BBSRC Delivery Plan

2011 - 2015

Maximising Economic Growth in The Age of Bioscience

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1.0 INTRODUCTION AND SUMMARY

2011-2015 will be a time of challenge and of great opportunities in bioscience

The 21st century will be the age of bioscience[1]. Driven by new concepts and technologies, a biological revolution is unfolding in the same way that advances in physics shaped the early 20th century and great leaps in electronics and computing transformed our lives over the past 40 years.

Modern bioscience offers **enormous benefits to society and unprecedented opportunities for innovation and growth in multi-billion pound sectors of our economy** such as food and drink, agriculture, biotechnology, energy, health and pharmaceuticals.

The UK is number 1 in bioscience[2] and BBSRC is the only public funder of world-class basic bioscience underpinning areas such as plant science, animal health, food production and biotechnology. These will contribute to boosting economic growth in the UK and to delivering enhanced quality of life and reduced environmental impact.

The UK faces the largest budget deficit outside wartime[3], resources are limited. In response BBSRC is transforming delivery and how we work with partners. With stakeholders, we have taken tough decisions in prioritising areas for investment and concentrating research.

Scientific research is vital to our future economic success. This Delivery Plan sets out how we will protect UK excellence to deliver growth through the UK knowledge-based bio-economy. BBSRC recognises its responsibilities, working with partners in business, the Technology Strategy Board (TSB), the Funding Councils, RCUK, academia, Government and internationally, to drive innovation and impact for the UK's benefit.

Our actions are centred on **six themes** which run throughout this plan:

Maintaining excellence in bioscience

UK excellence in research is the reason major life science companies invest here and why the best researchers are attracted to work here. To exploit and safeguard our national capability in bioscience we shall:

- Employ a balanced portfolio of funding mechanisms to prioritise the fundamental bioscience upon which all our strategic priorities depend, and protect crucial core subjects where BBSRC is the dominant funder.
- Ensure that the UK stays internationally competitive by driving data intensive and multidisciplinary approaches to bioscience to deliver new, deeper understanding of how complex living systems function.
- The institutes are a vital part of our national capability in food, bioenergy, biomedicine and bioinformatics. Their research will be focused more on the grand challenges and we shall increase access to Institute facilities to the wider research base for greater collaboration and added value.

Powering economic recovery and growth in the new green bioeconomy

The Knowledge-Based Bio-Economy in Europe is currently worth €2 trillion[4]. In partnership with others, including the TSB, we will further drive UK recovery and future growth in a rebalanced economy. Some key priorities include:

- Increase working with business to strengthen academic-industry links and to extend the range and depth of our own partnering with business.
- Support knowledge exchange and translation of bioscience into practical applications that benefit the UK economy and society. In particular to gain benefits from existing research, enable open innovation, and increase impact from institutes.
- Contribute to the strengthening of the UK innovation infrastructure and system to accelerate translation of bioscience, including working with partners in the further development of the

[1] BBSRC Strategic Plan 2010-2015: The Age of Bioscience, www.bbsrc.ac.uk/strategy
[2] www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=411986
[3] www.hm-treasury.gov.uk/spend_sr2010_speech.htm
[4] www.bioeconomy.net/reports/files/KBBE_BE_presidency.pdf

science and innovation campuses such as those around institutes in Aberystwyth, Edinburgh, Cambridge and Norwich, focusing on the latter two in the first instance.

- Drive culture change in academia and in BBSRC's own operations. Develop new ways to incentivise, capture and reward outcomes that benefit society and the economy, and engage the public in the direction of bioscience.

Ensuring a supply of highly skilled people

Skills and leadership are "vital in a highly competitive knowledge economy"[5] to drive innovation in business and policy and maintain research excellence. We shall:

- Concentrate on excellence in PhD training, combining cutting-edge research skills with broad-based scientific and professional development.
- Deliver skills for economic growth by strengthening user relevant training, e.g. CASE studentships and professional internships outside academia.
- Refocus Fellowships to develop the research leaders of tomorrow and maximise their potential to make an impact within and outside academia.

Meeting UK and global bioscience 'grand challenges'

Our research and training priorities focus on three major economic, policy and societal grand challenges facing the UK now and in the coming years:

- Food security - maintaining a safe, affordable and nutritious food supply for UK citizens and achieving food security globally to feed nine billion people by 2050.
- Sustainable bioenergy, chemicals and renewable materials from bioscience - through industrial biotechnology, developing options to lessen UK reliance on fossil carbon; making the low-carbon/green economy a reality.
- Enhancing lives and improving wellbeing - through fundamental bioscience, particularly as the proportion of UK society living beyond 65 continues to increase dramatically.

Working with others, particularly via the RCUK multidisciplinary themes, our sustained investment in bioscience will be vital to meet these challenges.

Underpinning national security

The UK faces many risks to national security[6], such as those to food and water supply, our over dependence on fossil fuels for energy and feedstocks, as well as threats from infectious diseases and pandemics. BBSRC bioscience through the food security programme, industrial biotechnology and bioenergy, along with major investments in national capability, such as the BBSRC institutes, particularly the Institute for Animal Health, will help the UK respond to these risks.

Transforming delivery and driving efficiency in the system

We are transforming ourselves and the delivery of bioscience by forging new partnerships to lever our funding, exploit synergies and drive efficiencies throughout the system. Priorities will include:

- Developing new strategic partnerships to transform the way in which we work with HEIs that have strengths in our major priority areas. The aim is to drive co-ordination, concentrate research and expertise, and share facilities, and to network the HEIs with the institutes.
- Institutes: complete the reform of Institute governance, establishing more sustainable, flexible operations. New funding mechanisms will enable a more strategic, focused approach to the grand challenges, knowledge exchange and commercialisation and national facilities.
- BBSRC leadership and leverage: we will drive greater cross-funder co-ordination (for added value) in key areas e.g. food and bioenergy. Working with others nationally and internationally we will lever more public, private and third sector funds alongside our own.
- Driving efficiency in BBSRC's operations, and in our interactions with HEIs. In particular work within RCUK and via the Shared Services Centre to streamline administration and reduce costs, without compromising what we must deliver.

[5] National Infrastructure Plan 2010, p7, HM Treasury
[6] National Security Strategy 2010, p27 Cabinet Office

2.0 RESEARCH AND TRAINING PRIORITIES

As we respond to today's problems and future grand challenges, BBSRC will continue to drive excellence in bioscience. High-quality research, people and institutions are the bedrock of our world-class bioscience base. They deliver social and economic benefits from public investment in science, underpin policy development, and attract funding from the private and third sector (see also section 2.2, National Capability).

2.1 RESEARCH AND TRAINING PRIORITIES WHERE BBSRC HAS LEAD RESPONSIBILITY

2.1.1 FOCUS ON STRATEGIC GRAND CHALLENGES

With business, academic, and policy stakeholders we have prioritised **three grand challenges.** These are some of the most significant economic, policy and societal issues facing the UK, and indeed the world. Fundamental bioscience is essential to find sustainable solutions. The UK already excels in the necessary disciplines, thus creating real opportunities to exploit bioscience in world markets to the UK's benefit.

Grand Challenge 1 - Food security

In the year to March 2008, the price of wheat rose by 130%, soya by 87% and rice by 74%, leading to food riots in some countries. Food in UK shops cost 15-40% more. Food price spikes and riots are being repeated in 2010 (UN FAO)

The food and drink supply chain is a major part of the UK economy, accounting for 7% of GDP, employing 3.7M people, and generating £80Bn per year (Food Matters, Cabinet Office report, 2008)

The UK food supply chain sustains millions of jobs and hundreds of thousands of businesses. There is great potential for innovation in the sector but we need research to increase the resilience and responsiveness of our food supply chain and to protect our economy and citizens from the increasing volatility of global food supplies, such as the food price spikes seen in 2008 and again in 2010, and the overall upward trend in global food prices.

