Chief Executive’s Foreword

The UK’s world leading bioscience is not only of the highest quality, it also has far reaching benefits for our economy and wellbeing. This report showcases some of the impacts of BBSRC’s investment in excellent bioscience that addresses fundamental questions about our world and ourselves, often working across disciplines. The case studies illustrate how that knowledge and understanding drives innovation and impact in fields as diverse as food, health, materials and energy.

Our investments in excellent bioscience underpin a growing and prosperous UK bioeconomy, support evidence-based policy-making, provide the training and skills the UK needs, and ultimately enable the UK to continue to compete globally. The value of research and innovation in supporting economic growth and prosperity is highlighted by the Government’s ‘Building our Industrial Strategy: green paper’, where it is identified as a key pillar of the strategy.

We gather evidence of our impact in many ways, but one of the most important is via researchfish®, the Research Councils’ outcomes collection system. Information submitted to researchfish® by BBSRC-funded researchers helps us understand and demonstrate the high quality of the research we fund as well as its broader impact, forming the basis of many of the indicators and case studies in the pages that follow.

This report provides a snapshot of the work done by our dedicated and innovative bioscience researchers to reveal the secrets of life and to use these discoveries to improve our lives. I am constantly impressed by the innovative spirit of our research community – who I would like to thank for ensuring bioscience makes a difference.

Professor Melanie Welham
Chief Executive
February 2017
Introduction

The UK bioeconomy was worth £220Bn GVA to the UK economy in 2014 and supported 5.2 million jobs.

Bioscience research offers solutions that can help us tackle the challenges we face as a society in health, nutrition, energy and materials and food security. Every year, BBSRC invests around £450M to sustain the UK’s world-leading bioscience research base and support Government objectives for science and innovation. Through support for research, innovation, infrastructure and training, this investment is making a tangible difference to the UK economy and society.

BBSRC’s new Delivery Plan, published this year, describes five outcome-focussed themes to drive advances in the biosciences and ensure those advances meet the needs of society.

BBSRC investments are enabling the creation of new companies as well as innovative products, processes and services. The knowledge and expertise generated from research drives inward investment to the UK. Excellent research is supporting evidence-based policy-making to help address national and global policy challenges such as food and energy security and tackling antimicrobial resistance, and enhancing health and quality of life.

BBSRC works closely with research users to ensure they can access relevant research outputs and expertise. Many of the major challenges facing industry and society require a global response that crosses discipline boundaries, and BBSRC coordinates its activities with other funders in the UK and overseas to enable excellent science and impact.

Impacts from BBSRC-funded bioscience are contributing to the UK bioeconomy. A report commissioned by BBSRC and the Department for Business, Energy and Industrial Strategy found that the bioeconomy was worth £220Bn gross value added (GVA) to the UK economy in 2014 and supported 5.2 million jobs. The bioeconomy includes sectors such as biotechnology and pharmaceuticals, agriculture and food and drink manufacturing.

The examples reported here illustrate the impacts of BBSRC-funded research and showcase the diversity of mechanisms BBSRC uses to stimulate, facilitate and deliver impact.
Impact from bioscience in the UK arises from a solid foundation of excellent research and training.

Each year, BBSRC invests more than £450M to sustain the UK’s bioscience research base to meet the aims and objectives set out in BBSRC’s Strategic Plan and Delivery Plan.

These investments support excellent frontier bioscience to creatively address challenges and advance our knowledge, often in unexpected ways. They also target our strategic research priorities in agriculture and food security, industrial biotechnology and bioenergy, and bioscience for health, and three key enabling themes: enabling innovation; exploiting new ways of working; and partnerships.

The UK’s world-leading bioscience research base is one of the main reasons why major life science companies invest here and why the best researchers from around the world choose to work in the UK. This research quality is further demonstrated by the high performance of UK bioscience in international citation rankings, which has been sustained for many years.

It can take many years for bioscience to produce tangible impacts for society, underlining the need to maintain investment in the UK’s outstanding bioscience research base.
Top journals for BBSRC research

The outputs of BBSRC research are published in top-ranked academic journals. The chart below shows where BBSRC-funded research was most commonly published, based on publications data from researchfish® (publications attributed to research grants for the years 2011 to 2015).

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<tr>
<th>Journal</th>
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<tr>
<td>PLoS ONE</td>
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<td>Proceedings of the National Academy of Sciences of the USA</td>
<td>336</td>
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<td>Nucleic Acids Research</td>
<td>232</td>
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<td>The Journal of Biological Chemistry</td>
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<td>Plant Physiology</td>
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<td>Current Biology</td>
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<td>Journal of Experimental Botany</td>
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<td>Methods in Molecular Biology</td>
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<td>Scientific Reports</td>
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<td>Journal of the American Chemical Society</td>
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<td>Journal of Virology</td>
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<td>PLoS Pathogens</td>
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<td>Molecular Microbiology</td>
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<td>PLoS Genetics</td>
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‘Self-protection’ proteins protect predatory bacteria from their own attacks

Certain species of bacteria have evolved to prey on other bacteria. These predatory bacteria produce enzymes that weaken the cell walls of their prey, allowing the predator to access the nutrients within. However, both predator and prey possess similar cell walls, so the predator needs a mechanism to stop it being targeted by its own enzymes.

BBSRC-funded research led by Dr Andrew Lovering and Professor Liz Sockett at the Universities of Birmingham and Nottingham has discovered a ‘self-protection’ protein in the predatory bacterium *Bdellovibrio bacteriovorus*. The protein inhibits the enzyme ‘weapons’ used by the predator until they can be deployed into its prey. Predatory bacteria that lack the self-protection protein are targeted by their own enzyme weapons.

Understanding how predatory bacteria invade prey could help researchers develop predatory bacteria as potential treatments for human infections, particularly in the context of rising antimicrobial resistance.

Mitochondria are essential for cell ageing

Mitochondria, which generate energy in the cells of eukaryotic organisms (including plants, animals and fungi), play a central role in cellular ageing, according to BBSRC-funded research at Newcastle University.

After a certain number of divisions, cells become senescent – they stop dividing – and this process plays an important role in tumour suppression, tissue repair and ageing. By manipulating a mechanism in human cells that eliminates damaged mitochondria, the researchers were able to remove almost all mitochondria from the cells. As a result, the cells did not undergo a number of the changes typically associated with ageing and senescence.

The results could help researchers develop therapies to counteract the effects of ageing cells, which can contribute to ageing-related disease.

