



Evaluation of BBSRC's Research Equipment Initiative

This document represents the views and conclusions of a panel of experts

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Abbreviations

BBSRC	Biotechnology and Biological Sciences Research Council
BIS	Department for Business, Innovation and Skills
CASE	Collaborative Awards in Science and Engineering (former definition)
Co-I	Co-Investigator
EPSRC	Engineering and Physical Sciences Research Council
ESRC	Economic and Social Research Council
EU	European Union
fEC	Full Economic Costing
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
IF	Impact Factor
LoLa	(Strategic) Longer and Larger grant
MRC	Medical Research Council
MRE	Mid-range equipment
NERC	Natural Environment Research Council
PI	Principal Investigator
RCUK	Research Councils UK
REI	Research Equipment Initiative
RM	Responsive Mode
SHEFC	Scottish Higher Education Funding Council
UUK	Universities UK

Executive Summary

This document sets out the views of a specialist Review Panel convened to provide an independent evaluation of BBSRC's Research Equipment Initiative (REI) and the effectiveness of BBSRC's current support for mid-range equipment through responsive mode. Specifically, the objectives of the evaluation were to:

- assess the effectiveness of the REI in enabling high-quality research within the BBSRC remit
- assess the effectiveness of the REI in promoting the sharing of equipment and partnerships between departments, institutions and external sponsors of research
- assess the quality of the outputs and outcomes arising from research which was facilitated by REI equipment
- comment on the approaches used by institutions to operate, maintain and acquire mid-range equipment
- assess the effectiveness of responsive mode funding for providing mid-range equipment
- in the context of other available support, consider whether a gap has developed in BBSRC's provision of mid-range equipment
- identify ways to build on successes and address identified gaps and issues

The Panel's analysis was based on questionnaire responses from 82 former REI grantholders. Relevant data were also collated from REI grant applications, responsive mode grant applications and the BBSRC grants database.

Key conclusions

1. The REI was a very successful initiative which provided excellent support for mid-range equipment to the BBSRC research community

The REI made an important contribution to the physical research infrastructure at UK universities and BBSRC strategically funded institutes. REI equipment facilitated high-quality research which produced exciting scientific discoveries and led to wider impacts. The initiative benefited a large number of researchers from across the BBSRC research community and it underpinned a large amount of other research funding. It promoted partnership and collaboration, and also delivered excellent value for money. Overall, the REI was a very effective mechanism for supporting mid-range equipment and it was extremely well regarded among the research community.

2. REI equipment facilitated high-quality research and contributed to good quality outputs and outcomes

The majority of REI grants performed very well. REI equipment facilitated a large number of research grants funded by BBSRC and other organisations. It contributed to a good number of publications in prestigious journals, provided important training opportunities for postdoctoral researchers and postgraduate students, and supported the development of larger research facilities or centres. The investment in mid-range equipment enabled researchers to conduct excellent research and helped to maintain the international competitiveness of UK bioscience research community. Moreover, REI equipment facilitated research which addressed BBSRC's current and past strategic priorities. Nearly all REI equipment is still in use and further achievements are expected. A small number of grants did not meet the expected standard and had produced very few outputs to date.

3. REI equipment benefited a large number of researchers

A major strength of the REI was its support for multi-user, multi-project, mid-range equipment; this promoted the sharing of resources and collaboration among researchers. A large number of researchers at all stages of their careers benefited from the equipment, including academic and non-academic users from within and outside the host institution. The technical expertise at institutions was and remains sufficient to enable the most imaginative experiments to be conducted with REI equipment, although it is often vulnerable to staff changes. Overall, the REI was a highly effective mechanism for supporting groups of researchers with unrelated research objectives.

4. The REI provided excellent value for money

The requirement for researchers to obtain non-BBSRC contributions towards their project was effective in lowering the overall costs of the initiative to BBSRC. Researchers leveraged substantial support from equipment manufacturers and distributors, other industry, other external sponsors of research, and host institutions. However, it was clear that the majority of external project partner contributions were manufacturers' discounts, making it difficult to assess the extent to which these represented genuine contributions to the costs of projects. Nevertheless, it was likely that the requirement for external contributions led to lower equipment costs than might normally be expected.

5. The REI promoted partnerships between academics and external sponsors of research

The REI provided further value by promoting partnerships with equipment manufacturers and other industry. These interactions were mutually beneficial, with the resulting collaboration and knowledge exchange often leading to additional benefits that were unanticipated at the time of application. The level of interaction was much higher than might be expected for the wider BBSRC responsive mode portfolio. However, some of the partnerships with manufacturers did not appear to represent a genuine collaboration and were of little value.

6. The balance and coverage of the REI portfolio was good

The REI's support for mid-range equipment was broad and there was particularly strong provision for microscopy, mass spectrometry and structural biology. The initiative supported the replacement of ageing equipment and the acquisition of new types of instrumentation, and there was an appropriate balance of lower-priced and more expensive items. The majority of grants were for standard, high-quality 'workhorse' equipment which was applicable to a large number of research projects; a smaller number were for equipment with a very specialised or unique technical capability. The majority of REI equipment was used to support research within the BBSRC remit. A small number of REI grants were used primarily to facilitate medical research and should not have been funded by BBSRC.

7. Some aspects of the REI's support for mid-range equipment could have been improved

The REI provided support for the purchase of the equipment and a small amount of further funding for its installation and initial set-up. Although BBSRC allowed for the costs of service maintenance contracts to be included as part of REI grants, across the initiative as a whole there could have been more consideration regarding how the long-term costs associated with the operation and maintenance of the equipment would be met. The time between application submission and the equipment being in place in the laboratory was sometimes too long. More broadly, there was no clear strategy to prioritise the REI's investments in different types of equipment, and there could have been greater emphasis on addressing BBSRC's strategic research priorities. The lack of reporting on REI grant outcomes and achievements also made it difficult for BBSRC to capture the impact of its investment in the initiative. BBSRC should identify better reporting mechanisms for any future funding scheme supporting equipment infrastructure.

8. It was difficult for BBSRC to justify support for the REI after the introduction of full economic costing (fEC)

Under fEC, institutions are able to support the long-term sustainability of their equipment infrastructure using costs recovered on research grants. This led to a perception that the REI was incompatible with fEC and the initiative was subsequently withdrawn. The closure of the REI had an adverse impact on the UK bioscience community and the current provision of mid-range equipment using costs recovered through fEC is inadequate. fEC has also limited BBSRC's ability to direct investments in mid-range equipment: there is no assurance that institutions will use funds generated under fEC to provide equipment infrastructure which facilitates high-quality research aligned to BBSRC's strategic priorities.

9. The support for mid-range equipment within responsive mode is not sufficient

BBSRC's provision for mid-range equipment within responsive mode is relatively modest and has not increased sufficiently since the REI was withdrawn. It is very challenging for researchers to obtain funding for more expensive equipment on a

standard responsive mode grant, although provision is better within the LoLa scheme. It is difficult to justify the full costs of mid-range equipment on a single research grant. In addition, it is not possible to fund equipment where the objective is to facilitate multiple, unrelated research projects, even when this represents a very effective use of resources. BBSRC should explore ways of improving the support for mid-range equipment within responsive mode. Research Committees should be made aware of the need to support equipment and the rules should be adjusted to accommodate a wider range of applications requesting equipment.

10. A funding gap has developed for the provision of mid-range equipment to UK bioscience researchers

Changes to the funding landscape, including those directly or indirectly associated with the introduction of fEC, have created a funding gap for the provision of mid-range equipment. BBSRC's withdrawal of the REI and its subsequent emphasis on support within responsive mode have reduced the overall level of support. In addition, many institutions are not using costs recovered through fEC to invest sufficiently in their physical research infrastructure and there is very limited support provided by other funders of bioscience research. It is increasingly difficult for researchers to replace old equipment or acquire new types of instrumentation which provide novel technical capability.

11. BBSRC should introduce a new dedicated funding scheme to support the purchase of mid-range equipment

A dedicated competition is a very effective mechanism for delivering support for mid-range equipment and there is a strong case for BBSRC to introduce an equipment funding scheme. This should build on the most positive aspects of the REI, but have a clearer focus on reinforcing existing BBSRC funding and addressing BBSRC's strategic research priorities. It should also support 'technical capability' in a much broader sense, for example, providing funding to use an external service if this would provide the best value. BBSRC will need to consider the introduction of a new scheme in the context of available resources and other competing priorities. However, failure to maintain the equipment infrastructure which underpins a large proportion of BBSRC's research base will be far more damaging to overall research effectiveness than, for example, the loss of a small number of responsive mode research grants.

12. The funding gap for mid-range equipment must be addressed to ensure the international competitiveness of UK bioscience research is maintained

Institutions, BBSRC, other Research Councils, and other funders of bioscience research have a shared responsibility to address the emerging funding gap for mid-range equipment, and organisations will need to work together to identify how this might best be achieved. BBSRC should examine how institutions are using the costs recovered through fEC to support their equipment infrastructure, and consider how good practice might be encouraged. There is also a need for Research Councils to provide direct support for mid-range equipment. In this context, BBSRC should identify

the appropriate balance between people and equipment necessary to deliver a world-class research base and ensure that its funding delivers this balance of support. In addition, BBSRC should consider clarifying responsive mode rules to make it a more effective mechanism for equipment provision, and consider supporting a dedicated equipment funding scheme. The impact of the funding gap for mid-range equipment is not yet fully evident but if it is not addressed the consequences will be severe. An ageing equipment infrastructure will lead to a massive loss of international competitiveness, BBSRC's mission to support world-class bioscience will be seriously compromised and, ultimately, the ability of BBSRC to deliver its strategic research priorities will be damaged.

1. Introduction

1.1 BBSRC

1. The Biotechnology and Biological Sciences Research Council (BBSRC) is one of seven Research Councils sponsored through the Department for Business, Innovation and Skills (BIS) of the UK government. Its principal aim is to foster a world-class biological science community in the UK. The mission of the BBSRC is to fund internationally competitive research, to provide training in the biosciences, to encourage opportunities for knowledge exchange and economic impact, and to engage the public and other stakeholders in dialogue on issues of scientific interest.
2. BBSRC supports research and training in a number of ways, including research grants, studentships, fellowships and strategic grants to BBSRC strategically funded institutes. In the 2009-10 financial year, 35% of BBSRC research funding (£165 million) was spent via the 'responsive mode' scheme, whereby research grants are awarded to unsolicited research proposals from eligible applicants in any area relevant to the mission of the Council. BBSRC also supports research through directed initiatives, where money is targeted to fund grants that will deliver specific strategic objectives.

1.2 Evaluation in BBSRC

3. BBSRC is committed to the effective evaluation of the research and training it funds, as part of its strategy for evidence-based decision making. Evaluation plays a central role in:
 - enabling BBSRC to account to government, the public, the scientific community and other stakeholders for the funds it allocates
 - justifying BBSRC funding allocation and contributing to the evidence that all Councils are required to submit to BIS
 - informing internal funding decisions, providing evidence of progress and achievement, and facilitating the development of a strategic overview for future funding decisions
 - helping BBSRC to improve its policy and practice, through informal policy decisions and the design of new schemes, programmes and processes; and through identifying good practice, lessons learned and ways to improve processes
4. Formal evaluation of research is currently conducted at a number of levels in BBSRC:

Project:	<ul style="list-style-type: none">• evaluation of final reports from grants
Scheme:	<ul style="list-style-type: none">• evaluation of major research investments, for example, through responsive mode or research initiatives (time-limited research funding in strategically significant areas)• evaluation of funding schemes (e.g. international Partnering Awards, Research Industry Clubs, early-career fellowships, equipment grants)
Institution:	<ul style="list-style-type: none">• Institute Assessment conducted every five years at the BBSRC strategically funded institutes

5. BBSRC's Evaluation Framework¹ outlines the Council's approach to evaluation and the methodology used.

1.3 Definition of mid-range equipment

6. For the purposes of this evaluation, 'mid-range equipment' (MRE) is used as a collective term to describe equipment in the £50K to £500K price range. This definition includes single items of equipment as well as collections of less expensive items that together form a coherent equipment set-up. Examples of scientific areas and techniques that often require MRE include: computing and bioinformatics, mass spectrometry, microscopy, nucleic acid analysis, and structural biology.

1.4 The Research Equipment Initiative

7. In 1996, the Research Councils introduced the Joint Research Equipment Initiative (JREI), a multi-sponsor equipment fund supporting high-quality bids for laboratory equipment and facilities, in order to develop and maintain the health of the science and engineering base in UK universities. The JREI ran until 2001 and, over the course of the initiative, funded 252 grants within the BBSRC remit with a total value of £18.0M.
8. In 2002, BBSRC introduced its own Research Equipment Initiative (REI) to replace the JREI. The aim of the REI was to:
 - contribute to the physical research infrastructure within UK Higher Education Institutions (HEIs) and BBSRC approved Independent Research Organisations (IROs) to enable high-quality research within the BBSRC remit
 - promote sharing of equipment and partnership between departments, institutions and external sponsors of research
9. The REI provided support (£50K - £250K²) for researchers to purchase mid-range, multi-user, multi-project equipment, and further funding for its installation and set-up. The REI did not meet associated running costs of the equipment (e.g. estates, staff, consumables etc.). The REI ran until 2007 and, over the course of the initiative, funded 221 grants with a total value of £29.6M.
10. The REI ran two annual competitions. The first was open to researchers at HEIs and approved IROs, whereas the second was open to BBSRC strategically funded institutes. In 2007, the institute competition was not run.
11. The REI required proposals to be supported by funding from external project partner(s) directly towards the costs of the equipment sought. There was no minimum contribution from external project partners, but BBSRC aimed to provide average funding of 50% towards the total cost of successful proposals across the initiative as a whole. Typically, researchers met this requirement through manufacturer discounts on the costs of equipment.
12. With the introduction of full economic costing (fEC), institutions were able to replace equipment through depreciation costs claimed on research grants. At that stage,

¹ www.bbsrc.ac.uk/researchevaluation

² Figures are for the 2007 REI competition.

BBSRC decided that REI was incompatible with fEC and, as a result, withdrew support for the scheme. This brought BBSRC into line with the other Research Councils.

1.5 Support for mid-range equipment through responsive mode

13. Since the REI was withdrawn in 2007, the primary route for researchers to obtain BBSRC funding for MRE has been through responsive mode. Requests for MRE in responsive mode applications should be associated with a specific research project. This differs from the REI where there was an emphasis on multi-user, multi-project applications. Responsive mode is able to support a broader range of costs than the REI. For example, staff costs and consumables associated with the use of the MRE can be included as part of the application.

1.6 Evaluation methodology

14. The aim of the evaluation was to obtain an independent assessment of the Research Equipment Initiative and the current support for MRE through responsive mode. Data for the evaluation were gathered from a number of sources:
 - **Grantholder surveys:** A sample of 105 out of 221 REI grants was taken for the evaluation. The sample was structured so that it was representative of the whole in terms of equipment types, institution type (HEI or BBSRC strategically funded institute) and REI funding calls. A questionnaire was sent to grantholders covering topics including the success of the grant, research outputs and outcomes facilitated by the REI equipment, approaches for maintaining and replacing MRE, views on the effectiveness of the REI, and views on BBSRC's current support for MRE. 82 responses were received (78% response rate).
 - **BBSRC data:** Relevant data were collated from REI grant applications, responsive mode grant applications and the BBSRC grants database.
15. The questionnaire is reproduced at Appendix 2 (p. 69). The survey responses were received between September 2009 and January 2010.
16. The evidence collected for the evaluation was reviewed by a Panel of experts who are familiar with research which requires MRE and who between them have expertise across the BBSRC remit. The Review Panel met in March 2010. For Review Panel membership, see Appendix 1 (p. 68).

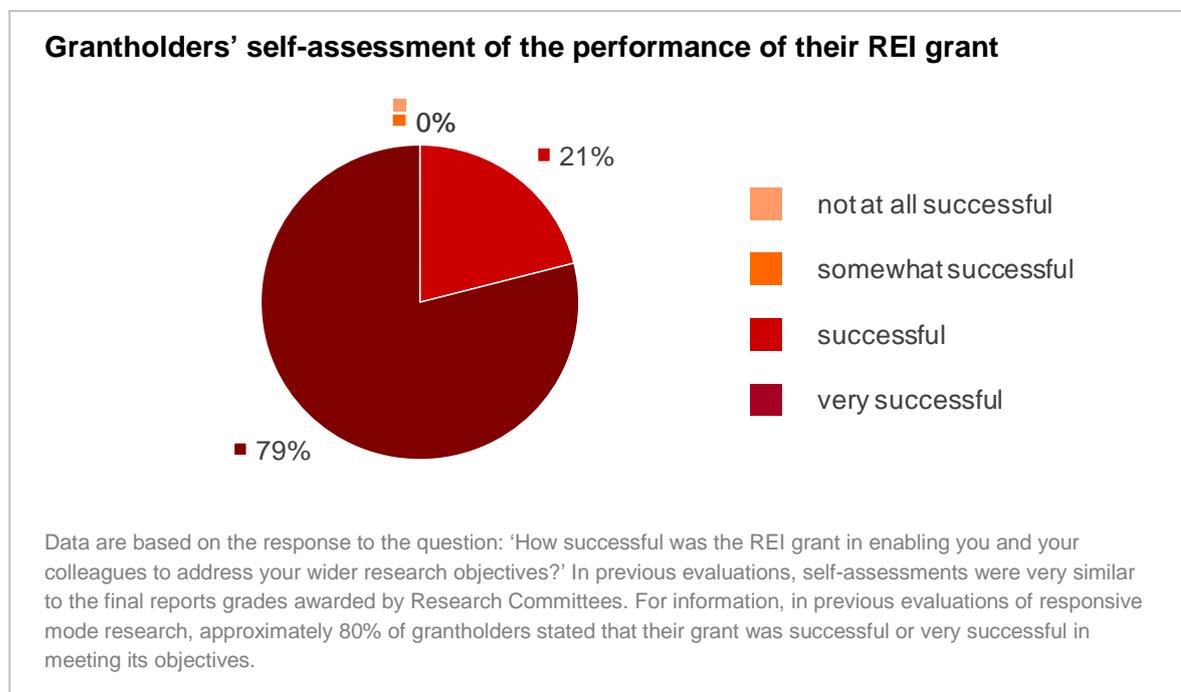
2. Grant outputs and achievements

Summary

- The REI enabled high-quality research which produced good outputs and outcomes
- REI equipment facilitated a large number of research grants funded by BBSRC and other organisations
- The REI contributed to the development of larger research facilities and centres
- The REI facilitated research which had economic and societal impacts
- The REI helped to maintain the quality of research infrastructure and this contributed to the high international standing of UK bioscience research
- A small number of REI grants did not meet the expected standard

2.1 Overview of grant performance

17. An overview of the performance of individual REI grants was obtained from grantholder self-assessments. Grantholders were very positive about the performance of their grants: all stated that the grant had been successful or very successful in enabling them to meet their research objectives. The self-assessments may have overstated the success of the initiative to a degree (see section 2.8, p. 24) but the Panel agreed that overall the performance of REI grants was very good.



