1. Imperial College London’s mission is to achieve enduring excellence in research and education in science, engineering, medicine and business for the benefit of society. Imperial is one of the world’s top universities with the greatest concentration of high-impact research of any major UK university.¹

2. Investment in science, research and innovation needs to be balanced across the research ecosystem from fundamental discovery to applied research. Without well-funded basic research, there is no pipeline of discovery and breakthroughs that applied research can then build on to address future global challenges.

3. To maximize research impact and return on taxpayers’ investment, research funding must be based on excellence, irrespective of where it is found. Funding allocation based on international excellence is a critical feature of our research system – ranked 1ˢᵗ in the world for impact and quality² - which increases the quality of research.

4. We welcome improved involvement of the research community in Wave 3 of the Industrial Strategy Challenge Fund (ISCF).

**Effectiveness of public spending on R&D, including Industrial Strategy Challenge Fund**

5. UK public spending on R&D has been highly effective: through rigorous focus on excellence it has created a world-leading highly competitive sector.³

6. We welcome improved involvement of the research community in shaping Wave 3 of the ISCF. It is vital that the UK research base has strong involvement to ensure coherent support of the ISCF to the UK research and innovation ecosystem.

**Phasing the increase in R&D spending to meet the 2.4%/3.0% targets**

7. The pledge to boost spending to 2.4% will involve an increase in investment of c. £20bn a year by 2027. As indicated by the Industrial Strategy Green Paper, the current balance between public and private spending (1:2) roughly reflects that of our international competitors. If this balance is to be maintained, around a third of the additional investment will need to come from public sources and two thirds from the private sector.

8. We propose the below to increase industry investment:

- Expand Prosperity Partnerships with major partners (Shell, BP, Rolls-Royce) as well as new partners, who will need to be incentivised (if reliance on private funding is to increase, it has to include new partners)
- Increase support of Centres for Doctoral Training that attract high levels of industry support and engagement
- More opportunities to move between industry and academia
- Expand collaborative funding for PhDs through UKRI, in particular to enable larger numbers of SMEs to participate in CASE awards
- Flexible, rapid (light touch) reviewing is needed for small proposals (<£100k). Current research council funding application procedures are too slow to allow industry to address questions on timescales that matter to them.
- Block funding such as Impact Acceleration Account Knowledge Exchange funding is cost-effective and effective at advancing research and engagement with industry. Block funding should be significantly increased for leading universities (e.g. REF top 20).

**Rationale for deciding on the balance of public R&D funding**

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¹ See [Imperial has UK’s greatest research impact, finds REF 2014](December 2014)
² [International Comparative Performance of the UK Research Base](report by Elsevier for BEIS (October 2017)) - the UK ranks first amongst its comparator countries by field-weighted citation impact, an indicator of research impact and quality.
³ Ibid.
Dual support system

9. The dual support system for funding underpins our world-class research base, first in the world for both impact and quality. We welcome the legislative protection for the Haldane Principle in the Higher Education and Research Act.

10. There is clear evidence that publicly funded R&D creates a strong ‘multiplier effect’ and ‘crowds-in’ private sector, charitable and inward investment, stimulating around 30% more self-investment from industry. Building a pipeline of discovery will support future productivity and growth and we are working with the Government to achieve increased investment in R&D to 2.4% by 2027.

11. This increased investment would strengthen the research base as the Government negotiates continued access to European research programmes. Imperial currently has 295 participations in Horizon 2020, receiving a total of €178 million of funding – the 4th highest of all EU HEIs. European Research Council grants have supported research into nanomaterials and tissue engineering; the development of the AcuPebble, a wearable wireless diagnostic tool for a range of illnesses; and the European AIDS Vaccine Initiative led by Imperial.

• We urge the Government to prioritise seeking associate membership of Horizon Europe as part of the negotiation of a future relationship with the EU to minimise disruption to the science base as a result of Brexit.

Fundamental (pure) research

12. Investment in science, research and innovation needs to be balanced across the research ecosystem from fundamental discovery to applied research. Fundamental research at Imperial has led to unanticipated breakthroughs, in some cases after a significant time period had passed. For example:

• One of the world’s leading theoretical physicists Professor Sir John Pendry pursued fundamental research which led to the development of metamaterials that can create perfect lenses and cloak objects.