The security of our food supply is tied to global markets. World demand for food is rising, but at the same time fresh water is becoming scarcer, competition for land is increasing and climate change is reducing the reliability of food supply. Agriculture worldwide must produce more food from the same or less land, using less water, energy, fertilisers and other inputs[7]. And it must do this whilst reducing environmental impact and greenhouse gas emissions. Cutting-edge bioscience is essential to address these challenges, drive growth and entrepreneurship in the UK multi-billion pound food & farming sectors, and at the same time contribute longer term to a safer and more stable world.

Building on current strength, through this Delivery Plan BBSRC will:

- **Improve coordination of UK food research:** BBSRC will lead the new Global Food Security (GFS) partnership (see also section 2.3.1) to achieve greater coordination and value-for-money of research spend between five research councils, the TSB and government, including the major funders in food research: Defra, DFID, and the Scottish Government.
- **Increase leverage from private sector, charities and international bodies:** Food security is a global problem with enormous scope for international collaboration and leverage. We are already leveraging more than £20M in joint research with international partners and will seek to strengthen links with the World Bank, CGIAR Centres[8], Wellcome Trust and Gatsby Foundation to further enhance mutual impact and reach. We will also build on the success of our industry/user clubs in leveraging private sector support for research which addresses industrially-relevant challenges.

[7] Reducing losses and waste in the food supply chain is also an important challenge

[8] The Consultative Group on International Agricultural Research, established in 1971, is a strategic partnership of diverse donors that support 15 international centres that mobilise science to benefit the poor (www.cgiar.org)

- **Boost crop yields through transformational research:** We will build an ambitious programme with business and international partners to enhance biomass through photosynthesis in plants. This builds on current work with the US National Science Foundation and is a vital long-term investment in potentially 'game-changing' research with global impact to boost sustainable crop yields for food, feed, fibre, biofuels and chemicals,
- **Position the UK as a global leader in wheat breeding:** Wheat has a multi-billion dollar global market, which UK expertise can exploit for growth[9]. The UK has a strong presence internationally in research and precompetitive breeding of wheat traits for both food and other products. Outcomes will include a sustainable increase in wheat yields, and varieties better adapted to climate change. The dramatic rise in wheat prices in 2010, precarious global stocks and a recurrence of food riots, reinforces the need for this research.
- **Increase the UK's economic resilience to livestock diseases:** BBSRC-funded research and specialist national facilities, particularly through the Institute for Animal Health (IAH), helps protect against incursions of devastating diseases of livestock such as foot and mouth, bluetongue and African swine fever. The 2001 foot and mouth outbreak alone cost the UK economy £8 billion[10]. We will prioritise investment to combat diseases that threaten food security, public health and the economy (see also section 2.2.4, Infrastructure and Facilities).
- **Underpin productivity and sustainability in the livestock sector:** UK strength in animal science, to which IAH and The Roslin Institute make a significant contribution, is crucial to sustainable food production, food safety, and the UK animal breeding industry. BBSRC funding will help to maintain this strength by supporting research in areas such as animal health and welfare, genetics and genomics for improved breeding, and endemic and exotic diseases including zoonoses.
- **Reduce greenhouse gas emissions from agriculture:** Agriculture accounts for nearly 10%[11] of our GHG emissions. Within the RCUK LWEC theme, BBSRC will lead 'Challenge C' with outcomes in, for example, improved carbon sequestration in soils.

Grand Challenge 2 - Industrial biotechnology and bioenergy

The European chemical industry is the biggest in the world, and has identified biotechnology as a key factor needed to maintain its future growth, innovation and competitiveness (European Bio-industries Association)

Industrial biotechnology is one of the key enabling technologies of the 21st Century economy in Europe and to support the Lisbon Strategy - economic growth and more and better jobs[12]

Our modern world is totally dependent on the unsustainable consumption of fossil carbon for energy, transport fuels and many industrial chemicals. But this contributes to climate change and makes the UK increasingly vulnerable to the geo-politics of oil and gas reserves. **Bioscience offers the only viable alternative sources (plants, bacteria, algae and fungi) of renewable liquid transport fuels, lubricants, solvents, raw materials for polymers such as plastics and synthetic fibres and other high-value chemicals to reduce the requirement for those currently derived from fossil carbon.**

For the UK to become a truly low carbon economy then high-value, multi-billion pound industries must move away from unsustainable petrochemical-based feedstocks. Bioscience will enable this transformation and provide new opportunities for growth and green jobs. The countries that are best able to exploit bioscience for renewable energy and chemicals will be those that dominate in the new global knowledge based bio-economy. The UK can be a leader in this market while tackling critical national needs in agriculture, energy, environment and health.

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[9] We have recently sequenced the wheat genome (a major 'win' for UK science) and have the knowhow to double yields in 20 years

[10] The economic and social impact of the Institute for Animal Health's work on Foot and Mouth Disease, DTZ, July 2008

[11] Agricultural Statistics in your Pocket, Defra, 2009 http://www.defra.gov.uk/evidence/statistics/foodfarm/general/auk/latest/index.htm

[12] European Commission COM (2005) 24: Communication to the Spring European Council – Working together for growth and jobs – a new start for the Lisbon Strategy

Through this Delivery Plan BBSRC will:

- **Drive innovation, economic growth and jobs through Industrial Biotechnology (IB):** We will focus on areas where we can have the greatest scientific and economic impacts. Examples include advances in enzymology, biocatalysis and the design of biological systems (systems and synthetic biology). Outcomes will be more efficient bioenergy, new biopharmaceuticals and renewable 'green' industrial feedstocks and chemicals.

  With the TSB and government departments we will also address the Industrial Biotechnology-IGT report[13], which aims to seize the tremendous opportunities for growth and jobs in a low carbon economy driven by biotechnology.

- **Join-up UK research on sustainable bioenergy:** BBSRC shall lead on sustainable bioenergy within the RCUK Energy theme, coordinating the many and diverse current activities and improving the application of research. We will also establish the BBSRC Sustainable Bioenergy Centre[14] (BSBEC) as a major hub for UK research and training, and forge new links with business and policy e.g. via the Energy Technologies Institute (ETI), and overseas with the USA, Brazil, and potentially India.

- **Invest in research to underpin future bioenergy businesses:** More research will be directed to 3rd and 4th generation bioenergy (algae, microbes and synthetic biology) to also develop the longer-term bioenergy applications. Bioscience is the only means to generate sustainable liquid fuels to replace petrol, diesel and, especially, jet fuel[15].

- **Drive innovation in our high-value chemicals industry:** Microorganisms are tremendously rich sources of compounds and metabolic pathways of use to the chemicals industry or as new pharmaceuticals. Building on our current excellence in genomics and bioinformatics, we will support the exploitation of microbes and plants for novel bioactive compounds, pathways of high-value and development of platform technologies.

Grand Challenge 3 – Fundamental bioscience enhancing lives and improving wellbeing

"most babies born since 2000 in France, Germany, Italy, the UK, the USA, Canada , Japan and other countries with long life expectancies will celebrate their 100th birthdays"
(Christensen, et al; The Lancet, 374, 1196, 3 October 2009)

We are in a period of unprecedented demographic change. The ageing population is a major policy challenge in developed nations, where more than ever before we need to maintain wellbeing over the lifecourse and particularly into the increasingly longer periods of old age. It is the crucial understanding of the basic biological mechanisms underlying normal healthy physiology and development that BBSRC's fundamental bioscience generates. As a result we are positioned uniquely at the vital, very early stage of knowledge generation in bioscience which then goes on through other public and private funders to underpin innovation in healthcare, new prevention strategies, treatments and pharmaceutical targets and leads.

