



Department
for Business
Innovation & Skills

**CREATING THE FUTURE: A 2020
VISION FOR SCIENCE & RESEARCH**

Government response to
consultation on proposals for
long-term capital investment in
science & research

DECEMBER 2014

The consultation is relevant to: the UK science and research community.

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1. Introduction

The Government has made a long-term commitment to investment in science and research infrastructure: increasing capital investment in real terms to £1.1 billion in 2015-16 and growing this in line with inflation each year to 2020-21. To ensure we made the most of this long-term capital commitment, a consultation on proposals for long-term capital investment in science and research was launched on 25 April 2014¹. The aim of this consultation was to identify strategic priorities for long-term science and research capital investment. The consultation closed on 4 July 2014, having received a total of 480 responses.

In addition to this Government response, the consultation fed into a Science Capital Roadmap (which is attached at Annex 2) which, as recommended by the 2013 House of Lords Science & Technology Committee report on *Scientific Infrastructure*, takes a long-term strategic approach to research infrastructure². This roadmap links to a broader Science & Innovation Strategy, which is published alongside this response. Taken together, these documents set out Government's long-term strategic vision for world-leading science and research infrastructure.

The consultation document sought feedback on two key questions in order to inform the development of this roadmap:

Q1: What balance should we strike between meeting capital requirements at the individual research project and institution level, relative to the need for large-scale investments at national and international levels?

Our world-class research environment is underpinned by funding for the capital requirements of individual research projects and institutions, (i.e. research institutes and universities). This investment is delivered through Research Councils UK (RCUK) and the four Higher Education (HE) funding bodies. To complement this, strategic decision making at the national and international level is often required to coordinate investments in the national interest. The consultation sought views on how to balance these complementary needs.

Q2: What should be the UK's priorities for large scale capital investments in the national interest, including where appropriate collaborating in international projects?

The impressive strength and breadth of the UK research base means that we are presented with a huge range of potential investment opportunities. Demand inevitably outstrips funding. Therefore, there is a constant need to prioritise, and this consultation sought views to inform our approach. These strategic judgements required us to look first at what international competitors are investing in, and to identify where it is in the UK national interest to collaborate in international infrastructure projects. Building on the RCUK Strategic Framework for Capital Investment, Investing for Growth³, this consultation then sought views on which of the important projects laid out in the consultation should be the highest priority, asking also whether there were new potential high priority projects not identified in the consultation document.

¹ www.gov.uk/government/consultations/science-and-research-proposals-for-long-term-capital-investment

² www.publications.parliament.uk/pa/ld201314/ldselect/ldsctech/76/76.pdf

³ www.rcuk.ac.uk/RCUK-prod/assets/documents/publications/RCUKFrameworkforCapitalInvestment2012.pdf

The consultation document also posed a number of supporting questions; all questions are listed in Annex 1.

Scope of the consultation

The Government is committed to the Haldane Principle, which recognises the legitimate role of Ministers in taking long-term and large-scale strategic investment decisions. The consultation sought views to inform such strategic decisions, noting that the geographical coverage of the consultation matches the geographical coverage of the long-term capital budget: this was a UK-wide consultation about a UK-wide investment programme.

The consultation focused on capital infrastructure, but recognised that investment in skills, capability and resource to underpin capital investment are all crucial to the sustainability of research excellence. The consultation therefore gave full consideration to resource costs, both in terms of operational costs and the research costs of using the infrastructure to its maximum potential, keeping mindful of the need to balance capital intensive research with other potential calls on resource funding.

Commitment to the UK Research Base

The UK is widely recognised as punching well above its weight in terms of its research excellence. According to the Times Higher Education World Rankings, the UK has 29 universities among the top 200⁴. Our research base produces just under 12% of citations – second only to the USA – and 16% of the world’s strongest articles⁵. This research also contributes to key national priorities, playing a pivotal role in supporting our industrial strategy and underpinning the “eight great technologies”⁶. The UK’s research base is remarkable for its strength and depth across a huge breadth of research fields. Only a handful of countries can compete with the UK in terms of the breadth of its research excellence.

Our research infrastructure plays a key role in this success. The Global Competitiveness Index ranks the UK 3rd for the quality of its research institutions, and we have world-class institutes such as the Diamond Synchrotron, ISIS, the Rutherford Appleton Laboratory, and the Sanger Institute. We also play a role on the international stage, participating in and co-funding laboratories such as EMBL, CERN and the Large Hadron Collider, and astronomical facilities such as the developing Square Kilometre Array.

The UK has a strong international reputation for the quality and range of its research facilities, but keeping up in the global race means maintaining this strength in the depth and breadth of the UK research base into the 2020s and beyond. With a long-term capital budget for science and research, the Government is committing to building the science and research infrastructure of the 2020s.

As the House of Lords’ Select Committee on Science & Technology recognise in their 2013 report, *Scientific Infrastructure*⁶, “sustained and efficient future investment in scientific infrastructure [is essential] to ensure that UK research is able to remain internationally competitive” and “efficient investment in scientific infrastructure requires long-term planning

⁴ www.timeshighereducation.co.uk/world-university-rankings/2014-15/world-ranking

⁵ Elsevier (2013). ‘International Comparative Performance of the UK Research Base – 2013’

⁶ www.policyexchange.org.uk/images/publications/eight%20great%20technologies.pdf

and transparent decision making”. With the long-term commitment to research capital made, this consultation was designed to inform our strategy to make the most of this investment.