18. To be eligible for REI funding, researchers were required to have BBSRC grant support. This requirement was used as an indicator of the likely quality of individual REI grants, as applicants had already been successful in a competitive peer-review process. There were indications that grant quality improved in the later rounds of the initiative. This may

have been due to a lower responsive mode success rate which led to REI applications being drawn from a smaller, more competitive pool of eligible researchers. In addition, in later years, BBSRC improved the guidance provided to the assessment panel regarding the objectives of the initiative and the types of applications it was seeking to support.

2.2 Outputs and achievements facilitated by REI funding

19. The REI provided funding to purchase MRE, but it did not provide support for the research activities associated with its use. As such, the outputs and achievements reported in this evaluation are indirect, and are a result of the REI equipment facilitating research supported by other funding.
20. REI grantholders did not submit a final report at the end of the grant. The Panel therefore based its assessment of the REI's achievements on information collected through grantholder survey responses. The level of detail provided by individual responses varied, and it is likely that all the outputs and impacts of the REI were not fully captured. Moreover, the data only represent the outputs and outcomes of the REI to date. The most notable outcomes arising from REI equipment often took considerable time to be realised, and further outputs are expected as nearly all of the equipment is still in use. However, there was also some over-reporting of outputs by grantholders and it was sometimes difficult to determine the extent to which particular outputs were attributable to the REI equipment.
21. The outputs and achievements reported from the REI were very good. They were wide ranging and included that REI equipment had:
 - enabled high-quality research
 - supported multiple researchers
 - contributed to good research outputs and outcomes
 - developed and maintained research infrastructure
 - represented a very effective use of BBSRC resources

Specific examples of the REI grant outcomes and achievements are included throughout the report.

22. There were many examples of REI equipment contributing to very good scientific discoveries. However, there were fewer outstanding scientific 'firsts' reported than might be expected from a similar investment in responsive mode funding. This may be related to the type of the equipment purchased through the initiative. A large proportion of grants were for 'workhorse' equipment which was used extensively by multiple researchers. A relatively small proportion of grants were for equipment with a very specialised technical capability which supported an individual research programme (see Chapter 5).

Researchers at the University of Cambridge received REI funding to purchase cryoprobe equipment for their Nuclear Magnetic Resonance (NMR) facility. They subsequently solved the first solution NMR structure of a seven-transmembrane protein using the enhanced sensitivity offered by the instrumentation, and their results were published in the prestigious journal *Nature Structural and Molecular Biology*. They are now developing approaches towards investigating the structure of G-protein coupled receptors (GPCRs), seven-transmembrane domain receptors which are the targets of many known drugs but are still highly intractable with respect to structural biology and crystallography.

Summary of achievements arising from REI funding reported by grantholders

Enabled high-quality research

- facilitated substantial amounts of research grant funding
- enabled new research directions and novel approaches, often beyond what was envisaged in the original proposal
- improved research efficiency (e.g. speed, scope, throughput)
- enabled pilot work to be conducted and preliminary data obtained
- led to important scientific discoveries

Supported multiple users

- contributed to the work of multiple users, including those who were not included in the original application
- encouraged other users to adopt the techniques supported by the equipment
- enabled and encouraged multi-disciplinary research

Led to very good outputs and outcomes

- contributed to a large number of high-quality publications in good journals
- led to new academic collaborations (local, national, international)
- enabled researchers to attract substantial research grant funding from BBSRC and other funders
- supported the training of researchers at many levels (MSc students, PhD students, postdoctoral researchers, technicians, visiting workers)
- led to improved links and closer interactions with equipment manufacturers
- led to improved links and closer interactions with other industry, including formal collaborations
- led to university funding for new academic positions (e.g. lecturers, specialist support staff)
- helped establish academic careers
- contributed to public engagement activities

Developed and maintained research infrastructure

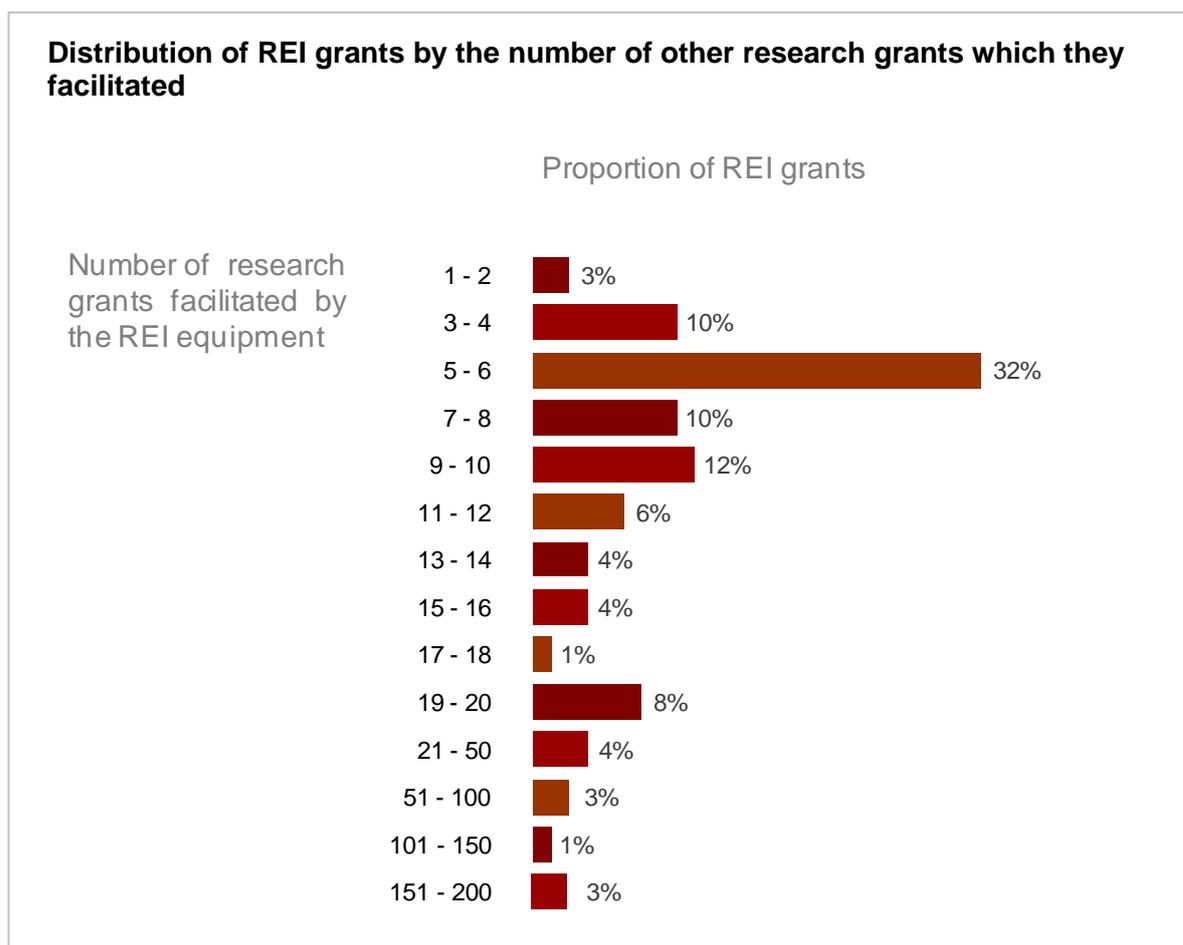
- provided previously unavailable capability
- leveraged further equipment grant funding (internally and externally)
- contributed to the development of centres of excellence and world-class facilities
- provided 'workhorse' equipment which was in constant use
- maintained the competitiveness of research groups at the national and international level
- enabled institutions to attract the best researchers

Represented a very effective use of BBSRC resources

- provided very good value for money
- encouraged sharing of resources
- provided equipment which would be difficult to justify for a single research project

2.3 Facilitating and attracting other research funding

23. The REI was highly successful in facilitating research supported through other grant funding. Grantholders were very positive about the contribution the REI equipment made to their and their colleagues' wider research programmes, stating that it enabled them to meet their research objectives and that without the equipment many research projects would have been limited in scope or impossible. REI support also enabled researchers to attract further funding for research and equipment.
24. Grantholders estimated that their REI equipment had facilitated the work of over 1400 research grants to date. The median number of research grants which were enabled by each REI grant was eight (mean = 18.3). This was impressive although, from the data provided, the exact extent to which the REI equipment had contributed to these grants was not clear. It seemed likely that some grants had been significantly underpinned by the REI, with the equipment being essential for the research. For others grants, it is probable that the REI equipment was more peripheral to the delivering the objectives of the research.



25. REI equipment facilitated research supported by grantholders' existing funding as well as funding obtained after the REI grant was awarded. Indeed, grantholders noted how REI equipment helped them to attract substantial further funding. For example, many researchers used the equipment to pioneer new approaches or gather preliminary data, which then led to successful applications for responsive mode funding. Further funding was obtained from BBSRC as well as other Research Councils, charities, industry,

government departments and agencies, overseas funding organisations, Higher Education Funding Councils, and academic institutions.

Scientists at the University of Newcastle received an REI grant for an 18-colour Fluorescence Activated Cell Sorter (FACS). Such equipment was not widely available in UK institutions at the time and it enabled the researchers to use multiparametric flow cytometry to study stem cell biology. The research resulted in several high-level publications (e.g. *Cell Stem Cell*) and the original applicants used this success to leverage fourteen additional grants from BBSRC, MRC, the EU, industry, charities, and the Wellcome Trust. They also used the equipment to provide international training courses in flow cytometry on a quarterly basis, increasing the reputation of the university in the field and providing funds to support and maintain the equipment.

Sources of further funding which were facilitated by REI equipment

BBSRC funding sources

- **responsive mode**
- **research initiatives:** Centres for Integrative Systems Biology, Crop Science Initiative, Diet and Health Research Industry Club, Membrane Protein Structure Initiative, Selective Chemical Intervention in Biological Systems, Sustainable Bioenergy Centre, Sustainable Agriculture Research for International Development, Systems Approaches to Biological Research
- **schemes:** Modular Training for Industry, LINK, Tools and Resources Development Fund, US Partnering Award
- **studentships** (including Industrial CASE studentships)
- **fellowships:** David Phillips fellowships, Institute Career Path fellowships

Non-BBSRC funding sources

- **other Research Councils:** EPSRC, ESRC, MRC, NERC
- **charities:** Arthritis Research Campaign, British Heart Foundation, Cancer Research UK, the Darwin Trust, Fight for Sight, Kidney Research Foundation, Leukaemia Research Fund, Leverhulme Trust, the Royal Society for the Protection of Birds, the Stroke Association, United Nations Environmental Programme, the Wellcome Trust, Yorkshire Cancer Research
- **industry:** Asterion Ltd, AstraZeneca, BD Biosciences, British Biotech, Cancer Research Technology, Danisco UK, Dynamic Extractions, Farfield Scientific, GlaxoSmithKline, ICI, Lonza Biologics, MICAP plc, Nestlé, Pfizer, Prolysis, Roche, Solay Pharmaceuticals, Shell Global Solutions, Syngenta, UCB, Unilever, Vernalis
- **government departments and agencies:** Department for Environment Food and Rural Affairs, Department for International Development, Department of Trade and Industry, Food Standards Agency, Health Protection Agency, National Health Service, North West Regional Development Agency, One North East, Technology Strategy Board
- **overseas funding bodies:** the European Union (e.g. FP6, FP7), European Research Council, Department of Energy (USA), National Cancer Institute (USA), National Institutes of Health (USA), the Iranian government, the Pakistan Higher Education Commission
- **Higher Education Funding Councils:** HEFCE, SHEFC
- **academic institutions:** host institutions, Scottish Universities Life Science Alliance

2.4 Contribution to the development of larger research facilities and centres

26. Seven grantholders (9%) reported that their REI grant contributed to the development of a larger research facility or centre. They used the REI equipment as leverage to obtain support for additional equipment from other funding agencies or the host institution. Contributions to the establishment and development of larger facilities or centres were an important impact of the initiative. Facilities provide valuable services to the wider research community and REI equipment was often used more effectively when it was embedded within a facility.
27. There are risks associated with establishing new research facilities. For example, the facility may not be sustainable in the long-term, it may divert resources from other more valuable research activities, or the service provided could be delivered more cost-effectively by the private sector. The rationale for the development of facilities which received REI equipment was not always clear. For example, were facilities developed as a result of a clear strategic vision with a defined purpose and business plan, or had they developed as an unintended consequence of an institution accumulating multiple pieces of related MRE? Although there was no evidence that the REI had contributed to facilities which were not needed, it might have been better if the strategic purpose and long-term sustainability of any facilities had been considered more carefully during the assessment process.
28. For some areas of research, BBSRC had adopted a strategic overview for its investments in equipment at facilities and centres. For example, in the field of structural biology, the crystallography equipment funded through the REI was focused on replacing old equipment in existing centres rather than setting up new facilities. This was good practice which ensured that BBSRC made best use of limited resources by encouraging researchers to share equipment based at established facilities.

Facilities and centres whose development was partly attributable to the REI

Biomembrane Solid State Nuclear Magnetic Resonance Unit
University of Nottingham

Brunel Advanced Bioprocessing Centre
University of Birmingham

Cambridge Centre for Proteomics
University of Cambridge

DNA Sequencing Facility
University of Cambridge

The Gene Pool
University of Edinburgh

Molecular Interactions Facility
University College London

Wellcome EPSRC Leeds Medical Engineering Centre
University of Leeds

The REI-supported purchase of a state-of-the-art capillary DNA sequencer allowed researchers at the University of Edinburgh to deliver advanced sequencing services to over 800 individual users. This resulted in high-quality publications, including two papers in the high-impact multidisciplinary journal *Science* describing the genetics underlying the microevolution of coat colour in wild sheep. The acquisition of the equipment helped the researchers attract substantial further funding and develop their centre (now known as The GenePool). For example, the centre was subsequently awarded an ongoing contract to deliver sequencing and bioinformatics support to NERC science, and a £2.5M grant to become one of four MRC Next Generation Sequencing Hubs.

Researchers at Brunel University received REI funding which contributed to the development of a pilot scale bioseparation facility. The REI investment enabled the grantholders to obtain considerable additional funding, including support from the host institution, the Technology Strategy Board and industry. The Brunel Advanced Bioprocessing Centre is now recognised as a world-leader in the scale-up of countercurrent chromatography for the purification of pharmaceuticals, natural products, biomolecules, synthetic mixtures and various other compounds. One of the achievements arising from the Centre was the development of an Intermittent True Moving Bed (ITMB) process for the semi-continuous purification of compounds at a pilot or industrial scale. The ITMB process was only made possible by the custom-built valving system funded by the REI. It has been used to fulfil a contract for the purification of a Chinese herbal medicine and is generating considerable industrial interest.

2.5 Publications

29. Grantholders provided details on the five most notable publications arising from research which was significantly enabled by the REI equipment. The published outputs were good: 288 published articles were reported in 140 peer-reviewed journals. It should be noted that this is not representative of the total number of publications arising from REI-facilitated research as in many cases the REI grant will have contributed to a large number of other publications.
30. 90% of grantholders published papers in peer-reviewed journals as a result of research conducted with the REI equipment. Eight grantholders (10%) had not yet published any peer-reviewed papers; this was because the equipment had not been in place for long enough or it had taken time to optimise the equipment's performance.
31. The quality of the publications was generally good, with papers published in an appropriate balance of high profile and specialised journals similar to that observed for responsive mode grants. A notable proportion of REI grants had contributed to the publication of papers in high-ranking, multi-disciplinary journals or prestigious journals in specific scientific fields. For example, 9% of REI grants had contributed to a paper in *Cell*, *Nature* or *Science*. More broadly, 28% of grants contributed to a paper in a journal with an impact factor (IF) of ten or more, and 51% of grants contributed to a paper with an IF of eight or more. A small proportion of articles were published in lower profile journals.

Researchers at the John Innes Centre received an REI grant for a surface-plasmon resonance instrument used in protein interaction analysis. The researchers used the equipment to investigate the interaction of the protein DNA gyrase with the antibiotic simocyclinone D8. DNA gyrase is an important drug target as it is an essential protein in bacteria but is not present in humans. The research showed that individual moieties of simocyclinone D8 are comparatively weak inhibitors of DNA gyrase, but that their combination generates a more potent inhibitor. The results were published in the high-impact multidisciplinary journal *Science*, and may eventually facilitate the design of more effective antibiotic molecules.

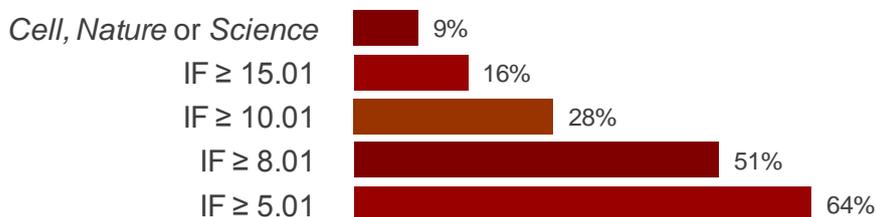
An REI grant was awarded to scientists at the University of Sheffield to purchase a laser scanning confocal microscope. The microscope was used in the development of time-resolved emission imaging microscopy (TREM) techniques for non-invasive imaging of live cells on a microsecond timescale. The results were published in the high-impact journal *Proceedings of the National Academy of Sciences of the USA*.

Researchers at the Cambridge Centre for Proteomics (CCP) (University of Cambridge) received three REI grants for mass spectrometry equipment over the lifetime of the initiative. The funding enabled the CCP to maintain its state-of-the-art facilities, which have been accessed by many researchers within the Cambridge Research Community, as well as UK and international researchers. Since the first of the REI grants was received, the CCP has contributed to over 80 publications. A particular highlight is a paper describing the organelle proteome of the model plant *Arabidopsis thaliana*. This was published in the prestigious journal *Proceedings of the National Academy of Sciences of the USA* and has been cited over 190 times.