Through this Delivery Plan BBSRC will:

- **Generate knowledge to increase national defence against infectious diseases:** The next global pandemic is overdue. Of the circa 60 new or emerging diseases, 75% are zoonotic diseases[16], examples of which include swine flu, West Nile fever and avian influenza. We will boost the impact of our investment in animal health research by linking veterinary and human medicine with other science disciplines, with outcomes in improved disease surveillance and diagnostics and speed of vaccine development.

- **Better coordinate UK ageing research:** Fundamental bioscience is increasing our understanding of the normal ageing process, underpinning the challenge of improving wellbeing and helping more people to enjoy a healthy old age. BBSRC will continue to

[13] IB 2025: Maximising UK Opportunities from Industrial Biotechnology in a Low Carbon Economy, a report to government by the Industrial Biotechnology Innovation and Growth Team, May 2009
[14] www.bsbec.bbsrc.ac.uk
[15] The future of biofuels, The Economist, 28 October 2010 www.economist.com/node/17358802
[16] National Centre for Zoonoses Research, www.zoonosis.ac.uk

support leading research on the basic molecular and cellular mechanisms responsible for longevity or premature ageing (e.g. triggers of cellular senescence, damage and repair processes) and how these are modulated by diet, exercise and developmental factors. BBSRC will also provide more focus and co-ordination for UK ageing research[17] across the RCUK LLHW theme.

- **Underpin the needs of industry:** BBSRC recognises the national importance of the strong science-based industries in this sector (e.g. pharmaceutical, biotechnology, diagnostic, nutrition). Together with other Research Councils, we shall further develop the strategic dialogue with these industries and encourage multiple mechanisms for technology transfer, including building on the success of our industry/user clubs in diet and health (DRINC)[18] and bioprocessing research (BRIC)[19].
- **Generate new and better biopharmaceuticals:** Half the novel drugs in late-stage clinical trials will soon be biopharmaceuticals such as antibodies, peptides, modified proteins and nucleic acids. BBSRC support for fundamental bioscience leads to the development of platform technologies, tools and molecular understanding that underpin the continuing growth of the sector (e.g. RNAi - first identified in plants, now a vital tool in target validation for drug discovery and a potential therapeutic intervention itself). In partnership with EPSRC we shall prioritise research to address technical challenges around the yield, purity and properties of biotherapeutics whilst reducing the costs of their development and manufacture.
- **Support platforms for discovery of new targets and leads:** BBSRC is the critical funder of the basic molecular science underpinning the translation of knowledge about drug targets (proteins) into chemical (an area of interface with EPSRC) and biological tools and drugs. This is an area of global leadership for the UK and has immense economic impact in the pharmaceutical and biotechnology industries.

2.1.2 DATA INTENSIVE AND MULTIDISCIPLINARY SCIENCE

We are in an era of rapid advances in technology with vast amounts of data available to researchers across the world. To remain competitive, bioscience must exploit fully modern ways of doing research, particularly to increase the ability to gain value and scientific leads from the enormous quantities and diversity of data available. We also recognise that many of the most exciting advances in biology will occur at the interface with other disciplines through truly multidisciplinary approaches.

Building on the commitments made in the last spending review, BBSRC will:

- **Fund cutting edge technology development:** Develop the next generation of tools and technologies (e.g. bioimaging, phenomics and biomolecular characterisation) to accelerate the pace of discovery in bioscience. For short-term impact we shall also explore, with users, innovative applications for existing bioscience tools.
- **Position the UK as a leading nation in data intensive bioscience research:** We shall prioritise new computational methods[20] to extract value and generate new biological understanding from the huge volume and diversity of bioscience data now available.
- **Drive bioinformatics underpinning research and innovation:** Bioinformatics and biological resources are vital for the UK to stay internationally competitive[21]. We shall lead on a significant part of the EU ELIXIR[22] project, which will place the UK at the centre of a new infrastructure for biological information in Europe (see also 2.2.4). We shall also work with TSB, business and users to formulate new business models to better exploit life science informatics tools and data.

[17] e.g. through the recently developed Strategy for Collaborative Ageing Research in the UK
[18] Diet and Health Research Industry Club (DRINC): www.bbsrc.ac.uk/drinc
[19] Bioprocessing Research Industry Club (BRIC): www.bbsrc.ac.uk/bric
[20] Such as new algorithms and computational architectures. Also new approaches e.g. semantic computing and novel Web tools will be vital to facilitate mass collaboration amongst researchers
[21] The Genome Analysis Centre (see page 16) will be a particular focus of our genomics activities
[22] European life science infrastructure for biological information www.elixir-europe.org

- **Make systems approaches more 'routine' in bioscience:** to maximise impact we must drive the routine application of computational and mathematical modelling to bioscience problems. BBSRC will continue to lead the UK biosciences in this direction, enabling a deeper and more rapid understanding of complex biological systems that may not be possible by any other means.
- **Support the emergence of synthetic biology:** We will build collaborations between biologists and engineers focused on the design and construction of new biological processes and systems, with applications in areas including energy, environment and materials. We will strengthen our partnerships with UK and European funders to support the development of this new multidisciplinary area.

2.2 NATIONAL CAPABILITY: MAINTAINING EXCELLENCE AND TRANSFORMING DELIVERY

2.2.1 WORLD-LEADING RESEARCH CAPABILITY

UK bioscience is the best in the world[23]. If we are to reap the economic benefits of this strength and of past investment then bioscience must continue to attract world-class researchers and give businesses the confidence to continue to invest and undertake their R&D here. High quality skills, capabilities and facilities not only generate 'home-grown' scientific discoveries but also allow us to understand, assimilate and add value to cutting-edge research done elsewhere in the world.

Strategic focus, research concentration critical mass and impact

We aim to shape a robust, modern and outward facing research base with strategic focus and critical mass that continues to generate innovation, economic growth, improve lives, and creates the industries of the future. Through a balanced portfolio of funding mechanisms we will drive the excellence on which all of our strategic priorities and national capability depends. We will maintain strength in HEIs and institutes (see section 2.2.4) in vital strategic areas by building critical mass through institutes and strategic longer-larger grants to our best HEIs. We will protect capability in strategically and economically important subjects (e.g. plant and crop sciences, animal and human health), especially where BBSRC is the principal funder.

2.2.2 TRANSFORMING DELIVERY OF BIOSCIENCE

BBSRC: moving from funding to investing in bioscience

To ensure that our world-class research base remains fit for purpose and to achieve even greater impact we are transforming ourselves and the delivery of bioscience in HEIs and the institutes. Together with a focus on strategic science, institute reforms (see section 2.2.3) and our innovation strategy (see section 3.0), actions include:

- **BBSRC: from funding to investing:** BBSRC has moved from the position of a funder to an 'investor' of public funding in excellent fundamental and strategic bioscience to achieve the greatest short, medium and long–term returns for society and the economy. It is a shift in culture that we are determined to see through, showing leadership, employing deep sector knowledge, working with others and with regard to the sustainability of UK bioscience.
- **Strategic partnerships:** BBSRC is forging strong strategic partnerships with key HEIs in our grand challenge areas. By working more closely with our partner HEIs, and ensuring that they are fully 'networked' with one another and with the institutes, we can deliver scientific advances more efficiently e.g. through common objectives, concentration of research and shared facilities. We are focusing initially on HEIs with a strong food security capability.

  Around 25% of our research funding to HEIs is already concentrated into just 3 leading institutions, with 51% funding into 10 institutions and 75% in just 17. We further

[23] http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=411986

concentrate around one third of our resource and capital budget into BBSRC funded institutes, all of which provide critical mass and mission focus in their strategic research fields. BBSRC is committed to further concentration where this drives greater impact and efficiency. A combination of specific actions will drive more concentration into the best institutions in the field. Actions include:

- more research focused into just three major economic and societal grand challenge areas
- strategic partnerships with leading HEIs
- driving greater efficiency and demand management (below)

By the end of the CSR period we anticipate that over 90% of our research funding will be in fewer than 30 UK bioscience institutions.