Stakeholder engagement

In addition to the formal consultation, BIS officials facilitated a number of stakeholder workshops and discussions to ensure that the research community was engaged and had the opportunity to feed in their views. Organisations which were engaged in this way included: devolved administrations, higher education funders, academia, business and interest groups.

The following stakeholder events took place during the consultation period:

1 May	UCL Open Forum Event (including introduction from David Willetts)
8 May	CBI Workshop in Bristol
2 June	Stakeholder event in Edinburgh
3 June	Stakeholder event in Cardiff
5 June	Ministerial Roundtable event
16 June	Live web chat with <i>The Guardian</i>
18 June	Stakeholder event in Belfast
26 June	Centre for Science & Policy event in Cambridge

Views expressed in these events were fed into the consultation process and have helped to inform the Government response to the consultation and capital roadmap.

Ministerial Advisory Group

The House of Lords Science & Technology Select Committee *Scientific Infrastructure* report recommended establishing an ad hoc, time-limited advisory group to advise on the long-term strategy for scientific infrastructure. Government accepted this proposal, setting up a Ministerial Advisory Group (MAG) to provide advice on the development of the long-term roadmap for science and research capital funding, in addition to the wider Science and Innovation Strategy.

Membership of this group included representatives from higher education funding bodies, Research Councils, the Technology Strategy Board (now Innovate UK), UK Trade and Investment, business and industry, the university community, National Academies, research charities and PSREs.

This group was invited to provide advice on the key questions contained in the consultation document. An additional working group on capital, with membership taken from organisations represented on the MAG, was established to provide expert advice on the project proposals. This group was able to provide assurance that all potential projects identified through the consultation process were aligned with research priorities.

2. Summary of responses

A total of 480 responses to the consultation were received. These were received either via the Government's Citizen Space portal or through the dedicated consultation email address.

Responses by sector

Responses by sector are illustrated by Figure 1 and show that 126 responses (28% of the total received) were from people sent in a personal capacity. The largest sector represented was the university sector, with 45 (10%) official university responses, in addition to 36 (8%) responses from individual university departments. The next largest group were responses from subject communities, mission or project groups with 76 (17%) responses.

Responses to the consultation will be published on Citizen Space in due course, subject to data protection and agreement from respondents.

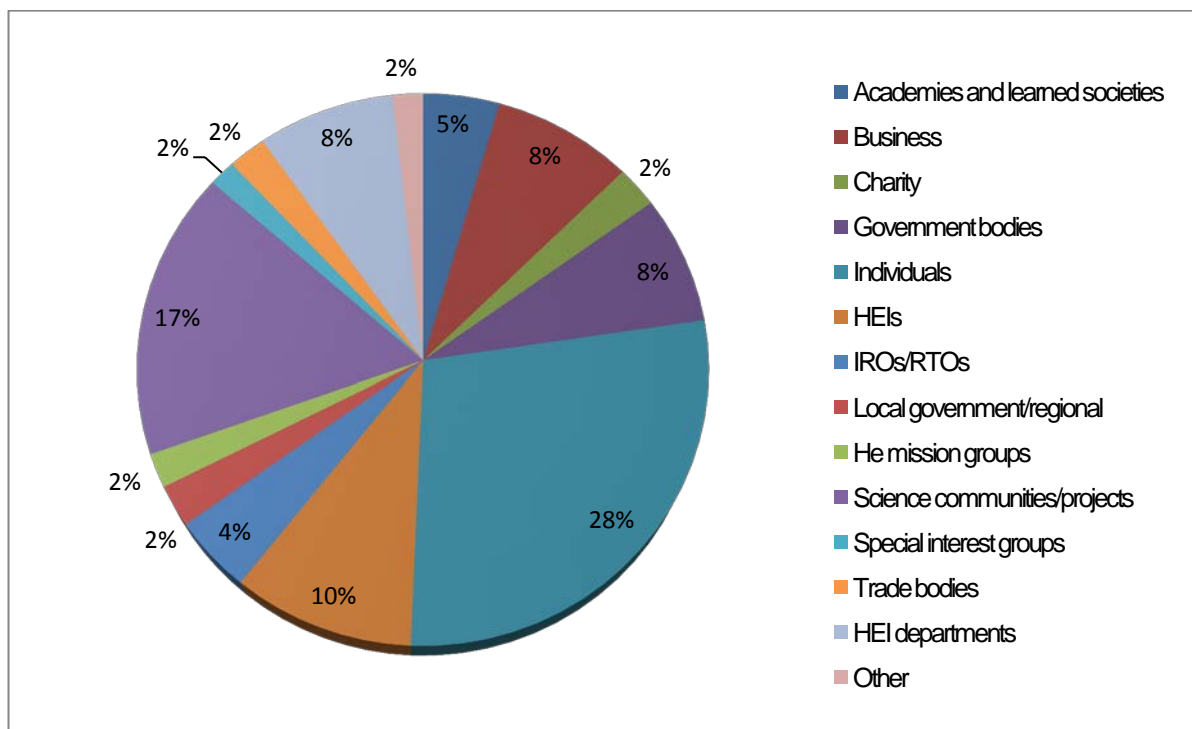


Figure 1: Percentage of responses to capital consultation by sector

Overview of responses to the consultation questions

The consultation sought views on two key questions:

- What balance should we strike between meeting capital requirements at the individual research project and institution level, relative to the need for large-scale investments at national and international levels?
- What should be the UK's priorities for large scale capital investments in the national interest, including where appropriate collaborating in international projects?