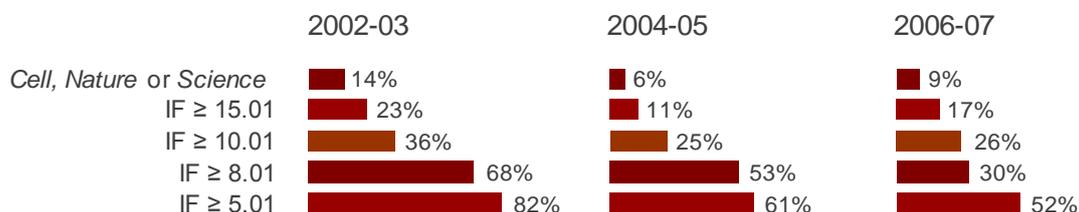
Scientists at University College London received REI support to purchase high-performance computing resources for structural biology and bioinformatics. The infrastructure has facilitated several publications in high-impact journals. For example, the structure of a chaperonin complex with a newly folded protein encapsulated in the folding chamber was published in *Nature*. Other papers were published in *Cell*, *EMBO Journal* and *PLoS Computational Biology*.

Proportion of REI grants which resulted in a peer-reviewed publication in a high-impact factor journal

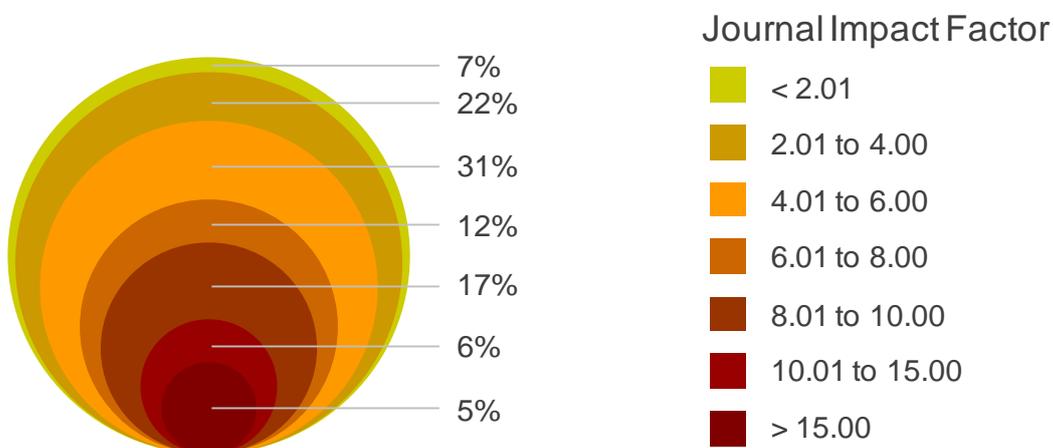
Data for all sample grants



Data for specific funding calls



Distribution of peer-reviewed articles by journal impact factor



Publication data are based on the information provided in grantholder surveys. Grantholders were asked to provide details on the five most significant publications arising from research that was facilitated by their REI equipment. Some grantholders selected these publications from their own research, whereas others included publications from other research groups who used the equipment. The analysis should be treated with caution as it places less emphasis on prestigious journals in specific fields which have more specialised readerships and therefore lower impact factors. In particular, strategic and applied research is less likely to be published in high impact, multidisciplinary journals such as *Nature* or *Science*. Moreover, journal impact factors should not be used as an indicator of the quality of individual research articles.

2.6 Economic and societal impacts

32. Economic and societal impacts are those ultimate impacts that relate to the overall objectives of BBSRC as an organisation and would generally be expected to arise in the longer-term. Examples of economic and societal impacts that should arise from BBSRC research funding include:
- research findings are used for the public good (e.g. food security, industrial biotechnology, human health, medical research, government policy)
 - research contributes to the increased competitiveness of the UK economy (e.g. provision of skills and expertise, or contributions to new or improved products and processes)
 - income to the research community and 'UK plc' (e.g. from new technologies, intellectual property, spin-out companies)
 - the UK maintaining its high standing in biological sciences
 - BBSRC maintaining its role as a key funder of biological sciences
 - public confidence in biological science research is maintained
33. These impacts relate to how effectively BBSRC is functioning and delivering the outcomes expected of publicly funded research. However, precise measurement and attribution of these impacts is difficult.
34. The REI contributed to BBSRC's objective of delivering economic and societal impacts from excellent research. REI-facilitated research has made, or has the potential to make, contributions to the wider public good in many different areas: animal health, bioenergy and biorenewables, the environment and combating climate change, food security, human health, industrial biotechnology, and other areas of government policy. In addition, the REI promoted closer links with equipment manufacturers and other industry (see Chapter 4).

The University of Sheffield received REI support to enhance its X-ray crystallography data collection infrastructure. The equipment contributed to structure-based antibacterial and antiparasitical drug development programmes, which were conducted in collaboration with industry partners. The researchers determined the structures of a number of essential proteins in pathogenic organisms. These were used as the basis for structure-based inhibitor design, targeting Methicillin-resistant *Staphylococcus aureus* (MRSA), toxoplasmosis, and melioidosis, and the research resulted in lead compounds and clinical trials. In addition, the equipment is contributing to other collaborative research programmes which may eventually produce benefits to the public good. These include the development of novel herbicides and investigations into the mode of action of a neutralising antibody to the leptin receptor (which has implications for the treatment of obesity and auto-immune disorders).

Scientists at the University of Aberdeen received support from the REI to purchase a portable X-ray fluorescence analyser for the non-destructive multi-element analysis of environmental samples. The equipment contributed to the studies of the level of inorganic arsenic in global rice food chains. Inorganic arsenic is a non-threshold, class 1 carcinogen, and the research indicated that rice could be a major route for inorganic arsenic into the human diet. The findings led to the European Union reconsidering legislation regarding dietary exposure to inorganic arsenic and resulted in the UK Food Standard Agency issuing warning advice that toddlers and young children should not be fed rice milk.

Researchers at the University of Nottingham received REI support to purchase a specialised computation resource for biomolecular simulation, which was used to provide insights into the structure, dynamics and recognition properties of biomolecules. The equipment contributed to the development of a new tool for computer-aided drug design, and this tool is now being used in the laboratories of at least two major pharmaceutical companies, as well as academic research groups across Europe.

An REI grant awarded to scientists at the University of Birmingham provided funding for Nuclear Magnetic Resonance instrumentation. The equipment was used in the development of a new screening method to discover and characterise novel protein ligands (SALMON: solvent accessibility, ligand binding and mapping of ligand orientation by NMR spectroscopy). The method is now used by the pharmaceutical industry as a convenient and sensitive tool to define ligand binding, and is particularly attractive as it has been put into the public domain without restrictions.

The REI provided funding for a phosphoimager, 2D-DIGE technology and differential dye-imaging software at the University of Durham, which were used to identify and quantify differences in protein samples. A research project using the equipment led to the identification of extracellular ATP in plants and its role in suppressing cell death. The work was patented and contributed to the development of a spin-out company.

2.7 International standing of UK bioscience research

35. REI equipment provided researchers with technical capability which helped the UK bioscience community maintain its international competitiveness. For example, the investment in equipment infrastructure for structural biology is likely to have contributed to the UK's high international standing in this discipline. Support provided by the REI also had an important impact in enabling the bioimaging community to compete with international academics.
36. It is not possible to measure the impact of the REI on the international standing of UK bioscience research. However, the Department for Business, Innovation and Skills publishes a number of Public Service Agreement target metrics for UK bioscience research as a whole. The metrics compare the performance of the UK in biosciences using bibliometric data from ISI National Science Indicators. Data published in 2009 show that in terms of the quality of its bioscience research, the UK was ranked second (behind the USA) for its share of citations in the biosciences, and was ranked first in citation impact (ratio of citations to publications). It is likely that widely cited publications arising from REI-facilitated research contributed to this high standing of UK bioscience research.

2.8 Grants which did not meet the expected standard

37. Although the overall performance of individual REI grants was very good, a small number of grants did not meet the expected standard. Approximately 10% of grants underperformed, producing relatively few outputs or achievements to date. However, there were notably fewer underperforming grants compared with a similar sample from responsive mode research grants. In particular, there were very few grants which had seriously underperformed, for example, where the equipment had not facilitated good quality research or had not contributed to any outputs.
38. The two main factors which contributed to grants which did not meet the expected standard were (i) a lead researcher leaving the host institution and (ii) technical faults with the purchased equipment. The loss of a lead researcher could adversely affect grant performance, especially if they were responsible for managing the equipment's effective use or maintenance, or if their expertise was needed to deliver excellent science using the equipment. The purchase of a small number of faulty pieces of equipment was inevitable given the scope of the initiative and the equipments' high technical specifications. It was encouraging that researchers worked closely with the manufacturers to resolve such issues.
39. Other factors which affected grant performance included the length of time taken to get the equipment installed and operational within the laboratory environment. In addition, for a very small number of projects, the lack of success was related to the associated scientific projects being of low quality.
40. A few grants produced good quality outputs but did not necessarily meet the wider objectives of the initiative. Some equipment was not used as extensively as originally anticipated. For example, for 14 grants (17%) there were fewer individuals reported as benefiting from the equipment than the number of researchers listed on the original application. A small number of grants appeared to have primarily supported research which was outside the BBSRC remit (see Chapter 5).

2.9 Reporting of outputs and outcomes

41. The REI did not require grantholders to submit a final report at the end of their grant. This was appropriate as the grants were only active for a single financial year, and there would be very little to report at the end of the grant other than that the equipment had been purchased. However, as a result, it was difficult to assess the scientific outcomes and achievements of individual REI grants or the impact of the initiative as a whole. For example, it was difficult to determine the extent to which the equipment facilitated the research described in the original application, how the equipment benefited the applicants and other researchers, or whether the proposed collaborations with external project partners were successful.
42. It is increasingly important for BBSRC to capture the impact of its investment in equipment infrastructure; this can be challenging as such impacts are often indirect. In retrospect, the lack of reporting on REI grant outcomes and achievements was a weakness with the initiative. It would have been beneficial for grantholders to report on the use of the equipment on related grants, although the Panel recognised that during the lifetime of the REI, BBSRC's reporting systems did not allow for this. It would also have been useful to insist grantholders acknowledge the REI grant on any research publication which made use of the equipment. Going forward, BBSRC should identify better reporting mechanisms for any possible future funding scheme supporting

equipment infrastructure. The Panel noted that the introduction of cross-Council systems for collecting outcomes from all grants could be useful in this respect.

3. Equipment use and maintenance

Summary

- The REI's support for multi-user equipment was a major strength of the initiative
- The REI was very successful at promoting the sharing of equipment among researchers
- REI equipment was used by large numbers of researchers at all stages of their careers
- The majority of REI equipment is still in good working order and is used regularly
- Obtaining funding to support the operation and maintenance of REI equipment is challenging
- The technical expertise at host institutions is sufficient for the most exciting and innovative experiments to be conducted with REI equipment
- The technical expertise is often with postdoctoral researchers and postgraduate students who may leave the institution at any time

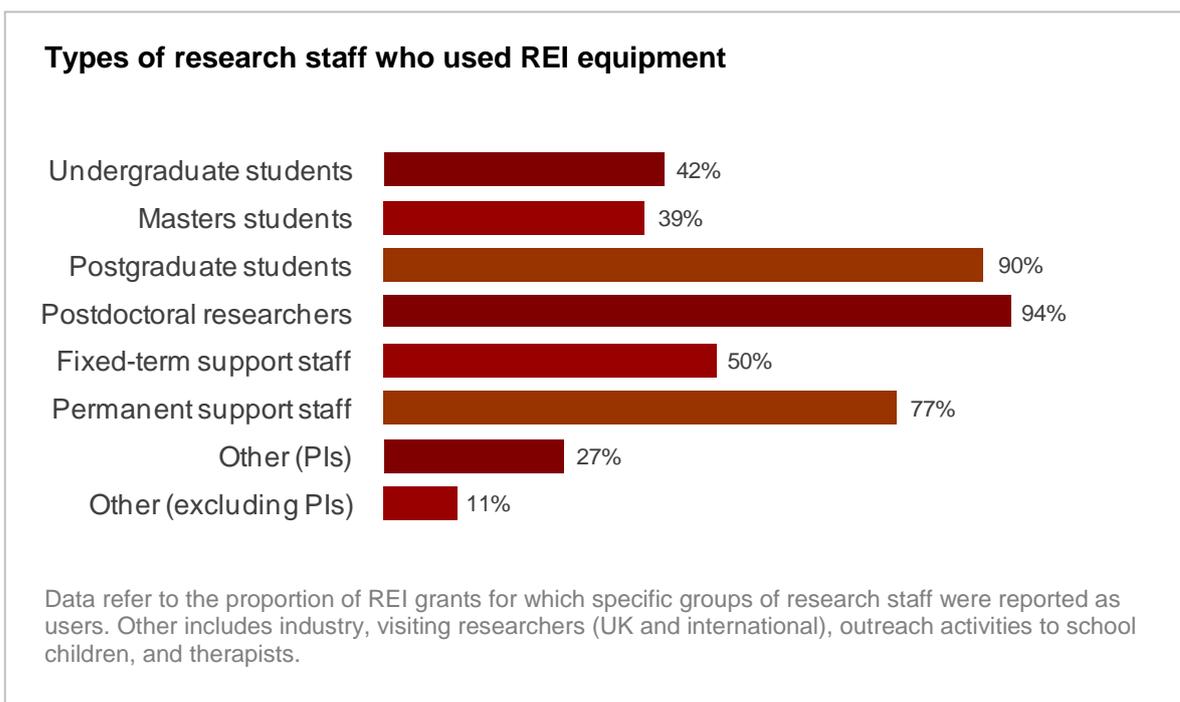
3.1 Users and beneficiaries of REI equipment

43. A major aim of the REI was to promote the sharing of equipment and partnership among researchers, institutions and external sponsors of research. The REI's support for multi-user equipment was essential to its success in meeting this objective. Multi-user equipment promoted collaboration within departments, within the host institution, and with other national and international institutions. It also represented an effective use of BBSRC resources, providing support for equipment which was very useful to a group of researchers but which could not be justified for a single user or single research project.
44. The REI benefited a large number of researchers within the BBSRC research community. Across the initiative as a whole, 1349 researchers³ were listed as a Principal Investigator (PI) or Co-Investigator (Co-I) on REI applications forms (this included 1003 individual researchers). The mean number of researchers per REI grant was 6.1, which was notably higher than the current mean number of researchers per BBSRC grant of 2.0. The REI also encouraged sharing of equipment between departments: the mean number of departments listed on each application was 2.0, with a range of one to eight.
45. Data from REI application forms underestimate the total number of users and beneficiaries, as the equipment also benefited researchers who were not named on the original application. Grantholders reported that 1823 researchers had directly benefited from the use of the equipment. The mean number of researchers who benefited per REI grant was 22.2 (median = eleven). As expected, there were differences in the number of beneficiaries depending on the equipment type: 'workhorse' equipment or equipment

³ In this context, the term 'researchers' is used to refer to scientists at the level of Principal Investigator or equivalent.

which was used to provide a service benefited a larger number of users than more specialised equipment.

46. It was commendable that the reported users of REI equipment also included researchers based outside the host institution. 71% of grantholders reported that the REI equipment was used by researchers at other institutions. The mean number of researchers based at the host institution was 13.6 (median = eight); the mean number of researchers based at other institutions was 8.6 (median = two).
47. Data for the number of users and beneficiaries are not a direct indicator of the success of the initiative. The exact extent to which REI equipment benefited individual researchers was not always clear and, for example, where equipment benefited a very large number of users (e.g. a DNA sequencer), it was likely that the impact on each individual researcher was relatively small. Nevertheless, it is clear that the REI had an impact of some kind on a large number of researchers.
48. REI equipment was used by many types of research staff. The main groups of users were postdoctoral researchers, postgraduate students and permanent support staff; others included fixed-term support staff, undergraduate students, MSc students, PIs, industry and visiting researchers. For a large proportion of grants the equipment was accessible to many different users groups. For other grants, the equipment was only used by core facility staff or by staff with specialised training, but this was appropriate as it ensured that the most reliable data were obtained.
49. REI equipment provided training opportunities for scientists, particularly for postgraduate students and postdoctoral researchers at the early stages of their careers. The role of REI equipment in training was not a focus of the evaluation. However, it was clearly an important outcome arising from the investment: training in the use of state-of-the-art equipment is very beneficial in the provision of skilled scientists for academia and industry.



