
EPSRC

Engineering and Physical Sciences
Research Council

EPSRC Delivery Plan 2008/09 to 2010/11

Updated for 2010/11

May 2010

Polaris House
North Star Avenue
Swindon, SN2 1ET
01793 444000
www.epsrc.ac.uk

Contents

1. Summary	3
Responding to the Challenges Facing Society and the Economy.....	3
Healthy Research Base.....	4
Ensuring the Future Supply of People	4
Stepping Up to Better Exploitation	5
2. Introduction	6
3. Priority Themes	9
Energy.....	9
Digital Economy	10
Towards Next-Generation Healthcare	15
Contribution to other Research Councils UK Research Themes	16
4. Sustainability	18
A Healthy Science and Engineering Base.....	19
Securing the Future Supply of People	20
5. Greater Economic Impact	23
Impact on Public Policy and Government Service Delivery	25
6. Facilities and Infrastructure	28
High-End Computing.....	28
Other Facilities.....	28
Next-Generation Facility Users	28
7. Science in Society	29
8. International	31
9. Improving Efficiency and Effectiveness	33
Annex 1 - Economic Impact Baseline	34
Delivering Impact from Excellence	34
Delivering Highly-Skilled People into the Wider Economy.....	34
Delivering Benefits to Business through the Exploitation of Excellent Research	35
Delivering Benefits to Government and Public Services	36
Summary of Economic Impact Baseline	36

1. Summary

This refreshed Delivery Plan provides an update on progress since its publication in November 2007 and highlights our plans and targets for 2010/11. The Science and Investment Framework challenged EPSRC to deliver two key components of the knowledge economy if the UK is to retain international prominence and economic stability:

- New knowledge from research, producing both scientific innovation and economic benefit.
- The supply of people with the skills to drive forward a modern economy.

Aligned to this is the need to demonstrate the economic impact of our investment, ensuring that its outcomes are efficiently transferred to users for potential exploitation.

Responding to the Challenges Facing Society and the Economy

Mission themes development

The government has set out its vision for the key challenges that face UK society and the economy: climate change and the decline of fossil fuels, the rapidity of technological change, global uncertainty and terrorism, demographic change, including an ageing population, and the globalisation of markets. Being mindful of these challenges our plans include a number of specific research themes:

- **Energy** aims to support a full spectrum of basic energy research with particular focus on increasing support in demand reduction, transport, speculative research and whole systems energy work. Successful partnerships are an important element of this programme. Working in partnership with our sister Research Councils, the TSB, Government departments we have been able to push forward in key areas of the portfolio such as energy demand reduction. A strong relationship with the Energy Technologies Institute has been forged and continues to be strengthened. Internationally, we have supported joint research with China, India, the USA and via the EU Strategic Energy Technology Plan.
- **Digital Economy** draws together ICT research outputs and industry across a variety of applications and sectors including healthcare, transport, and the creative industries. Networking of the Digital Economy Research Hubs forms the backbone of the programme responding to future strategy and helping us to reach out to other stakeholders. This is underpinned by long term basic research in 'challenge' areas identified by the programme.
- **Nanoscience through Engineering to Application** has worked to build a coherent programme to pull basic research through to application in areas of social importance such as healthcare and energy. The programme has focussed community research effort through three grand challenges with the potential to directly benefit the UK society and economy. We are planning for the transition of the content of this programme back into mainstream Research Council business. Through

this we hope to maintain some of the particularly successful aspects of the programme such as the use of public dialogue and the consideration of the full breadth of potential impacts from the research at an early stage.

- **Next-Generation Healthcare** is linking appropriate engineering and physical science research to the work of healthcare partners for the improved translation of research outputs into clinical products and services. This programme has been successful in establishing partnerships and leveraging investment from charities and government. These and other activities have helped focus the community on applying engineering and physical sciences to healthcare impacts.

Healthy Research Base

Peer review supporting our objectives

In order to support a healthy research base, we will continue to support the core Engineering and Physical Sciences so that they remain an effective enabler for much of the rest of science and for innovation. We have restructured our peer review process and peer review panels to support a healthy research base. Best practice and guidance we have provided to institutions to help them adapt to these changes has been successful and we aim to continue providing support in this way.

Encouraging creativity and longer term thinking

We are developing longer term thinking in our community and are building a shared understanding with the community of national capability requirements. We have removed barriers to multidisciplinary collaboration and trialled a number of novel approaches to stimulate and support creativity in research. Although it is too early to gauge the impact of these novel approaches and their suitability for wider application we have strong support from leading members of our community and believe they will lead to new thinking across our community and beyond.

Ensuring the Future Supply of People

As nations move out of recession, there will be competition for skills, so the UK will need more home-grown people who can apply and understand the key technologies. A secure future supply of researchers is essential for the research base and industry to be able to respond to as yet unforeseen challenges, to identify future opportunities, and to transfer knowledge - in person – when moving between the research base and industry.

Developing breadth in people

Following our major changes to the way in which we support postgraduate students we have reviewed EPSRC's support for people across all career stages. The advice arising from the exercise has provided us with a forward agenda which focuses on the importance of developing people at all career stages with a broader outlook and breadth and ability to form linkages beyond their specific field.

Stepping Up to Better Exploitation

Key partnerships

Our plans consciously embrace the task of enhancing the pace and effectiveness of transferring research outputs into application by users in industry, business, government and elsewhere. This is not, however, an ambition we can realise alone: partnership with key players is crucial. Notable amongst these are the Energy Technologies Institute (ETI), the Technology Strategy Board (TSB) as well as large and small companies working across the EPS sectors. We have increased our number of Strategic Partnerships, skills has been the focus of many new partnerships. As we move forward with our broad range of partnerships we will look at sector based partnerships and third sector partners.

Knowledge Transfer

The success of two pilot Integrated Knowledge Centres led to a modification of the concept into Innovation and Knowledge Centres. This successful activity joins the Knowledge Transfer Accounts and Knowledge Transfer Secondments fostering the creation of environments in which impact and knowledge exchange are valued and encouraged.