In addition, it posed a number of sub-questions to help inform these key decisions:

- How can we maximise collaboration, equipment sharing, and access to industry to ensure we make the most of this investment?
- What factors should we consider when determining the research capital requirement of the HE estate?
- Should – subject to state aids and other considerations - science & research capital be extended to Research and Technology Organisations (RTOs) and Independent Research Organisations (IROs) when there are wider benefits for doing so?
- What should the criteria for prioritising projects look like?
- Are there new potential high priority projects which are not identified in this document?
- Should we maintain a proportion of unallocated capital funding to respond to emerging priorities in the second half of this decade?
- Are the major international projects identified in the consultation the right priorities for this scale of investment at the international level? Are there other opportunities for UK involvement in major global collaborations?

On the balance between capital requirements for individual research projects and institutional funding relative to large-scale investments, the consultation revealed strong support for investment at individual research project and institution level to support our world-class labs. Many responses emphasised the importance of small- to medium-sized ‘underpinning’ investments, noting that this type of funding was vital in supporting our world-class research base. The majority of respondents favoured maintaining or increasing capital funding for world-class labs at 2015-16 levels. There was also recognition of the need to make some large-scale strategic investments, particularly in cases where we would not want to miss an opportunity to invest in international infrastructure or where there are wider opportunities that meet national need.

With regards to priorities for major capital investment, respondents were generally supportive of the projects outlined in the consultation document. There was particular support for projects relating to “Big Data” and for those which addressed “Grand Challenges.” There was also strong support for participation in international projects, including continued support for the European Space Agency and for membership of the XFEL laser facility in Germany. A number of projects outside those summarised in the document were also suggested. There was strong support for agility funding to be available for newly-identified projects which could arise in future years.

Detailed overview of responses to the consultation questions

Q1: What balance should we strike between meeting capital requirements at the individual research project and institution level, relative to the need for large-scale investments at national and international levels?

A range of responses was received on the balance of funding between capital at individual research project and institutional level and large-scale capital investments. Many responses recognised the importance of making some strategic large-scale investments, particularly in support of international collaborations or areas where opportunities would otherwise be lost. Projects with significant opportunities for leverage & efficiency – either from industry, charity or through being part of a wider collaboration – were flagged as being particularly worth exploring,

as were projects where Government investment would enable truly world-leading research in a particular area.

The majority of consultation respondents favoured either an increase in underpinning capital funding at institutional and research project level or maintaining this at 2015-16 levels. This message was consistent across a range of different respondent groups including universities, academies & learned societies, charities and businesses. This view is also reflected in the House of Lords Science & Technology Select Committee report of 2013, *Scientific Infrastructure*, which queried the approach of supporting big projects at the expense of underpinning funding.⁷

“[Our business] wishes to see the majority of the budget spent on equipping the nation’s universities – at institutional level - with truly leading-edge equipment. We believe that this will develop the UK’s excellence and global competitiveness in academic research. This science base is the beginning of the innovation chain that is so important for our own downstream activities of applied research, product development and, eventually, manufacture.”

Many respondents wrote in support of one of the illustrative scenarios provided in the consultation document. While there was a recognition of the need for some large-scale strategic investments, the vast majority of respondents favoured increasing or maintaining underpinning funding at 2015-16 levels (Scenarios 1 or 2 in the consultation document).

‘Funding should enhance and reinforce the existing excellent research base, only creating new additional capability in cases of specific national need or emerging science that cannot be met by the existing science base. Small-scale and mid-range facilities within institutions are crucial to maintain excellence’ - HE Mission Group

Q2: What should be the UK's priorities for large scale capital investments in the national interest, including where appropriate collaborating in international projects?

A large number of responses on UK priorities for large-scale capital investment were received. These responses ranged from identifying general priority themes for investment to suggesting or endorsing specific capital projects.

The priority areas for investment identified through consultation responses broadly aligned with the themes outlined in the consultation document. Big Data was a key priority theme identified in many responses, as was the need to address Grand Challenges, particularly in the areas of health, manufacturing and energy security.

There was broad support from the consultation responses for the illustrative projects identified in the consultation document. In particular, the proposed “Inspiring Science Capital Fund” received strong support. In addition, the important role of international projects was recognised. The consultation also revealed strong support for continuing investment in the European Space Agency (ESA), in addition to support for the M3 Space Mission which was announced in April 2014.

⁷ www.publications.parliament.uk/pa/ld201314/ldselect/ldsctech/76/76.pdf

Sub-questions

A world-class research environment:

Q: How can we maximise collaboration, equipment sharing, and access to industry to ensure we make the most of this investment?