- **Greater efficiency in universities:** working with other Research Councils and Funding Councils we shall drive efficiency savings on grants consistent with the Wakeham review[24] and agreed RCUK policy. In particular we shall look to see where BBSRC funding can add value to existing investments in people, research or equipment. In addition we will encourage HEIs to complement BBSRC's investments in, for example, fellowships or studentships or when purchasing equipment by making corresponding commitments themselves.

- **Demand management:** Research Councils are committed to achieving improvements in the efficiency of the research funding system. A number of tools are available to deliver efficiencies and Councils will work across HEIs, RCUK and other stakeholders to determine those that are most appropriate to manage demand in their communities, and to monitor the impacts and share good practice.

  We will continue our successful suite of demand management measures that have so far achieved reductions in applications of over 30% in five years, seeking to ensure that award rates are as high as possible, whilst remaining highly competitive. In addition, in the coming period we shall work with HEIs to support them in self-managing demand and delivering quality control of research proposals by:

  - fostering awareness of the peer review process
  - setting success rate targets and capping the number of applications allowed from those institutions or departments that fall consistently below an appropriately modelled percentile. This may be reinforced by a meeting or visit to explore and identify causes and to stop behaviours that encourage high, unsuccessful application rates. This method has been proven to work to improve success rates in BBSRC institutes.
  - providing information on the rank ordered position of grants to all (including unsuccessful) applicants and copied to the institution, to ensure that a proper common understanding of the relative competitiveness of proposals is shared with the applicant and institution, not least to provide the evidence and momentum to drive internal change.
  - sharing anonymised success rate information with other Research Councils and the research community, and making this publicly available on the BBSRC website.

  BBSRC will seek a reduction in applications of at least 10% using these approaches.

- **Enhancing leverage:** We are focusing more on strategic priority research areas (see section 2.1.1) that are of great economic and policy relevance. Their importance predisposes these areas for co-funding around shared priorities with a range of partners; business, investors, government departments, third sector and international funders. Examples of current leverage include partners in food security (see 2.1.1) but also our highly successful industry/user clubs[25] (currently over 40 companies involved),

[24] Financial Sustainability and Efficiency in Full Economic Costing of Research in UK Higher Education Institutions, report of RCUK/UUK Task Group, June 2010 www.rcuk.ac.uk/cmsweb/downloads/rcuk/reviews/fec/fECReviewReport.pdf

[25] Research and Technology Clubs (RTCs), www.bbsrc.ac.uk/business/collaborative-research/industry-clubs

industrial partnering on grants and a total of around 70 companies involved in Institute campuses.

2.2.3 TRANSFORMING BBSRC INSTITUTES

The institutes are central to delivering BBSRC's vision and strategic priorities. They provide vital and sustained national capability in key strategic areas of agriculture, food, bioenergy, biomedicine, and diet and health. They underpin responsibilities of other Government Departments e.g. Defra and DFID, and play a key role in creating new opportunities for UK business. As part of the UK national infrastructure, IAH in particular plays a crucial role in national biosecurity and is a cornerstone of the UK's crisis response capability (see 2.2.4).

This CSR period will see transformative changes to the organisation and operation of the institutes. This continues a programme of changes to put the institutes on a self-governing basis, increase integration with HEIs and expand the accessibility of Institute facilities as national resources**.**

Through this Delivery Plan BBSRC will:

- **Reform institute governance:** By 1 April 2011 we will have finalised the reform of governance arrangements at all institutes with full implementation during 2011. This will ensure clarity of governance and establish more sustainable, flexible operation. Following normal consultation, staff will transfer to Institute employment under TUPE regulations. Subject to Treasury approval, existing staff will remain in the Research Councils' Pension scheme as a 'closed scheme'. Institutes will make separate pension arrangements for new staff. These changes will place institutes within the private sector and as such will have the same classification as for universities. The institutes shall also create stronger links to HEIs for increased efficiency and impact.
- **Drive focus and transparency:** We will embed new funding mechanisms such as the Institute Strategic Programme Grants to increase transparency and strengthen institutes' focus on major grand challenges and to enable a strategic approach to both knowledge exchange and commercialisation activities and the management of national capabilities and infrastructure.
- **Improve strategic co-ordination and integration of institutes:** We will increase joint working across the institutes and drive wider partnerships with HEIs, such as the joint programmes in bioenergy and wheat genetics. Outcomes will include improved efficiency through collaborative research and sharing of facilities. Greater integration between HEIs and institutes will also help to co-ordinate and further concentrate UK research in grand challenge areas.
- **Position institutes as national facilities:** The institutes are national facilities. Their unique resources will be made available to the wider research base (and also internationally where it benefits the UK), for greater efficiency and synergy. See next section (2.2.4) on infrastructure and facilities for more details.

2.2.4 INFRASTRUCTURE AND FACILITIES

Modern bioscience research facilities, which attract inward investment and the best scientists to work here, are vital to sustain the UK's world leading position. Some facilities are costly, particularly those which must meet exacting regulatory standards, e.g. for disease containment and animal welfare.

BBSRC invests most of its capital in national infrastructure and facilities including high spec laboratories, high containment large animal isolation units (ISOs), facilities for avian studies (zoonotic diseases), plant growth controlled environment facilities, transgenic mouse facilities and a significant, fully instrumented farm scale research platform. In addition, we fund capital equipment such as genome sequencing and magnetic resonance imaging.

Over the CSR period, our funding will be focused on multi-user facilities made available to the research community and which meet national and strategic priorities. Institutions will be encouraged to make greater use of shared resources and equipment.

BBSRC institutes as national facilities

The institutes represent a family of national institutes of bioscience. This national asset has sites and campuses which are an integral part of the UK research and innovation infrastructure. Major facilities include: The Genome Analysis Centre (TGAC); the new high-containment labs at IAH-Pirbright; the agri-environment platforms at the Rothamsted Research North Wyke site, part of an international network; and the new phenomics centre at IBERS.

Through this Delivery Plan BBSRC will focus on:

- **Science and innovation campuses:** we will work with others to deliver a strategy that will enhance and extend the potential of our institute campuses and sites to contribute to innovation in the UK. In particular we will grasp the opportunity for Science & Innovation campuses to contribute to regional growth, new jobs and national innovation. Currently at least 70 companies share campus facilities with BBSRC institutes, and there is tremendous opportunity to expand these as part of the UK's innovation system. Initially we will focus on campuses at Cambridge and Norwich:

  At **Cambridge** we are developing the **Babraham Research Campus (BRC)** beyond the 30 companies already on site within the context of the Cambridge science and innovation cluster. Working with appropriate partners, the opportunities of the campus will be greatly enhanced, ensuring that excellent science facilities, accommodation and support for start-up and small companies are developed to enable the companies to benefit from the 'low risk' environment, expertise and facilities on the BRC

  The vision for the **Norwich campus** is for it to be a major innovation hub in food, agriculture, diet and health and bioenergy encompassing IFR, JIC, TGAC, the Sainsbury Laboratory, University of East Anglia (UEA), and Norfolk and Norwich University Hospital. Strong support has been received from local authorities and significant progress has already been made with this major initiative.

- **National crisis management infrastructure:** BBSRC research and facilities play an important part in UK emergency preparedness and crisis management, especially in respect of Food Security and Animal Disease. Government departments depend on the availability of our facilities and research capabilities, especially those at, or planned for, IAH-Pirbright which underpin the **national response to disease risks**.