Mean number of users for REI equipment

Mean number of applicants on original REI application



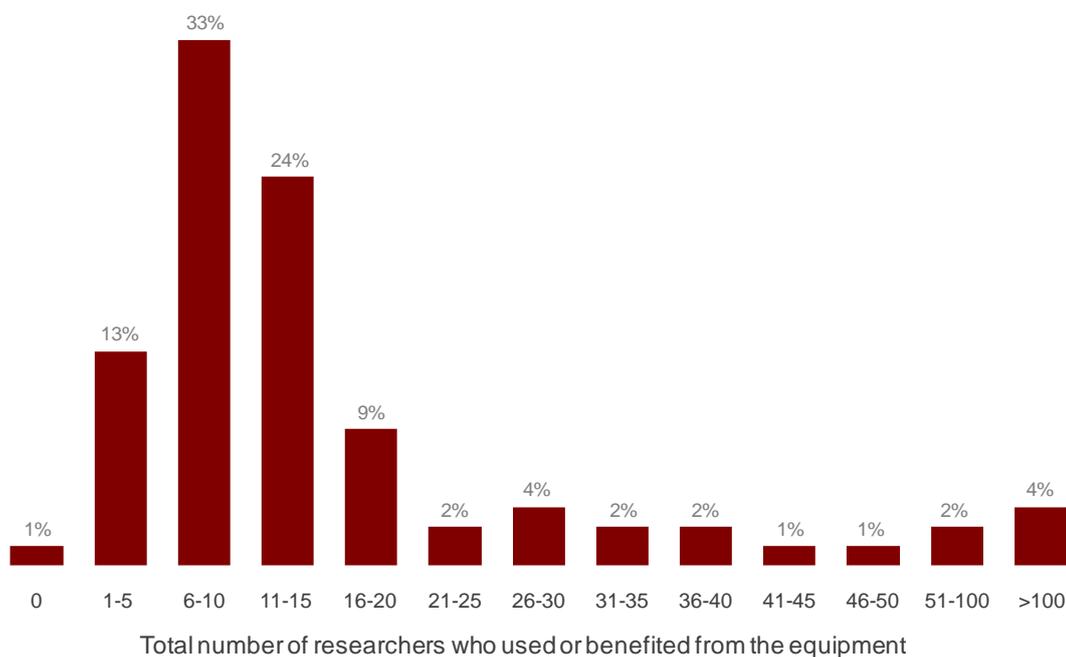
Mean number of users and beneficiaries reported in surveys



Mean number of applicants on BBSRC grants in the wider portfolio



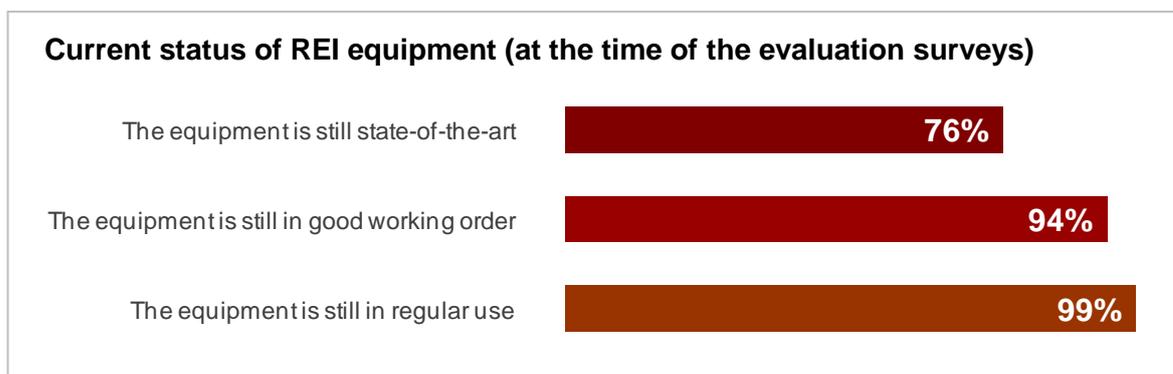
Distribution of REI grants by the number of researchers who directly benefited from the equipment



Data refer to researchers at the level of Principal Investigator or equivalent. Data for the number of users reported on application forms refer to all 221 REI grant applications. Data for grantholder surveys refer to the 81 survey responses. Data from the wider BBSRC funding portfolio are provided for information. As at 31 December 2009, there were 1757 BBSRC responsive mode, initiative and fellowship grants live. 3532 researchers were listed as PI or Co-I on these grants (i.e. a mean of 2.0 researchers per grant). 2382 unique researchers (PIs or Co-Is) were supported.

3.2 Equipment operation and maintenance

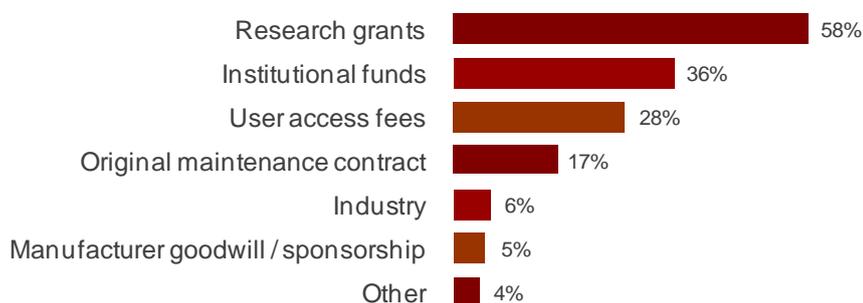
50. It was noteworthy that the overwhelming majority of REI equipment is still in good working order and is still used regularly. Many items of equipment are being used extensively on a daily basis. A large proportion of equipment is still state-of-the-art although, as would be expected, some is no longer cutting-edge and is used for more routine work.



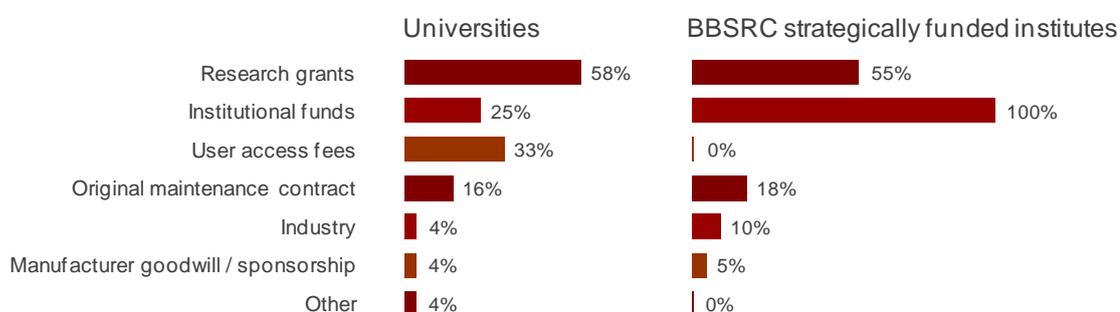
51. Grantholders noted that obtaining funding for the long-term operation and maintenance of REI equipment was very challenging, particularly after the original maintenance contracts expired. Researchers used a variety of funding models and funding sources to meet these costs including: their own research grants; users' research grants; institutional funds; user access charges; the original maintenance contracts; and industry support. Some grantholders were inventive in their approach to supporting their equipment's operation, for example, developing an income stream through providing training courses using the equipment.
52. There was some concern about the different approaches used by institutions to determine user access charges. For example, some institutions charge for the costs of operating and maintaining the equipment, whereas others also include depreciation costs (which should be incorporated into fEC). It was noted that BBSRC is very good about funding the real costs for access charges on responsive mode grants. However, other funding agencies do not always provide sufficient support to meet these costs.
53. BBSRC allowed for the cost of service maintenance contracts to be included as part of REI grants, and some grantholders negotiated cost-effective extended maintenance contracts within their REI equipment purchase (e.g. five year contracts). This was good practice, and the Panel noted that going forward this model should be considered seriously as a component of any funding scheme supporting MRE, even though this would reduce the number of grants funded. The Panel noted that some researchers may have obtained a competitive price for the initial purchase of their equipment, but that the subsequent maintenance costs were very expensive. These costs may be passed onto BBSRC through user access charges on responsive mode grants, negating some of the initial saving.
54. Some grantholders reported that their institution was not willing to provide funding to support the long-term use of the equipment (e.g. core staff to operate the equipment, or assistance with maintenance costs). They suggested that BBSRC should have insisted on institutional contributions to operational and maintenance costs within the grant terms and conditions. While this may have been beneficial, it is not permitted under fEC and probably contributed to the perception that the REI was incompatible with fEC.

Funding sources used to operate and maintain REI equipment

Data for all institutions



Data by institution type



Data indicate the proportion of REI equipment whose operation and maintenance is supported by the specified funding sources.

3.3 Expertise at the host institution

55. The technical expertise at host institutions was sufficient to conduct the most exciting and innovative experiments with REI equipment. 94% of grantholders stated that the expertise at their institution was good (26%) or very good (69%).
56. The pool of expertise is often the postdoctoral researchers and PhD students working at the institution. This prompted a concern that the technical capability within institutions is vulnerable to staff changes: these researchers may leave at any time, disrupting the continuity of expertise. For some types of equipment, there are benefits of having a specialised staff position associated with the operation and management the equipment. However, obtaining funding for these positions from the host institution is often challenging.

4. Contributions towards project costs

Summary

- The REI was effective in leveraging external contributions towards total project costs
- The requirement for external contributions helped drive down the costs across the initiative as a whole
- It was difficult to determine the extent to which manufacturers' discounts represented genuine contributions to the costs of REI projects
- The introduction of fEC prevented BBSRC from requiring host institutions to make substantive contributions towards REI project costs
- The REI was effective in promoting interactions between researchers and external project partners
- Overall, the REI provided excellent value for money for BBSRC

4.1 Overview of project costs

57. BBSRC aimed to fund approximately 50% of the total costs associated with the REI projects. The remainder was to be met by external project partners and institutional contributions. BBSRC required the external sponsorship to be in the form of a direct financial contribution or a discount supported by collaborative effort. The external sponsorship had to be given specifically for the purchase of the equipment through the REI scheme and not money provided through an existing scheme or arrangement.
58. Information from REI application forms indicated that of the £50.2M total project costs: 55% were met by BBSRC, 34% by external project partners, and 11% by host institutions. These data suggest that the REI was close to meeting its target of funding 50% of project costs. However, the majority of the external project partner contributions were manufacturers' discounts, making it difficult to determine the extent that these represented genuine contributions to REI project costs. If manufacturers' contributions are excluded, BBSRC met 79% of total project costs.
59. The Panel recognised that the requirement for 50% external project partner contributions was an aspirational target, designed to reinforce the message of cost effectiveness. The requirement was effective in driving down costs across the initiative as a whole and it put pressure on grantholders to negotiate the best deals with equipment manufacturers and distributors. It also provided grantholders with leverage with manufacturers and host institutions. 66% of grantholders stated that the requirement for external contributions was an effective (32%) or very effective (34%) way of leveraging external support. The Panel also recognised that had the 50% requirement had been robustly enforced (e.g. if manufacturers' discounts were not permitted as contributions), it would have adversely affected the types of proposals which could be funded, limiting support to areas of the remit where it was possible to obtain large amounts of industry funding.

Overview of contributions towards total REI project costs

Including manufacturer contributions

£50.2M



Excluding manufacturer contributions

£35.1M



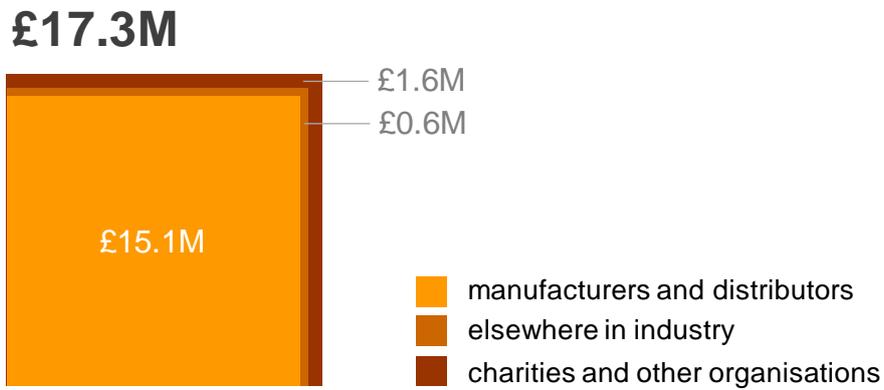
- BBSRC
- external project partners
- host institutions

Information on project costs was obtained from the application forms of 199 of the 221 REI grants. For 22 of the 221 REI grants, application forms were not readily available. Total project costs are based on the amounts requested from BBSRC; the actual amounts awarded may have differed slightly. Contributions from external project partners included manufacturer's discounts which were reported in different ways. In some cases, the total discount from the list price was reported, whereas in other cases only the discount above any standard academic discount was reported. As such, the contribution from external project partners is likely to be an underestimate.

4.2 Contributions from external project partners

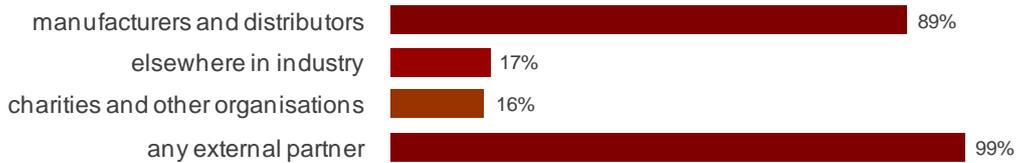
60. £17.3M toward project costs was contributed by external project partners, including industry, charities and other organisations. For the purpose of this evaluation, industry was divided into two distinct groups:
 - manufacturers and distributors of equipment (hereafter referred to as 'manufacturers')
 - other industry (hereafter referred to as 'industry')
61. 99% of REI grants received contributions from an external project partner. These included manufacturer's discounts, cash, training, equipment, maintenance contracts, consultancy and staff time. The majority of REI grants had one (58%) or two (28%) external project partners. The median number of external project partners per REI grant was one (mean = 1.6).

External project partner contributions to REI projects



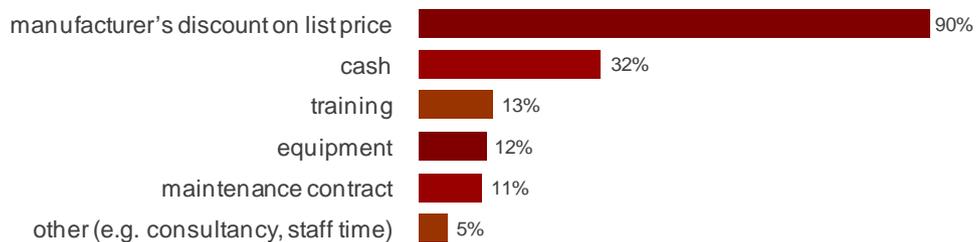
Proportion of REI grants which received contributions from an external project partner

External project partner:



Proportion of REI grants which received different types of contributions from external project partners

Type of contribution:



62. 35% of grantholders reported receiving further benefits or contributions from an external project partner which were unanticipated at the time of application. These included:
- direct contributions from the manufacturer
 - adaptations to existing equipment to ensure compatibility with the REI equipment
 - free software upgrades
 - free or discounted service costs
 - free or discounted user training
 - discounted reagents
 - stronger partnership links with manufacturers
 - improved follow-up support, ensuring equipment is kept at the cutting-edge of performance
 - support for training workshops (including discounted reagents / loan of equipment)
 - access to new technologies, testing of new instruments
 - sponsorship of facilities
 - establishment of long-term relationships
 - stronger partnership links with industry
 - new collaborations
 - CASE studentships
 - supply of tools and reagents
 - stronger partnership links with other organisations
 - further charitable funding to support equipment maintenance

It is unlikely that a similar pattern of additional benefits would emerge from the funding of mid-range equipment through responsive mode.

4.3 Contributions from manufacturers

63. £15.1M was contributed to REI project costs by manufacturers. Manufacturers' contributions varied, but the majority were effectively discounts on equipment costs. They included list price discounts as well as other in-kind contributions such as free or discounted consultancy, maintenance contracts, staff time or training. 136 manufacturers were listed as external project partners on REI grants. The median number of REI grants each manufacturer participated in was one (mean = 1.8). 89% of REI grants had a manufacturer as an external project partner.
64. It was difficult to assess the extent to which the REI had leveraged genuine contributions towards the costs of the equipment from manufacturers. The Panel was concerned that some manufacturers' discounts did not appear to be associated with a collaborative partnership, and that some discounts appeared to be artificial. Moreover, it was not possible to determine whether similar discounts could have been obtained by any academic researcher who negotiated with the manufacturer. However, comments from researchers suggested that they had obtained deeper discounts through the REI compared with their other equipment purchases. On balance, it was likely that REI grantholders obtained discounts beyond what would usually be received, but not to the high level indicated on application forms.

65. Opportunities for obtaining manufacturer discounts vary depending on the type of equipment being purchased. For example, some items are effectively sold as commodities with little opportunity obtain a genuine reduction in price (e.g. compute nodes). There was a risk that the requirement for a high level of external contribution may have encouraged some manufacturers to artificially inflate their prices to create the appearance of a discount.

Manufacturers and distributors who were listed as external project partners on REI grants



Font size in this word cloud reflects number of REI projects the manufacturer participated in, not the financial value of their contribution: smallest text represents a partner on one REI grant; small, two to three grants; medium, four to six grants; large, seven to nine grants; largest, ten or more grants.

4.4 Contributions from industry and other organisations

66. £2.2M was received in cash and in-kind contributions from external partners other than manufacturers. These partners included industry, charities, other academic institutions, and other government-funded organisations. 17% of REI grants had an industrial company as a partner; 16% had a charity or another organisation as a partner.
67. Contributions from these external partners were equivalent to 4% of the total REI project costs (rising to 7% if manufacturers' contributions are excluded). This level of contribution was notably higher than that observed in the wider BBSRC responsive mode portfolio.
68. 33 industrial companies were project partners on REI grants. In general, industry provided cash contributions towards the costs of the equipment, often to support existing research collaborations. The mean contribution made by industry was £15K (median = £10K). Most industry companies were only involved with a single REI grant.
69. 29 other organisations were project partners on REI grants. They included charities, academic institutions and other government-funded organisations. They generally provided cash contributions to support existing collaborations or research projects, to deliver research relevant to their own remit, or to gain access to the equipment. The mean contribution made by other organisations was £48K (median = £24K).