2. Introduction

This Delivery Plan provides a strategic overview of the Engineering and Physical Sciences Research Council's (EPSRC's) plans for the period 2008/09 to 2010/11. The plan sets out to describe our high level priorities and the approaches and principles we will use for achieving these priorities. It also outlines what EPSRC intends to do during the period to meet the Government's Science and Innovation Framework. The overall plan has been agreed by EPSRC Council with the activities described having been developed as part of our business planning processes.

The EPSRC scorecard of targets and milestones for the period published alongside this document includes details of the specific actions that we will take to implement the Delivery Plan and the measures we will use to gauge our success.

Progress against milestones is reported to the Department for Business, Innovation (BIS) on a quarterly basis and published annually. The EPSRC Delivery Plan and scorecard complement the Research Councils UK (RCUK) Delivery Plan and scorecard, where common plans for priorities for all Research Councils are described.

The Government published its **10-Year Science and Innovation Investment Framework**¹ in July 2004. This presented the Government's commitment to science and research over the next decade, with the long-term objective of increasing the overall levels of investment in research and development to 2.5% of gross domestic product by 2014. This Delivery Plan sets out how EPSRC is continuing to contribute to the achievement of the overall ambitions of the framework, which are to:

- Make the UK world-class in all areas of science, engineering and technology.
- Translate the new knowledge generated more effectively into innovation
- Improve the prosperity and quality of life of the UK.
- Make the UK the location of choice for R&D and high value-added business.

These challenging goals have been summarised by BIS in two main outputs:

1. A healthy UK science and engineering base.
2. Better exploitation.

In April 2006, Government reinforced these ambitions with the **Science and Innovation Investment Framework 2004-2014: Next Steps**² where it identified a number of enhancements to the research landscape, including the need for a step-change in the economic impact of Research Councils' research investments, the encouragement of transformative, multidisciplinary research, and the formation of the Science & Technology Facilities Council (STFC).

¹ http://www.hm-treasury.gov.uk/spending_review/spend_sr04/associated_documents/spending_sr04_science.cfm

² http://www.dti.gov.uk/science/science-funding/framework/next_steps/page28988.html

In November 2006, the Government set out its **Long-term Opportunities and Challenges for the UK**³, which reiterated the major challenges facing the UK (see box 2), and also highlighted eight broad emerging technologies likely to have significant impact on society over the next decade: sensors and tracking, network interactions, security technologies, advanced materials and robotics, nanotechnologies, body and mind sciences, and energy technologies.

Box 2 – Drivers and Influencing Factors

Drivers and influencing factors in developing our plans are:

- The government's long-term public policy challenges facing the UK:
 - Pressure on natural resources
 - Demographic change, including an ageing population
 - Shifting economic activity and the growth of emerging markets
 - Acceleration of innovation and technology requirements
 - Global uncertainty and the threat of terrorism
- The need to encourage innovation through transformative research.
- Increased emphasis on the economic impact of supported research, and the need for EPSRC to work effectively with key partners such as the Technology Strategy Board and the Energy Technologies Institute.
- The increased need for an interdisciplinary approach across traditional boundaries.
- New arrangements for publicly-funded health research, including the formation of the Office for Strategic Coordination of Health Research (OSCHR).
- The dynamics of research globally, including the rapidly maturing economies of India and China, and the importance of the UK exerting influence on the direction of EPS research.

This Delivery Plan builds on our 2006 Strategic Plan⁴, deploying approaches described in that document, including:

- Enhancing partnerships with academia and business
- The identification and use of incentives to help effect greater flow of knowledge between academia and industry
- A focus on the enhancement of research careers
- The pursuit of grand challenges to galvanise the research community to set stretching research objectives for itself
- Enhanced international activity to work with emerging economies.

³ http://www.hm-treasury.gov.uk/spending_review/spend_csr07/spend_csr07_longterm.cfm

⁴ <http://www.epsrc.ac.uk/publications/corporate/strategicplan2006.htm>

These will be further supported by establishing and actively managing new and existing relationships with partner organisations, such as the Technology Strategy Board, the Energy Technologies Institute, key companies, and Regional Development Agencies/Devolved Administrations, to ensure joined-up approaches to the pursuit of research and the take-up of the knowledge generated.

3. Priority Themes

Energy

The Research Councils' Energy Programme, led by EPSRC and in partnership with BBSRC, ESRC, NERC, STFC, brings together all facets of energy research and training across the Research Councils in a comprehensive, multi-disciplinary programme. We will:

- Work to realise the potential of Energy Technologies Institute (ETI) for a step-change in energy research, development & demonstration (R, D&D) in the UK and internationally. EPSRC will provide the public funding in partnership with others, including TSB. We will seek to ensure that ETI work is highly focused in appropriate technology areas and pulls through the most promising work from the research base. ETI also presents a major opportunity to grow internationally competitive energy research capacity in the UK. EPSRC will work with ETI to ensure that our joint capacity building activities have maximum impact across the spectrum from postgraduate to leadership level.

We engage fully with and are members of the ETI Board, Technical Committee, Programme Management Board and Strategic Advisory Groups, achieving better coordination and collaboration. We will maintain this position and continue to seek effective relations with the ETI.

We have scoped new initiatives during 2009/10 in consultation/partnership with the Technology Strategy Board.

- Lead the Research Councils' Energy Programme, ensuring it plays a key part of the UK energy innovation landscape. The aims are to support a full spectrum of energy research meeting the government's long term policy goals, to work in partnership to meet the research and postgraduate training needs of business, to develop research capacity, and to increase the level and impact of international collaboration.

The Research Councils programme of research in Energy will be assessed in an International Review in October 2010. A steering group has used the impact assessment and evaluation framework drawn up by the programme to frame the review. A panel has been appointed with Carston Hein Westergaard, of Vestas Technology R&D Americas Inc. as panel Chair.

Following the funding of eight new Centres for Doctoral Training (CDTs) the Directors of these Centres have been brought together to establish a network across these Centres. They have been working to establish a framework for joint initiatives and summer schools/workshops across the energy DTC portfolio.