  IAH-Pirbright: consolidating the IAH on the Pirbright site is phase 3 of a plan to ensure the UK has state of the art research facilities. Phase 1 was construction of the UK's only category 4 isolation units for large animals; Phase 2, which will be completed during the SR period, is upgrading infrastructure and containment laboratories for work on **foot and mouth and related exotic diseases.** Phase 3 is the final stage and will provide vital high containment laboratories and national facilities for avian **research to help protect both poultry and humans from pandemic risks.** As a result of reductions from previous levels of capital funding BBSRC will split phase 3 into two parts by prioritising key avian facilities and extending the programme to match available resources, some of which will be made by accelerating closure of non essential facilities at Compton and the early release and disposal of land.

- **Establish TGAC as a central bioinformatics and sequencing facility:** TGAC is a national facility in modern genomics, high throughput data analysis and advanced bioinformatics, focusing on plants, animals and non-medical microbes. We shall continue to develop TGAC as an integral part of the UK bioscience research base, underpinning research across all of our grand challenge areas.

Other infrastructure and facilities

- **European hub for bioinformatics:** The European hub for bioinformatics (ELIXIR) is a joint project with MRC, NERC and Wellcome. Hosting ELIXIR will cement the UK's status as the leading nation in Europe for genomics and bioinformatics, and the place to do research, thus increasing our reach and inward investment leveraging European funds and from business partners (see also section 2.1.2).

- **Diamond:** BBSRC will continue to build on commitment to the Diamond Light Source (capitalising on the new Diamond 2) and ongoing investment in structural biology.

2.2.5 SKILLS AND LEADERSHIP

BBSRC has a responsibility to underpin key sectors of the economy including industrial biotechnology, pharmaceuticals, food, farming and industrial biotechnology by creating a supply of highly skilled people. This role was recognised in the National Infrastructure Plan 2010[26] as "vital in a highly competitive knowledge economy". Researchers need broad-based skills to have an impact beyond academia, and the public and private sectors need specialist staff to access new developments in the biosciences and biotechnology.

Through this Delivery Plan BBSRC will:

- **Focus on excellence in PhD training:** Through our postgraduate training strategy we shall provide broad-based scientific and professional skills, particularly in BBSRC's priority areas. We will protect our investment in studentships but fund student awards better to ensure high-cost, cutting edge research is maintained.
- **Supply skills for economic growth:** Over the CSR period, a higher proportion of our studentships will be user-led to supply the skills needed by business and Government. CASE awards will be extended to encourage a wider group of commercial partners and all BBSRC students will have the opportunity of a professional internship outside of academia. BBSRC will also continue to support entrepreneurial training for PhD students and postdoctoral researchers, and champion the 'innovators in bioscience'.
- **Develop tomorrow's leaders:** We shall undertake a significant rationalisation of our fellowships to support the bioscience leaders of tomorrow, enabling them to maximise the impact of their science within and outside of academia. We shall also continue our programme of culture change to improve the training and leadership development of postdocs on BBSRC grants.
- **Boost R&D skills and capabilities:** We shall promote people movement between academia and user sectors such as industry or policy. We shall also foster innovative public-private sector training partnerships to support the specialist scientific skills and expertise to help businesses in key areas to use new science and innovation (see also section 3.4).

2.3 CROSS-COUNCIL, MULTIDISCIPLINARY PRIORITIES

2.3.1 CROSS-COUNCIL THEMES

Global Food Security

BBSRC leads the multi-agency programme in Global Food Security, bringing together the research interests of five Research Councils, five Government Departments and the TSB. The partners will focus on four multidisciplinary themes: economic resilience; resource efficiency; sustainable food production; and sustainable, healthy and safe diets. The programme will take a global perspective but also address challenges around food security for the UK.

BBSRC's priorities within GFS are described at section 2.1.1. The other GFS partners will contribute in topics within their respective remits including (among the Research Councils) economic and social research, engineering and physical science solutions, nutrition and diet-related ill health, and environmental impacts of the food system. Involvement of the Government Departments and TSB will help ensure relevance to policy and maximise the effectiveness of knowledge exchange with industry and other end-users of research.

The programme will provide enhanced co-ordination, synergy and value for money from all the partners' investments. It will bring additional coherence by acting as a focus for joint activities and alignment of their individual but complementary activities around shared goals.

Total anticipated Research Councils' investment in this theme over the spending review period is shown in table 2.3.1a below.

[26] National Infrastructure Plan 2010, p7, HM Treasury

Table 2.3.1a. Research Councils' contribution to the Global Food Security programme

BBSRC	£416M
ESRC	£8.1M
MRC	£10M
NERC[27]	£15M
Total	**£450M**

Further contributions will be made by EPSRC (largely delivered through its manufacturing portfolio)

Living with Environmental Change

BBSRC will lead LWEC Challenge C - the Sustainability Challenge - *ensuring a sustainable supply of food and water.* This is an important interface between LWEC and the Global Food Security Programme. Research priorities for BBSRC will include the role of farming practices in mitigating GHG emissions, systems and modelling approaches to the impact of climate change on agriculture, and enhancing carbon sequestration in plant roots and soils. BBSRC's estimated contribution to LWEC over the spending review period is shown in table 2.3.1b below.

Energy

BBSRC's priorities in the Energy theme are described in section 2.1.1 under **industrial biotechnology and bioenergy.** BBSRC's estimated contribution to the cross-Council energy programme over the spending review period is shown in table 2.3.1b below.

Ageing: Life-long health and wellbeing

BBSRC's priorities within LLHW are described in 2.1.1 under **fundamental bioscience enhancing lives and improving wellbeing.** BBSRC's estimated contribution to LLHW over the spending review period is shown in table 2.3.1b below.

Global uncertainties: security for all in a changing world

BBSRC input will be primarily through the Global Food Security programme (see above). More sustainable global food supplies will contribute a more stable world. Research will also improve biosecurity through a greater understanding of diseases of plants and animals (including zoonoses) occurring naturally or released deliberately. BBSRC's anticipated level of support for research of direct relevance to the Global Uncertainties programme over the spending review period is shown in table 2.3.1b below, with further contributions through the Global Food Security programme.

Table 2.3.1b. BBSRC contribution to cross-Council themes

£M	Baseline	2011-12	2012-13	2013-14	2014-15	Total over CSR period
Energy	12	12	12	13	14	51
Global Food Security	101	104	104	104	104	416
Global uncertainties	1	1	1	1	1	4
LLHW	12	12	12	12	12	48
LWEC[28]	13	13	13	14	14	54

[27] The NERC figure for Global Food Security is supported by a similar investment within LWEC in GFS-related research

[28] BBSRC's projected expenditure is based on an analysis of BBSRC's broad portfolio of research relating to environmental change. A smaller portfolio of research (approx £3M p.a.) is directly relevant to LWEC, once overlaps with food security and bioenergy are removed

2.3.2 OTHER CROSS-COUNCIL ACTIVITIES

Public engagement with research

Many advances in bioscience challenge the way in which we view the world and our place within it. They become part of our understanding of the world, and influence the way we think about engineering, computation and physics; examples are neural networks and selection in evolution. Other conceptual and experimental advances such as stem cells, GM, synthetic biology and cloning have had both positive and negative impacts on societal views.

BBSRC, working with other Research Councils and through RCUK, will continue to positively engage the public, be it through activities such as the very successful dialogue on Synthetic Biology, or through ensuring that the scientists we fund go out into their communities to promote and widen public understanding. For example, we will help to develop (under leadership from the National Coordinating Centre for Public Engagement) training to enable researchers to engage effectively with ethical and related societal issues. We will be guided in our approach by the four principles in the new Concordat for Engaging the Public with Research[29] supported by RCUK, the Funding Councils, The Royal Society and other leading bodies. Through this we will ensure that our bioscience is grounded in society's needs, and it has the trust and support of the UK public.