Non-manufacturer external project partners on REI grants

Industry

Amersham Biosciences, Ark Therapeutics, AstraZeneca, Auvation Ltd, Avacta, British Biotech, BTG plc, Cancer Research Technology, CellTran Ltd, Fine Agrichemicals Ltd, Fort Dodge Animal Health Ltd, Germinal Holdings, GlaxoSmithKline, Haptogen, Hill's Pet Nutrition Inc, Killgerm Ltd, Linnaeus Inc, Merck Sharpe and Dohme, Millenium Pharmaceuticals, Muridica Ltd, Nestlé, PalindromiX, Pepsyn Ltd, Prolysis Ltd, RenaSci Consultancy Ltd, SATCO Ltd, Semundo Ltd, Somantis Ltd, Stiefel UK, SW Seed Ltd, Syngen International plc, Syngenta, Unilever, XIROS Plc

Charities

Cancer and Polio Research Fund, Cancer Research UK, Cancer Tissue Bank Research Centre, Candlelighters Trut, Clatterbridge Cancer Research Trust, Coventry and Warwick Medical Research Fund, Fight For Sight, Gatsby Charitable Foundation, Hampson Trust, John Shivas Memorial Trust, King's College Hospital Charitable Trust, National Translational Cancer Network (NTRAC), Sir James Knott Trust, The Development Trust, Tommy's - the baby charity, Wellcome Trust, Wolfson Foundation

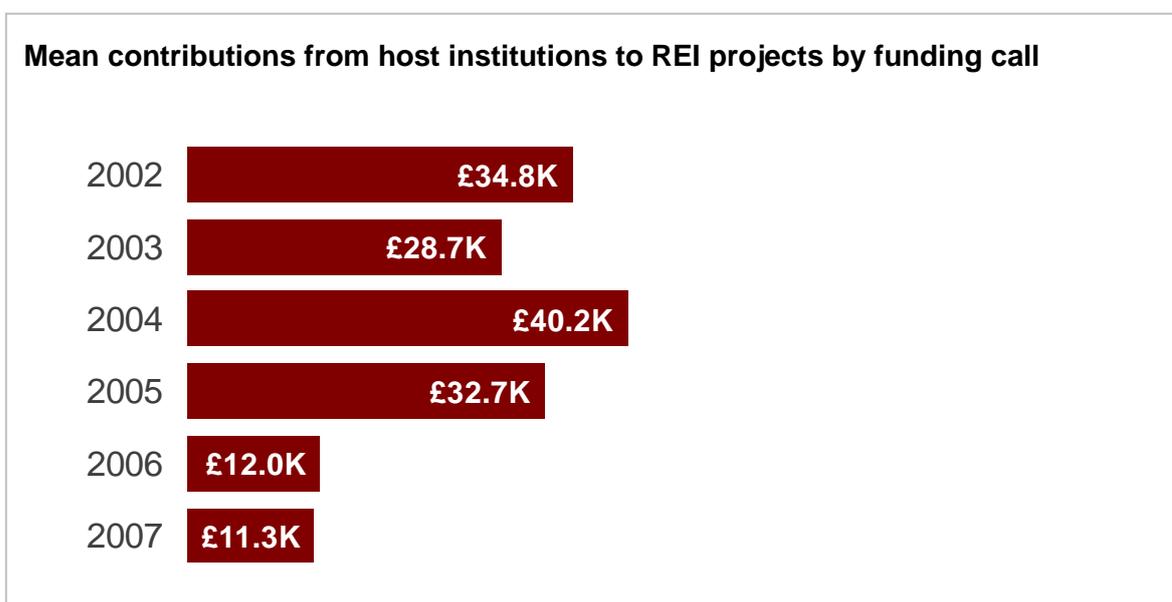
Other organisations

Cardiff Eye Unit (NHS Trust), Cardiothoracic Centre (NHS Trust), Central Science Laboratory, Food Standards Agency, Institute of Food Research, NIAB, North West Development Agency, Pain Research Institute, Royal Agricultural Society of England, Royal Society, Scottish National Blood Transfusion Service, University of East Anglia

70. The involvement of non-manufacturer external partners in the REI was very welcome and their contributions reduced the overall costs of the initiative to BBSRC. However, there was a slight concern that a few of the contributions may already have been committed by the external partners for a separate collaboration, and that they were subsequently appropriated to strengthen the REI application.

4.5 Contributions from host institutions

71. Host institutions contributed £5.3M to REI projects. Prior to 2006, the mean institutional contribution to an REI project was £34K. However, in 2006 the rules regarding institutional contributions were changed to limit institutional contributions to £10K towards the direct costs of the equipment. This had an adverse effect on BBSRC's ability to deliver the most effective value for money from the REI, but it was necessary to ensure the initiative was FEC compliant.



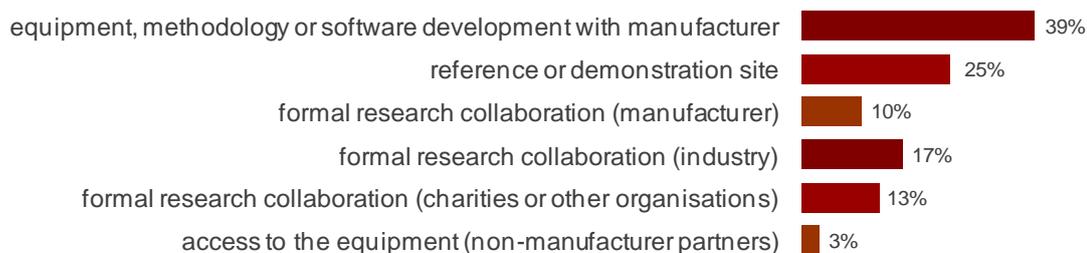
4.6 Collaborations with external project partners

72. A major objective of the REI was to promote partnership among researchers, manufacturers and external sponsors of research. At the time of their applications, 71% of grantholders planned to use their REI grant to develop new or existing collaborative links with external project partners (including manufacturers, industry and other organisations). These collaborations included:

- equipment, methodology, or software development with the manufacturer
- use of the equipment as a reference or demonstration site
- formal research collaborations with manufacturers, industry, charities or other organisations
- providing non-manufacturer partners with access to the equipment

73. In the absence of a comprehensive final report, it was difficult to assess the success or significance of these collaborations. There were notable examples within the REI portfolio where grantholders and external projects had worked closely together. For example, liaisons with manufacturers enabled grantholders to make the most effective use of the equipment, identify and solve technical problems, and beta test new cutting-edge equipment. However, some of the partnership links reported in application forms did not appear to represent a genuine engagement with an external partner and were of limited value.
74. It was commendable that REI sought to promote linkages between academics and external project partners. Such interactions and the resulting knowledge exchange are very valuable and mutually beneficial. Overall, the REI was successful in encouraging researchers to interact with manufacturers and other industry: the level of partnership observed was higher than expected for a similar sample of responsive mode grants.
75. Manufacturers benefited considerably from the REI through the sale of their equipment to grantholders. In addition, it is likely that the broader interactions with grantholders produced other benefits, raising the profile of the equipment and ultimately encouraging future sales to other researchers. For example, it was reported that interactions between grantholders and manufacturers could contribute to:
- further development of equipment, methodology or software
 - new uses for the equipment
 - equipment being featured in high-profile publications
 - equipment being used and featured in training programmes
 - equipment being used as a reference or demonstration site
 - data / images being made available for use in publicity material

Proportion of REI grants which involved different types of collaboration with external project partners



Data are based on information provided on REI application forms.

An REI grant awarded to scientists at the University of Liverpool provided support for the purchase of an optical biosensor. The researchers developed a collaborative partnership with the equipment manufacturer, which led to two CASE studentships for the university and two Small Business Research Initiative awards from the Technology Strategy Board for the company. Two of the publications arising from research using the equipment had co-authors from the manufacturer. On a wider scale, the collaboration seeded a North West Regional Development Agency proposal to create a NW Glycocentre, uniting academia and industry.

Researchers at the University of Warwick received REI funding to develop linear dichroism instrumentation which would allow for realtime, small volume analysis of biomacromolecule structure and ligand binding. The grant provided support to adapt the optics of a conventional spectropolarimeter to accommodate a new sample holder, thereby providing new capabilities for the equipment. The researchers worked closely with the two manufacturer companies who were the external project partners on the grant. The thermostatted linear dichroism cell which was developed is now a commercial product for one of these companies.

Researchers at the University of Cambridge were awarded an REI grant to purchase a dual beam environmental scanning electron microscope. They worked with the equipment manufacturer to determine the strengths and weaknesses of the equipment, and subsequently co-authored a paper with the manufacturer. In addition, the researchers obtained CASE studentships with two other industry companies. The CASE students used the equipment to demonstrate the use of the technology for industrially-relevant samples.

4.7 Value for money

76. It was not possible to provide a completely robust assessment of the value for money provided by the REI within the scope of the evaluation. This would require historical data on whether the equipment purchased through the initiative was cheaper than that otherwise available at the time. However, based on the information provided, it was the Panel's view that the REI delivered excellent value for money which went beyond what would normally be expected from other BBSRC research grant funding.
77. The emphasis on value for money within the initiative had a substantive effect on lowering its overall cost to BBSRC. Researchers negotiated competitive prices for the equipment and obtained contributions to the costs of their project from external partners and host institutions. Value for money is not just obtaining the lowest costs for a piece of equipment and the REI also realised value by promoting partnership links between researchers, manufacturers and other industry. In addition, the REI's focus on multi-user equipment ensured that BBSRC's modest investment in each individual grant benefited a large number of users and research programmes.
78. Although the initiative as a whole provided very good value for money, there were some grants which did not meet this standard. There were examples of very similar equipment purchases which incurred notably different costs, suggesting that the higher priced equipment did not provide good value for BBSRC.
79. A contributory factor in the effectiveness of the REI was that applications were assessed by individuals with expertise in equipment. This helped to ensure that applications with genuine discounts or real engagement with manufacturer partners were viewed more favourably during the assessment process (providing the associated science was of a high-quality).

5. Balance and coverage of the portfolio

Summary

- The balance and coverage of the REI portfolio was good
- The REI provided support to replace or update existing equipment and to acquire new types of equipment which were not already available at the institution
- The REI provided support for standard 'workhorse' equipment and for equipment with very specialised technical capability
- The REI facilitated research from across the BBSRC remit
- A few grants were outside the BBSRC remit and should have been funded by other Research Councils
- There was no clear strategy to prioritise the REI's investments in different types of equipment
- REI equipment facilitated research which addressed BBSRC's current and past strategic priorities
- The REI may have delivered even greater impact if more emphasis had been placed on addressing BBSRC strategic research priorities during the assessment process

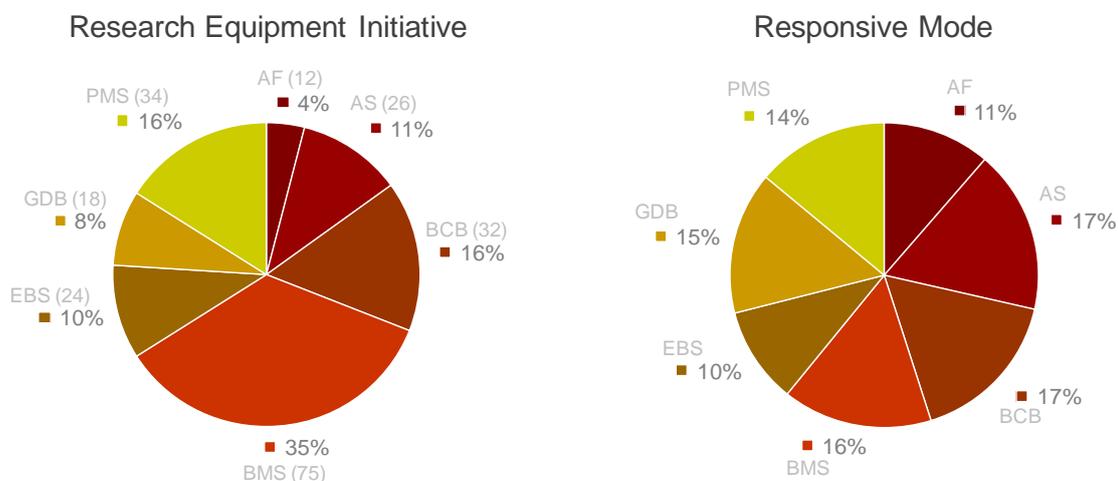
5.1 Funding by BBSRC Research Committee area

80. REI funding was awarded by a specific Panel rather than by BBSRC Research Committees. However, each REI grant was assigned to an individual Research Committee area and all of the former Committees were represented across the initiative. The largest number of grants was funded in the Biomolecular Sciences Committee area, reflecting the greater reliance on MRE within this community.

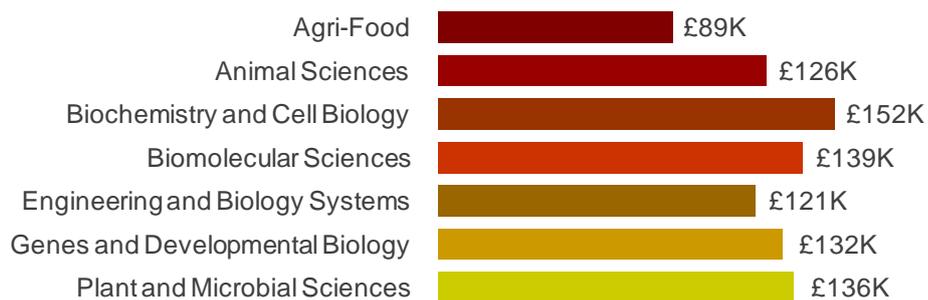
5.2 Funding by institution type

81. 87% of REI grants were awarded to HEIs or approved IROs; 13% were awarded to BBSRC strategically funded institutes. This was an appropriate balance and was representative of BBSRC grant spend by institution type over the evaluation period. Forty HEIs and approved IROs, and six BBSRC strategically funded institutes received REI funding. In general, institutions which received the most BBSRC research grant funding were also the most successful in obtaining REI grants.

Proportion of REI funding by Research Committee Area



Mean value of REI grants by Research Committee Area

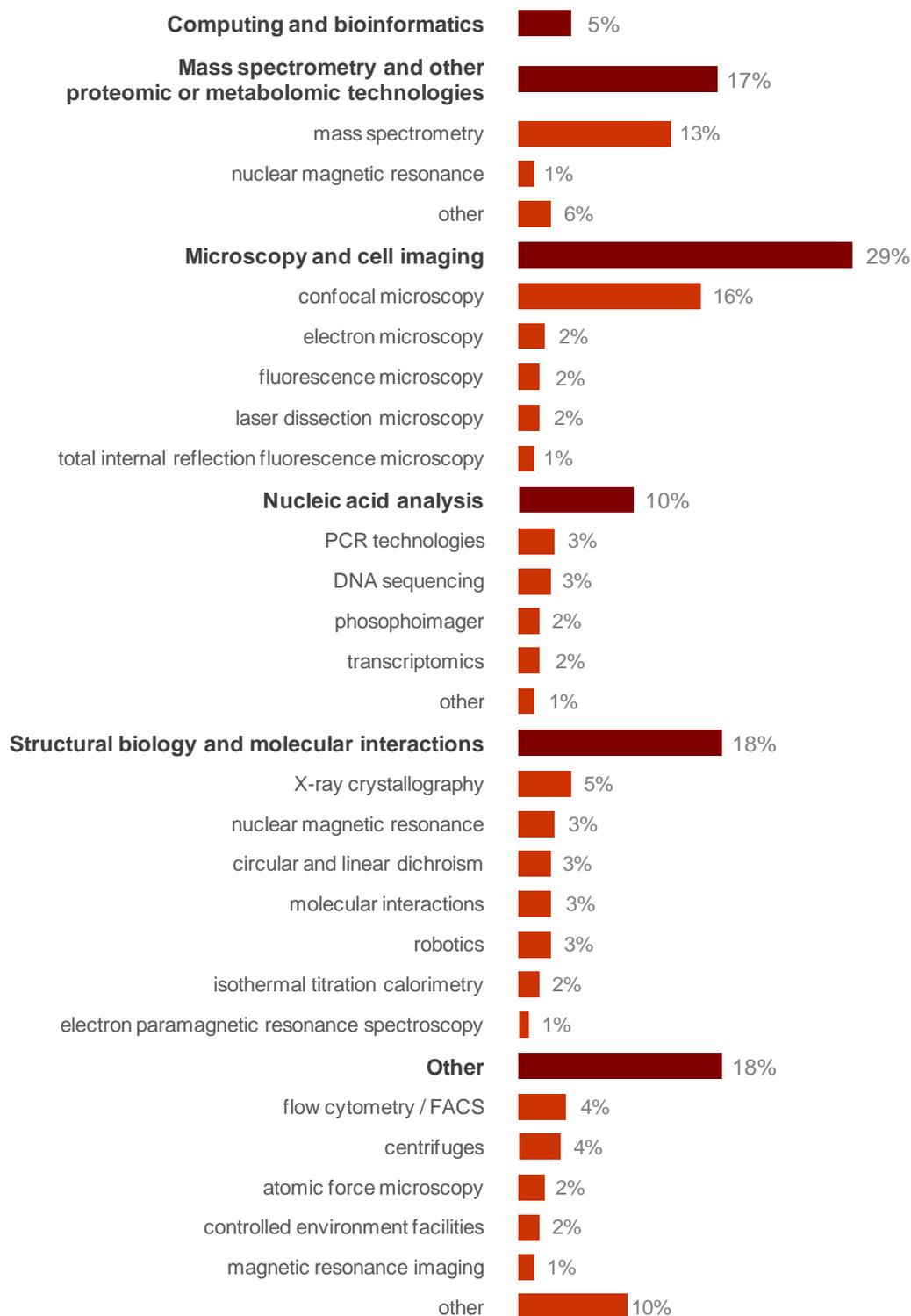


Data represent the proportion of grant funding by value. The numbers in parenthesis indicate the number of REI grants funded in each Research Committee area. Information on responsive mode funding by Research Committee area is provided for context. It is based on the responsive mode spend for the financial years between 2002/03 and 2007/08.

5.3 Funding by equipment type

82. To provide an overview of the balance and coverage of the REI equipment portfolio, REI grants were placed into six broad categories:
- bioinformatics and computing
 - mass spectrometry and other proteomic or metabolomic technologies
 - microscopy and cell imaging
 - nucleic acid analysis
 - structural biology and molecular interactions
 - other
83. Information on the extent to which the REI supported equipment in each of these categories is at p. 43. The largest category of equipment was microscopy and cell imaging (29%). At a more detailed level, the two largest single groups of equipment were confocal microscopy (16%) and mass spectrometry (13%). Most REI grants were for 'off the shelf' equipment purchases, although a small amount of instrument development was also funded.
84. The REI provided support to replace or update existing equipment which was old, obsolete, or no longer state-of-the-art. It also supported researchers who sought to acquire a new type of equipment which was not already available within their department or institution (i.e. providing a novel technical capability).
85. The majority of REI equipment was relatively standard MRE found in many internationally-competitive research institutions. It was often very high quality 'workhorse' equipment, applicable to a large number of research projects and used extensively by many researchers within the department. Although similar equipment was usually available at many other UK institutions, the REI had a very valuable impact in improving researchers' local access.
86. A smaller number of REI grants provided support to acquire a very specialised or unique technical capability (either through a specific item of equipment or the combination of distinct items of equipment). Such investments were inherently more risky as there could be technical challenges associated with the equipment's effective use, and the equipment was usually applicable to a narrower set of research projects. Nevertheless, it was important to fund these projects, as the equipment was very useful in driving the research forward, sometimes far beyond what was previously possible.
87. Overall, the balance and coverage of equipment types supported by the REI was good. The coverage of the REI was very broad (e.g. support for different research techniques; equipment replacement vs. new capability; 'workhorse' vs. cutting-edge) and grantholders credited all the supported categories of equipment with maintaining their research competitiveness at national and international levels. However, it was noted that BBSRC did not have a clear strategy to prioritise these different areas of REI investment. For example, should the REI have prioritised the purchase of novel equipment providing new technical capabilities over the replacement of old equipment?