- Increase support for research in demand-reduction and transport, whilst maintaining research in power generation and supply (see box 3), addressing UK government priorities in, for example, reducing greenhouse gas emissions. With ETI providing a major vehicle for R, D&D, EPSRC will give greater emphasis to developing a portfolio of highly speculative energy research to meet long-term needs.

Working to build a full spectrum of energy research the research portfolio continues to be boosted in key areas with targeted calls for proposals in areas such as ICT energy demand reduction and shipping. Where appropriate we are working in partnership with organisations such as DfT with whom we have been scoping a transport challenge and internationally with DST in India with an initiative in solar energy.

- Support the fusion programme at Culham, using the internationally leading facility, Joint European Torus (JET). The major challenge facing the international programme over the next 10 years is the construction of the International Tokamak Experimental Reactor (ITER).

In July 2009, as part of the RCUK Energy Programme, STFC and EPSRC set up a project to address a series of interrelated fusion issues that affected both councils. In magnetic confinement fusion (MCF) the issues included funding levels for JET and the MAST upgrade. In inertial confinement fusion (ICF) the focus was on the HiPER project and its role in the international pathway to inertial fusion as an energy source.

Underpinning all of this was the need for a long term UK vision for fusion in the international context. To help with the development of this vision, an Expert Group, chaired by Professor Keith Burnett, was convened. The new strategy has been approved by EPSRC and STFC Councils. EPSRC, STFC and Culham are now working together to implement the new strategy.

Box 3 – Supporting UK Emission Targets: Sustainable Power Generation and Supply (SUPERGEN)

SUPERGEN is a multidisciplinary initiative managed and led by EPSRC in partnership with BBSRC, ESRC, NERC and the Carbon Trust. Between 2003 and 2008 the programme has invested over £32 million to help the UK meet its environmental emissions targets by improving the sustainability of power generation and supply. Establishing multi-disciplinary partnerships between industry and universities, the programme has been highly successful in generating new ideas and the transfer of research results in, for example, bio-fuels, photovoltaics, offshore wind, and energy storage.

In 2009/10 SUPERGENs in the following areas were renewed: energy storage, wind and biological fuel cells. Including these renewals, the SUPERGEN initiative has invested over £95 million since 2003.

Digital Economy

Early adoption of Information & Communication Technology (ICT) tools supported by research capacity and skilled people brings economic and social benefits⁵. ICT has already transformed the way business operates, the way government delivers, and the way science is undertaken to improve the quality of life, but being able to respond rapidly to new opportunities and challenges is crucial to the future economic and social prosperity of the UK.

In supporting the Digital Economy we are building on a strong existing research base:

⁵ "Increased production of ICT contributes to output, employment and export earnings, while ICT use increases productivity, competitiveness and growth", World Bank Working Paper no 24.

- EPSRC has developed a strong portfolio of research in multidisciplinary ICT focused research through £43 million supporting five IT-Centric IRCs from 2000 to 2006, and the Wired and Wireless Intelligent Networked Systems programme, both of which have a strong user focus.
- EPSRC and ESRC have jointly supported a £9 million research programme around People at the Centre of Communications and Information Technologies, aimed at gaining a greater understanding of the psychological, social and organisational aspects of people interacting with IT.
- ESRC have additionally supported a £6.5 million research programme called the E-Society which explored the impact of digital technologies on society through 6 focused cluster areas.
- MRC has partnered other Research Councils in supporting methodological and behavioural research to underpin new opportunities in health data transfer and integration for a step change in information driven healthcare.
- AHRC has developed a £5.5 million multidisciplinary, user focused research programme exploring the increasingly rapid and transitory nature of digital culture, and a co-funded Collaborative R&D programme with BBC Future Media & Technology tackling issues such as the inhibited engagement with ICT based services in an aging population.

These activities have been underpinned by research funded through responsive mode in each of the Councils, providing a strong foundation in the core enabling technologies and understanding, linking to a rich research foundation in potential areas of application where user engagement will be vital.

In order to ensure the fundamental research in the Engineering and Physical Sciences is aligned to future needs of the Digital Economy we have identified key long term basic research required to underpin the Digital Economy; signpost calls have been issued through responsive mode and research clusters called for. Outputs from a strategy retreat in January 2010 which pulled together the outputs from the various strategy workshops and gap analysis will be used to inform the future strategy of the programme.

Our focused research theme in the Digital Economy in partnership with AHRC, ESRC, MRC, and STFC will contribute to output, employment and export earnings for the UK, and new tools will increase productivity, competitiveness and growth.

We will:

- Make a step-change in the level of industrial engagement to pursue key research challenges, so that the transformational possibilities of ICT are brought to fruition quickly and efficiently.
- Concentrate on areas of maximum transformational impact: Healthcare, Transport and the Creative Industries for example, achieving alignment with public policy goals and concerns, including more efficient and accessible delivery of government.

Since their formation the Directors of the Digital Economy hubs have met a number of times and they are moving forward on areas of commonality between the hubs with workshops to identify key research strands independently. The hubs continue to be a great source for input into future planning and enhancing links with the broader community, e.g. the Nottingham hub director is the academic lead for a BIS workshop into future shape of the Services Sector.

We will continue to work with the Digital Economy research hubs to build and strengthen relationships with the growing list of stakeholders working directly with the Centres. The outputs from these links will be varied; some of this activity will result in new research grants funded through the programme, other outputs might be the identification of underpinning research requirements.

We are working to develop an evaluation framework that extends beyond the standard Research Council measures to capture the more ephemeral measures of success and progress of the Digital Economy hubs. A set of evaluation criteria for the programme has now been agreed and a suite of approaches to capture the qualitative and quantitative information to populate these criteria for each of the DE activities will be developed with the hubs.

In order to build links with the Financial Services Sector we will hold another workshop at Tradetech 2010 where a dragons den activity will be used to identify areas ripe for collaboration. We will develop our relationship with the Financial Services KTN and develop this relationship as a focus for collaboration.

- In partnership with the Technology Strategy Board, develop consortia of researchers around user-identified challenges and funding large research programmes or centres, focused around clearly defined grand challenges in the targeted sectors.

We continue to work with the TSB in the development of their Digital Britain activity. There is now shared membership in the DE cross programme group and the corresponding group in TSB allowing us to pick up cross working opportunities.

