within disciplines, programmes should also enable research which crosses traditional disciplinary boundaries by removing barriers.
- d) **Attract researchers to the UK** | All programmes should be open to researchers wishing to move their research to the UK in addition to being open to researchers already based in the UK. Successful researchers should be eligible (based on the existing immigration rules) for Tier 1 Exceptional Talent accelerated route to ensure improved access to the UK.
- e) **Protecting current funding for discovery research** | Both the Academies and UKRI (through the Research Councils) already provide funding for frontier research. It is essential that as any Future Fund is introduced that levels of funding for curiosity led research currently provided through the Academies and UKRI are maintained at least at the same level. The spread of disciplinary funding must also be maintained.
- f) **Availability of and access to high quality research infrastructure** | Continuing to support the development of high-quality research infrastructure in the UK, providing access to international partners to conduct high-quality research in the UK. Supporting international partnerships and programmes which seek to develop high-quality research infrastructure so that UK researchers can continue to access international research facilities.