Plant disease resistance mechanisms revealed in key crops

BBSRC-funded researchers at the Earlham Institute and The Sainsbury Laboratory have surveyed recently discovered components of plant immune systems across 40 species, including 19 crops. They found that the components occur in the genomes of most flowering plants, including economically important crops such as wheat, potatoes and rapeseed.

The components, known as NLR-IDs, contain a variety of protein domains fused to proteins called nucleotide-binding leucine-rich repeat (NLR) proteins, which form part of a plant’s immune system. The protein domains work as a ‘trap’: pathogens interact with the domains, triggering an immune response in the plant.

The findings could help researchers identify new disease-resistance pathways in plants, which could be used to breed new disease-resistant varieties.
Researchers from the University of Bristol have developed a new device, which relies on the ability of humans to detect polarized light, to measure the density of pigment in a part of the eye known as the macula. The innovation arose from BBSRC-funded visual ecology research into the ability of coral reef fish *Chromis viridis* to see polarized light.

Macular pigment density is one of the risk factors for age-related macular degeneration (AMD), which affects more than two million people in the UK and can result in the loss of central vision.

The device can be used during regular eye examinations to provide patients with extra information about eye health and lifestyle changes that can help reduce the likelihood of developing AMD, or slow progression of the disease. The researchers are now commercialising the technology through spin-out company Azul Optics.

2M: People in the UK are affected by age-related macular degeneration.

<1: Number of minutes to test macular pigment using the new device.

£325K: BBSRC responsive mode grant to support the research.

Fundamental bioscience research at Queen Mary University of London led to the creation of spin-out company Activiomics in 2011. Activiomics provided mass spectrometry services to the pharmaceutical industry as well as conducting in-house research into ‘biomarkers’ associated with breast cancer.

The methods used by Activiomics arose in part from BBSRC-funded research into PI3 kinase proteins and the signalling pathway they mediate. The PI3 kinase pathway controls vital cellular processes, and mutations in the pathway have been linked to various cancers.

The researchers developed a new mass spectrometry technique to overcome shortcomings in existing methods. The new technique could be used to identify biomarkers – molecular changes that allow clinicians to monitor disease progression and the effectiveness of treatment.

In 2014, the company was sold to Retroscreen Virology Group plc (now hVIVO) for £4M, and now focusses on biomarkers for respiratory disease.

2011: Year Activiomics was founded.

£4M: Value of Activiomics when it was sold to Retroscreen Virology Group.

£332K: BBSRC grant to researchers at QMUL, which contributed to new methods development.
BBSRC is committed to supporting researchers to take their ideas from the lab to where they can deliver economic and social impact.

Our support includes funding such as the follow-on fund and follow-on fund pathfinder, which support the translation of research into practical applications, and the Impact Acceleration Accounts Pilot, launched in 2015 to support knowledge exchange activities in universities aimed at strengthening user engagement and the flow of knowledge and skills.

BBSRC is the main sponsor of the Biotechnology Young Entrepreneurs Scheme (YES). The scheme aims to raise awareness of commercialisation among early career researchers, and is now in its 21st year. Since it was founded, over 5000 researchers in 1125 teams have taken part in YES⁶.

In 2016, BBSRC’s Fostering Innovation competitions saw the culmination of BBSRC’s second Excellence with Impact competition, which recognised institutions that developed and successfully delivered a vision for maximising impact alongside a relevant institution-wide culture change. Fostering Innovation includes the annual Innovator of the Year competition to celebrate researchers who have harnessed the potential of their research (See ‘Fostering Innovation 2016’).
Fostering Innovation 2016

At the 2016 Fostering Innovation event, BBSRC announced the winners of both the 2016 Innovator of the Year competition and the long-running Excellence with Impact competition, which began in 2013.

**Excellence with Impact**

**Overall winner: John Innes Centre**

**Runners-up: University of Glasgow**

The independent panel of judges also awarded commendations to those institutions that demonstrated outstanding practice in particular areas:

- The Genome Analysis Centre (now The Earlham Institute) for social media engagement.
- Queen Mary University of London was awarded two commendations for schools outreach and PhD internship programmes.
- The Babraham Institute, Royal Veterinary College and The University of Edinburgh were each commended for public dialogue and openness around the use of animals in research.
- Aberystwyth University and IBERS for impact policy around global food security.
- The University of Manchester was awarded two commendations for outreach in collaboration with the Manchester Museum and effective recognition of impact in staff development.
- University of Leeds for the development of impact metrics.

**Innovator of the Year**

**Overall winner and commercial innovator: Professor Tom Brown, University of Oxford**

Nucleic acids – the molecular building blocks of DNA and RNA – are at the heart of modern bioscience. Over several decades, Professor Tom Brown, now at the University of Oxford, has developed and commercialised a suite of innovative technologies based on chemically modified nucleic acids with increased functionality. These innovations formed the basis of three spin-outs, and successful products commercialised by other companies. (See page nine for details.)

**Social innovator: Dr Barrie Rooney, University of Kent**

Researcher Dr Barrie Rooney at the University of Kent has developed a new diagnostic test for human African trypanosomiasis, or sleeping sickness. The prototype tests are currently undergoing clinical trials, and will contribute to World Health Organisation (WHO) efforts to control the disease and provide access to treatment. (See page nineteen for details.)

**Most promising innovator: Dr Martin Pule, University College London**

University College London researcher Dr Martin Pule created spin-out company Autolus Ltd in 2014 to commercialise his research to ‘programme’ immune cells to specifically target and destroy cancer cells. Autolus raised £30M in their first, or ‘series A’, funding round, the largest series A investment raised by a European biotechnology company. A subsequent round raised an additional £40M. (See page nine for details.)

www.bbsrc.ac.uk/news/people-skills-training/2016/160519-n-bioscience-impact-innovation-competition-winners-announced/
New businesses from bioscience

BBSRC has identified 374 spin-out companies with links to BBSRC investments. Of those, 267 were still active in 2016.

New businesses created from BBSRC research often depend on many different funding mechanisms, progressing from ideas developed during fundamental bioscience research and training, to translational funding, as well as training and support for researchers seeking to commercialise their ideas and establish a company.

This has led to a substantial number of spin-out companies from excellent bioscience. For instance, in 2016, BBSRC-funded researchers reported 50 unique spin-out companies via researchfish®, including ten registered in 2015 and 2016.

Including historical data, and data submitted to researchfish in 2014, BBSRC has identified 374 spin-out companies with links to BBSRC investments. Of those, 267 were still active in 2016, employing 2,375 people in the UK.