- Fund a programme in Information-Driven Healthcare, developed with key partners (e.g. MRC, GE Healthcare), feeding the early stages of healthcare research and development. The programme aims to use ICT to transform healthcare provision from 'get ill, get cured' to prevention and early identification via dynamic information provision which empowers the patient and the clinician. We will add value to the early stages of the healthcare pipeline, and seek to ensure a seamless transition from basic research through proof of concept to clinical trials. We will work in partnership with industry and other health funders to support research encompassing the whole healthcare sector, from the health service to medical equipment suppliers.

Following a series of feasibility studies undertaken in 2008 three challenges have been funded. We will work to ensure the sharing of common issues between these three projects and endeavour to engage

relevant stakeholders at an early stage to identify how to best ensure exploitation of the research.

- Support a training programme aimed at providing a cohort of students with a strong research capability in ICT research, but with an understanding of business and the other research areas needed to deliver the benefits of ICT (to include the social sciences). We will invest in at least four doctoral training centres supporting a cohort of 10 students per year for five years.

We have worked to connect the seven Digital Economy Centres for Doctoral Training with each other and the rest of the CDT community in the EPS space. Collaboration between the CDTs is good with joint activities such as the first DE CDT summer school planned for the year ahead.

We are also working with the SIN network in the US to arrange a mission and workshop to identify links with the leading US centres in this space with the potential for student exchanges.

- Establish a management structure across the user-focused areas to ensure that lessons and common research challenges are shared, and engage industrial mentors to provide appropriate guidance to projects and engender a spirit of entrepreneurship in the research community.

Box 4 - IT-Centric Interdisciplinary Research Collaborations

EPSRC has supported five IRCs to build on the potential of information & communication technologies to facilitate inter-institutional working and its increased importance in a wide range of interdisciplinary activities. These collaborations were reviewed in 2007 and found to be internationally-leading examples of multi-disciplinary, multi-centre collaborations with strong industrial engagement. The mechanism allows for more speculative research and for the incorporation of new lines of enquiry. Our plans include the wider deployment of the IRC mechanism across other areas of our portfolio.

Nanoscience through Engineering to Application

Nanotechnologies can revolutionise society; they offer the potential of disruptive step-changes in electronic materials, optics, computing and in the application of physical and chemical understanding (in combination with biology) to generate novel and innovative self-assembled systems. The field is maturing rapidly, with a trend towards ever more complex, integrated nanosystems and structures. It is estimated that by 2015 products incorporating nanotechnology will contribute US\$1 trillion to the global economy, and that the UK has a 10 percent share of the current market.

We propose to build on the previous investment of £92 million nanotechnology research (at 2004, and representing 1.3% of UK R&D expenditure). Of this, the EPSRC has contributed a responsive mode investment of around £30-40 million per annum and 40 new PhD starts, in addition to the MNT investment of £90 million over 6 years. These investments complement a sum of €3.6 billion for nanotechnology research in the 7th EU Framework Programme.

With support from all Research Councils and a wide range of stakeholders, EPSRC will lead a co-ordinated, focused programme designed to:

- Consolidate earlier investments by bringing together the various elements into a coherent, directed programme taking basic research through to application to realise the potential benefits through a series of Grand Challenges addressing areas of societal importance.

A theme day was held in September 2009 with input from around 80 members of the UK nanosciences community. A panel of UK and overseas representatives reviewed the RCUK nanoscience portfolio and commented on progress made since the inception of the programme in 2007. The report will be published shortly.

A plan for the transition of the content of the nano programme back into mainstream RC business is to be developed by mid 2010 and implemented by the end of this delivery plan period.

- Support goal-driven research programmes, staged over a timeframe of the CSR period and beyond, with increasing sophistication and complexity of structures moving, for example, from polymer liposomes (nanosomes) for molecular delivery in the healthcare, personal products and food sectors within three years, to self-assembling nanostructures within ten years.
- Deliver Grand Challenges in applying nanotechnology to energy (e.g. harvesting solar energy), environmental remediation, healthcare & digital economy, using a stage-gate approach from basic research through to application.

A third Grand Challenge under nanoscience for carbon capture and utilisation was announced in 2009 resulting in three projects totalling over £4M being announced in March 2010.

- Build doctoral training centres to generate critical mass in required skills in this interdisciplinary subject.

As in other themes we have started networking the three Centres for Doctoral Training meeting to share best practice and identify potential areas of future collaboration.

- Ensure the wide availability of cross-cutting infrastructure via equipment-sharing.

The Nanotechnology KTN has launched an equipment database to maximise use of equipment across the community.

We have worked with NERC contributing approximately £450 thousand to their Environmental Nanoscience Initiative. This initiative has the aim of supporting the development of novel tools and technologies to underpin the detection and characterisation of nanomaterials within the environment.

- Building on the past investment of public funds, support a broad base of research with signposting of strategic areas.

Box 5 – Nanotechnology Grand Challenges

EPSRC is using Grand Challenges which address societal and/or economic issues where nanotechnology can make a unique and significant

contribution. We have issued a call for proposals of large-scale, integrated projects exploiting nanotechnology to enable cheap, efficient and scalable ways to harvest solar energy. A future Grand Challenge will focus on medicine and healthcare.

Towards Next-Generation Healthcare

This element of our Delivery Plan recognises the challenges of an ageing population and aims to improve the health of UK citizens at all stages of their lives, through earlier disease diagnosis and better treatment, reducing the associated costs. EPSRC already supports a strong portfolio of medical engineering, including collaborative work with key companies (e.g. GE Healthcare), the NHS and the MRC. Healthcare-related investment will enhance both the excellence of the research base and translation to products and services.

We will:

- Work with key partners to ensure a seamless transition from basic research through proof of concept to clinical trials;
- Obtain co-funding from partners in industry, charities and NIHR over the period, with the emphasis on:
 - Excellent research to support the development of novel medical technologies, sensors and information systems.
 - Partnerships with business and charities to maximise pull-through of underpinning research into products and clinical practice.
 - The delivery of better health and well-being through dynamic information and intervention.
- Increase the volume of high-quality collaborative research and pull-through to clinical products and practice, in the areas of Systems approaches to healthcare, Medical information systems, Medical sensing, and Targeted therapies. We will establish further strategic partnerships with public and private funders such as those already in place with Cancer Research UK (see box 6), the TSB, GSK, Pfizer and AstraZeneca.