Categories of equipment and techniques supported by the REI



This classification is an approximation as some equipment can be used for multiple purposes. Each grant was placed in the most appropriate category based on the equipment type and its proposed use. A small number of grants were placed in more than one category as they purchased two or more distinct items of equipment.

88. A few grants were funded where it would have been more appropriate for the equipment to be provided by the host institution. For example, equipment which was essential for research across the whole department such as controlled environment rooms or freezers. A very small number of grants provided equipment to help establish new research laboratories. This was a useful activity, but it was not clear whether this was the intended role of the REI.
89. The REI invested public money in equipment infrastructure and sought to encourage the sharing of resources. It would therefore have been useful for BBSRC to advertise the REI's investment in MRE more widely within the bioscience research community, particularly when the equipment was not widely available elsewhere within the UK. This would have enabled researchers from academia and industry to learn about the equipment purchase and, where appropriate, seek to establish collaborations to gain access to it.

5.4 Supporting research in the BBSRC remit

90. The REI was effective in enabling and reinforcing research within the BBSRC remit. The initiative delivered technical capability to a wide range of BBSRC-supported research areas and the great majority of equipment was used to facilitate BBSRC research projects.
91. A small proportion of REI grants were primarily used to support research which was outside the BBSRC remit and these should not have been funded by BBSRC. A few of these grants may have been identifiable at the application stage. However, most related to the equipment's use being poorly aligned with the objectives described in the original application. Remit issues were more common with applications funded in the earlier years of the initiative. In later years, more emphasis was placed on ensuring the REI was supporting BBSRC research.
92. The most common examples of out-of-remit research related to REI equipment being used for medical research which fell within the remit of the MRC. This problem was probably exacerbated because MRC did not have its own equipment funding scheme during the lifetime of the REI.
93. Applicants were required to have BBSRC grant support to be eligible for REI funding and this should have ensured that the equipment was primarily used for BBSRC research. However, there were a few examples of grants where the application appeared to be 'loaded' with a high-profile BBSRC-supported researcher who was not the real target audience for the equipment (e.g. did not appear as an author on the list of most notable publications). This highlights a need to ensure that all applicants justify the request for the equipment and that a final report is submitted explaining how each of the applicants used or benefited from the equipment.
94. The REI was used to 'pump-prime' new research programmes and to support newly appointed researchers. In later years of the initiative, this aspect of the REI was given less emphasis, and the REI became more focused on reinforcing established research programmes within the BBSRC remit.

5.5 Addressing BBSRC strategic priorities

95. The REI was open to applications from across the BBSRC remit. While there were no specific priority areas, the strategic relevance of the proposed research, including the extent to which the research met the priorities identified in the BBSRC Strategic Plan, was part of the initiative's assessment criteria. This reflected the degree of strategic relevance required at the time.
96. REI equipment has facilitated research which addressed BBSRC's current and past strategic priorities⁴ in areas such as: food security, bioenergy and industrial biotechnology, basic bioscience underpinning health, bioscience for industry, developing new tools and technologies for biological research, economic and environmental sustainability, exploiting genomics, the healthy organism, integrative biology, and sustainable agriculture. However, the REI may have delivered even greater impact in these areas if more emphasis had been placed on addressing BBSRC strategic research priorities during the assessment process.

⁴ BBSRC's current strategic priorities are described in the 2010-2015 Strategic Plan: www.bbsrc.ac.uk/strategy

6. Current approaches used to acquire mid-range equipment

Summary

- There are notable variations in the effectiveness of institutions' provision of MRE
- The introduction of fEC made it difficult for BBSRC to justify the REI
- Institutions are not using fEC to support their equipment infrastructure in a way that will ensure its long-term sustainability
- Support for MRE from UK funders of bioscience research is relatively poor
- A funding gap has developed for the provision of MRE to UK bioscience researchers
- It is the responsibility of institutions and funding organisations to address the funding gap for MRE
- Failure to address the funding gap for MRE will have serious consequences for the UK bioscience research base

6.1 Support from the host institution

97. Institutions have a responsibility to ensure their research staff have access to high-quality equipment infrastructure. Universities and BBSRC strategically funded institutes use a wide range of approaches to provide support for MRE. However, grantholders' comments indicated that the effectiveness of this support varies considerably between institutions and departments.
98. The majority of university-based researchers stated that there was either no or limited provision of MRE by their institution. There were insufficient resources available to support the purchase of MRE, especially in the current financial climate, and there was a great dependence on external sources of funding. Researchers were expected to obtain their own funding through responsive mode grants, equipment grant schemes, industry, charities and regional development agencies. In addition, grantholders commented that:
- institutions have no formal mechanisms to manage the replacement of old equipment or the purchase of new equipment
 - institutions do not recognise the need for capital investment in MRE to support high-quality research
 - funding is only used to support senior staff at the institution; there are limited opportunities for junior researchers to gain access to the required equipment
 - capital funds tend to be invested in building infrastructure rather than equipment
 - institutions are not able to provide matching funds for applications to external equipment competitions
 - institutions are only able to provide funds for smaller, less expensive items of equipment
 - smaller items of equipment are purchased by individual researchers on grants; there are no mechanisms to purchase MRE

- funding for MRE could be obtained from large programme grants (e.g. from Research Councils or charities) but this was atypical
99. It was also very difficult for researchers at BBSRC strategically funded institutes to obtain funding for MRE from their institution. The primary source of support was from BBSRC core funding, supplemented with research grants and industry funding where possible. Researchers reported that the opportunities to use core funding were limited as there were insufficient funds in the capital equipment grant, the value of which had not increased since the REI ended. The competition for the core funding was intense, and using resources to purchase MRE could prove contentious.
100. The overall level of support for MRE by host institutions was disappointing. However, a small proportion of researchers were more positive about their institutions' approach. For example, they noted that the institution would provide matching funds for external bids, the institution would provide funds for equipment in core facilities, or the institution would provide funds for strategically important equipment.

6.2 Full economic costing

101. In September 2005, the system of full economic costing (fEC) was introduced. fEC was designed to enhance the sustainability of the research environment within UK institutions and, under fEC, institutions are able to use depreciation costs claimed on research grants to purchase new and replacement equipment. The use of funds generated by fEC is not governed by Research Councils; the fEC funding stream is flexible, and universities and other research organisations should have sufficient strategic management to use the funding to remain sustainable. Research Councils cannot expect or compel institutions to use funds claimed under fEC to support MRE. Moreover, the provision of fEC research grants does not necessarily preclude the need for Research Councils to provide direct support for MRE.
102. Grantholders felt strongly that fEC was not effective in providing adequate funding for MRE. They stated that institutions were not using fEC to support equipment infrastructure and they expressed frustration at that. It was also noted that Research Councils award research grants at 80% fEC and that it is difficult for universities to make up the shortfall: institutions would prioritise support for items with clear expenditure, such as postdoctoral researcher salaries, over the long-term sustainability of equipment infrastructure. Implicit within the several grantholders' comments was a lack of understanding of fEC. This was a concern but it is best addressed by host institutions.
103. The issues surrounding fEC and the provision of equipment infrastructure are complex, and a detailed analysis is outside the scope of this evaluation. However, it is clear that the costing of MRE within fEC needs to be given more careful consideration. The 2009 *RCUK / UUK Review of the Impact of Full Economic Costing on the Higher Education Sector*⁵ concluded that the introduction of fEC had a positive impact on in supporting the financial and physical sustainability of UK institutions, but it also stated that:

“There are many issues surrounding the use of fEC for maintenance of facilities and equipment, the overlap of direct and estates costs with equipment access charges and resources from capital investment funds, and direct funding of equipment use.

⁵ www.rcuk.ac.uk/Publications/reports/Pages/fecreview.aspx

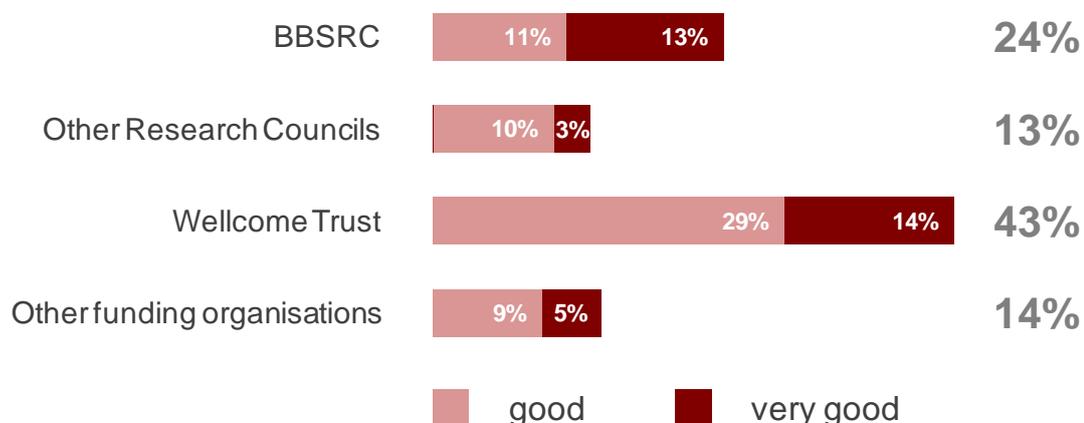
Clarification of these issues should be provided by the TRAC Development Group and RCUK⁶

104. There is a need for institutions to improve their support for MRE provision and this will include using funds recovered under fEC. BBSRC can only influence the behaviour of institutions indirectly, but the Council should seek to encourage best practice among institutions. In particular, BBSRC should discuss the issues surrounding MRE provision with institutions' heads of departments and senior management teams.
105. The introduction of fEC made it much more difficult for BBSRC to justify its support for the REI and the scheme was consequently withdrawn. Several aspects of the initiative's rationale and operation were incompatible with fEC. For example, BBSRC could no longer require institutions to make substantial contributions to project costs. The loss of the REI has undoubtedly had an adverse impact on the provision of MRE to bioscience researchers at universities and BBSRC strategically funded institutes. This was an unfortunate, albeit unintended, consequence of fEC.
106. The introduction of fEC limited BBSRC's ability to direct investments in equipment infrastructure. BBSRC has no direct influence on how universities use fEC funds to acquire MRE, or the strategies which underpin such investments. There is no assurance that institutions' equipment purchases are supporting international quality research. A key advantage of the REI was that it was run as a competition; decisions on equipment investments were made by expert peer-review and this ensured that the funding facilitated high-quality research. Moreover, BBSRC has no influence on whether any MRE purchases are facilitating research within the BBSRC remit or, more specifically, are aligned to BBSRC's strategic priorities.

6.3 Support from UK funders of bioscience research

107. Grantholders rated the current support for MRE provision by UK funders of bioscience research including BBSRC, other Research Councils, the Wellcome Trust, and other funding organisations. Overall, the level of support was perceived to be relatively poor.
108. BBSRC's current support for MRE was viewed relatively unfavourably and, in particular, support for MRE through responsive mode was considered to be ineffective (see Chapter 7). Grantholders noted that BBSRC's support for MRE was substantially better before the REI was withdrawn.
109. The Wellcome Trust received the highest rating of all the UK funders. Their equipment grant scheme was viewed as very valuable, despite the observation that it was very competitive and that it only supported some areas of the BBSRC remit.
110. The majority of grantholders were not aware of any provision for MRE from other funding organisations or thought that the support they provided was relatively poor. However, seven grantholders (9%) gave examples of other organisations which had provided good support in the past including: Advantage West Midlands, the European Union, One North East, Science Cities, the Scottish Universities Life Science Alliance, the Technology Strategy Board, and the Welsh Assembly. An aim of much of this funding was to promote regional development. The current financial climate is likely to severely limit the ability of such organisations to support investments in MRE. Moreover, several of these organisations are being closed (e.g. Regional Development Agencies).

Proportion of REI grantholders who rated the current support for MRE provision by UK funders of bioscience research as good or very good



Data are based on grantholders response to the multiple-choice question: “How would you rate the current support for the provision of mid-range equipment by BBSRC and other funders of UK bioscience?” where the answer options were: poor, fair, good, very good, or don’t know.

6.4 A funding gap for the provision of mid-range equipment

111. A funding gap has developed for the provision of MRE to UK HEIs and BBSRC strategically funded institutes. This is a result of changes to the funding landscape (e.g. the introduction of fEC, the withdrawal of equipment funding schemes), coupled with inadequate support by institutions. There are now few opportunities for researchers to obtain funding specifically for MRE.
112. A failure to invest in MRE will eventually have very harmful consequences for the health of the UK bioscience research community. Without access to cutting-edge equipment, researchers will not be able to maintain their international competitiveness or be as successful in attracting international funding. An ageing equipment infrastructure will adversely affect the training opportunities for postgraduate students and postdoctoral researchers, limiting the supply of skilled individuals into academia and industry. It will also seriously impede BBSRC’s ability to deliver its strategic research priorities in areas such as food security, bioenergy and industrial biotechnology, and basic bioscience underpinning health.
113. The effects of insufficient investment in MRE are slowly becoming apparent across UK institutions. If nothing is done, these effects will worsen as equipment infrastructure ages. Within three years it is likely that research performance across UK institutions will begin to be seriously affected. Within five years, there will be a crisis, with a massive loss of international competitiveness and a major impact on BBSRC’s front line mission of supporting world-class bioscience research.
114. It is the Panel’s view that institutions and research funders all have a responsibility to address this funding gap. Institutions must ensure that they are making investments which ensure the long-term sustainability of their research infrastructure. There is also

still a need for Research Councils to provide direct support for MRE. It is recognised that this is very challenging within the context of the current financial climate. However, future costs to repair a degraded research infrastructure will be very high, and it is possible that parts of the research base will not recover.

7. Support for mid-range equipment through responsive mode

Summary

- BBSRC is providing some support for MRE within responsive mode
- Funding for MRE within responsive mode has not increased sufficiently since the REI ended
- Support for MRE within responsive mode is skewed towards less expensive items of equipment
- It is difficult to justify the costs of MRE within the context of a single responsive mode grant
- The responsive mode funding mechanism does not address the need to support MRE used by multiple researchers for unrelated projects
- There is a strong perception among the research community that responsive mode is not an effective mechanism for supporting MRE
- Responsive mode funding arrangements should be adjusted to accommodate a wider range of applications requesting MRE

7.1 Context

115. Since the REI ended, the primary route for researchers to obtain BBSRC funding for MRE is through responsive mode. To determine the effectiveness of this mechanism of provision, responsive mode applications which included a request for MRE were identified from the BBSRC grants database⁶. For conciseness, these are referred to as 'RM-MRE applications'.

116. The data refer to RM-MRE applications from the 2006, 2007, 2008 sessions⁷, together with those from the 2009 session which were entered into BBSRC's internal database as at 20 July 2009.

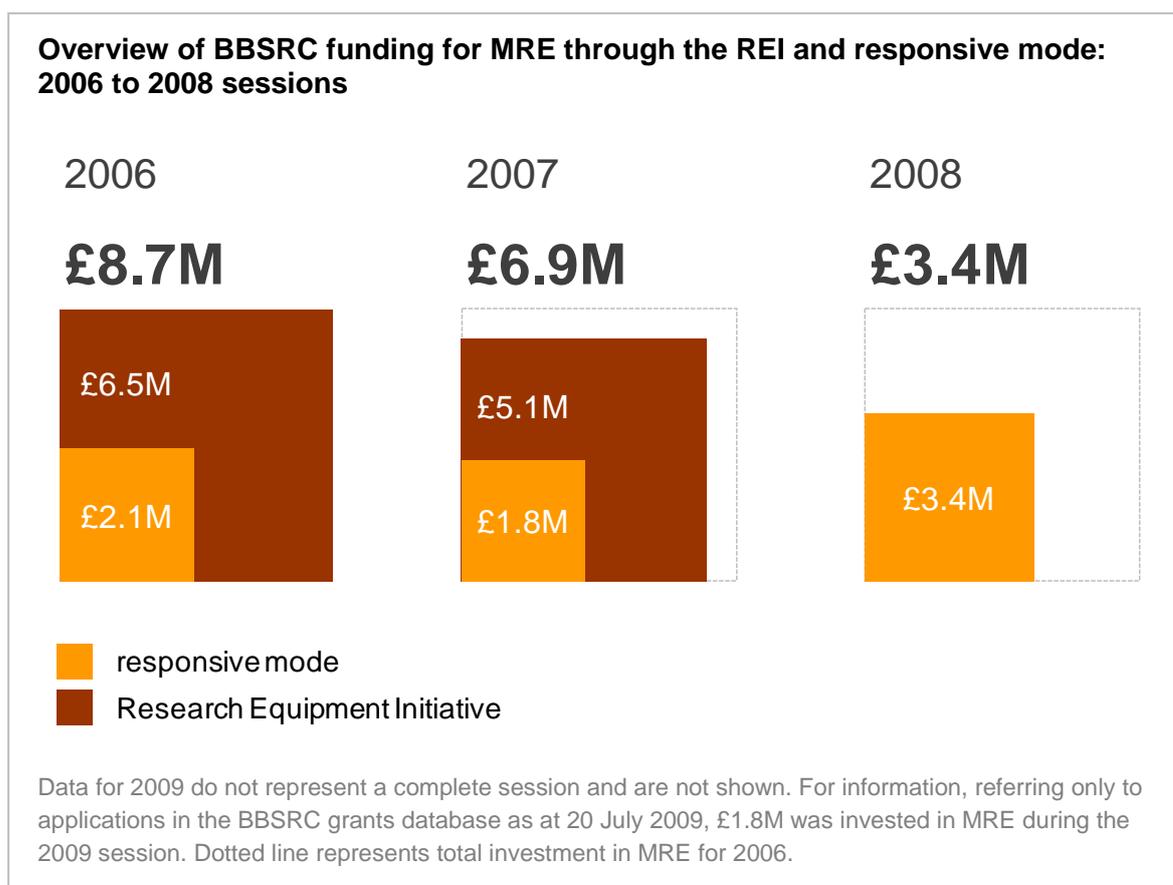
⁶ The following process was used to identify relevant responsive mode grant applications:

- identify applications with spend in the Equipment Exception field (indicates that the total request for equipment costs is over £50K)
- screen applications to identify those with requests for MRE (£50K to £500K); remove applications which only contain requests for several smaller items of unrelated equipment or a very expensive item of equipment (>£500K)
- determine the status of the application (funded, not funded, withdrawn or out of remit)
- for funded applications, determine if the equipment was cut from the grant at the Committee stage

⁷ The term 'session' refers to the Committee meeting at which the decision on an application is made. For example, the 2009 session included applications considered at the Spring (May 2009), Summer (September 2009), Autumn (November 2009) and Winter (February 2010) Committee meetings.