• Professor Steve Bloom’s revolutionary advances in appetite reduction therapies came from a breakthrough understanding of how gut hormones act as neurotransmitters some thirty years after initial discoveries. His research has been brought to society through two spin out companies and he is now working on an EU-funded project on a microchip to recognise and process signatures of appetite, mimic instructions to the brain and reduce the urge to eat.

13. Current research being undertaken at the College could lead to similarly transformational breakthroughs:

• Dr Luca Magnani’s genetic profiling of breast tumours has developed an understanding of a gene-activating molecule’s potential role in tumour growth and how it may allow tumours to adapt and evade treatment. Published in Nature Medicine and funded by the Wellcome Trust, Cancer Research UK and the European Union, the team studied which genes were switched on and off in the tumours – a process called epigenetics – which enables cancer tumours to adapt to their environment, evade treatment and survive longer. Through focussing on understanding this underlying fundamental biological process first, the team can now study larger patient samples and focus on a type of breast cancer that is very difficult to treat.

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4 International Comparative Performance of the UK Research Base, report by Elsevier for BEIS (October 2017) - the UK ranks first amongst its comparator countries by field-weighted citation impact, an indicator of research impact and quality.

5 The Economic Significance of the UK Science Base, Haskel, Hughes and Bascavusoglu-Moreau (March 2014)

6 UK’s participation in Horizon 2020, BEIS (February 2017)

7 See UK participation in horizon 2020: May 2018

8 See Nanotechnology to help rebuild bodies and detect disease, ERC (January 2013);

9 See www.imperial.ac.uk/people/e.rodriguez/research.html

10 See HIV scientists launch 23 million euro project to develop vaccine, Horizon 2020 (October 2015)

11 See Imperial physicist shares $1M Kavli Prize for perfect lens (May 2015)

12 See Hormone combination reduces appetite (March 2013)
• Professor Steven Rose is testing the Breit-Wheeler theory that suggests light can be directly turned into matter by smashing together two particles of light. This process, which creates an electron and a positron, could recreate processes crucial in the in the first 100 seconds of the universe. This research is in a similar category to the discovery of the Higgs boson particle – it is essential for understanding the fundamental physics of our universe as well as potentially leading to unexpected technological inventions.\(^\text{14}\)

14. Our international competitors recognise that a strong foundation of fundamental research results in discoveries that lead to truly new innovations. The **Chinese Government has increased spending on fundamental research** in response to concerns that their historic weakness in this area has hindered innovation.\(^\text{15}\) The recognition of the importance of basic research spend continued when China's total spending on R&D reached 1.76 trillion yuan (£215bn) in 2017.\(^\text{16}\) Across the Organisation of Economic Cooperation for Development (OECD), 22% of research budgets in 2013 were spent on basic research. Across the European Union, this proportion was 52% with Germany devoting 57% and France 45% of the government appropriation for R&D to basic research.\(^\text{17}\)

**Research excellence and impact**

15. To maximise impact, investment in R&D should be driven by excellence irrespective of where it is created.\(^\text{18}\) This is the fairest funding principle for the taxpayer. Regional economic development is not a primary responsibility of research funding.

16. Investment in research at Imperial drives high quality scientific output that has importance and impact way beyond our campus boundaries and **supports valuable collaborations with research partners across the UK for the benefit of society as a whole.** From 2015-2017 Imperial shared research grants with 106 UK institutions and from 2015-2017 Imperial co-authored publications with over 511 UK organisations (refer Fig 1 below).

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14 See [Experiments underway to turn light into matter](https://www.imperial.ac.uk/news/research/experiments-underway-turn-light-matter) (March 2018)
15 [Nature](https://www.nature.com) (March 2014)
17 [UNESCO](https://www.unESCO.org) (February 2017)
18 As Professor Graeme Reid, previously head of research funding in BIS, argues “…strong science is sustained by meritocratic allocation of resources based on peer review…” [National Centre for Universities and Business](https://www.ncub.org.uk)
17. **London’s scale and capacity to accelerate discovery into a vibrant and competitive science and innovation ecosystem provides an important source of translation for the UK.** The concentration of high-quality research at universities like Imperial and a thriving business culture drives productivity and growth right across the UK.