Box 6 – Partnership with Cancer Research UK

EPSRC and Cancer Research UK have established a strategic partnership to promote the application of imaging science to cancer research. UK engineering and physical sciences researchers have a strong history of delivering fundamental insights and technologies that have revolutionised imaging science. Cancer Research UK's knowledge of cancer biology, clinical need and imaging development is similarly internationally leading. This partnership will draw upon these strengths to stimulate the research base with challenges associated with clinical need and to ensure technology pull-through to clinical practice.

Through this strategic partnership four Cancer Imaging Centres were announced in 2008 alongside five programme grants co-funded with Cancer Research UK and the MRC. We have agreed a review framework for these imaging centres with Cancer research UK and the first annual review of the Centres took place on 24 March 2010.

Our strategic partnership with the Wellcome Trust has resulted in four new interdisciplinary research centres. Imperial College London, Kings College London, the University of Leeds and the University of Oxford have received a combined total of £41 million for the next five years to produce high tech solutions to medical challenges. Over the course of 2010 events will be put in place to encourage them to network with each other.

In July 2009 the Towards Next generation Healthcare programme launched a new scheme to fund collaborations between research teams and smaller medical charities and healthcare SMEs. We expect to fund between 5 and 15 partnership proposals through the first call. A second call will be announced mid-2010.

A strategy for EPSRC support for healthcare will be developed before the end of this delivery plan period.

Contribution to other Research Councils UK Research Themes

Living with Environmental Change

Living with Environmental Change (NERC, AHRC, BBSRC, EPSRC, ESRC, MRC, and working with partners in at least nine Government departments/agencies) is focused on increasing resilience to - and reducing costs of - environmental change, addressing the associated pressures on natural resources, ecosystem services, economic growth and social progress. EPSRC will contribute the engineering research to tackle the implications of climate change for buildings, infrastructure and utilities. EPSRC has established consortia in its Building Knowledge for a Changing Climate programme, working with key stakeholders (e.g. DEFRA) to pull through outputs, and has supported the Dongtan Ecocity project in China providing technology and people via Network grants, in partnership with Arup.

This programme now brings together 20 UK organisations (including all of the Research Councils and TSB) that fund, undertake and use environmental research. EPSRC 's major contribution is to fund research that helps to make infrastructure, the built environment and transport systems resilient to environmental change, less carbon intensive and more socially acceptable

The most important investment by EPSRC has been the ARCC (Adaptation and Resilience to a Changing Climate) programme which comprises 14 research projects (with a value of £12 million) concerned with the probable effect of climate change on buildings and infrastructure in the urban environment and the general UK wide infrastructure (such as transport and water systems). A further investment of up to £3 million is planned in 2010/11 to fund research into the effect of climate change on future resilient energy systems.

Global Threats to Security

The Global Threats to Security programme (AHRC, BBSRC, ESRC, EPSRC and NERC) will integrate research in crime, terrorism, environmental stress and global poverty, to address causes of security threats, their detection and possible interventions to prevent harm. EPSRC will focus on research and innovation to support the development of technology, systems and services for the prevention and detection of crime and terrorism or manage/minimise its impacts.

Two IDEAS Factory Sandpits comprised the major part of the EPSRC contribution to the RCUK 'Global Uncertainties: Security for all in a Changing World' Programme in this period. 'Detecting Terrorist Activities' was held in May 2009, 'Towards Next Generation Resilience' in November the same year. £7 million of research was funded as a result of these sandpits, around £1million of this being a direct cash contribution from co-funders. Other GU community building activities have also taken place. We anticipate committing an additional £4 million in support of research relevant to this Programme next financial year.

Ageing: Life-Long Health and Wellbeing

This initiative will establish new interdisciplinary research centres targeting the major determinants of health and wellbeing over the whole life-course and reducing dependency in later life. EPSRC's contribution to this Cross-Council investment (MRC, AHRC, BBSRC, EPSRC, ESRC and NERC) will provide underpinning medical engineering, building on our established portfolio of investment in the area.

Following on from the initial cross-council support of three interdisciplinary research centres three collaborative grants and ten networks have also been awarded. Funding for these networks will come to an end in April 2010, it is hoped the priming network funding will have positioned them well to respond to the phase three call. This call will be issued in quarter 1 2010/2011.

4. Sustainability

Support for the core of engineering and physical sciences research activity ensures a vibrant and healthy research capacity, delivering outputs for all of science and the knowledge-driven economy. The UK has a clear dependence on a healthy engineering and physical science (EPS) base, both as an underpinning factor in a successful economy and in contributing across the whole research sector (see box 7).

Box 7. The Value of the Engineering and Physical Sciences Sector⁶ 7 8

- Surveys of R&D managers in the EU and the US have shown that EPS-related scientific fields are more pervasive in their impact than other disciplines particularly in Engineering, Materials Science and Computer Science.
- Global companies use quality of R&D personnel as a major determinant for their location indicating the need for a strong research base to ensure inward investment.
- Sectors with the fastest growth of value-added per employee are those with the highest dependence on the EPS sector.
- Engineering and physical sciences are most frequently cited as critically important for advances in all other areas of science.
- The growth in productivity of different industrial sectors is highest in those with EPS relevance.
- The UK has a lead in areas such as plastic electronics, pharmaceuticals and aerospace.
- EPS postgraduates contribute more to the economy in terms of average salaries than non-EPS.

Nonetheless, it is clear that capacity needs to be enhanced in strategic and emergent areas of the research base. In addition, more can be done to align research activity with broader challenges.

Our aspirations for a sustainable research base are to:

- Deliver a vibrant, creative and healthy science and engineering base.
- Ensure the long-term health of disciplines.
- Encourage a move to more transformative and multidisciplinary research.
- Supply trained people for the economy and provide the next generation of world-leading researchers.