The consultation document highlighted a number of examples of successful equipment-sharing initiatives and collaborations with industry. These were reinforced by consultation responses, with a number of respondents stressing that this is an area where the research community is already actively engaged. Regional collaborative networks of universities, such as the N8, M5, SE5 and GW4, were viewed by respondents as valuable in providing access to facilities which would otherwise be unaffordable for individual universities, while a number of responses also highlighted the role of Research Councils in helping to compile asset databases. Such databases were raised by a number of respondents as a useful tool for enabling sharing, efficiency, and planning of future capital needs:

‘Searchable databases of facilities and equipment are helping to establish whether there is spare capacity and enable sharing, negotiate lower cost maintenance service contracts, and plan better to meet future needs’ – HEI

‘[we should expand] asset registers to catalogue equipment and facilitate wider access’ – Charity

Some potential barriers to collaboration and equipment sharing were flagged in consultation responses. One important factor was the need to ensure proposals account for costs of expert staff, training, access costs, support, maintenance and consumables as well as the capital costs involved in sharing. Another potential barrier flagged was the VAT rules applying to some forms of equipment sharing. Several respondents suggested that greater collaboration and access to industry could be encouraged through incentives provided by funding providers.

Q: What factors should we consider when determining the research capital requirement of the HE estate?

The question regarding factors we should consider when determining the research capital requirement of the HE estate received a wide range of responses. Analysis of consultation responses identified a number of common themes: the underpinning nature of HE research capital, human capital and resource requirements, skills, regional considerations, funding stability, flexibility and historic trends in capital.

The important underpinning role of HE research capital was highlighted by a number of respondents. In many cases it was flagged that the research conducted at large-scale facilities, such as Diamond, would not be possible without preparatory work undertaken in university laboratories:

“Much basic work, for example characterisation, is done in universities before a project goes to a major facility.” - Academic

As recognised in the consultation document, it is important to consider the wider costs associated with research capital investment. Many consultation respondents flagged that, in addition to initial capital costs, universities also had to account for the funding of skilled technicians to operate facilities in addition to other operating costs. On-going maintenance costs were also raised as an area that required consideration:

“[Our needs are] more than just capital. We need to account for the funding of skilled people that populate our facilities and the maintenance of facilities built with capital investment.” - HEI

Many consultation responses flagged that world-class labs play a crucial role in attracting and retaining world-class researchers. Without sufficient capital funding to maintain and upgrade university facilities, respondents argued, their ability to attract the brightest and best would be reduced, thus weakening the UK research base. Similarly, some respondents also mentioned the role of universities in training the next generation of researchers and technicians. Several respondents stressed the importance of access to state-of-the-art facilities to the development of students and early career researchers.

Regional considerations were raised by a number of consultation respondents. While some argued that research capital should be awarded solely on the basis of excellence, others pointed out that there are pockets of excellence across the UK and that it is important to enable regional access to mid-range facilities.

The importance of funding stability was stressed repeatedly in consultation responses. Stability, respondents argued, enabled universities to plan strategically, maximise efficiency, and make high impact investments:

“Stability in baseline funding [is needed] to ensure strategic decision-making and the autonomy of institutions to implement strategic plans.”

Linked to stability, there was also a call for a return to an allocation system similar to the former SRIF. This, argued a number of respondents, would provide the flexibility universities require to meet strategic needs while also providing greater transparency.

A number of consultation responses flagged recent trends in capital funding, arguing that the balance of capital funding had shifted away from underpinning capital in favour of major capital investments. Some respondents argued that recent levels of investment in underpinning capital were not sustainable, with universities struggling to maintain their research capital estate.

Q: Should – subject to state aids and other considerations - science & research capital should be extended to RTO and IRO organisations when there are wider benefits for doing so?

Responses to this question recognised the vital role that Research and Technology Organisations (RTOs) and Independent Research Organisations (IROs) can play in the research base. There was some concern that extending capital investment could dilute available funding or duplicate existing efforts. Some responses also noted the role of universities in providing skills, something they considered RTOs/IROs less able to provide. Despite these reservations, however, there was general support for capital investment in RTO/IROs where this funding was part of collaboration and showed clear benefits:

“Yes, but only with compelling case, and only in conjunction with bid for investment led by university or public sector research establishment that has critical mass and expertise necessary to manage large scale infrastructure project.” - HEI

*Science Strategy for Major New Projects:***Q: What should the criteria for prioritising projects look like?**

Consultation responses revealed general support for the criteria outlined in the consultation document. Excellence in particular was identified as a key criterion:

“Excellence should be the primary and over-riding criterion” - HEI

An additional criterion identified through consultation responses and feedback was the timeliness of the project. As noted in the consultation document, resource costs were an important element when considering affordability. This was reflected in consultation responses.

There was some discussion regarding whether consideration should be given to the regional balance of investments. Some respondents argued that it was important to support a broad science base by having regionally-accessible centres of excellence. This, they argued, could facilitate further access to industry. Others believed that project funding should always be subject to a competitive process based on excellence, regardless of location.

Q: Are there new potential high priority projects which are not identified in this document?

A number of priority areas for investment were identified through the consultation process. The level of detail provided ranged considerably, from identifying priority areas for investment, such as Big Data, to fully-costed project proposals. A total of 36 project proposals included indicative costs.