We will engage with the issues raised by the research we fund, in particular relating to our three grand challenges. Specifically, we will focus on Global Food Security, and Bioenergy where we are establishing broad-based outreach groups to deliver integrated programmes of communication and public engagement that will enable public participation in debate and help to ensure that our policy making and funding decisions take account of the views, aspirations and needs of the wider public. To add value to our activities to enthuse and engage young people with bioscience, we are co-ordinating activities across the Swindon office and BBSRC institutes including a focus on Bioenergy and industrial biotechnology.

Additionally, BBSRC will work with RCUK to develop the capabilities of researchers to discuss their research with wider audiences - e.g. business, local communities, special interest groups - and to work with schools to inspire the next generation of researchers.

International

International interactions help sustain the vibrancy of UK research. They promote the free flow of ideas and researchers, and provide a vital route to enhance UK influence and reach. Our scientists make a major contribution to international projects. These involve considerable leverage (well beyond *juste retour* in EU funding), advance national research agendas and position the UK to exploit advances in bioscience research that occur elsewhere in the world.

Through this Delivery Plan BBSRC will:

- **Boost the UK's influence worldwide** through links with counterpart organisations overseas. Supported by RCUK Offices and the BIS/FCO Science and Innovation Network, we shall forge stronger links with international partners keen to collaborate with the UK's strong bioscience base, particularly in our grand challenge areas, allowing us to lever additional funds. Beyond Europe, our primary focus will be on Brazil, India and North America.
- **Boost the UK's influence in the EU:** The UK is a successful partner in the EU's 7th Framework Programme and we will continue to work with others to maximise opportunities for UK researchers and SMEs in Framework 8.

  BBSRC leads one of the first EU JPIs: Agriculture, Food Security and Climate Change. We will press this as a blueprint for concerted action on food security research amongst more than 20 member states, and seek to cement food security as a major theme in Framework 8.

[29] See: www.rcuk.ac.uk/per/Concordat.htm

- **Increase the impact of UK research for international development:** UK bioscience contributes to tackling challenges that are truly global in nature, and which have major impacts on international development, such as food security, renewable energy, climate change, and the threat of pandemics. We will continue to work within the UK Collaborative on Development Sciences (UKCDS) to achieve greater co-ordination across DFID, the Research Councils and other partners such as the Wellcome Trust.

Research careers and diversity

BBSRC is a signatory to the *Concordat to Support the Career Development of Researchers*[30], and will play an active role in cross-Council work to promote equality and diversity in research, and improve the attractiveness and sustainability of research careers within and outside of academia. We will seek to embed funding support for the development of postdoctoral researchers through our research grants, beyond the end of 'Roberts' ring-fenced funding and the current *Vitae*[31] contract. In addition, BBSRC will seek to further embed researcher development in the peer review of its grant awards, to underline their role as investments in highly-skilled people. BBSRC will seek to ensure that all postdoctoral researchers have opportunities to explore the wider impact of their research outside of academia in the UK, and continue to champion a culture change in the employment of academic researchers in order to improve the quality and impact of research for the benefit of UK society and the economy.

2.4 OTHER GOVERNMENT R&D INITIATIVES

BBSRC's strategic priorities in food security, industrial biotechnology, bioenergy and ageing are all significant social and economic issues and major Government priorities. In addition we will address the following:

2.4.1 NC3Rs[32]

To help deliver the Government pledge to reduce animal usage, BBSRC will continue to support the NC3Rs, working with MRC to maintain our joint contribution at the current level in real terms (rising to £5.6M pa by 2014-15).

2.4.2 Stem Cells

BBSRC has a long history of funding stem cell research. Much of the basic understanding of stem cells has been learned from studying them in animals. Research on stem cells is crucial to advancing our understanding of developmental biology, and provides the potential to identify new therapies. Working with others, BBSRC will continue to contribute to the UK's world leading national capability in stem cell science particularly in the fields of regenerative medicine and tissue engineering.

2.4.3 Energy Technologies Institute (ETI)

See our Bioenergy plans (section 2.1.1).

2.4.4 Technology Strategy Board (TSB)

A key partner for us to deliver economic impact from bioscience is the TSB where, over the CSR period, BBSRC will provide £50M in complementary and collaborative funding. Building on our strong working relationship, we will ensure good alignment of the TSB bioscience activities and competitions with BBSRC's innovation agenda. TSB and BBSRC will increase activities involving bioscience-dependent industries, thereby increasing the competitiveness of a broad range of sectors of the economy. In addition, BBSRC will explore further opportunities to engage the TSB on our strategic activities where these complement their major programmes.

Areas of particular focus will include[33]:

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[30] www.researchconcordat.ac.uk
[31] www.vitae.ac.uk
[32] National Centre for the Replacement, Refinement and Reduction of Animals in Research, www.nc3rs.org.uk

- **Agriculture and food:** Working with Defra and the TSB through the Innovation Platform in Sustainable Agriculture and Food, we will strengthen UK agriculture and food businesses. The research base in the UK is extremely strong. Encouraging this community to translate research through industry-led projects will support an increasingly innovative sector, able to address the challenges in food security such as productivity and sustainability.
- **Regenerative medicine:** With the TSB and others we will support the development of a strong industry based on regenerative medicine. We will connect the academic and business communities and support activities to develop innovative platforms.
- **Industrial biotechnology:** A key area for collaboration between BBSRC and the TSB, driving excellent science into practice in existing and emerging businesses. We will work with the TSB to ensure exciting science emerging from genomics is drawn into application, and in particular seek to support collaboration between the research base and SMEs in this area.
- **Emerging technologies and industries:** BBSRC science leads to the development of bioscience platform technologies, which in turn lead to new companies[34]. With the TSB we will support the translation of revolutionary technologies (for example in industrial biotechnology), enabling development of technologies to address multiple industrial opportunities, leading to products in existing markets and the development of new industries where the value chain will be retained within the UK.

Technology and Innovation Centres

RCUK has worked closely with the Technology Strategy Board over the last few months as the TSB has developed the proposal for Technology and Innovation Centres (TICs). We have analysed our portfolios of major investments in order to inform the TSB of the research excellence which could be drawn upon, and to identify areas of high priority from the research base perspective. Any TICs should be closely aligned with the outcomes of our investments but will operate to fill the gap that exists in certain sectors between the early stages of research and development and the commercialisation of innovation and technology. RCUK will be represented on the proposed TIC board, continuing to provide a strong link.

As part of RCUK, BBSRC will work closely with the TSB as the process for identifying TICs is developed, recognising that there are significant opportunities in areas of relevance to BBSRC such as industrial biotechnology, regenerative medicine and biotherapeutics. In particular we will explore, with TSB, how excellent fundamental science, for example in genomics of microorganisms and plants, can be adopted by TICs so as to accelerate industrial adaptation and adoption of such research. In addition, the TSB is aware that BBSRC research campuses, whilst not TICs, may offer opportunities to consider how research facilities contribute to this whole area.

We will also work with the TSB and other Research Councils to explore other mechanisms to accelerate the translation of research into practice through creation of shared entrepreneurial environments, such as Innovation and Knowledge Centres and other new ways of engaging industry and the research base (see sections 3.1. and 3.4).

[33] RCUK has agreed a process with the TSB to finalise priorities and to determine appropriate indicators of progress and impact.

[34] e.g. sequencing - Solexa; Streptomycetes - Novacta and Biotica; protein structure-based design - Astex therapeutics

3.0 ECONOMIC IMPACT

Major economic sectors depend on bioscience for innovation, enterprise and growth. We embrace our responsibility to support the translation of ideas, knowledge, skills and technologies into practical applications. These improve people's wellbeing, provide an evidence base to underpin government policy, and equip UK business to compete in the global marketplace. Through the CSR2007 period, BBSRC focused strongly on the impact of bioscience. We invested in staff and extended support for knowledge exchange and commercialisation via funding schemes and prizes. **In this delivery plan we prioritise actions to aid economic recovery, drive growth, and influence public policy**.

