

Response to Life Sciences and the Industrial Strategy Inquiry

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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.

Summary

2. We **support sustained and balanced investment across the whole research spectrum** from fundamental discovery to applied research. Providing sources of **long term capital for SMEs to grow** is also crucial for the development of a competitive life sciences sector.
3. **Support for successful university research clusters** will accelerate and develop innovation ecosystems to create start-ups and spin-outs and attract investment from other partners. Imperial's **White City Campus is a new research and innovation district** where academics will co-locate and collaborate with industry and research partners on the next generation of advanced technologies.
4. The ability to **collaborate across borders with people from different backgrounds, cultures and nationalities is what drives the world's best universities**. We support continued access to EU programmes and collaboration and our immigration system needs to attract the best and brightest students, academics and entrepreneurs.

Science and innovation

Supporting basic research

5. The dual support system underpins our world-class research base and we welcome the additional £4.7 billion investment in R&D over this Parliament.¹ The LSIS rightly makes the case for additional support for research and innovation and recognises the important role of the charitable sector in the funding landscape. 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.**²
 - The government should now develop **a roadmap for increasing R&D investment to 3% of GDP** in line with our international counterparts.³
6. Public funding has an important role to play in supporting early-stage research to take risks. This is particularly true for life sciences where there is typically a long lag time from initial investment to commercialisation, and where benefits return broadly across society more than to the investor alone. Professor Steve Bloom's **revolutionary advances in appetite reduction therapies** came some **thirty years after initial discoveries**. His research has been brought to society through two spin-out companies.⁴ Imperial's own **Excellence Fund for Frontier Research** is one example of how we support a culture that embraces discovery. The fund has supported breakthroughs already, such as adapting technology used by the oil and gas industry to use in medical imaging.⁵
 - Investment in life sciences research should be **balanced across the research ecosystem** from fundamental discovery to applied research.⁶ To maximise impact, **investment in R&D should be driven by excellence.**⁷

¹ See [Funding for Higher Education in England for 2017-18: HEFCE grant letter, DfE](#) (February 2017)

² See [The Economic Significance of the UK Science Base, Haskel, Hughes and Bascavusoglu-Moreau](#) (March 2014)

³ See [Now is the time to innovate: the road to three percent](#), CBI (March 2017)

⁴ See [Hormone combination reduces appetite](#) (March 2013)

⁵ See [Future game-changers win backing from Excellence Fund](#) (March 2017)

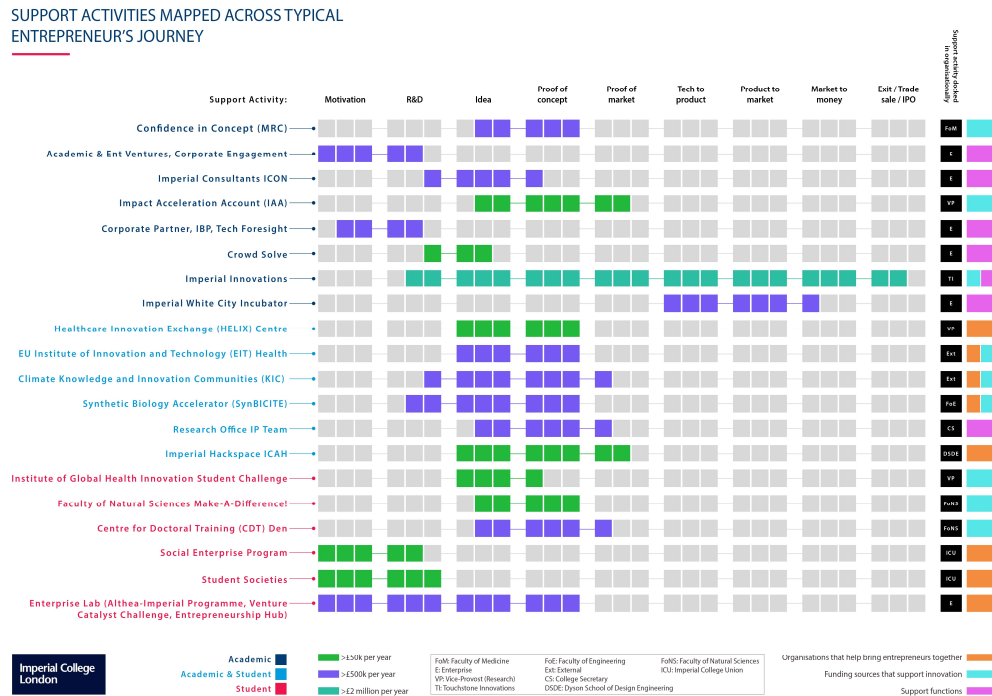
⁶ The Chinese Government has increased spending on fundamental research in response to concerns that their historic weakness in this area has hindered innovation [Nature](#) (March 2014)