Q: Should we maintain a proportion of unallocated capital funding to respond to emerging priorities in the second half of this decade?

Consultation responses revealed strong support for unallocated capital funding to respond to emerging priorities in the second half of this decade:

“[unallocated funding is] a good idea given impossibility of anticipating some of the new challenges.” - University Department

Some responses made suggestions regarding the proportion of funding which should remain unallocated, with a number of responses suggesting that the fund should be a relatively small proportion of funding of initial funding, rising in the latter part of the decade to provide greater flexibility.

Q: Are the major international projects identified in the consultation the right priorities for this scale of investment at the international level? Are there other opportunities for UK involvement in major global collaborations?

Consultation responses demonstrated a general recognition of the importance of international collaborations, in addition to some explicit support for the international projects announced or underway.

A number of further opportunities for international investment were outlined. Some responses suggested potential opportunities for the UK to take an international lead, particularly with regards to addressing grand challenges such as dementia research, anti-microbial resistance and energy security. A proposal for full membership of the XFEL laser facility received widespread support from a range of respondents.

3. Government response

Q1: What balance should we strike between meeting capital requirements at the individual research project and institution level, relative to the need for large-scale investments at national and international levels?

The Government recognises that capital funding is required both to support research in Grand Challenges as well as for supporting institutions and smaller-scale projects. Both these elements are essential if we want to maintain the UK's world-class research base.

We will support world-class labs in the UK through underpinning funding via Higher Education funders and RCUK capital for small-to-medium projects. This funding will support the underpinning infrastructure that is the bedrock of our research base. In addition, we will fund a number of larger-scale projects which demonstrate excellence and meet strategic national needs.

Q2: What should be the UK's priorities for large scale capital investments in the national interest, including where appropriate collaborating in international projects?

The consultation exercise has had an instrumental role in informing Government priorities for large scale capital investment. Responses to the consultation have helped to confirm and refine priority areas for investment; demonstrated strong support for some of the projects proposed in the consultation document; and highlighted new opportunities for world-leading research.

This input has helped to shape the Capital Roadmap, which is published alongside this document, and which highlights a number of projects that will be funded in the short term. This roadmap includes projects summarised in the consultation document, as well as those put forward by researchers themselves.

The projects, which will be funded subject to agreed business cases, include:

- A national e-infrastructure development to drive big data research at Daresbury Campus in association with IBM
- A National Institute for Materials Research and Innovation based in Manchester and embracing institutions across the UK to focus UK efforts in this area
- An Energy Security and Innovation Observing System for the Sub-surface in conjunction with industry that will drive forward UK capabilities in sub-surface technologies in oil & gas
- An imaging centre of excellence in Glasgow
- UK membership of the XFEL laser facility in Germany to give UK researchers increased access to a world-class facility
- An Inspiring Science Capital Fund which will provide capital funding for science discovery centres and similar organisations to work with HEIs on public engagement projects.

In addition to these projects, the consultation also highlighted possible major projects which have the potential to provide a step-change in our research in particular Grand Challenges. These "Frontier Projects" will be considered alongside the Government's wider portfolio in

these areas and put through a robust process of international peer review with a view to funding in the future, subject to availability of capital from the Government, industry and others and a robust business case. Government will take a decision on whether to fund these projects at Budget 2015.

Q: How can we maximise collaboration, equipment sharing, and access to industry to ensure we make the most of this investment?

The Government is keen to maximise opportunities for collaboration and equipment sharing. We support the excellent work already being done in this area through EPSRC, regional collaborative networks of universities and others. Professor Sir Ian Diamond's review of efficiency and effectiveness is considering the role of asset and equipment sharing and his review will make recommendations. His review is due to report in February 2015 and Government will consider his recommendations carefully with a view to supporting a sector-led, national approach to equipment sharing which will benefit both academia and industry. We will also continue to support projects that drive collaboration with industry, such as the collaboration on big data with IBM at Hartree.

Q: What factors should we consider when determining the research capital requirement of the HE estate?

In determining the level of funding allocated to the higher education estate, Government has carefully considered all the input to the capital consultation in addition to expert advice from the Higher Education Funding Council for England (HEFCE) and others. Government will provide targeted underpinning funding at institutional and project level to support the concept of the "well found" lab equipped with the instruments and facilities to support the science that we need in the future. Research capital funding to institutions via HEFCE and the devolved funding agencies will continue to be based on excellence-based formulae, but with increased transparency to highlight the developing impacts of this spend on the wider research base. Project-based funding will be awarded based on established mechanisms, driven by excellence.

Q: Should – subject to state aids and other considerations - science & research capital be extended to RTO and IRO organisations when there are wider benefits for doing so?

The Government is clear that RTOs and IROs represent a vital part of our research base, and that there is a case for providing capital funding in certain circumstances. At present eligibility criteria for RTO/IRO capital funding is not clearly articulated. We will clarify the criteria to ensure that such organisations understand the circumstances under which they can apply for funding.

Q: What should the criteria for prioritising projects look like?