⁶ Engineering & Physical Sciences in the UK, SPRU, 2003

⁷ Thursby & Thursby, Where is the New Science in Corporate R&D, Science, volume 314; Rising Above the Gathering Storm: Energizing & Employing America for a Brighter Economic Future, National Academy of Sciences, 2007

⁸ O'Leary & Sloane, The Return to a University Education, Dept of Economics, Swansea University: lifetime premiums on higher degrees over 2 A levels

- Enhance capacity in areas of national importance.

A Healthy Science and Engineering Base

Support for the core of engineering and physical sciences research activity ensures a vibrant and healthy research capacity, delivering outputs for all of science and the knowledge-driven economy. Enabling the flexibility for researchers to take the lead on the areas we support assists the academic base to fit to a changing research landscape where traditional boundaries have broken down and where new areas of research (e.g. plastic electronics, spintronics, quantum coherence, complexity) need to be swiftly pursued.

We will:

- Access the potential creativity in the research base via researcher-led activity. This base is crucial both for the health of disciplines and to ensure that the skills and knowledge are available to meet as yet unknown problems.

We have continued our investment in Platform and Programme grants and will continue to make new financial commitments throughout 2010/11 progressing towards the 2011 target. We will also be planning and adopting a more strategic framework for the placement of new programme grants

- Use signposting of specific research areas to help galvanise researcher effort around topics of strategic importance.

Criteria for the evaluation of the effectiveness of signposting have been drawn up and evidence gathered. This evidence will be reviewed by EPSRC's advisory panels and Council in April 2010.

- Emphasise output-focused, multidisciplinary research, using vehicles such as IDEAS factories and Grand Challenges, and 'bridging the gap' awards, encouraging researchers to identify and pursue opportunities for transformative research in areas such as low-carbon manufacturing, molecular electronics, and DNA-based devices.
- Invest in the necessary research infrastructure (see Facilities and Infrastructure below).

An International Review of Mathematical Sciences is being planned for 2010/11 completing our second round of International Reviews. Following the International Review of Chemistry in 2009 an action plan has been formed and is currently open for community consultation; we will be acting on this plan during 2010/11. A benchmarking analysis of the UK activities in Manufacturing Research and Training will also be completed in 2010.

In mid 2009 the EPSRC research landscape was published on the EPSRC's website. This document is being used as an engagement tool for ongoing dialogue about the shape of the portfolio as we develop the next Delivery Plan.

Since the review of UK physics research chaired by Professor Wakeham we have been working to deliver the actions in our space agreed across Research Councils in response to this review. We completed a review of Nuclear Physics and Engineering jointly with STFC in October 2009. a cross- Council strategy

group has been established to facilitate communications to the wider physics community.

A detailed Balance of People assessment was undertaken by EPSRC's Advisory panel's and Council in the autumn of 2009. As well as the actions detailed in Securing the Future this balancing exercise led to the further development of the concept of Challenging Engineering.

Following dialogue with our community EPSRC decided to take a phased introduction of measures to safeguard peer review. The measures build on the 2006 RCUK review of the effectiveness of Peer review and a need for the system to support EPSRC's mission of supporting World class research, improving quality of life and promoting economic impact. From April 2009 EPSRC no longer accepted uninvited resubmissions and from April 2010 repeatedly unsuccessful applicants will be constrained to one full application to EPSRC in a twelve month period. Throughout 2009/10 EPSRC has been providing best practice and guidance to institutions and will continue to do so.

Throughout 2009/10 we, along with our sister Research Councils have required applicants to outline the potential impact of their research by submitting Impact Plans as part of their application. We have provided guidance to applicants in the form of impact plan workshops and have seen a good response to the introduction of this requirement. However, to clarify what we are asking for EPSRC as part of RCUK have changed the name of impact plans to Pathways to Impact and will continue promotion to our community.

Box 8 – Boosting Capacity – Science & Innovation Awards

Science & Innovation Awards, co-supported by the Funding Councils, are large, long-term grants supporting new research groups in areas where research capacity needs to increase in order to ensure the future international standing of the research base. Areas where EPSRC has recently invested include analytical science, energy, operational research, structural ceramics, and tribology. We will invest in a further tranche of these awards.

Securing the Future Supply of People

Discovery and innovation in science and engineering happen through creative people working in a high quality research environment. Whilst the demand for EPS graduates in the workplace, especially in the knowledge economy sectors, appears to be increasing⁹, falling numbers of UK-based degree entrants in those subjects is a major concern.

We will:

- Support the next generation of world class researchers and research leaders so that the UK can increase its global research impact and economic competitiveness.

Early in 2009/10 we supported 24 Career Acceleration and 17 leadership Fellows following the second call for Fellowships in this format. Submissions have been received against a third call and we expect to announce the successful Fellowships early in 2010/2011.

⁹ EPSRC analysis of employment data from Labour Force Surveys between 1998 & 2002

In the autumn of 2009 we reviewed the balance of EPSRCs support for people along the length of the research career path. Council has approved financial outputs from this exercise with some adjustment between research, training and fellowships across some programmes. Recommendations included reviewing the scope of our fellowship support and piloting an approach to encouraging creativity in fellowships. We are also developing a statement of expectations for all EPSRC doctoral students.

As part of the Roberts Skills Evaluation we will be investigating the use of enterprise training in 2010/11.

- Strengthen strategic research areas by using targeted funding to create new research teams.
- Attract the most talented people to research by enhancing the Doctoral experience, working with the Funding Councils.
- Help the flow of people through their research career pathways, either in industry or academia, and enhance skills to meet user needs.

Targets for HEIs to increase user collaboration in their Doctoral Training Accounts have been maintained and included a target of 10% conversion to CASE studentships. We will continue to include a target in the Doctoral Training Grant to increase user collaboration in the DTAs.

In January 2010 of Organic synthesis Studentships co-funded with AstraZeneca, GlaxoSmithKline, Pfizer and Novartis. Additionally, through our Strategic Partnership with Rolls Royce we have supported a new postgraduate training activity in Structural Metal Systems for Advanced Gas Turbine Applications based at Birmingham, Cambridge and Swansea Universities. This will help create the next generation of world-class materials scientists and metallurgical engineers. We plan to develop more targeted training support in collaboration with Strategic Partners as necessary, to both meet the needs of our Strategic partners and accounting for our existing training portfolio.