⁷ See [Imperial has UK's greatest research impact, finds REF 2014](#) (December 2014)

Supporting innovation

- Investing in **innovation at universities supports the commercialisation of ideas** and creates an institutional culture that embraces discovery and entrepreneurship. Imperial has an established **innovation ecosystem** involving students, staff, alumni and commercial partners.⁸ We are creating new spaces for start-ups, spin-outs and entrepreneurs to work alongside Imperial at every stage of their development and growth (see Fig 1).

Fig 1: Support activities at Imperial mapped across the entrepreneurial journey



- The **Advanced Hackspace network** allows our students and staff to work alongside SMEs and industry partners to support the commercialisation of their ideas. The network of spaces across the College gives the community, alumni and partners access to advanced prototyping and fabrication equipment including a **bio-lab** (one of only three based in UK hackspace) **which enables synthetic biology and molecular fabrication**.⁹
- The **Invention Rooms at White City** (including our hackspace) are dedicated innovation spaces for people of all ages and backgrounds. One of the first projects of its kind in the UK it will create opportunities for the public to develop new skills and an understanding of **'making and manufacture'**, thereby encouraging the next generation of inventors at White City.
- Incentivising the development and operation of **small business incubators** is a key part of supporting research and innovation in local areas. Our **White City Incubator is a hub for innovation and entrepreneurship for deep science companies**. In under a decade, 60 companies have grown within its walls, attracting £750 million of investment. Imperial is developing a **shared lab incubator for small companies** to rent-a-bench, alongside our

⁸ A [MIT Skolkovo Institute](#) study found Imperial was one of three UK universities ranked alongside MIT and Stanford from the USA in creating entrepreneurial ecosystems, with the other two universities being the University of Cambridge and the University of Oxford. *Creating university-based entrepreneurial ecosystems: evidence from emerging world leaders*, (2014)

⁹ The network includes facilities at the Dyson School of Design Engineering (South Kensington) and the National Heart and Lung Institute (Hammersmith Hospital). The Invention Rooms and the Molecular Sciences Research Hub at White City make Imperial home to one of the largest hackspace networks in the world, covering almost 30,000 sq ft.

Incubator. This would replicate models like QB3 in San Francisco, LabCentral in Cambridge Massachusetts and the Harvard LifeLab. We are also encouraging post-docs to start companies in such a facility, progressing the ideas arising from their time in academic labs.¹⁰ In the US the **Small Business Innovation Research** programme is a common source of such funding and a similar scheme exists for start-ups in Munich.¹¹