The criteria set out in the consultation document - affordability (including sustainability costs), excellence, impact, skills development, and efficiency and leverage of other funding sources – were supported by consultation responses and have been taken forward as the agreed criteria. The consultation exercise also revealed an additional criterion – timeliness for investment – which has been added to the criteria. In addition to these criteria, projects in the roadmap were considered against the Government's broader priorities: the Eight Great Technologies, the Industrial Strategy, and developing collaboration across disciplines and boundaries.

Location was not added as a specific criterion. Some of the projects in the roadmap are location-specific, while others will be subject to a competitive process, allowing the best centres across the UK to benefit from this funding regardless of location.

Q: Are there new potential high priority projects which are not identified in this document?

A number of additional projects were identified through the consultation process. The capital roadmap includes several projects which were identified through the consultation process. In addition, the Frontier Projects also originated as proposals submitted through the consultation process.

In future years, there may be an opportunity to fund additional projects identified through capital consultation as part of future Research Council calls or via the Capital Agility Fund.

Q: Should we maintain a proportion of unallocated capital funding to respond to emerging priorities in the second half of this decade?

A strong recommendation emerging from the consultation exercise was the need to maintain flexibility to respond to emerging priorities. Government will support excellent research projects as they arise through the introduction of a Frontier Projects scheme, and support developing capital priorities through future unallocated Grand Challenges funding. This will provide the flexibility and agility needed to support the frontiers of science wherever and whenever they emerge.

In addition to this, Government will fund additional rounds of RPIF, a successful mechanism that can attract up to 200% additional funding from private sources (businesses, charities, individual donations). The benefits of the scheme are enhancing the research facilities of higher education institutions (HEIs) undertaking world-leading research, encouraging strategic partnerships between HEIs and other organisations active in research, stimulating additional investment in HE research and strengthening the contribution of the research base to economic growth.

Q: Are the major international projects identified in the consultation the right priorities for this scale of investment at the international level? Are there other opportunities for UK involvement in major global collaborations?

The consultation revealed strong support for continued investment in the European Space Agency. Recognising the mutually beneficial collaborations and world-class scientific and industrial capacity that ESA membership brings, we will renew ESA subscriptions to 2020/21.

XFEL, an international free electron laser project based in Germany, was flagged in the consultation as a high priority for investment. Government will begin discussions to join the project as a full member, enabling greater UK participation in revolutionary scientific experiments in a variety of disciplines spanning physics, chemistry, materials science and biology.

4. Conclusion

The aim of the capital consultation on proposals for long-term capital investment in science & research was to inform Government's strategic vision for long-term science and research capital. It was a public consultation of particular interest to the research community. Through targeted communications and stakeholder events we achieved a high level of engagement, receiving a total of 480 direct responses in addition to input through stakeholder events. All these inputs were fed into the development of the Government's strategy for capital investment.

This consultation response, together with the annexed Capital Roadmap, sets out Government's strategy for maintaining world-class infrastructure. We will continue to support our world-class labs through underpinning funding via higher education funders and RCUK capital for small to medium projects until 2020-21. We will drive forward major capital investments which address Grand Challenges, such as research in medical imaging, advanced materials, Big Data/information economy, laser physics, space technology and life sciences. As advised by consultation responses, we will maintain the flexibility to respond to opportunities as they emerge through the introduction of a Frontier Projects scheme, together with a Capital Agility Fund and further rounds the Research Partnership Investment Fund. Government will ensure we make the most of these investments through support for a sector-led, national approach to equipment sharing which benefits both academia and industry, and continue to support projects that drive collaboration with industry such as the collaboration on Big Data with IBM at Hartree.

This response links to the broader Science and Innovation Strategy, which will be published this month and outlines Government's long-term strategic vision for a world-leading science and research infrastructure.

Next steps

The consultation exercise has helped to inform Government's vision for world-class scientific infrastructure which is set out in the Capital Roadmap and Science and Innovation Strategy. These documents set out a strategy which includes:

- A commitment to underpinning funding for HEFCE/devolved funders and RCUK capital to 2020-21
- Investments in larger-scale strategic projects which address Grand Challenges
- A further unallocated Grand Challenges fund to provide agility and enable us to respond to priorities as they emerge
- Careful consideration of Professor Sir Ian Diamond's recommendations with a view to supporting a sector-led, national approach to equipment sharing.
- A clarification of RTO/IRO eligibility for capital funding

Annex 1: Consultation questions

The consultation sought views on two key questions:

What balance should we strike between meeting capital requirements at the individual research project and institution level, relative to the need for large-scale investments at national and international levels?