- Continue to support and monitor the success of the academic fellowship scheme on behalf of all Research Councils.
- Enhance the attractiveness of research careers and share best practice to address diversity issues, working with the RCUK Research Careers and Diversity Unit.
- Inspire the young to pursue research careers in science, mathematics and engineering, in collaboration with the RCUK Science in Society Unit, through our Public Engagement programme.

Box 9 – Doctoral Training Centres

Future research needs require appropriately trained multidisciplinary manpower. The Doctoral Training Centre mechanism offers a new and exciting approach to post-graduate training. Each centre supports up to five annual cohorts of up to ten students, with taught training fully integrated into research projects. Each centre, focused around a small number of research themes, has strong industrial engagement, both in the

management and support for research. This approach has been used so far in the Life Sciences Interface, Systems Biology and Complexity. Our plans include an increase in the use of such centres in order to bring greater alignment of training with strategic research areas.

We now have a portfolio of fifty two Centres for Doctoral Training. This year we have invested in another three new CDTs in Mathematical Sciences. These may be added to again in 2010/11 if we seek to fill some gaps in the portfolio in areas where a clear need has been identified.

In 2009/10 we began the process of networking the Centres for Doctoral Training across our portfolio. A best practice and evaluation meeting was held in December 2009; this provided a stimulus for groups of CDTs in similar fields to maintain links with each other. We will continue to work with the centres to establish a framework for evaluation and best practise.

5. Greater Economic Impact

Knowledge transfer is integral to all of EPSRC's research and training activities, being significant in the core, researcher-led portfolio via collaboration on research grants, and providing a supply of trained people into industry and the wider economy. We already support a research portfolio which is around 40% collaborative with industry, and circa 40% of EPSRC-supported research studentship training involves the participation of industry. There is more to do, however, to reduce the time to exploitation of break-through research.

We will:

- Accelerate the exploitation of research outputs for economic benefit through major strategic partnerships with the Energy Technologies Institute and the Technology Strategy Board.

We have committed at least another £20 million in collaborative and complementary research with the TSB over the 2009/10 period. This will be maintained in the next year with a minimum of £20 million new commitment in 2010/11. Thus the total over the Delivery Plan Period is expected to be some £80 million, compared with a "target" of £45 million. More widely we are on track to meet our target of doubling our numbers of collaborative grants.

Within our priority research themes, Energy, Digital Economy, Nanoscience, and Towards Next Generation Healthcare, work with key stakeholders to form bridges that pull research through to exploitation more rapidly and efficiently.

- Within our priority research themes, Energy, Digital Economy, Nanoscience and Towards Next Generation Healthcare, work with key stakeholders to form bridged that pull research through to exploitation more rapidly and efficiently.
- Align the skills base more closely to the needs of business innovation through more targeted, demand-led doctoral training.

In 2009/10 we have awarded 206 industrial CASE awards directly to companies and industrial CASE agents and a further 68 through an open competition. We plan to make a total of 266 awards in 2010/11. In response to industry requirement of a guaranteed allocation to allow for more forward planning over the period 2008-2011 we made a three year allocation to our top 18 collaborating companies as well as to our agents.

To better coordinate skills provision with the user base we are investigating the potential benefits of harmonising with other Research Councils' Industrial CASE schemes, especially where sector interests coincide across councils and are planning a review in 2010 to inform our future strategy.

- Enhance the flow of knowledge and people between academia and industry by facilitating partnerships and through targeted vehicles for collaboration, including knowledge transfer centres of excellence, and via post-doctoral follow-on opportunities based in industry.

EPSRC's 12 Knowledge Transfer Accounts (KTAs), awarded at a total costs of £44 million, started in October 2009, together with 13 Knowledge Transfer Secondment (KTS) awards (£11 million). These follow on from the Collaborative Training Accounts and aim to facilitate increased two way flow of ideas, research results, expertise and skilled people between research organisations and user communities. Monitoring and evaluation frameworks have been agreed with the KTA Directors and established. In 2010/11 we will capture initial outputs and outcomes from KTAs including qualitative evidence of the impact KTAs have had on generating a cultural 'step change' in Universities regarding the 'Excellence with Impact' agenda of RCUK and EPSRC investments. We have also increased our funding for the Royal Society Industry Fellowships from £250 thousand to £400 thousand per annum and increased funding through the Technology Strategy Board for support of Knowledge Transfer Partnerships.

Further funding has been provided for the next tranches of the existing Innovation and Knowledge Centres, this rolling renewal will continue in 2010/11 when we will also fund some new IKCs jointly with TSB and potentially BBSRC.

Three new Centres for Innovative Manufacturing (total £14.5 million) were announced in January 2010 and we expect to commit around £46 million to a new tranche of Centres for Innovative Manufacturing in 2010/11.

- Publicise the opportunities for, and successes of, knowledge transfer so that it becomes normal business for the research community.
- We have specified a baseline for our economic impact (see Annex 1).

EPSRC's sectors have been re-structured and have more support available to take advantage of cross-sectoral opportunities. Through the work of our sectors we have good lines of communication with our Strategic Partners and have been able to have extensive dialogue in areas such as best practice, user need and partnership models. This network will be used throughout 2010/11 as we look ahead to the next Delivery Plan and consider the best models for our Strategic Partnerships to take. More funding will be available for Strategic Partnership with key business and third sector stakeholders.

Box 10 – Demand-Led Training: the Engineering Doctorate

The Engineering Doctorate was established in 1992 to provide a high-quality, broad-based doctoral research experience with a taught component relevant to the needs of users. A 2006 review of the scheme was “convinced of the value and performance of the EngD scheme, the quality of the intake and outputs, and the contribution it makes to EPSRC strategic objectives by providing high quality knowledge transfer through people.” We will build on this endorsement by raising the profile of the EngD brand, and by extending the use of the concept to other areas of doctoral training.