- Schemes such as **reducing or removing business rates completely for incubators would help stimulate growth from start-ups.**
11. During the last decade **research commercialisation activity at UK universities has grown**, revenues from licensing and the sale of spin-out companies have more than doubled and the investment in intellectual property by universities has risen by a third.¹² Higher Education Innovation Fund (HEIF) support has been pivotal to forming and maintaining rich partnerships with industry and to identifying new commercialisation opportunities.¹³ For example at Imperial, HEIF supported the creation of our Enterprise Lab, which encourages and supports student entrepreneurs through an environment which facilitates peer collaboration and mentoring. The Enterprise Lab is currently being extended to also provide skills development to post-docs and early career researchers. It follows a team-based mentoring programme, building on the MIT Venture Mentoring Service, launching in 2017/18. Extending this service, to staff for example, would be possible with additional HEIF funding.
- **Increased HEIF funding would support the development of the innovation ecosystem**, increasing the number of spin-outs created, engaging academic and student inventors more fully, creating greater impact, and ultimately improving productivity and growth for the UK.
12. Imperial continues to innovate with initiatives such as the Founders Choice™ scheme which gives academics the choice of a founder-driven route with minimal equity stake for the university and a significant equity stake (up to 95%) for the academic where the academic progresses the company themselves with reduced support from the TTO.¹⁴ The traditional route will also be available, in which the TTO plays a greater role in the company formation and development. The academic will have a choice of which route to adopt.
- Implementing **targeted tax reform to incentivise university-business collaboration and co-location**, and **maintaining autonomy over managing intellectual property and technology transfer** would be other practical ways to incentivise research commercialisation.

Supporting SME growth

13. Providing sources of long term capital for SMEs to grow is essential for the development of a competitive life sciences sector. There remains a clear gap ('valley of death') in early stage venture funding available to university-led start-ups that are not market ready. Initiatives to improve early stage seed funding is an area which Government could look to address through the **'Financing growth in innovative firms' consultation** (Patient Capital Review).
14. The university start-up funding environment is a relatively small segment of the VC funding market but has grown in sophistication and attracted new investors and funders over the last 10 years, which is welcome as diversity improves choice for academics and universities alike. Looking to the future, we would **support initiatives that take investment in university start-ups more mainstream and further grow diversity of funders and funding.**

¹⁰ See also www.setsquared.co.uk/research-commercialisation/applications-cohort-11-re-opened

¹¹ See www.sbir.gov/about/about-sbir and www.muenchen.de/rathaus/wirtschaft_en/business-development/finance-funding.html

¹² University Knowledge Exchange (KE) Framework: good practice in technology transfer, HEFCE (August 2016)

¹³ The return on investment from £1 of HEIF is currently estimated at £9.70 in benefits for the economy and society, and may deliver even higher returns in future. See *Assessing the Economic Impacts of the Higher Education Innovation Fund: a Mixed-Method Quantitative Assessment* (October 2015)

¹⁴ See www.imperial.ac.uk/media/imperial-college/research-and-innovation/research-office/public/Founders-Choice-pilot-programme-for-forming-spin-outs.pdf

15. **Patient Capital** is a model that is **particularly suitable for advanced technology businesses emanating from university research, such as life sciences**.¹⁵
16. A **'one size fits all' funding model and timeline is not appropriate for 'deep science' start-ups** from various sectors. For effective deployment of patient capital, high quality 'deep science' therefore need to be matched equally with high quality, diverse and 'deep' long term funding.
17. Effective supply of patient capital seems to be held back by the perception that it is a niche industry requiring specialist skills. While this may have been the case, **supply would benefit from better visibility of the successes** (and not only the risks) as well as by **skills development in evaluating and investment**, drawing in a wider range of funders and funding.
18. The **European Investment Fund (EIF)** has been **pivotal within the innovation ecosystem** and has also acted as a cornerstone investor helping to crowd in other investors. Therefore, we would encourage the government to seek to at least secure or replicate the current level of EIF funding post-Brexit. We propose that should EIF funding drop away, government consider and initiate new, separate funding programmes that relate to and support the various disciplines.
19. The government should also **retain and continue to support current schemes such as the EIS and SEIS**. Government should seek to increase incentives associated with these schemes to investors e.g. through tax incentives. The long-term benefit would be substantial for both the economy and investor.