3.1 SECURING RAPID ECONOMIC BENEFIT FROM PAST RESEARCH

Bioscience is high-impact science: it drives advances in health and wellbeing, 'green materials', new pharmaceuticals, and safe and nutritious food. It leads to more sustainable agriculture, helps combat infectious diseases and underpins responses to climate change. Bioscience has transformed our understanding of ourselves and of the world around us.

We will respond to the opportunities offered by bioscience not only by investing for growth in the new bio-based businesses of tomorrow but also by focusing on **extracting the maximum near-term economic benefit from existing research by:**

- **Expanding the Follow-on Fund**, which helps researchers to bridge the gap between basic science and its translation/commercialisation, to allow for a small number of major projects, and also to widen to encompass more clearly 'public good' projects. We will aim to increase support to over £4M p.a. by 2014-15.
- **Widening user knowledge of existing research,** working even more closely with users including industries, entrepreneurs, policy makers, government departments and the third sector.
- **Enabling pathways to application of research:** following up on a jointly commissioned project to analyse these pathways in agrifood, we will work in partnership with Defra, and other appropriate bodies, to further develop our understanding of research translation in this and other sectors, and to establish the most effective mechanisms for support.
- **Continuing to implement BBSRC's science and innovation campus strategy:** see section 2.2.4.
- **Working with the TSB, EPSRC and other funders:** Collaborate with other funders to use existing mechanisms to accelerate research into practice and economic benefit (e.g. through IKCs, proof of principle funding).

3.2 INCREASE WORKING WITH BUSINESS

Bioscience businesses (research intensive or not) are key partners in realising impact. We already have strong links with major companies from all the sectors that bioscience underpins as well as a variety of smaller businesses in these sectors. We will further strengthen links to business to secure the impact of bioscience and ensure user needs influence our research and training priorities.

Through this Delivery Plan BBSRC will:

- **Improve academic - industrial links:** Create more opportunities for engagement between business and the research base such as the BBSRC Food Security Seminars for retailers and food producers, industry/user clubs and focused showcasing events. Help researchers to understand the bioscience challenges facing industry, and to explore opportunities for collaborative research. Industrial Partnership Awards and LINK will be important mechanisms.
- **Partner business in research and training:** increase the range and depth of our interactions with business by building on successful partnership models such as our

industry/user clubs and developing Advanced Training Partnerships. We will also explore new opportunities and mechanisms for further joint working with business.

- **Leverage more private sector funds:** Given the commercial potential of modern bioscience and biotechnology there are real opportunities to encourage private sector investment in these areas. BBSRC institute campuses already enable such investment, for example in new companies[35], and will continue to do so through implementation of our campus strategy. We shall promote even closer working with businesses to co-fund research through mechanisms such as industry/user clubs and IPAs.

3.3 KNOWLEDGE EXCHANGE AND TRANSLATION

We invest in bioscience for the widest possible benefit. Our research brings innovation to all aspects of the economy and society, not just in business. To support translation into practical applications, including policy, BBSRC will:

- **Drive the generation of 'quick wins' from existing research:** there is much excellent existing research that could be drawn into application (see section 3.1).
- **Focus on economic and policy grand challenges:** Our grand challenge priorities underpin key business sectors and policy. We will focus on translation in these key areas to maximise the value of our investment.
- **Improve the 'translation readiness' of research:** Premature protection or exploitation of research can restrict its value and potential. We are driving recognition of this across the Research Councils, the institutes and the HEI sector and will ensure research outcomes are matured sufficiently within the research context for successful commercialisation, for example via the Follow-on Fund.
- **Make more of innovation and intellectual assets:** We will work with other Councils to encourage HEIs to recognise the importance of managing all outcomes of research (not just IP) to strengthen the innovation framework and intellectual capital of the UK. A vital feature will be to support an open innovation environment, increasing the two-way flow of knowledge and expertise between private and public sector research.
- **Increase impact from institutes:** We will establish the institutes as centres of excellence in knowledge exchange and commercialisation through clear strategies and funding streams. Implementation of our strategy for Science and Innovation campuses will enhance the potential of the institutes to deliver impact through closer interactions with users (see section 2.2.4).
- **Promote the value of bioscience research:** We shall develop new, cost-effective communication mechanisms and formats that are targeted to business and other end-users. The aim is to demonstrate clearly how BBSRC bioscience can add value to their sector.

3.4 THE INNOVATION INFRASTRUCTURE

Early stage research is often too 'risky' for business to pursue. We need to 'de-risk' early innovation by bridging the gap between research outputs and their development into commercial prospects. This requires close relationships between researchers and business, and benefits from co-location in 'clusters'. Clusters also enable innovation, drive businesses, growth and jobs by encouraging spinouts based on modern bioscience, thus contributing to regional and national economic growth.

BBSRC has an important role within the wider UK innovation system and framework, particularly through the institutes and in partnership with the TSB and other bodies. We will support the development of the innovation and translational infrastructure in the UK in key bioscience sectors.

Through this Delivery Plan BBSRC will:

[35] Four of the six most significant venture capital investments in Europe in the last 18 months have been in SMEs at the Babraham Research Campus.

- **Develop and deliver the BBSRC vision and strategy for innovation:** Focusing both on our role as investor in bioscience and supporter of innovation and enterprise.
- **Focus on innovation through strategic partnerships with HEIs and research organisations:** Thereby encourage approaches to the widest possible exploitation of existing and future research.
- **Promote science and innovation campuses as part of the UK innovation system driving the UK economy:** We shall extend the opportunities for campuses such as Babraham Research Campus in Cambridge, and BBSRC institutes in Norwich to contribute to economic growth through science and innovation clusters.
- **Develop approaches to support innovation:** With other Research Councils and the TSB we shall accelerate exploitation of emerging bioscience research and technology by creating a shared entrepreneurial environment (e.g. Innovation and Knowledge Centres). These allow researchers, potential customers and skilled professionals from academia and business to scope applications, business models and routes to market.

3.5 R&D SKILLS AND CAPABILITIES

Skilled, highly trained people drive innovation, new ideas and technologies. To ensure that UK bioscience has the skills it needs to deliver impact, BBSRC will:

- **Ensure high-quality PhD training:** Focus on the highest standards in our PhD programmes (see section 2.2.5) and ensure a good supply of skills to enable growth in bioindustries through user-led CASE awards.
- **Boost business critical R&D skills:** Prioritise PhD investment in flexible, responsive mechanisms to support the UK's major bioscience industries. We will work with the UK Commission for Employment and Skills (UKCES) to promote the benefits of high-level skills to companies.
- **Increase support for skills for innovation:** We will increase support for people movement between the university base and other sectors to enhance and develop researchers' personal knowledge exchange networks. We will continue to support the development of enterprise skills through mechanisms such as the Young Entrepreneurs Scheme and Enterprise Fellowships.
- **Develop Advanced Training Partnerships (ATPs)[36]:** Support the uptake of industry-relevant specialist and technical professional development, to help businesses in key sectors take up new science and innovation.

3.6 RECOGNISE AND REWARD IMPACT

Recognising and rewarding impact is a vital part of our activities, driving culture change within the research base and within BBSRC itself in encouraging a broad range of impacts from bioscience research. Over the CSR2007 period we established highly successful, innovative ways to capture, reward and celebrate impact, such as the Innovator of the Year and Excellence with Impact prizes. In the coming CSR period we shall build on these, extending our robust evidence base of the impact of bioscience research, and developing further approaches to reward and recognise success.