**Considering university and research funding holistically**

18. Recovery of full economic cost (FEC) of research activity is decreasing across the sector, thereby increasing institutional subsidy and threatening sustainability. Imperial is no exception to this.

19. International students make a significant contribution to Imperial’s financial sustainability:

- As a STEM-focused, research-intensive institution, we face a particular set of challenges in relation to financial sustainability. In the case of our undergraduate home students, we teach at a deficit of £2,650 per student per year. Tuition fees do not cover the full economic costs for high-cost science subjects. The higher tuition fees paid by non-EU international students provide a significant contribution to addressing the funding gap between home

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19. According to data published by the Office for Students (OfS), there is a “substantial deficit” in research funding, amounting to nearly £3.4bn in 2016/17.
tuition fee income and additional OfS teaching grant funding received by the College, and
the cost of delivering a world-class STEM education. At Imperial, non-EU overseas
students are projected to provide two-thirds of tuition fee income in 2017-18 and 2018-19.

- Any future restrictions on Imperial’s ability to attract international students would impact our
ability to conduct world-leading research and to teach domestic students. The Home Office
therefore has an important role to play in ensuring UK R&D is supported (both financially,
as well as to ensure access to talent and skills).

Effectiveness of and balance between levers for encouraging innovation

Strengthening university-business collaboration

20. Imperial has more than 500 corporate partners with whom we work closely on collaborative
research, applying academic intellect to address fundamental challenges, and developing
the next generation of talent to join the companies’ workforce. This takes the form of research
 consortia like the BP International Centre for Advanced Materials; capital projects like the Dyson
School of Engineering; or spin-outs like Permasense, Pulmocide and Topivert. In 2017/18 our
research income from industry was £61m (over 16% of total research income).

21. HEIF is very effective in helping universities translate research ideas, knowledge and
technology strengths into both economic and social impacts. The average return on
investment across the sector is £9.70 in benefits for the economy and society for every £1
invested, and considerably more when invested in the most research-intensive universities.20

- Lifting the cap on funding available to individual universities would allow us to build
on successful HEIF projects. For example, HEIF funding supported the creation of our
Enterprise Lab which encourages and supports student entrepreneurs through an
environment which facilitates peer collaboration and mentoring. The Lab is being extended
to include post-docs, early career researchers and flagship mentoring programme to
support our innovators and entrepreneurs,21 building on the MIT Venture Mentoring
Service. Extending this service, to staff for example, would be possible with additional HEIF
funding.

22. Some of our most productive university-industry collaborations involve co-location with staff from
our corporate partners. The R&D tax environment could be further reformed to incentivise
greater university-business collaboration and co-location. Uncertainty over liability for VAT on
new research facilities and the supply of research services create unnecessary barriers to co-
location and collaborations between businesses and universities.

- A targeted VAT exemption for new university buildings used for collaboration with business
would remove these disincentives. 22

23. Universities support innovation in multiple ways including: attracting young skilled people; spinning
out new companies based on new technologies and services; and attracting research-intensive
businesses to locate in the area.

- Our White City Campus is a new research and innovation ecosystem in the heart of West
London where a diverse community of researchers are co-locating and collaborating with major
corporates, start-ups and scale-ups, entrepreneurs and research partners to develop the next
generation of advanced technologies.23 The Transformation and Innovation Hub (I-HUB)
provides space for companies to work alongside Imperial researchers and turn scientific and
 technological innovations into new products and services. Opened in autumn 2018, the
Molecular Sciences Research Hub provides state-of-the-art equipment and infrastructure to

Assessment (October 2015)
21 https://www.imperial.ac.uk/enterprise/ivms/
22 Commons Science & Technology Committee ‘Managing intellectual property and technology transfer’ (2017)
23 Our research priorities are based around four themes: discovery and the natural world; engineering novel solutions;
health and well-being; and leading the data revolution.
Written evidence submitted by Imperial College London (BER0067)

support nearly 800 scientists, clinicians, engineers and business partners to address common challenges in areas such as energy, healthcare, and sustainability.

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