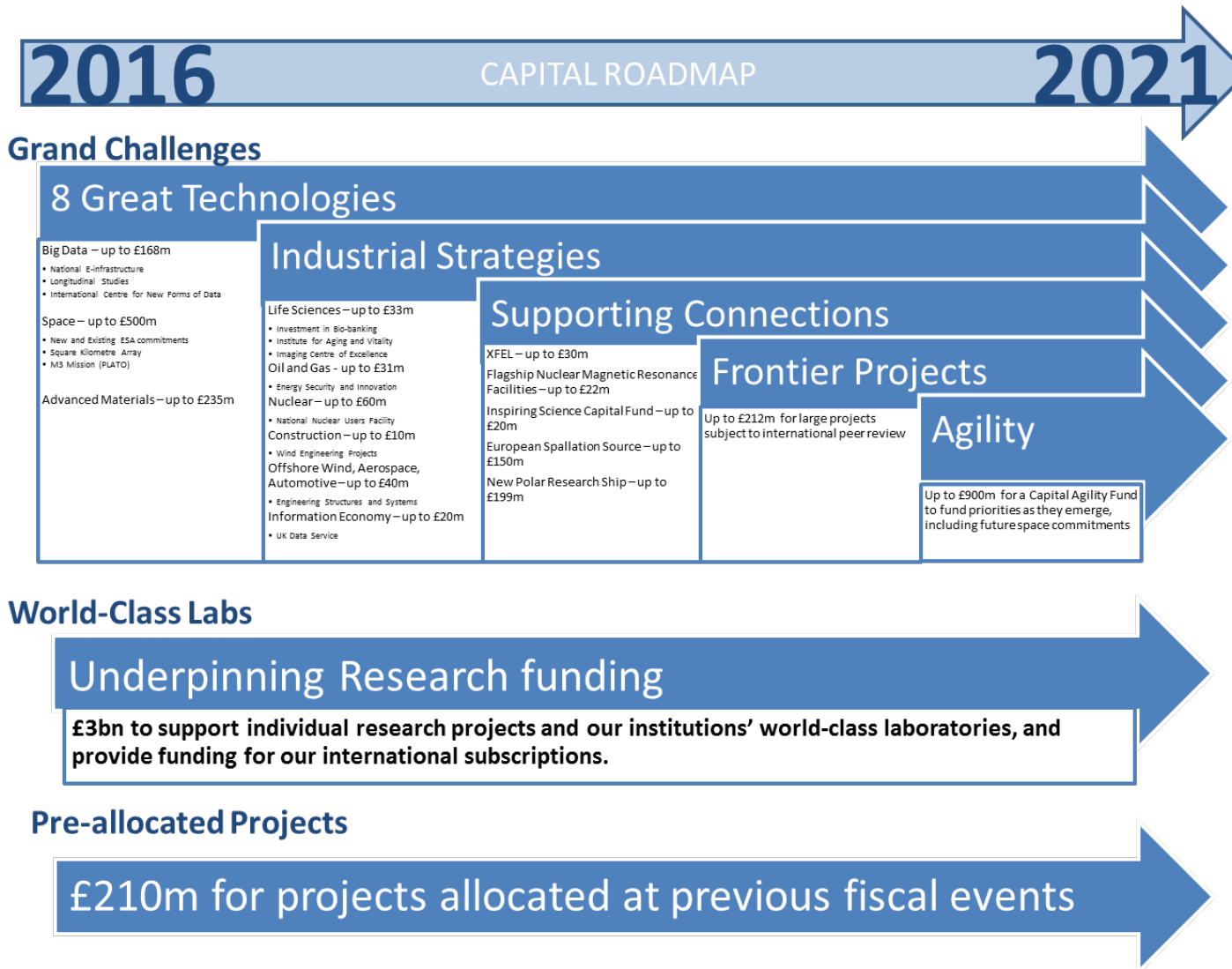
What should be the UK's priorities for large scale capital investments in the national interest, including where appropriate collaborating in international projects?

In addition, it posed a number of sub-questions to help inform these key decisions:

- How can we maximise collaboration, equipment sharing, and access to industry to ensure we make the most of this investment?
- What factors should we consider when determining the research capital requirement of the HE estate?
- Should – subject to state aids and other considerations - science & research capital should be extended to RTO and IRO organisations when there are wider benefits for doing so?
- What should the criteria for prioritising projects look like?
- Are there new potential high priority projects which are not identified in this document?
- Should we maintain a proportion of unallocated capital funding to respond to emerging priorities in the second half of this decade?
- Are the major international projects identified in the consultation the right priorities for this scale of investment at the international level? Are there other opportunities for UK involvement in major global collaborations?

Annex 2: Capital roadmap

All projects will be subject to agreement of full business cases and budgets are maximum indicative funding levels.



Project summaries

Support for 8 Great Technologies

Big Data:

***National E-infrastructure** - A major computing research collaboration at the Hartree Centre in Daresbury, which will deliver world-leading computing capability, enabling non-computer specialists to gain insights from big data in order to enhance and design products, services and manufacturing processes.

***Longitudinal Studies** – An investment in longitudinal studies, integrating the biosocial across the life course to underpin understanding of society.

***International Centre for New Forms of Data** – Working with international partners, this Centre will establish new methods and data resources that will enable truly multidisciplinary research to be conducted. This will underpin Government's Information Economy Strategy and Data Capability Strategy

Space:

***UK contribution to European Space Agency 2014 negotiations** – This additional investment in the UK space sector will enable the UK to take a leadership role in the ExoMars mission, support new science on the International Space Station, and leverage private sector investment in satellite telecoms through the ARTES programme.

***Continued UK Participation in European Space Agency projects and programmes** – Continuing commitment to UK participation in European Space Agency programmes, which will enable the UK to be part of and benefit from projects it would be unable to fund on its own, and from which are developed mutually beneficial collaborations and world-class scientific and industrial capacity.