Rainbow Seed Fund

The Rainbow Seed Fund was established in 2002 to provide kick-starting finance to technology companies that spin out of publically funded research institutes, are based on a campus of one of the funding partners, or are in the early stages of commercialising innovations based on synthetic biology.

The Fund has invested in more than 40 companies, and has generated wider economic impact: 2014/15 data generated by the Fund show Rainbow has a GVA (Gross Value Added) to date of £46.3M.

The Rainbow Seed Fund is supported by BBSRC, NERC, STFC and DSTL, as well as CCFE, FERA, James Hutton Institute, NPL, AHVLA and Public Health England. It is managed by Midven Ltd.

http://midven.co.uk/funds/rainbow-seed-fund/
Interdisciplinary BBSRC-funded research into nucleic acid chemistry has underpinned the development of a suite of innovative technologies based on chemically modified nucleic acids with increased functionality.

The technologies, created by Professor Tom Brown, now at the University of Oxford, led to the creation of three spin-out companies:

- Oswel, which arose from Wellcome Trust funding;
- ATPBio, founded by Brown in 2005 to continue designing and selling modified nucleic acids to researchers and to the biotech and pharma industries;
- Primer Design, also founded in 2005, developed diagnostic kits using modified nucleic acids, which are used to detect bacteria and viruses such as ebola and swine flu.

Brown was also co-inventor of Scorpion primers and HyBeacons, commercialised by AstraZeneca spin-out DxS and by international life science measurement company LGC, respectively.


$100M: Annual sales of Scorpion primers in 2013.

£6.6M: Value of BBSRC funding for Brown’s research since 1996.

Dr Martin Pule and colleagues at University College London have developed a novel method from BBSRC-funded synthetic biology research to programme engineered immune T-cells with simple ‘logic gates’, enabling them to target and destroy specific cancer cells.

The logic gates allow the cells to be directed against cancers that cannot be targeted using other therapeutic approaches.

To develop the technology, Pule established spin-out company Autolus and sought venture capital funding. The first funding round, known as ‘series A’ funding, raised £30M investment, the largest series A funding ever raised by a European biotechnology company. A second funding round in 2016 raised a further £40M.

The researchers are now running a clinical trial to test the efficacy of engineered T-cells in treating acute lymphoblastic leukaemia and are planning a second, focussed on neuroblastoma.

2014: Pule founds Autolus Ltd to commercialise innovative cancer therapy from synthetic biology.

£70M: Investment received since founding, including largest series A funding for a European biotech company.

£412K: BBSRC responsive mode funding to support the research.
Enabling UK industry – supporting existing businesses

BBSRC works with industry and government to ensure our research adds value. We have a sustained and productive record of enabling researchers to work with industry to maximise the impact of their research.

This is accomplished through a variety of mechanisms, delivered in partnership with Innovate UK, the other Research Councils, companies and others.

For instance, BBSRC funds Networks in Industrial Biotechnology and Bioenergy, which support collaborations between industry, policy-makers, NGOs and academia to enable the translation of research into benefits for the UK. Through the Networks, over 600 companies are now working with 2600 academic researchers: membership has more than doubled since 2014.

BBSRC is working closely with Innovate UK to support the Agri-Tech Catalyst. In October 2015 the Catalyst announced £17.8M funding for 21 projects, including £6.7M from industrial partners. The projects aim to improve agriculture in the UK and overseas, focussing on commercially promising new technologies. In 2016 the Agri-Tech Catalyst announced a call for ‘Innovation funding in developing countries’, to support uptake of agricultural innovation in developing countries.

In May 2016 the Industrial Biotechnology (IB) Catalyst, supported by BBSRC, EPSRC and Innovate UK, announced £17M funding for 16 projects. The projects built around academic-industrial collaborations, cover a wide range of biotechnology concepts, including creating biofuels and developing new antibiotics. All of the projects are built around an academic-industrial collaboration, to support research translation. The IB Catalyst has invested more than £75M over four funding rounds since it was created in 2014.

The first phase of the UK Biofilms Programme, funded jointly by BBSRC and Innovate UK, supported 22 industry-led collaborative R&D projects involving 44 new academic and industrial partnerships. The Programme leveraged £560,000 of private sector investment from over 20 businesses operating across at least eight UK industry sectors.

Together with other Research Councils and consortia of companies, BBSRC also supports six Research and Technology Clubs, which have collectively invested more than £76M in research to address strategic industry needs. For instance, in 2016:

- Diet and Health Research Industry Club (DRINC) awarded £3M to six research projects to improve our understanding of the link between diet and health. Industry partners will harness the outcomes of the projects to develop new products and processes.
- Sustainable Agriculture Research and Innovation Club awarded £3.2M to support 10 interdisciplinary research projects, including 12 industry partners, to address key challenges facing the UK crop and livestock sectors.
Extending the shelf life of chilled foods

Evidence on the levels of bacterial spores in raw food ingredients is helping the food industry produce chilled food with a longer safe shelf life, reduce energy inputs during manufacturing, and meet consumer demand for fewer preservatives. Products developed using the research are already on sale in supermarkets.

The bacterium *Clostridium botulinum* produces the potentially deadly neurotoxin that causes botulism. As even the smallest amount of the toxin can result in illness and death, food manufacturers follow strict safety criteria to reduce the risk of food containing *C. botulinum* spores.

Through the Sustainable Shelf Life Extension project, researchers led by Professor Mike Peck and Dr Gary Barker at the Institute of Food Research, working with the Chilled Food Association and Unilever Research, quantified the number of *C. botulinum* spores found in food ingredients, vital information for food safety and risk assessment.

Unravelling cell signalling to enable drug discovery

**18,000:** Genes screened to find those that regulate the Wnt pathway.

**51,103:** Cases of breast cancer in the UK in 2012.

**£348K:** BBSRC Industrial Partnership Award supported the research.

BBSRC-funded cell biology research at the University of Cardiff is enabling drug discovery at pharmaceuticals company Merck.

The researchers screened 18,000 genes to identify those that regulate the activity of the ‘Wnt’ signalling pathway in cells, which controls the activity of genes associated with embryo development. The BBSRC funding also led to the development of a cell-based assay used to test the effects of potential drug molecules on the Wnt pathway.

The researchers then worked with Merck to identify potent and selective chemical tools that inhibit the pathway.

Such drugs could be used to treat diseases caused by malfunctions in Wnt signalling, such as some forms of melanoma, breast, colorectal, prostate and lung cancers.
As an organisation committed to openness and transparency, BBSRC openly accounts for the funds it invests. The collection of outputs, outcomes and impact data from our research investments is an important component of meeting this requirement. In 2014, BBSRC adopted the use of the researchfish® system to capture these data.