Skills for a world-class life sciences sector

20. The LSIS recognises the importance of **STEM skills** to the future success of the sector. This work needs to reach back into primary and secondary education to increase the proportion of the population who go on to be equipped with the advanced skills needed by industry. As the UK's foremost science and technology university¹⁶, Imperial recognises its role in reaching out and inspiring young people to take up STEM subjects.
21. The provision of **high-quality, research-led STEM education is resource-intensive**, requiring the use of expensive facilities and high cost consumables. These substantially higher costs compared to other disciplines should be reflected in the relative subject funding weightings. Lack of sufficient funding for STEM disciplines would lead to less choice and diminishing opportunities for students, and to a wider impact on the UK economy where there is already a shortage of suitably qualified STEM graduates.¹⁷
 - Government can support this work through **sustainable funding for STEM disciplines**.
22. The LSIS rightly calls for universities to provide entrepreneurship training. Imperial leverages its **extensive links with industry to provide students with entrepreneurial and technical skills**.
 - Industry experts provide one-to-one mentoring in our **Venture Catalyst Challenge**, an enterprise pre-accelerator run for our students. The programme tests the commercial viability of their ideas culminating in pitching for funding to a panel of judges to help them develop their ideas to market. A recent winner, 'FungiAlert', is a start-up to improve crop yields with a device that detects plant pathogens in fields before they infect crops.¹⁸
 - Our **innovation partnership with AstraZeneca** encourages collaboration on fundamental research and will develop new talent that understands the motivations of both sectors. AstraZeneca is also partnering with Imperial on our flagship **Research Fellowship** scheme to mentor and guide a cohort of fellows to develop research leaders of the future with

¹⁵ Written evidence [submitted](#) by Imperial, Commons Science and Technology Select Committee (October 2016)

¹⁶ Imperial is the UK's foremost science and technology-focused university, ranked third in the UK for Physical Sciences, Engineering and Technology, Life Sciences and Medicine [World University Rankings by Subject, Times Higher Education](#) (2016-17)

¹⁷ For example, [Jobs and growth: the importance of engineering skills to the UK economy](#), Royal Academy of Engineering

¹⁸ See ['FungiAlert' crowned winners of the Imperial Showcase entrepreneurship awards](#) (2015)

understanding and experience of both world-class academic research and the need to translate and commercialise research into products.

23. The increase in the number of STEM PhD places and investment in new fellowships for early and mid-career researchers¹⁹ should form part of a strategy to support academic career paths to ensure highly skilled life sciences researchers are developed and retained in the UK.
- Investing some of the **Apprenticeship Levy** in support for early career academics could strengthen their training and career development.
 - The LSIS identifies a **specific need for convergent training in therapeutics**. We are addressing this with initiatives like our new **NHLI MSc in novel pharmacology** (*Genes, Drugs and Stem Cells*).²⁰

Industrial Strategy

24. Life sciences at Imperial cover a wide range of research areas and we would like the LSIS to reflect these. The sector includes research areas such as synthetic biology, agritech and nutrition. The Committee's inquiry provides an opportunity to gain clarity on the scope of the LSIS.