****Square Kilometre Array** - UK investment announced in March 2014 which will ensure that the UK continues to play a leading role throughout the construction and operation phases of the world's largest and most sensitive radio telescope. The project will focus on studying the formation of the first objects in the Universe (the first stars and galaxies), probing cosmology (understanding Dark Energy and how galaxies evolve to what we see today) and testing Einstein's theories – the search for gravitational waves.

****M3 Mission (PLATO)** - Investment announced in March 2014 secures UK participation in the European Space Agency's next major space science mission, PLATO, which has been selected as the third Medium-class mission ('M3') in its 'Cosmic Vision' programme. PLATO is an exoplanet mission, which will observe up to a million stars to search for Earth-like planets orbiting them, and assess their potential for hosting life. When combined with follow up observations by ground based facilities and space-based telescopes like the James Webb Space Telescope, PLATO will allow us to detect and characterise life signatures on other planets.

Advanced materials:

The Sir Henry Royce Institute for Advanced Materials – A national institute in advanced materials that will focus UK efforts, provide national facilities, act as an international flagship and be a major attractor for investment and employment in this exponentially expanding area.

Support for Industrial Strategies**Life sciences:**

Investment in Bio-banking – Partnership funding for charities investing in collections of biological material and linked data for research purposes.

Institute for Aging and Vitality - Investment towards an integrated environment where world-class scientific, medical, social and technological solutions address the needs and opportunities of an ageing population.

Imaging Centre of Excellence – As part of City Deal Investment in a proposal developed by the University of Glasgow to provide new imaging, R&D and commercialisation facilities for clinical researchers and companies that are developing new life sciences products.

Oil and gas:

***Energy Security and Innovation Observing System for the Sub-surface, focussing on unconventional oil and gas research** – Through partnership between research and industry this investment will strengthen UK leadership in subsurface technologies, contributing to UK energy security. The research centres will focus on shallow geothermal energy, shale gas, underground gas storage, coal bed methane, underground coal gasification, underground waste disposal, and carbon capture and storage.

Nuclear:

***National Nuclear Users Facility (NNUF) to support UK nuclear power** – funding to extend capabilities of the NNUF, both enhancing the initial investments that support nuclear material research and allowing capital investment in other key areas of nuclear energy research, science and technology, across the full nuclear lifecycle for current and future nuclear reactor systems.

Construction:

Wind Engineering Projects – investment in wind engineering projects, building on national capability and with strong engagement from industry to enable the UK engineering and design community to assess future wind flow impacts on all aspects of urban environments and provide the best advice available in the world.

Offshore wind, aerospace, automotive:

***Engineering Structures and Systems** – investment to create unique advanced mechanical test capabilities in collaboration with key companies that will allow industry to capitalise on the UK's expertise in the dynamic behaviour of complex structures, emerging new materials, advanced sensors and analysis methods

Information economy:

***UK Data Service and Administrative Data Centre to exploit data held by Government departments** - funding to drive forward seamless access to the burgeoning volume of social and economic data through enhanced, data discovery, metadata standards and new software platforms.

Supporting connections across boundaries and disciplines

XFEL, an international free electron laser project based in Germany – UK membership of XFEL, providing UK researchers with greater access to this facility which enables revolutionary scientific experiments in a variety of disciplines spanning physics, chemistry, materials science and biology. The facility is located at DESY, the German national laboratory in Hamburg, and will start operations in 2017.

Flagship Nuclear Magnetic Resonance (NMR) facilities - Investment in a flagship ultra-high field national NMR facility (1.2 GHz), to be shared between the biological and physical sciences' NMR communities

***Inspiring Science Capital Fund** - Funding to support capital investment for public engagement in association with HEIs. Funding would be open to, amongst others, Science and Discovery Centres and other visitor attractions which involve the public in science.

****European Spallation Source** – UK investment in The European Spallation Source (ESS), a new powerful neutron source to be built in Sweden, was announced in March 2014. The ESS will in time become the leading continuous neutron source in Europe (superseding the Institut Laue-Langevin), and complement the pulsed ISIS neutron source at Harwell, Oxford.

****New Polar Research Ship** - Investment in a new ice-strengthened ship, announced in April 2014, will keep the UK amongst world leading nations for research in the Polar regions by providing a world class scientific platform, supporting a wide range of oceanographic, marine ecosystem and marine geosciences research, as well as logistics support.

Frontier projects

Through the consultation, potential high-impact proposals to tackle Grand Challenges were put forward. In order to ensure these are subject to proper scrutiny, we will put these frontier projects through a robust process of international peer review, and will take a decision on whether to fund them at Budget 2015. As part of any final decision to commit funds, we would expect to see substantial industrial or other co-funding.

Pre-allocated projects

A number of projects, including RPIF and the UK National Quantum Technologies Programme, totalling £210m were allocated as part of previous fiscal events.

Agility

As informed by consultation responses, the capital agility fund will maintain the flexibility to respond to opportunities to support Grand Challenges as they emerge, including future space commitments.

* Projects included within the consultation document: *Creating the Future: a 2020 vision for science & research*⁸ which includes further details on the projects

** Projects pre-announced in April 2014

⁸ www.gov.uk/government/consultations/science-and-research-proposals-for-long-term-capital-investment

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