The graphic below shows the total instances of each outcome type reported in researchfish® to March 2016.
Lameness treatment guidelines save UK farmers £700M

Research at the University of Warwick supported by BBSRC and Defra has enabled UK farmers to reduce the prevalence of lameness in UK sheep from 10% in 2004 to 5% in 2013. Over ten years, the research has saved UK farmers £700M and prevented 7.5 million sheep from becoming lame.

Professor Laura Green and colleagues showed 95% of sheep recovered from lameness within ten days when they were given an antibiotic injection within three days of becoming lame. In contrast, traditional methods were successful on less than 25% of sheep.

Lameness is endemic in the UK. 80% of cases are caused by the bacterial disease footrot. Lame sheep suffer chronic pain and lose weight rapidly.

The researchers are working with the Sheep Veterinary Society, industry body AHDB Beef & Lamb and others to engage farmers and disseminate their results.

£700M: Cost savings for UK farmers over a decade thanks to the research.

95%: Proportion of sheep that recover within ten days if treated promptly with antibiotics.

75,000: Sheep flocks in England alone.

£902K: Funding from BBSRC to support the research.

International space policy builds on BBSRC microbiology

BBSRC-funded microbiology research into the limits of life on Earth is being used by the international space community to help define planetary protection policy.

The project, led by Dr John Hallsworth at Queen’s University Belfast, showed that certain substances allow microbes to survive and replicate at much lower temperatures than previously thought.

As a result, Hallsworth was invited to join the Special Region Science Analysis Group of NASA’s Mars Exploration Program Analysis Group to help define ‘Special Regions’ on Mars where life may be possible and which could be contaminated by terrestrial microbes carried on spacecraft.

Following review by the international Committee on Space Research, the Science Analysis Group report will form the basis of international planetary protection policy, used by space agencies to design future space missions.

-50°C: Average Mars surface temperature, varying from -153°C to 20°C.

8: months. The time it takes for NASA’s robotic missions to reach Mars.

£132K: Value of BBSRC funding for the research.
Improving public policy and public services

BBSRC investments have a significant impact on policy-making in the UK and overseas. Working with BBSRC-funded researchers enables policymakers to draw on the best possible evidence to inform responses to key global challenges such as food security, sustainable agriculture, and tackling antimicrobial resistance.

Many policy issues are so large that they can only be tackled in partnership. For instance, BBSRC is working with MRC, EPSRC and ESRC through the cross-Council Anti-Microbial Resistance Initiative, which in 2016 announced £9.5M funding for three large collaborative grants that aim to identify novel antimicrobials from fungi, to develop new diagnostic tools, and to understand how elements of our immune systems work.

In March 2016, BBSRC, Defra, ESRC, Forestry Commission, NERC and the Scottish Government awarded £2M through the Living With Environmental Change Partnership to two projects to help combat threats to trees and plants, as part of the Tree Health and Plant Biosecurity Initiative.

Bovine TB costs the UK £100M per year. In 2016 BBSRC, the National Centre for the Replacement, Refinement & Reduction of Animals in Research and Defra invested £7M in nine research projects that aim to develop new control and eradication strategies for the disease.

As part of a broader drive to make the UK an international centre for vaccine research and development, BBSRC, EPSRC and MRC launched a joint funding highlight to promote innovation in novel veterinary and medical vaccines, through the development and application of new tools and technologies.
BBSRC funding enabled researchers at the Wellcome Trust Centre for Human Genetics at the University of Oxford to develop innovative software to analyse the data from high-throughput DNA sequencing.

The software has enabled NHS and Institute of Cancer Research researchers to reduce the cost of identifying gene variants that can predispose people to cancer, enabling them to study almost 100 genes in all of their patients, rather than just two in a fraction of patients.

The researchers also established spin-out company Genomics plc to support data analysis for the 100,000 Genomes Project. The company employs 40 people and is working with major pharmaceutical companies.

NHS Blood and Transplant are investigating how the software can accelerate the process of matching unrelated haematopoietic stem cell donors and recipients, and improve the outcome of these transplants.

10×: faster data analysis using the new software, compared with existing tools.

$20M: Investment received by Genomics plc since its founding.

£626K: BBSRC grant to support the research.

High throughput sequencing devices can produce many gigabytes of data in a single day.

Informing policy to enhance chicken welfare

800M: Broiler chickens raised in the UK each year.

2010: EU Broiler Directive adopted in the UK.

39 Kg per m²: maximum density of broiler chickens allowed in the UK.

£1.6M: Funding from BBSRC and Defra to support the research.

With BBSRC and Defra funding, Professor Marian Dawkins CBE FRS and colleagues from the University of Oxford have developed scientific ways of studying animal welfare, enabling better animal husbandry and improved animal health.

Dawkins’ research varied the stocking density of 2.7 million chickens on a total of 11 farms. Although very high densities were confirmed to have detrimental impacts on bird health and welfare, the research showed that, in commercial trials at lower densities, the housing and environment in which the chickens are kept affect the welfare of broiler chickens even more than density. In particular, air and litter quality, as well as temperature and humidity, played a major role in determining welfare.

Her findings influenced the 2007 EU Broiler directive, adopted by the UK in 2010. The results were also used by Defra in the UK to guide their implementation of the policy.
Building partnerships to solve global challenges

Working in partnership to address major societal challenges often requires international coordination and collaboration.

BBSRC works closely with funders in other countries to tackle global problems such as food security, the threat of disease and the impacts of climate change.

Through the Newton Fund, BBSRC, ESRC and MRC worked in partnership with the National Natural Science Foundation of China to invest £4.5M in six collaborative research projects. The projects bring together leading UK and Chinese researchers to address the global challenge of antimicrobial resistance. 

In July 2016, BBSRC and the Brazilian Agricultural Research Corporation (Embrapa) invested £4M (including £2M from the Newton Fund, delivered through BBSRC, with matched funding from EMBRAPA) to support collaborations between UK and Brazilian wheat researchers. The project aims to develop new crop traits or practices to improve the sustainability of wheat production.

BBSRC is a partner in the International Wheat Yield Partnership, alongside national funders, aid agencies, research organisations and wheat breeding companies. The Partnership aims to stimulate research to boost the genetic yield potential of wheat by 50% over the next 20 years. In October 2015, IWYP announced US$20M funding (including $7.5M from BBSRC) for eight projects across the UK, Australia, USA, Mexico, India, Argentina and Spain. Five of the eight projects are led by UK-based researchers.