[36] Advanced training partnerships (ATPs) bring together key stakeholders from the agri-food industry and the academic/research base to develop collaborative training programmes that provide specialist scientific skills for the agri-food sector in the UK. For further details see: www.bbsrc.ac.uk/atp

4.0 DELIVERY ANALYSIS

4.1 ALLOCATION AND SPEND DATA

4.1.1 BBSRC'S ALLOCATION 2011-12 to 2014-15

Allocation £'000	Baseline 2010-11	2011-12	2012-13	2013-14	2014-15	SR10 Total
Resource	362,341	370,306	359,471	351,471	351,471	1,432,719
Depreciation/impairments		7,500	7,900	10,100	10,100	35,600
Resource DEL	362,341	377,806	367,371	361,571	361,571	1,468,319
Capital DEL		38,000	29,700	29,700	29,700	127,100
TOTAL	**362,341**	**415,806**	**397,071**	**391,271**	**391,271**	**1,595,419**

4.1.2 ESTIMATED EXPENDITURE BY MECHANISM

Budget[37] £M	Baseline	2011-12	2012-13	2013-14	2014-15
Research Grants	212	210	203	198	198
Institute Strategic Programme Grants	58	57	54	53	51
Studentships	51	51	51	49	49
Fellowships	9	9	9	7	6
Multi -user, Council-owned or - sponsored national facilities	22	22	22	22	22
National Infrastructure - Pirbright	1	6	6	6	6
International Subscriptions	1	1	1	1	1
Knowledge Exchange Activities	20	20	25	27	30
Resource Income	-12	-6	-12	-12	-12
Resource Total	**362**	**370**	**359**	**351**	**351**
Depreciation / impairments	7	8	8	10	10
Capital - excluding Large facilities	**60**	**38**	**30**	**30**	**30**

[37] Excludes administration; budget to be confirmed

4.1.3 ESTIMATED EXPENDITURE BY THEME

BBSRC's strategic priorities dictate an indicative trend for expenditure over the next 5 years as described in the following table. The intention over this period is to effect a greater alignment of the basic underpinning bioscience investment into the critical strategic priorities within the available funding envelope. Actual expenditure will continue to depend on the absolute priority of research excellence, the responsiveness of the science community to new priorities and the requirement to retain some flexibility to support new discoveries.

Budget £M	**Baseline**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Global Food Security	101	104	104	104	104
Bioenergy	12	12	12	13	14
Industrial Biotechnology	20	22	24	26	30
Bioscience enhancing lives and wellbeing	17	17	17	17	17
Ageing	12	12	12	12	12
Other bioscience and skills	212	209	202	191	186
Resource Income	-12	-6	-12	-12	-12
Resource Total	**362**	**370**	**359**	**351**	**351**
Depreciation / impairments	7	8	8	10	10
Capital	**60**	**38**	**30**	**30**	**30**

4.2 ADMINISTRATION AND EFFICIENCY

4.2.1 BBSRC OFFICE ADMINISTRATION

In addition to cuts made in 2010/11 we will make savings in administration costs of around 25% in real terms over the CSR period. Through a range of internal actions and working through RCUK we will further reduce our administrative costs in line with Government requirements by actions including:

- freeze pay and honoraria for two years
- reduce travel through increased video conferencing
- reduce honoraria and meeting costs through fewer committee, panel and board meetings
- continue successful suite of demand management measures that have achieved reductions in applications of over 30% in recent years
- reduce support costs for IT infrastructure and systems
- reduce institute related costs following planned governance changes
- reduce initial Shared Service Centre charges and maximise procurement savings
- work across RCUK for further harmonisation and integration of non 'core' support activities.

4.2.2 INSTITUTE FOR ANIMAL HEALTH ADMINISTRATION

BBSRC acts as corporate trustee for the IAH and will work closely with the Trustee Board to reduce administration costs, principally through consolidation of administrative and other support services on the Pirbright site as part of the plan to consolidate the Institute's science programmes and increase its impact through the creation of a single-site, national research facility with expertise in virology. IAH will be the partner of choice for public, private and academic researchers.

4.2.3 SHARED SERVICES CENTRE

Working with RCUK partners we will increase sharing and standardisation of common processes and functions across the Research Councils to streamline administration and reduce costs, whilst retaining specialist sector knowledge in retained functions. In particular we will seek to maximise procurement savings and optimise the benefits from SSC services delivered to the institutes which will go live in late 2010-11. We will also review how best to integrate and migrate into the SSC the finance, human resources and procurement services of The Operations Centre (TOC) in Norwich, which provides full local shared services support services to JIC, IFR and TGAC and others.

4.2.4 NATIONAL CAPABILITY GRANTS TO INSTITUTES

As part of a fundamental change to institute funding we are introducing National Capability Grants to ensure that facilities and skills are made available across the research base. In addition to minimising capital and operating costs across the sector this will promote increased research collaboration and sharing. Examples include IAH high containment isolation facilities, TGAC sequencing and bioinformatics, a new Phenomics Centre at IBERS and the Rothamsted Research farm platform at North Wyke.

4.2.5 INCENTIVISING GREATER EFFICIENCY IN HEI RESEARCH

Working with RCUK Partners we will introduce efficiencies by implementing the recommendations of the Wakeham report.

4.2.6 PARTNERSHIPS

BBSRC will build relationships with other funders, nationally and internationally, and users, to leverage additional funding, particularly in areas of strategic importance. The combination of national facilities and world leading research excellence and capability places BBSRC is an excellent position to secure collaborative research funding. We will intensify existing work on building closer collaborations with UK Government (e.g. DFID, DECC, Defra) and with major charities (e.g. Wellcome Trust, Gatsby Foundation) and industry. Internationally we will also expand our collaborations, especially on grand challenge projects as described within the main text and with focus on India, Brazil and the CGIAR centres.

BOUNDARIES BETWEEN BBSRC AND THE MRC

BBSRC and the MRC have clearly different remits which are synergistic and complementary:

- BBSRC funds world-class research to understand how complex living systems function (normally and abnormally) across life-science - in microorganisms, plants and animals, including research to better understand normal function in humans. BBSRC is positioned uniquely across bioscience to drive innovation in many sectors such as agriculture, food, biotechnology, energy and pharmaceuticals. BBSRC's fundamental bioscience also underpins vital further research and innovation in healthcare and disease prevention, including the development of platform technologies and associated companies that attract inward investment and create wealth.
- MRC supports a wide portfolio of research relevant to human health and disease, ranging from fundamental molecular studies to population and social sciences. MRC aims to add value by linking the best fundamental science with the best clinical and population science, in multidisciplinary centres and initiatives, and by working across health/disease themes. By working across the spectrum, MRC can ensure that its investment is in the most productive type and stage of research in each area.

Whilst our remits are clear and distinct, there are particular areas at our boundary where we have complementary interests, for example aspects of ageing, food security, neuroscience, immunology and stem cells. The combination of BBSRC and the MRC's strategic perspectives and respective remits serves the UK well and is backed up with good coordination and dialogue to avoid duplication, maximise synergy and ensure effective routes for funding exciting work at our boundary. Coordination mechanisms include:

- Shared top-level planning in areas such as the pharmaceutical sector, stem cells/regenerative medicine and NC3Rs
- Continued co-planning for major initiatives – e.g. DIAMOND, ELIXIR, and frequent joint consultation on smaller scale initiatives
- Cross-Council initiatives covering areas such as infectious disease (e.g. linking veterinarians and medical researchers to study zoonotic diseases), ageing (LLHW) and diet and health (GFS)
- Mutually agreed administrative rules to aid boundary management in grants and peer review.

In developing their CSR2010 Delivery Plans, Research Councils have considered examples of areas in which they may increase or reduce funding. Specific to the BBSRC / MRC boundary, where areas are of interest to both Councils we will continue to discuss changes together before action is taken to ensure that UK capability in important areas is not adversely affected.