7.2 Overview

117. Three hundred and sixty nine RM-MRE applications were identified in the BBSRC grants database. Of these, 81 were subsequently funded (a success rate of 22%). £47.3M was requested for MRE; £9.2M was awarded (a success rate by value of 19%).
118. Support for MRE within responsive mode has increased slightly since the REI scheme was closed. However, this increase was not sufficient to address the reduced level of investment in MRE caused by the withdrawal of the REI. Based on the information provided, it is estimated that BBSRC's provision for MRE has decreased by £5M per annum since the initiative ended.



119. There was a perception among the research community that Research Committees will cut requests for MRE from funded grant applications. However, there was little firm evidence to support this view. Of the 369 RM-MRE applications, there were only two funded grants where the requested MRE was not provided. In both cases, the MRE was cut from the grant because it was not necessary for the proposed research project. These two applications are considered as 'not funded' for the analyses.

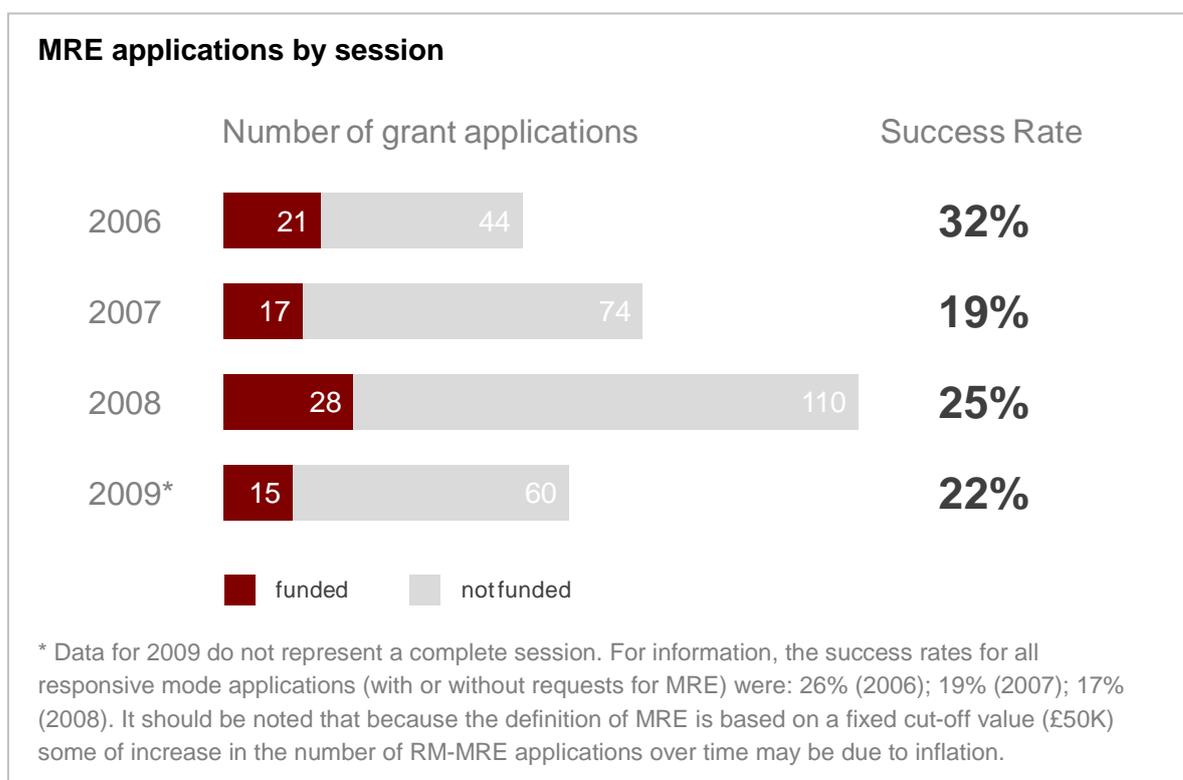
7.3 Balance and coverage of responsive mode support for MRE

Longer and Larger grant applications

120. Twenty two (6%) of the 369 RM-MRE applications were Longer and Larger (LoLa)⁸ grant applications. LoLas were overrepresented both as a proportion of funded applications and as a proportion of the amount of funding awarded: nine (11%) of the funded RM-MRE applications were LoLas and they accounted for £1.8M (20%) of the total investment in MRE.
121. The inclusion of LoLa applications does not notably affect the data on support for MRE within responsive mode. For example, if LoLa applications are excluded, the success rate for RM-MRE applications only drops slightly from 22% to 21%. LoLa applications are therefore included in the analyses.

RM-MRE applications by year

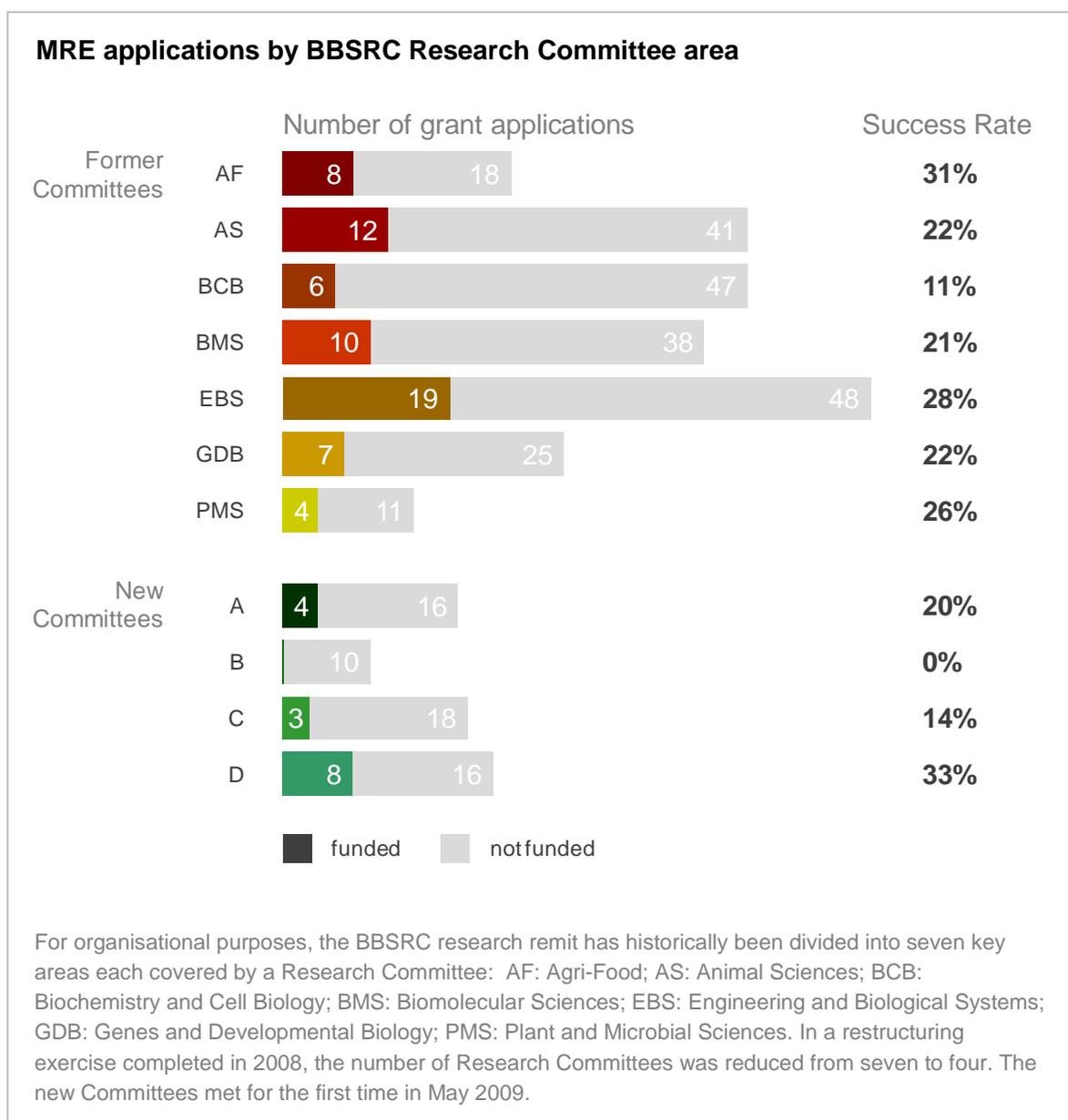
122. The number of RM-MRE applications has increased since the REI ended, with approximately twice as many received in 2008 compared with 2006. The number of funded RM-MRE applications has remained relatively constant. This indicates that although demand for MRE within responsive mode has grown since the REI was withdrawn, support through responsive mode has not risen accordingly.



⁸ BBSRC launched the LoLa scheme in 2006 to provide support within responsive mode for research projects requiring longer timescales, extensive resources, or multidisciplinary approaches. LoLa applications must be over £2M in value and up to five years in duration. The scheme was subsequently realigned to only support research in BBSRC strategic priority areas; it is now known as the Strategic Longer and Larger grant scheme.

RM-MRE applications by BBSRC Research Committee

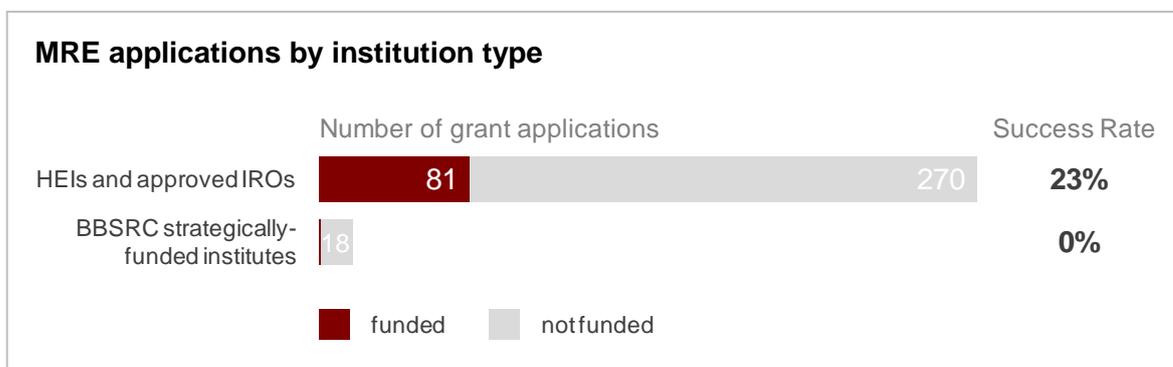
123. RM-MRE applications were received by all the former and new BBSRC Research Committees⁹. Success rates for RM-MRE applications were relatively similar between the former Committees, with the exception of the BCB Committee which had a lower success rate. The number of MRE applications submitted to the new Committees was too low to make an accurate assessment of the level of support. However, it was concerning that Committee B had not supported any RM-MRE applications, especially considering the importance of this area of the remit to the delivering the food security agenda and the previous support received through the REI. BBSRC should continue to monitor the support for MRE provided by individual Research Committees.



⁹ The new Research Committees are: A (Animal disease, health and welfare); B (Plants, microbes, food and sustainability); C (Genes, development and STEM approaches to biology); and D (Molecules, cells and industrial biotechnology). Further details on the science areas supported by each Committee are at: www.bbsrc.ac.uk/funding/grants/areas.aspx

RM-MRE applications by institution type

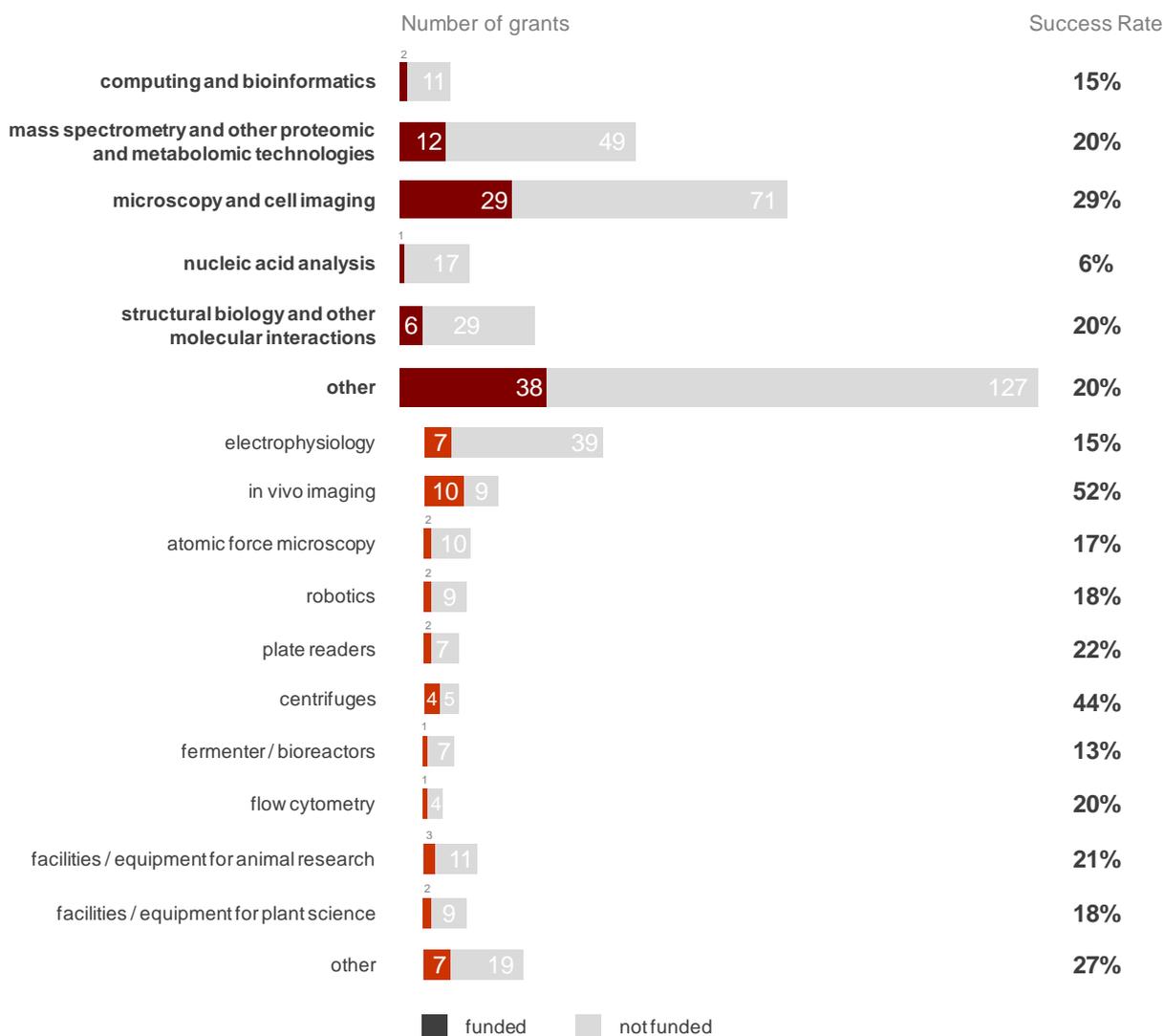
124. The balance of support for MRE across responsive mode was heavily weighted towards HEIs and approved IROs. 95% of MRE applications were submitted by researchers based at HEIs and approved IROs; 5% were from researchers based at BBSRC strategically funded institutes. The institutes were not awarded any funding for MRE through responsive mode.



RM-MRE applications by equipment type

125. The coverage of equipment types supported through responsive mode was broadly similar to that of the REI. For example, microscopy and mass spectrometry were major areas of investment through both funding mechanisms. However some types of research have received less support through responsive mode. For example, MRE which supported structural biology research constituted 7% of funded RM-MRE applications compared with 18% of REI grants.
126. In general, requests for MRE within responsive mode were more specialised than those funded through the REI (e.g. a very large proportion of responsive mode requests were classified as 'other'). The MRE also supported fewer researchers: the mean number of researchers named on each funded application was 2.2 compared with 6.1 for REI grants. These differences reflect the distinct aims of the two funding schemes. Responsive mode seeks to provide support for specific research projects, whereas a major aim of the REI was to support multi-user, multi-project equipment.
127. Another major difference was the large number of applications for electrophysiology equipment received through responsive mode compared with the REI. Typically, these RM-MRE applications requested a coherent collection of smaller items which were used together (e.g. microscope, multi-electrode array, patch-clamp accessories) and whose value was very close to the lower end of the MRE definition cut-off (£50K). This equipment does not have a strong multi-user focus and would not have been supported through the REI. Other differences included that responsive mode received fewer applications for the more expensive items of MRE and that it received applications with a strong 'self-build' element which aimed to develop equipment with new capabilities as part of the research grant.