BBSRC also supports funding schemes to enable UK researchers to work with researchers in other countries. For instance, in 2016:

- BBSRC launched a new travel award scheme to support collaborations between BBSRC-funded researchers and their international counterparts. This includes short visits to establish new collaborations, as well as visits to use specific equipment and facilities not available in the UK.

- BBSRC awarded 24 International Awards, with a total value of almost £800K, enabling long-term international collaborations between researchers in the UK and colleagues in Brazil, China, Japan, the USA, Taiwan and elsewhere.
Research at the University of Glasgow is informing foot-and-mouth disease (FMD) control strategies in Tanzania.

Data from the research, which was led by Professor Sarah Cleaveland, allowed the Government of Tanzania to place the country on the international ‘Progressive Control Pathway for FMD control’ and is contributing to a national FMD action plan.

The research, which showed that FMD outbreaks in the region are mostly driven by livestock factors, not interactions with wildlife, is helping local communities identify actions to reduce the spread of FMD among their animals.

The results will also help safeguard Tanzania’s unique ecosystem, which underpins a large tourism industry, as they showed that using fencing to restrict wild animal movement would not help control FMD.

The Global Challenges Research Fund is a new £1.5Bn resource funding stream announced by the UK Government in 2015, which aims to ensure that UK research takes a leading role in addressing the problems faced by developing countries. The Research Councils are primary delivery partners for GCRF, and have already announced several funding opportunities. BBSRC is leading or contributing to several, including:

- GCRF Foundation Awards for Global Agriculture and Food Systems call, led by BBSRC, which aims to encourage multidisciplinary research and build research partnerships to address challenges in agriculture and food security in Low and Middle-Income Countries (LMICs). Up to £16.3M is available, with a BBSRC contribution of £12M.

- Bioinformatics and Biological Resources Fund, which supports development and maintenance of biological resources, and includes a highlight for proposals relevant to GCRF.

- Networks in Vector Borne Disease (VBD) Research, launched in September 2016, informed by key research priorities identified in a recent BBSRC-led survey of the UK VBD Research, Training and Infrastructure landscape.

- Infections Foundation Awards: Global Infections, led by MRC, with up to £3M from BBSRC.

- NCDs (Non-Communicable Diseases) Foundation Awards: Global Health Science – Beyond Infections, led by MRC, with up to £4M from BBSRC.

Further details are available at: www.bbsrc.ac.uk/funding/filter/global-challenges-research-fund/
Delivering highly skilled people

BBSRC supports high-quality postgraduate and postdoctoral training to ensure the UK has the skills to support a world-leading bioscience research base and to enable the continuing growth of the bioeconomy.

Investing in postgraduate training

The first cohort of 250 students funded through BBSRC’s 12 Doctoral Training Partnerships began their studentships in late 2015. BBSRC is investing £125M in the Doctoral Training Partnerships over five years to support 1250 postgraduate students. Of those, 30% will be trained in agriculture and food security, 20% in industrial biotechnology and bioenergy, 10% in bioscience for health, and the remaining 40% in other world-class frontier bioscience, to ensure greater alignment between BBSRC’s research and training portfolios. In 2015-16 BBSRC also allocated 90 industrial CASE (iCASE) studentships to the BBSRC Doctoral Training Partnerships, awarded alongside standard studentships.

In January 2016, BBSRC announced the first STARS (Strategic Training Awards for Research Skills) awards for five UK universities. The scheme provides postgraduate training in strategically important and vulnerable skills for bioscience researchers, such as advanced empirical methods for reproducible science, bioinformatics and computational biology, entomology and plant pathology and mathematical biology²⁴.

BBSRC launched a new Collaborative Training Partnerships scheme in February 2016. It will allocate 75 studentships to key non-academic organisations (including companies) to provide high-quality training in a collaborative environment. The studentships must include a placement of between three and eighteen months with the non-academic partner.

Supporting research careers

BBSRC support for postgraduate training focuses on the needs of researchers in academia and elsewhere. For instance, BBSRC supports a range of fellowships to foster the next generation of world-leading researchers, including five new David Phillips Fellowships awarded in 2016, which support researchers to conduct high-quality research and establish independent research careers²⁵. In 2015-16, BBSRC also announced 12 new Future Leader Fellows to enable early-career scientists to carry out independent research to become future research leaders. BBSRC also supports Returners to Research Fellowships to support researchers returning to work after a career break of two or more years²⁶.

Two of the 11 Enterprise Fellowships awarded in 2016 by the Royal Society of Edinburgh, with support from BBSRC, Scottish Enterprise and STFC, were funded by BBSRC²⁷. These Fellowships provide one year’s salary as well as entrepreneurial training and access to experienced mentors, enabling Fellows to develop their own business ideas.
New diagnostic tests for sleeping sickness

Researcher Dr Barrie Rooney at the University of Kent has developed a new diagnostic test for human African trypanosomiasis, or sleeping sickness. Rooney received a BBSRC Flexible Interchange Programme (FLIP) award to enable her to work at Kent to develop the technology underpinning the new tests. FLIP enables researchers to spend time in different organisations to exchange knowledge and skills.

A prototype is currently undergoing testing at the Tropical Institute, Antwerp. Rooney is also working with Belgian company Coris BioConcept to scale up production of the test for a clinical trial, which will be conducted with IRD in Marseilles.

Sleeping sickness is classified as a neglected tropical disease by the World Health Organisation. There are 3000-4000 cases reported per year in central African countries, usually amongst poor rural communities and those affected by war. Related diseases affect animals, including livestock.

3796: Cases of sleeping sickness reported in 2014.
2 Years: Length of time the parasite can lie dormant before causing symptoms.
2016: Rooney wins BBSRC Social Innovator of the Year award.
£319K: Funding from BBSRC, including a FLIP award and two follow-on fund grants.

Milkalyser – innovative fertility detection technology

BBSRC/Royal Society of Edinburgh Enterprise Fellow Professor Toby Mottram at the Royal Agricultural University has produced a sensor that analyses hormones in milk to track cows’ fertility. The Milkalyser could save farmers around £150 per cow, and will be tested on farms in late 2016.

Failure to detect peaks in fertility and thus get cows pregnant on schedule costs the average 100-cow farm £25,000 per year. Hormone analysis detects 97% of peaks in fertility, but is too time-consuming for large modern dairies.