Supporting university-based research clusters

25. As stated in the LSIS, '*...the key attribute driving success in life sciences is the great strength in university-based research.*'²¹ Universities are best-placed to create the environment for multi-disciplinary research and innovation in life sciences. For example the **Antimicrobial Research Collaborative** at Imperial expands interdisciplinary collaborations across the Faculties of Natural Sciences, Medicine, Engineering and the Imperial College Business School, the Imperial College Healthcare NHS Trust and a broad range of academic, industrial and third party collaborators.
26. The LSIS rightly points out the **internationally recognised life sciences cluster** in the South East of England is '*a clear driver for growth in the life sciences sector.*' The **potential of universities to attract R&D investment** is in no small part due to existing UK clusters of ideas, talent and capital. By bringing together inventors, entrepreneurs, investors, academics and creatives on a grand scale, our enterprise and technology capabilities allow us to compete with major centres such as San Francisco, Boston and South East Asia. The UK must capitalise on these clusters to ensure we remain globally competitive.
27. Translating excellent research is also dependent on the ability of industry to identify and use the knowledge produced. **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.
28. Universities have an important role in seeding research clusters, however the LSIS rightly recognises **the role of government in supporting the growth of emerging and successful clusters** through funding for science, research and vital infrastructure. This will accelerate their work with major corporates, start-ups and scale-ups and other partners.
- Our **White City Campus** is a **new research and innovation district** in 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.²² We are already developing collaborative research facilities for **molecular sciences** and **biomedical engineering** along with a new **Transformation and Innovation Hub (I-HUB)** which provides a home for businesses looking to turn cutting-edge

¹⁹ See [Spring Budget, HM Treasury](#) (March 2017)

²⁰ See [Genes, Drugs and Stem Cells – Novel Therapies MSc](#)

²¹ See www.gov.uk/government/uploads/system/uploads/attachment_data/file/640696/life-sciences-industrial-strategy.pdf

²² 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.

research into new products and services. Professor Chris Toumazou, **founder of DNA Electronics** (genomic analysis to develop fast, low-cost tools for patient diagnosis) is among the first wave of entrepreneurs to locate a spin-out company at the White City Campus.

- For the next phase of development on the 23 acre site we are looking for government and industry partners to collaborate on building new multidisciplinary hubs and facilities such as an **Advanced Technologies Innovation Hub** to develop the next generation Advanced Materials, Robotics, Synthetic Biology, Sustainability and Industrial Biotechnology and Agritech and a **MedTech Hub** to work with industry to lead the AI-driven revolution in health and medicine and create a broader ecosystem of top researchers, practitioners, business and the public sector close to our existing centre for innovative research at Hammersmith Hospital.

NHS collaboration

29. Imperial has a long history of **working in partnership with the NHS to translate discovery into innovative products for patient benefit**. This is exemplified by the **Imperial College Academic Health Science Centre (AHSC)** which aligns the research, education and patient care missions of the partner NHS organisations with that of the College.²³ Through our partnership we are delivering promising new technologies arising from university discovery science that are and will in the future improve patient care and health outcomes. For example, the iKnife scalpel that tells surgeons if the tissue they are cutting is cancerous or not, transforming surgery and saving lives.²⁴
30. The LSIS correctly identifies some barriers that still need to be addressed.²⁵
- The general **stress on the NHS system**, the **burdens on staff time** and the **lack of incentives to engage with novel therapies** (which have challenging requirements for use). The Advanced Therapies Manufacturing Action Plan recommended locating Advanced Therapies Centres within existing university/hospital partnerships to develop and deliver cell and gene therapies to a larger number of patients.²⁶
 - The Advanced Therapies Manufacturing Taskforce stressed that the biotech sector would not remain anchored in the UK unless they could see a **way forward for early reimbursement in the NHS system**. There was a danger that gene and cell therapies developed here could drift abroad. The extension of the Accelerated Access Review and early engagement of NICE are important outcomes of the LSIS.
31. We welcome the **support in the LSIS for the recommendations of the Advanced Therapies Manufacturing Taskforce Action Plan** including the increase in the manufacturing base for novel gene and cell therapy vectors and the access for universities to this through UKRI for early academic-led trials.
32. We welcome the LSIS focus on **digital innovation in the NHS** and the recommendations to ensure that the unique data assets of the NHS are harnessed for both economic growth and the health of the nation. Through the Imperial College AHSC we are at the vanguard of developing such a health informatics infrastructure for the analysis and interrogation of electronic patient information. We are bringing together IT and research investment in the NHS with the high end computing and analytical capability of the College, with a governance structure to ensure patient confidentiality and compliance with data protection regulations. We welcome the ambition in the LSIS to establish regional digital innovation hubs to lead industry engagement and development across the UK. To enable these, we also welcome the LSIS recommendation that NHS Digital and NHS England set out national approaches and incentives to system interoperability and data access requirements across all health care providers and particularly primary care.