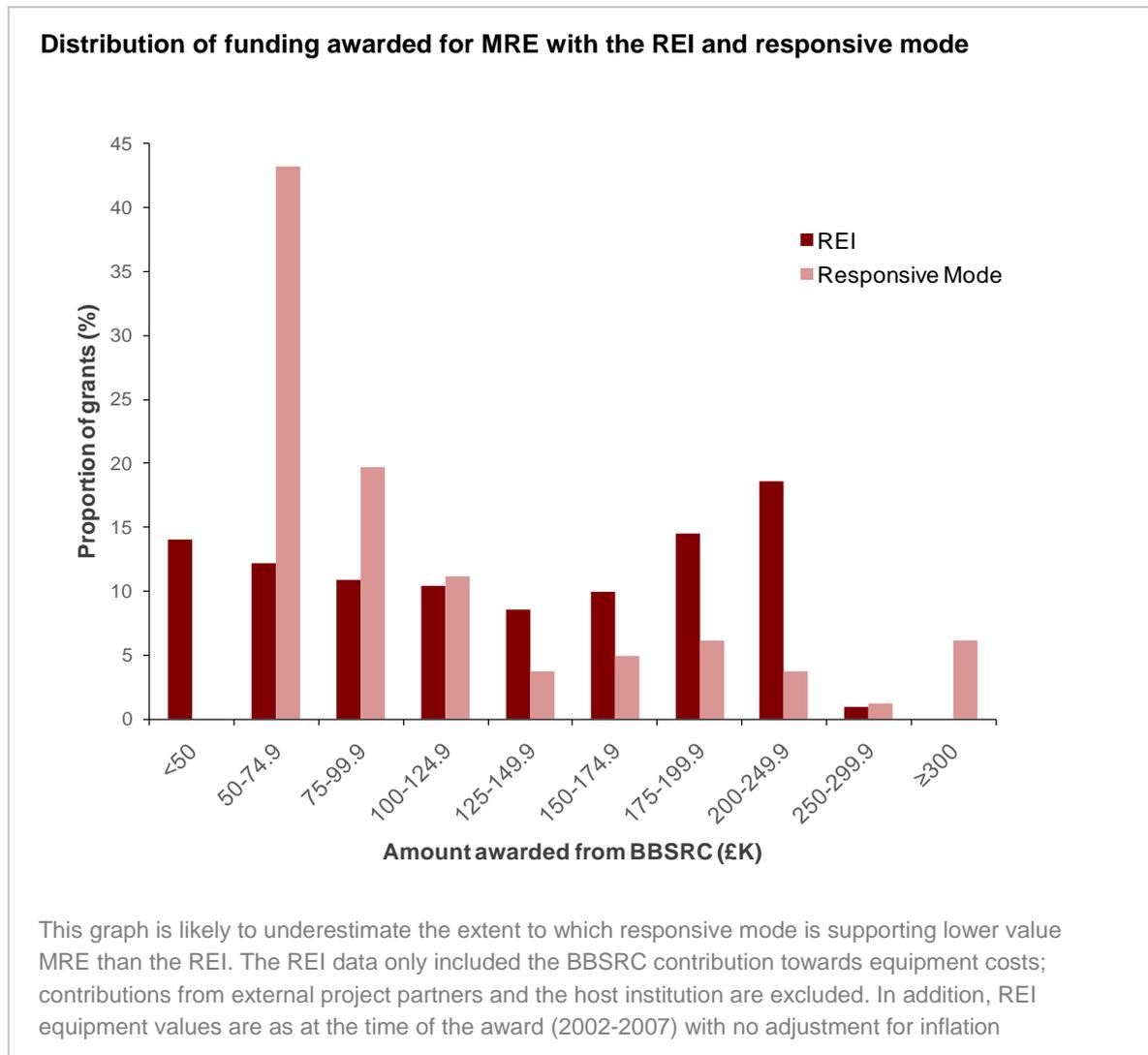
Categories of equipment and techniques supported through responsive mode



The MRE requested through responsive mode is shown assigned to six major categories, with further details provided for equipment categorised as 'other'. For information, in vivo imaging includes techniques such as computed tomography (CT); intravital microscopy; high speed fluoroscopy magnetic resonance imaging; optical projection tomography; and ultrasound.

Value of MRE funded through responsive mode

128. The provision of MRE within responsive mode was skewed towards less expensive items of MRE. For example, only a relatively small proportion of funded grants supported MRE requests of £150K or more. Overall, it was very difficult for researchers to obtain support for the most expensive items of equipment through a standard responsive mode grant, although provision was better within LoLa grants (the mean value for MRE funded on the LoLa grants was £200K compared with £103K for the standard grants).



129. The types of MRE requested were similar between responsive mode and the REI. However, within responsive mode researchers opted for less expensive models of equipment, with lower technical specifications. The reasons for this were not clear. It may be because the less expensive equipment was sufficient to meet the needs of the research project. Alternatively, it may be because researchers perceived that more expensive items were unlikely to be funded.

130. It is important that BBSRC's investment in MRE delivers the best value for money. In many instances, this will be best achieved by providing funding for less expensive, basic models of equipment. However, the best overall value will regularly be obtained

by providing more expensive MRE with higher technical specifications, as it can be more efficient and effective in driving the research forward. It is worth noting that there was very little evidence that the REI's investment in more expensive MRE had led to researchers acquiring more technical capability than was necessary to deliver their research objectives.

131. The reduced support for more expensive items of MRE within responsive mode will have had different impacts across the BBSRC research community. Researchers who rely on more expensive equipment, such as those within the biomolecular science community, are likely to have been particularly adversely effected.

7.4 Perceptions of the support provided for MRE within responsive mode

132. There was a strong perception among former REI grantholders that responsive mode was not an effective mechanism for supporting MRE. 38% of grantholders would not consider applying for MRE through responsive mode; among the other 63% there was little enthusiasm for using responsive mode to request MRE, with many stating that they would only do so because there were no alternatives. Grantholders were reluctant to use responsive mode to request MRE because of the following perceptions or experiences:

- a low expectation of success
- a request for MRE makes a grant too expensive and reduces the chances of success
- reviewers and Committee members take a negative view of equipment requests on grants
- reviewers are unaware that BBSRC's policy regarding the funding of MRE on responsive mode grants
- responsive mode funding is very competitive; it is too risky to include a request for equipment
- Research Committees are already under considerable pressure to fund research grants; funding MRE will reduce the overall number of grants that can be supported
- previous attempts to request MRE through responsive mode had not been successful
- requests for equipment often get cut by Research Committees
- researchers were dissuaded by comments from Committee members

133. Grantholders listed a large number of disadvantages associated with responsive mode support for MRE compared with the REI. These covered topics such as: promoting collaboration; support for multiple users and multiple projects; justification of resources; the scope of the support; leveraging additional contributions; and the application and assessment processes. However, there was also some recognition of advantages provided by responsive mode funding. For example, it ensures that the MRE is used for an innovative research project within the BBSRC remit, the application process is simpler (with no requirement to obtain external contributions), it offers greater financial flexibility (maintenance costs and staff costs can be included), and the funding rounds are more frequent.

134. 85% of grantholders felt that there was a significant or very significant need for BBSRC to provide a separate funding mechanism for MRE. They were aware that this would impact on responsive mode funding, but many commented that losing a small number

of research grants would have less impact on overall research effectiveness compared with losing the instrumentation that underpins a very large proportion of the research portfolio.

135. The Panel shared many of the concerns expressed by grantholders regarding the effective delivery of MRE within responsive mode. A major issue which constrains the effectiveness of responsive mode support is the requirement to justify the whole costs of the equipment in the context of a single research project. Many research projects are unlikely to require the full-time use of the equipment for the whole duration of the grant, and the MRE therefore becomes ineligible for responsive mode funding. Moreover, investment in MRE often delivers the greatest impact and value when equipment underpins the research of multiple individuals working on unrelated research projects. It is difficult to envisage how applications requesting MRE for a cluster of researchers with unrelated research objectives could be supported under the current responsive mode funding arrangements. It is possible to make a stronger case for MRE support on a LoLa application, but these grants only support a small subset of the BBSRC research community.
136. There are opportunities to improve the support for MRE within responsive mode. BBSRC should ensure that Research Committee members are attuned to the closure of the REI and recognise the need to support applications requesting MRE. There should be greater use of Pool Committee members who have equipment expertise and who can provide a better informed assessment of the request for MRE. More broadly, there is a need to adjust responsive mode rules to accommodate a wider range of applications requesting MRE. For example, BBSRC should consider how applications where the requested MRE will only be used for part of the time during the grant could be supported (both within the context of responsive mode rules and fEC).

7.5 Leveraging of external support

137. Responsive mode is less effective in leveraging external support towards MRE costs than the REI. Eight of the funded RM-MRE applications (10%) had an external project partner compared with 99% of REI grants.
- none had support from a manufacturer partner (compared with 99% of REI grants)
 - two (2%) had support for industry (compared with 17%)
 - six (7%) had support from another organisation (compared with 16%); for responsive mode grants these were all other academic institutions
138. The majority (82%) of grantholders agreed that responsive mode was less effective in leveraging external support than the REI. They noted that manufacturers were more interested in participating in the REI than in responsive mode. In particular, manufacturers were likely to have felt greater 'ownership' of the REI as their contributions were perceived to have more value and a greater influence on the success of the application.
139. In addition, the REI encouraged behaviour which resulted in downward pressure on equipment prices. Manufacturers were aware of the annual funding call and the possibility of obtaining multiple contracts within the same accounting period. This encouraged competition between manufacturers and gave researchers greater leverage. Responsive mode funding is likely to dilute these effects.

140. Weakened contact and partnership with manufacturers will eventually have adverse consequences for the UK bioscience research base. It will reduce the opportunities for strong technical support and collaboration, and may also discourage manufacturers from providing researchers with early access to new technology.

8. Conclusions and future perspectives

8.1 The Research Equipment Initiative

141. The REI was a very successful funding scheme which made an important contribution to the physical research infrastructure at UK universities and BBSRC strategically funded institutes. The initiative facilitated high-quality research which produced exciting scientific discoveries and led to wider impacts. It benefited a large number of researchers from across the BBSRC remit and underpinned a large amount of other research grant funding. It promoted partnership and collaboration, and also provided excellent value for money. REI equipment facilitated research which addressed BBSRC's current and past strategic priorities. Moreover, as nearly all of the equipment is still in use, the initiative's investment in MRE continues to benefit the bioscience research community.
142. The REI was a very effective mechanism for supporting MRE and it made very good use of limited resources. The emphasis on multi-user, multi-project equipment was a major strength, encouraging sharing and collaboration. The requirement for external contributions lowered the overall costs to BBSRC and promoted mutually beneficial partnership links with industry and other external sponsors of research. In addition, the use of a separate competition to assess applications for MRE was very useful; it ensured that proposals for MRE were assessed against one another by individuals with appropriate expertise and that the funding decisions were community driven.
143. However, there were also some weaknesses with the REI. A small proportion of grants did not meet the expected standard, for example, producing relatively few achievements or primarily supporting research outside of the BBSRC remit. There could have been more consideration regarding how the long-term costs associated with the operation and maintenance of the equipment would be met. In addition, the time between application submission and equipment being in place in the laboratory was sometimes too long; a more agile process would have enabled researchers to take greater advantage of emerging opportunities. More broadly, there was no clear strategy to prioritise the REI's investments in different types of equipment and there could have been greater emphasis on addressing BBSRC's strategic research priorities. The lack of reporting on REI grant outcomes and achievements also made it difficult for BBSRC to capture the impact of its investment in the initiative.
144. With the introduction of fEC, it became much harder for BBSRC to justify its support for the REI and the initiative was subsequently withdrawn. The closure of the REI was understandable but regrettable; the initiative was a very valuable funding scheme and was extremely well regarded among the research community. Researchers were adversely affected by its closure, particularly those whose work is heavily reliant on expensive MRE.

8.2 Support for mid-range equipment in responsive mode

145. Responsive mode is now the primary route for researchers to obtain BBSRC funding for MRE. However, this mechanism is only partially effective and the level of support provided is too low. BBSRC's total investment in MRE through responsive mode has not increased sufficiently since the REI was withdrawn. It is also very challenging for researchers to obtain funding for more expensive items of MRE (e.g. >£150K) on a standard responsive mode grant.
146. Several factors limit the effectiveness of MRE provision within responsive mode. For example, it is difficult to justify the full costs of an item of MRE on a single research grant and it is not possible to fund MRE where the objective is to facilitate multiple, unrelated research projects. However, there are potential advantages with responsive mode funding. It ensures equipment is being used to support a high-quality research project within the BBSRC remit. It is also more flexible, with the ability to support a wider range of associated project costs.
147. BBSRC should explore ways of improving the support for MRE within responsive mode. This includes considering changes to the responsive mode rules so that a wider range of applications requesting MRE can be accommodated. In addition, although many of the most positive aspects of the REI are not precluded by responsive mode funding, in practice, they are not very prevalent (e.g. leveraging of external contributions, collaboration with external project partners). This represents a weakness which BBSRC may wish to address.

8.3 A funding gap for the provision of mid-range equipment

148. Changes to the funding landscape, including those directly or indirectly associated with the introduction of fEC, have resulted in a funding gap for MRE provision within the UK bioscience research community. BBSRC's withdrawal of the REI and the subsequent emphasis on supporting MRE within responsive mode has reduced the overall level of support. In addition, many institutions are not using costs recovered through fEC to invest sufficiently in MRE and there is very limited support provided by other funders of bioscience research.
149. It is increasingly difficult for researchers to replace their old equipment or to acquire new equipment which provides a novel technical capability. In addition, there are clear challenges associated with funding MRE's operation and maintenance costs. The full impact of the funding gap for MRE is not yet fully evident. However, unless it is addressed, the situation will continue to worsen and the consequences for UK bioscience will be severe. An ageing equipment infrastructure will lead to a massive loss of international competitiveness, BBSRC's mission to support world-class bioscience will be seriously compromised, and ultimately the ability of BBSRC to deliver its strategic research priorities will be damaged. In addition, a national backlog of investment in MRE will require a major capital investment to rectify.
150. It was not possible within the context of this evaluation to determine the full extent of the funding gap for MRE across the UK bioscience research community. It is however

important that BBSRC identifies the appropriate balance between people and equipment infrastructure necessary to deliver an effective, world-class research base. This balance will vary depending on research area: BBSRC should consult with its Strategy Panel and Research Committee members to determine the optimum ratio of people (e.g. postdoctoral researchers) to equipment in major areas of the BBSRC remit. BBSRC should then ensure its funding delivers this balance of support.

151. Institutions, Research Councils and other funders of bioscience research have a shared responsibility to address the funding gap for MRE. Institutions must use their resources to ensure the long-term sustainability of their physical research infrastructure. BBSRC can only influence the behaviour of institutions indirectly, but it should discuss the issues surrounding MRE provision with institutions' heads of department and senior management teams. Institutions are unlikely to be able to address the funding gap for MRE provision on their own, especially in the current financial climate. There is a clear and urgent need for Research Councils to continue to invest in equipment infrastructure in order to maintain the international competitiveness of UK bioscience research.

8.4 Future BBSRC support for mid-range equipment

152. The issues surrounding the provision of MRE are complex and it will be necessary for BBSRC to work with other Research Councils, institutions and the research community to identify how MRE might best be supported. BBSRC must provide leadership on this issue and should adopt a multi-faceted approach to improving the provision of MRE, focusing initially on three different mechanisms of support:

- **Institutional support:** BBSRC should examine closely how institutions are using the costs recovered through fEC to invest in MRE and support the long-term sustainability of their physical research infrastructure. BBSRC should then consider how it might encourage good practice among institutions within the context of fEC rules.
- **Responsive mode support:** BBSRC should consider changes to responsive mode which would make it a more effective mechanism for supporting MRE. This includes ensuring Research Committees are aware of the need to support MRE and adjusting the responsive mode rules so they can accommodate a wider range of applications requesting MRE.
- **Dedicated support:** BBSRC should consider introducing a new funding scheme which provides dedicated support for MRE.

153. The future funding climate is likely to be very challenging, with limited resources and many competing priorities. It is therefore essential that BBSRC's investments in MRE are effective and provide the best value, irrespective of the funding mechanism. As such, BBSRC should adopt a number of important principles for its MRE provision:

- MRE should be cost effective and provide good value for money
- MRE should facilitate research which is clearly within the BBSRC remit
- MRE should facilitate research which is addressing BBSRC strategic priorities
- funding decisions for MRE investments should be made by the research community
- the leverage of external contributions should be encouraged (both financial contributions and collaborations)
- interdisciplinary collaboration should be encouraged

- there should be a fast turnaround from application submission to the MRE being in place within the laboratory
 - there should be formal reporting requirements to enable the impact of individual investments in MRE to be captured and assessed
 - BBSRC's support for MRE should not create perverse incentives which discourage institutions from investing in their physical research infrastructure
 - BBSRC's support for MRE must be compliant with fEC rules
154. All applications requesting MRE should demonstrate that the equipment will deliver very good value for money. BBSRC should not be prescriptive about how this is achieved as this may encourage 'gamesmanship' in the application process. However, BBSRC should recommend that researchers are able to demonstrate one or more of the following:
- a competitive price for the MRE
 - a genuine partnership or collaboration with the equipment manufacturer
 - external contributions from industry or other stakeholders
 - a tangible research collaboration with industry or other stakeholders
 - that the equipment will benefit multiple-users, including academics and non-academics based outside the host institution
 - strong commitment from the institution to support the MRE (e.g. funding for core technical staff positions)
155. A dedicated equipment competition is a very effective mechanism of delivering support for MRE based on the principles described above. There is a strong case for BBSRC to introduce a new funding scheme for MRE and this would represent a major step towards addressing the relatively low level of support which is currently available through responsive mode. A new scheme should build on the most positive aspects of the REI, but should also make substantive changes. It should be firmly aimed at reinforcing existing BBSRC funding and addressing BBSRC's strategic research priorities. It should be run as a single competition open to HEIs, approved IROs and BBSRC strategically funded institutes. The scheme should also support 'technical capability' in a much broader sense, for example, providing funding for researchers to purchase a service or outsource activities if this would provide the best value. The rules of a new scheme would need careful consideration to ensure that they are compatible with fEC.
156. The current funding climate is very challenging and BBSRC will need to consider support for a new scheme within the context of its other competing priorities. The introduction of a new dedicated equipment funding competition could clearly reduce the number of responsive mode research grants which could be funded, which is obviously problematic. However, it is the Panel's view that the failure to invest sufficient resources in MRE will be far more detrimental to the overall research base than the loss of a small number of responsive mode research grants.
157. In advocating increased support for MRE within the BBSRC portfolio there is no intent to 'overequip' the research community. Indeed, the request for additional support is based on the need to maintain the existing level and quality of equipment infrastructure within the UK bioscience research base. It is also recognised that investment in equipment is largely facilitatory and that its impact is dependent on other research grant funding. Nevertheless, it is clear that state-of-the-art equipment is a vital component of any world-class research base.
158. New equipment technologies are constantly emerging and established technologies are continually improving. As such, there will always be a need to invest in equipment

infrastructure to remain at the forefront of scientific discovery. Access to high-quality equipment is essential for facilitating excellent research within the BBSRC remit which will deliver wider benefits to the public good. It enables traditional and emerging areas of research where BBSRC has a strong international profile (e.g. structural biology, systems biology). Investments in equipment infrastructure are also important to the international competitiveness of UK bioscience research. The consequences of allowing this infrastructure to deteriorate are severe and BBSRC must work alongside other stakeholders in bioscience research to ensure that this outcome is avoided.

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