Supported by BBSRC follow-on funding, an Innovate UK SMART award, and a BBSRC/Royal Society of Edinburgh Enterprise Fellowship, Mottram has created a hormone sensor that fits into milking parlour machinery and analyses each cow’s milk, displaying fertility data on the user’s smartphone. Mottram predicts that the Milkalyser could pay for itself in under 18 months by boosting milk yields and reducing the need to replace livestock.

£25K: cost to an average 100-cow farm of failure to get cows pregnant.
£150: cost savings, per cow, to farmers using Milkalyser.
97%: Oestrus events detected by hormone analysis, compared with 65% for other methods.
Norwich Research Park

The new centre for food and health research to be located on the Norwich Research Park will be called the Quadram Institute. It will be based in a new £75M facility, with initial investment from BBSRC and three Norwich-based partners: the Institute of Food Research (IFR), the Norfolk and Norwich University Hospitals NHS Foundation Trust (NNUH), and the University of East Anglia (UEA). Building began in February 2016, with an anticipated opening in 2018.

The Quadram Institute will integrate research teams from the IFR and UEA’s Faculty of Science and Norwich Medical School with the NNUHs’ gastrointestinal endoscopy facility into one of Europe’s largest concentrations of food, health and environmental science research.

In June 2016, The Genome Analysis Centre (TGAC) changed its name to the Earlham Institute. The Earlham Institute will build upon the research foundation developed as TGAC and continue to help answer fundamental questions in biological sciences.

Babraham Research Campus

The Babraham Research Campus has been voted the best lifescience BioIncubator in Europe in a pan-European poll. Construction of a new bioincubator follow-on building ‘Eddeva’ was completed on schedule in December 2015, and construction of improved campus amenities, conference and business interaction space is due to be completed in late 2016. These projects are managed by the campus company BBT Ltd but with BBSRC involvement. Construction of the Imperial Innovations building is underway, funded and built by Imperial College on a plot leased directly from BBSRC. The building is expected to be completed and operational in early 2017. The Campus has remained 100% full throughout 2015-16, with over 60 companies on site.

Rothamsted Research Campus

The new campus governance and operational structures have been established, including creation of a new campus operating company, RoCRE Ltd.
Aberystwyth Innovation and Enterprise Campus

The £40M project at the Aberystwyth Innovation and Enterprise Campus, funded by Aberystwyth University, BBSc and the Welsh European Funding Office, has established a new campus governance structure, including the new campus operating company, AIEC Ltd. Planning is underway to award the main construction contract in late 2016.

Easter Bush Campus

Construction of the Roslin Innovation Centre is underway. It is due to be completed in early 2017 and will provide flexible laboratory and office space for companies and business collaborators in the animal and veterinary sciences.

New Heritage Barley Ltd – reviving Victorian barley for modern brewing

BBSRC-funded researchers at the John Innes Centre on the Norwich Research Park, established start-up company New Heritage Barley Ltd to commercialise a heritage variety of barley called Chevallier, last grown in the UK in the 1930s, for beer production.

Starting with seeds from the JIC Germplasm Resources Unit, the researchers have scaled up production and are working with Crisp Malting Group to produce malt from the barley. Crisp are now selling the malt to UK and US breweries. The Cheshire Brewhouse in the UK used Chevallier malt to brew a pale ale called Govinda ‘Chevallier Edition’.

Chevallier is also resistant to fusarium, a costly fungal disease of barley. The JIC researchers are working with colleagues in the USA and Canada to develop fusarium-resistant barley varieties that can be grown on the humid east coast of North America, where fusarium is a major problem for barley growers.


1431: Number of breweries in the UK 2015.

£198K: BBSRC follow-on funding to support commercialisation of the research.
BBSRC continues to work closely with all of the Research Councils and RCUK through the RCUK Performance Evaluation Network.

In common with all of the Research Councils, BBSRC continues to collect research outcomes data through researchfish®. In 2015-16, for the first time, the Councils have adopted a set of common indicators (see page 23). BBSRC is also using researchfish® data to identify and develop impact case studies, many of which are included elsewhere in this report.

The Research Councils continue to work together to identify and develop examples of impact from their investments. BBSRC runs integrated programmes for gathering and analysing evidence from its investments: one focussing on the evaluation of outcomes, the other on impacts arising from BBSRC bioscience. These, together with analyses of data collected through researchfish® and other internal and external data sources (such as the REF impact case studies dataset), provide a broad base of evidence of outcomes and impacts.

Policy evidence

BBSRC continues to develop its portfolio analysis toolkit to better understand our research portfolio, to assess the impact of past investments and inform strategic planning.

Working with the UK National Centre for Text Mining, BBSRC has developed a tool to automatically classify research against 21 core research topics. Now embedded as ‘business as usual’, this approach enables greater accuracy, efficiency and timeliness in our reporting capability.

BBSRC has developed a new portfolio analysis tool, in collaboration with the National Science Foundation, to analyse ‘text rich’ data such as grant abstracts and research objectives. This data mining tool enables greater exploration of our research portfolio, new knowledge discovery and rapid data-driven insights. It is interactive, combining text searching with data visualisation; these visualisations are simple and intuitive and have drill down capability. This new tool can integrate with multiple datasets enabling consistency in analysis across multiple sources and types of data, enabling us to understand how BBSRC research investments fit within the wider research landscape in the UK and internationally and with the capability to help us to explore the impact of our research investments.

In all of this this work, BBSRC uses mostly open source technologies and algorithms which are cost effective and can evolve to meet our business needs. Our developments are shared with other funders for maximum benefit.
## Common Indicators

### Introduction

The Research Councils have agreed a revised set of common indicators on performance with the Department of Business, Energy and Industrial Strategy (BEIS). These indicators draw on information from grants databases and the researchfish® system.