²³ Imperial College Healthcare NHS Trust, Royal Brompton & Harefield NHS Trust, Royal Marsden NHS Foundation Trust

²⁴ See ["Intelligent knife" tells surgeon if tissue is cancerous](#) (July 2013)

²⁵ This was strongly voiced as part of the [House of Commons Science and Technology Committee report on Regenerative Medicine](#) (April 2017)

²⁶ See [Advanced Therapies Manufacturing Action Plan: Retaining and attracting advanced therapies manufacture in the UK, Medicine Manufacturing Industry Partnership](#) (2016)

Impact of Brexit on Life Sciences

33. The ability to collaborate across borders with people from different backgrounds, cultures and nationalities is what drives the world's best universities. We welcome the ambitions in the UK position paper on science and research collaboration to **secure continued access to European programmes supporting excellent research**.²⁷

- European Research Council grants at Imperial have supported research into [nanomaterials and tissue engineering](#); the [AcuPebble](#), a wearable wireless diagnostic tool for a range of illnesses; and the [European AIDS Vaccine Initiative](#).

34. Imperial's 2,000 **staff from other European countries are vital** for our ongoing teaching and research excellence. Our immigration system needs to attract the best and brightest students, academics and entrepreneurs.

- **EU citizens must be able to remain in Britain** and the Government should take a proactive position to ensure Europeans who live here today are welcome to stay.²⁸
- In future we support **linking scientific mobility with research funding** where participants in EU-funded research projects automatically receive a visa for free movement between Britain and the EU.²⁹

35. The UK's **world-class life sciences research base is dependent on a pipeline of highly skilled world-class research talent**. Imperial must be able to continue developing home grown talent, while also having the ability to recruit and retain the very best researchers from around the world who enhance the quality of existing research as well as opening up unexplored areas.

- We support the LSIS recommendation to create a high-level recruitment **programme to attract world-class scientists to the UK** over the next ten years.³⁰

36. We advocate **a range of visa reforms that are targeted at the best and brightest students, academics and entrepreneurs** and should apply across other sectors and industries aligned with the over-arching Industrial Strategy:

- Easing the **Tier 1 visa route for workers with exceptional talent** such as top researchers.
- Expanding the **Doctorate Extension Scheme for STEM PhD students from one year to three years** to match recent US reforms targeted at STEM PhDs.
- Expanding **Tier 1 graduate entrepreneur visas to encourage the brightest foreign students** to develop their business ideas and create jobs.
- Expanding the **Tier 4 pilot scheme for Masters students to cover undergraduate and PhD students** at highly trusted institutions.
- Introducing a **new post-study work visa for top STEM graduates**.

37. The impact of Brexit upon long term, pan-European research infrastructure projects is of concern (particularly pan-European data sets and information sharing).

- The UK should **remain a member of the European Medicines Agency (EMA)**.
- Regulatory requirements (legislation such as the Medicinal Products Directive, the Clinical Trials Regulation and the Regulation on Supplementary Protection Certificates) are largely harmonised across the EU. While there is no indication as to what would happen to these post-Brexit, **there is the prospect of divergent regulation** for medicines and clinical trials.
- Loss of EU support for pharmaceutical and biotechnology companies and academic institutions may impact on the willingness of companies and institutions around the world to view their UK counterparts as prospective research partners.

²⁷ See [UK's participation in Horizon 2020, BEIS](#) (February 2017); [UK Position Paper on Science and Collaboration](#) (September 2017)

²⁸ See [President's Address 2017](#) (March 2017)

²⁹ See [Letter to the editor of The Economist](#) (October 2016)

³⁰ See [Life Sciences Industrial Strategy](#) (August 2017)