### Total Funds Available

<table>
<thead>
<tr>
<th>Year</th>
<th>2011/12</th>
<th>2012/13</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Budget Allocation</td>
<td>494,306</td>
<td>462,771</td>
<td>463,371</td>
<td>485,871</td>
<td>421,073</td>
</tr>
<tr>
<td>1.2 Leverage</td>
<td>14,846</td>
<td>18,382</td>
<td>14,015</td>
<td>19,180</td>
<td>23,754</td>
</tr>
<tr>
<td>1.2.1 of which Private</td>
<td>5,411</td>
<td>36%</td>
<td>7,380</td>
<td>40%</td>
<td>5,773</td>
</tr>
<tr>
<td>1.2.2 of which from other Research Councils</td>
<td>7,822</td>
<td>52%</td>
<td>8,051</td>
<td>44%</td>
<td>5,735</td>
</tr>
<tr>
<td>1.2.3 of which from other source</td>
<td>1,753</td>
<td>12%</td>
<td>2,951</td>
<td>16%</td>
<td>2,507</td>
</tr>
<tr>
<td>1.3 Additional funding leveraged by research projects</td>
<td>22,933</td>
<td>99,461</td>
<td>33,661</td>
<td>20,985</td>
<td>15,656</td>
</tr>
<tr>
<td>1.3.1 of which Private</td>
<td>4,057</td>
<td>18%</td>
<td>6,369</td>
<td>64%</td>
<td>20,768</td>
</tr>
<tr>
<td>1.3.2 of which Public</td>
<td>15,199</td>
<td>66%</td>
<td>254</td>
<td>3%</td>
<td>1,90</td>
</tr>
<tr>
<td>1.3.3 of which Non-profit</td>
<td>7,682</td>
<td>52%</td>
<td>8,051</td>
<td>44%</td>
<td>5,735</td>
</tr>
<tr>
<td>1.3.4 of which Academic sector</td>
<td>3,608</td>
<td>16%</td>
<td>3,300</td>
<td>33%</td>
<td>12,534</td>
</tr>
</tbody>
</table>

### Research Expenditure

<table>
<thead>
<tr>
<th>Year</th>
<th>2011/12</th>
<th>2012/13</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Research expenditure</td>
<td>284,145</td>
<td>56%</td>
<td>307,896</td>
<td>64%</td>
<td>312,888</td>
</tr>
<tr>
<td>2.2 Training expenditure</td>
<td>63,749</td>
<td>13%</td>
<td>52,281</td>
<td>11%</td>
<td>52,307</td>
</tr>
<tr>
<td>2.3 Other</td>
<td>161,258</td>
<td>32%</td>
<td>120,976</td>
<td>25%</td>
<td>112,191</td>
</tr>
</tbody>
</table>

### Human Capital

<table>
<thead>
<tr>
<th>Year</th>
<th>2011/12</th>
<th>2012/13</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Principal Investigators</td>
<td>1054</td>
<td>1067</td>
<td>1208</td>
<td>1343</td>
<td>1427</td>
</tr>
<tr>
<td>3.2 Research Fellowships</td>
<td>62</td>
<td>58</td>
<td>51</td>
<td>39</td>
<td>45</td>
</tr>
<tr>
<td>3.3 Number of PIs and CO-Is on research grants (on 1st April)/ the number of Research Organisations (including Independent Research Organisations)</td>
<td>2008</td>
<td>149</td>
<td>2018</td>
<td>140</td>
<td>2309</td>
</tr>
</tbody>
</table>

### Human Capital – Postgraduates

<table>
<thead>
<tr>
<th>Year</th>
<th>2010/11</th>
<th>2011/12</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Number of new doctoral students within that financial year</td>
<td>535</td>
<td>393</td>
<td>418</td>
<td>415</td>
<td>415</td>
</tr>
<tr>
<td>4.2 Doctoral submission rate</td>
<td>92</td>
<td>89</td>
<td>94</td>
<td>94</td>
<td>89</td>
</tr>
</tbody>
</table>
### Collaborations, partnerships and secondments

<table>
<thead>
<tr>
<th>Year the collaborations, partnerships or secondments were first reported</th>
<th>2011/12</th>
<th>2012/13</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Instances of new collaborations reported in researchfish®</td>
<td>192</td>
<td>336</td>
<td>383</td>
<td>422</td>
<td>411</td>
</tr>
<tr>
<td>5.2 Instances of secondments reported in researchfish®</td>
<td>66</td>
<td>142</td>
<td>171</td>
<td>303</td>
<td>282</td>
</tr>
</tbody>
</table>

### Publications

<table>
<thead>
<tr>
<th>Year outcome realised</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.1 Instances of journal articles</td>
<td>3182</td>
<td>3792</td>
<td>4035</td>
<td>4477</td>
<td>4168</td>
</tr>
<tr>
<td>6.1.2 Instances of books</td>
<td>26</td>
<td>20</td>
<td>22</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>6.1.3 Instances of books chapters</td>
<td>113</td>
<td>125</td>
<td>143</td>
<td>129</td>
<td>63</td>
</tr>
</tbody>
</table>

### Publications: Number/proportion of awards

<table>
<thead>
<tr>
<th>Year the award started</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.4 Number/proportion of awards that gave rise to at least one example of a publication within five years of award start date</td>
<td>528</td>
<td>66%</td>
<td>594</td>
<td>75%</td>
<td>448</td>
</tr>
</tbody>
</table>

### Other outputs

<table>
<thead>
<tr>
<th>Year outcome realised</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2.1 Instances of artistic and creative outputs</td>
<td>3</td>
<td>8</td>
<td>13</td>
<td>26</td>
<td>32</td>
</tr>
<tr>
<td>6.2.2 Instances of research databases and models reported</td>
<td>72</td>
<td>93</td>
<td>95</td>
<td>103</td>
<td>96</td>
</tr>
<tr>
<td>6.2.3 Instances of software and technical products reported</td>
<td>43</td>
<td>59</td>
<td>74</td>
<td>93</td>
<td>84</td>
</tr>
<tr>
<td>6.2.4 Instances of research tools and methods reported</td>
<td>58</td>
<td>81</td>
<td>95</td>
<td>122</td>
<td>89</td>
</tr>
<tr>
<td>6.2.5 Instances of medical products, interventions and clinical trials</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>6.3 Instances of IP reported</td>
<td>23</td>
<td>26</td>
<td>31</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>6.4 Instances of spin-outs/start-ups</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

### Further funding

<table>
<thead>
<tr>
<th>Year the award started</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.1 Number/proportion of with at least one instance of further funding within five years of the start date</td>
<td>85</td>
<td>11%</td>
<td>110</td>
<td>14%</td>
<td>116</td>
</tr>
</tbody>
</table>
Notes on Common Indicators data

The outcomes data included in the Common Indicators are not static. Researchers can enter data retrospectively, which may result in changes to individual indicators in subsequent Impact Reports.

BBSRC has used the researchfish® system for outcomes collection since 2014. As such, data for earlier years may not be complete.

A particular output, for example a publication or a collaboration, might have arisen from more than one award. In this report, a particular output is always reported against each individual award where the unit of analysis is at the award level (for example the number of instances or distribution of activity). Duplicate outputs are removed, where possible, in analyses at the level of the type of output generated. Duplicate outputs are removed using system-generated codes to indicate when a researcher has attributed an output to more than one award. This cannot identify duplicate outputs where researchers have entered similar information independently of one another.

Percentages in this report are rounded up or down to the nearest whole number and so some may appear as zero if this represents less than half of one per cent.

Additional information on individual indicators is provided below. In general, information is only provided for indicators that are new or revised for the 2015-16 Impact report. Please note that the common outcomes indicators have been expanded to include a wider variety of outcomes types beyond publication, spin-outs and intellectual property. The Common Question Set used by researchfish® is available from the Researchfish website (www.researchfish.com).

<table>
<thead>
<tr>
<th>Engagement activities</th>
<th>Number/proportion of awards</th>
<th>Year the award started</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.1 Number/proportion of with at least one instance of engagement within five years of the start date</td>
<td>109 14% 175 22% 159 28% 184 34% 215 41%</td>
<td>2007 2008 2009 2010 2011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Influence on Policy and Practice</th>
<th>Number/proportion of awards</th>
<th>Year the award started</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1.1 Number/proportion of with at least one instance of policy influence within five years of the start date</td>
<td>18 2% 17 2% 15 3% 24 4% 33 6%</td>
<td>2007 2008 2009 2010 2011</td>
</tr>
</tbody>
</table>
Notes on individual common indicators

Total funds available
Total additional funds leveraged by projects: This indicator reports the cash and in-kind contributions from partner organisations that were listed on the original research proposal. It does not include any further leverage funding that may have arisen during the course of the award. It does not include additional funding leveraged by Research Council Centres, Institutes, and other intramural investments.

Total expenditure
Total Expenditure: Research expenditure: This indicator reports all research expenditure. In previous Impact Reports, this indicator was referred to as ‘responsive mode expenditure’.

Human Capital
Number of PIs: This indicator has now been standardised across Research Councils to report the number of PIs supported on research grants on the 1 April of each reporting year. It excludes PIs supported through intramural investments, unless they are in receipt of a research grant.

Number of Research Fellows: This indicator has now been standardised across Research Councils to report the number of Research Fellows supported on the 1 April of each reporting year.

Number of PIs and Co-Investigators on research grants: This indicator reports the number of PIs and Co-is supported on research grants on the 1 April of each reporting year. It excludes PIs and Co-Is supported through intramural investments, unless they are in receipt of a research grant. This indicator also includes the number of Research Organisations (including Independent Research Organisations) where these PIs and Co-Is are located.

Postgraduate Destinations: The destination of leavers data is drawn from the HESA Destination of Leavers from Higher Education (DLHE) dataset. All Research Councils now use a harmonised set of categories for this indicator.

Collaborations, Partnerships and Secondments
Instances of collaborations: This indicator relates to collaborations reported within the research proposal at the point of application. It includes the proportion of awards (expressed as a percentage) reporting at least one partner organisation at the point of application.

Instances of new collaborations: This indicator relates to new collaborations as reported within researchfish®. Collaborations are only included in the indicator for the first year that they were reported, but may continue for several years after this date. Researchers may also report collaborations that were in place at the point of application.

Instances of secondments: This indicator relates to secondments as reported within researchfish®. Secondments are only included in the indicator for the first year that they were reported, but may continue for several years after this date.

Knowledge generation
Instances of publications: A publication may have arisen from more than one award. Duplicate publication outputs are removed, where possible, using system-generated codes to indicate when an individual researcher has attributed an output to more than one award. This cannot identify duplicate outputs where different researchers have entered similar information independently of one another. It is not feasible to calculate the precise number of unique publications as some publications/publication types do not have unique identifiers (e.g. a Digital Object Identifier, a PubMed ID). The indicator is intended to provide information on the trends over time, rather than a precise measure of total publication output.

Instances of research databases and models: Some of the data within researchfish® do not have an associated time stamp. For BBSRC, there are 189 instances of research databases and models which do not include a time stamp and which are therefore excluded from the common indicators. This represents 22% of the Council’s research databases and models data within researchfish®.

Instances of research tools and methods: Some of the data within researchfish® do not have an associated time stamp. For BBSRC, there are 526 instances of research tools and methods which do not include a time stamp and which are therefore excluded from the common indicators. This represents 42% of the Council’s research tools and methods data within researchfish®.

Intellectual Property
Instances of Intellectual Property: This indicator includes patents, copyrights and trademarks. Some of the data within researchfish® do not have an associated time stamp. For BBSRC, there are 61 instances of intellectual property which do not include a time stamp and which are therefore excluded from the common indicators. This represents 20% of the intellectual property data within researchfish®.
Spin-outs
Instances of spin-outs/start-ups: Within researchfish®, researchers are asked to provide details of links between their research and the establishment, development or growth of new private sector organisations, including for profit and not-for-profit organisations. Supplemental information was used to identify duplicate spin-out companies where available (e.g. Companies House IDs for UK companies).

Further funding
Number/proportion of awards with further funding: This indicator includes further funding to continue or develop the research, or to support the translation of outcomes into practical application.

Engagement activities
Number/proportion of awards with engagement activities: Researchers engage with a wide variety of audiences and stakeholders to communicate research outcomes, disseminate knowledge, stimulate public awareness, and encourage public engagement and dialogue. The engagement activities indicator helps demonstrate the extent to which researchers are engaging with audiences outside academia.

Influence on Policy and Practice:
Number / proportion of awards with policy influence: Research may be used to inform policy and practice, which may subsequently lead to wider societal and economic benefit. The influence on policy and practice indicator helps demonstrate the extent to which researchers are informing decision making within government departments and elsewhere.
Notes and references

1. “BBSRC publishes Delivery Plan for 2016 to 2020”, BBSRC
6. In addition to BBSRC and organisers The University of Nottingham’s Haydn Green Institute for Innovation and Entrepreneurship, YES is supported by MRC, NERC and the Royal Society of Chemistry, alongside significant industrial sponsorship from Syngenta, GSK and Unilever.
7. Agri-Tech Catalyst. BBSRC: http://www.bbsrc.ac.uk/funding/filter/agri-tech-catalyst/
11. “Sharing challenges”. Research and Technology Clubs. BBSRC: http://www.bbsrc.ac.uk/innovation/sharing-challenges/
26. Returners to Research Fellowships. BBSRC: http://www.bbsrc.ac.uk/funding/filter/returners-to-research/
27. “Enterprise Fellowships awarded to support research commercialisation”. BBSRC: http://www.bbsrc.ac.uk/news/people-skills-training/2016/160318-pr-enterprise-fellowships-awarded-support-research-commercialisation/
30. This project is outside of the BBSRC campus programme, but recognised within BBSRC’s overall campus strategy.