Impact on Public Policy and Government Service Delivery

EPSRC has a unique position in helping to maximise investments across a wide range of Government policy and delivery, and in supporting, for example, better healthcare, improved transport, flood control, crime-prevention, anti-terrorism, and reduction of carbon emissions.

Many Departments and agencies will continue to be key stakeholders in these endeavours, co-sponsoring our research programmes, and will be major users of our research outputs, both knowledge and trained people.

Box 11 – EPSRC Partnership across the Public Sector: Department for Transport

Our extensive partnership with the Department for Transport covers (a) transport technology research, e.g. Future Intelligent Transport Systems - co-funded with TSB and Rail Research UK; and (b) transport and land use planning, e.g. the Solutions and Revisions Research Consortia which has co-funding from the East of England Regional Development Agency.

Our Delivery Plan will have major impact on all five of the Government’s Public Policy Challenges, as described below.

Natural Resources and Climate Change

EPSRC’s leadership of the Research Councils’ Energy programme builds on our established partnership with the BERR Energy Programme. Key areas of research that will inform future energy policy include:

- Keeping the Nuclear Option Open and Future Network Technologies.
- Partnerships with DEFRA, CLG and the Carbon Trust on low-carbon buildings and on the mitigation of, and adaptation to, climate change.
- Informing key Government policy instruments e.g. Building Regulations & Planning Policy.
- Targeted knowledge transfer activities (e.g. Knowledge Transfer for Sustainable Urban Environments) to synthesise raw research outputs to better inform policy and practice, and with DEFRA, focused on the quantification of environmental risks in policy formulation.
- Partnership with DEFRA on (i) Flood Risk Management, generating output that is directly benefiting both policy development, and the Environment Agency’s service delivery; and (ii) waste management, with joint benefit on policy and service delivery in the local Government domain.

Technological change

Engineering and the physical sciences are critical to the development of technological innovation across the spectrum of business. EPSRC is the largest Research Council partner with the TSB, and we have our own extensive range of direct collaboration with industry, from major strategic partnerships to our extensive support to all aspects of industry, including SMEs, through collaborative training and knowledge transfer activities. Our key Delivery Plan priorities will broaden our engagement with business and the service sector, working in partnership with TSB and BERR.

Examples are:

- Engaging with financial service and retail sectors on innovation in services e.g. advanced techniques to combat credit card fraud, through the Digital Economy theme.
- Supporting Government as a major user of ICT, e.g. in partnership with the Home Office Passport and Identity Agency through the Network & Security Innovation Platform.
- Contributing to energy transformation (e.g. efficient photovoltaics) via the Nanoscience theme, supporting new technologies e.g. plastic electronics, quantum information processing, advanced composites, and beyond silicon electronics (e.g. DNA-based devices).

Globalisation and Shifting Economic Patterns

The challenges globalisation raises for business in the UK are constantly evolving. Features of EPSRC'S contribution include:

- Our portfolio of Innovative Manufacturing Research Centres (IMRCs) fund a wide range of research in manufacturing technology, supply chains, business process engineering and manufacturing management. This work, which has contributed to the forthcoming Sainsbury Review, will continue to provide an important evidence base for BIS and the Treasury in the development of innovation policy and strategy.
- Our deployment of user-driven Grand Challenges will ensure that we remain aligned with the strategic needs of the economy and society.
- Realigning our PhD training to be competitive internationally, and will gain leverage from international expertise by partnerships with peer funding agencies.

Global Uncertainty and Terrorism

In tackling the challenges of the prevention, detection and response to crime and terrorism, EPSRC has funding partnerships with a number of key stakeholders. Our crime portfolio features extensive end-user collaboration including Home Office Agencies, Police services, Local Authorities and industry. Activities will include:

- Ideas Factories in crime and terrorism in collaboration with the Home Office, initially on container screening at ports, building on the success of earlier events on gun crime and combating terrorism in public places.

- Establishing partnership with the Centre for Protection of the National Infrastructure (CPNI), aiming to expand this to include other key stakeholders such as the MoD and the Cabinet Office.
- Further collaboration with the Home Office and the Communities & Local Government in areas such as designing out crime and crime-free communities.
- EPSRC is the dominant Research Council partner in the MoD Joint Grant Scheme, with discussions underway to expand our interaction with MoD initially focused through the Nanoscience theme.
- Defence interests also feature strongly in our portfolio of strategic partnerships with industry, in particular with BAE Systems and QinetiQ.
- Emerging partnership with DFID, building on international development activity focused on Energy.

Demographic Change

EPSRC's key interests in demographic change are concerned with ensuring that society is able to rise to the challenges that the new demographic profile will present, the ageing population in particular. Key areas will be:

- The Next Generation Healthcare theme, encompassing our collaboration with the Department of Health in areas such as Information-Driven Healthcare and Assisted Living, both of which support the cross-Council Life-Long Health and Wellbeing agenda.
- Our Extended Quality of Life portfolio, addressing issues such as rehabilitation technology and the inclusive design of products and environments, with strong engagement with social care agencies both in the charity sector, local Government and the NHS.
- The IMRCs' support for healthcare service delivery, with dedicated centres focused on the provision of infrastructure and on technology assessment and procurement, working closely in partnership with NHS stakeholders.

6. Facilities and Infrastructure

High-End Computing

We will ensure the provision of high-end computing infrastructure through the following activities:

- The High-End Computing Terascale (HECToR) service commenced in October 2007. Work is in hand with the sponsoring Research Councils, industry and academia to ensure good exploitation of the facility.
- The scale and cost of provision required beyond HECToR has led to negotiation at European-level, with the scientific case already agreed. EPSRC will invest in the initial 2-year phase of technology development activities (due to be matched by funds from the Commission).

Other Facilities

We will support a number of facilities where critical mass and centralisation offer more appropriate provision than dispersed, multiple provision. Continued investment in the following will ensure that researchers have access to essential infrastructure in a cost-effective manner:

- Isaac Newton Institute & International Centre for Mathematical Sciences
- Engineering Loan Pool
- Materials science equipment sharing
- Meso-scale facilities
- Capital equipment to support leading-edge research.

We will also follow up the International Review of ICT recommendation to maintain the software necessary to support UK researchers' competitive advantage in the Digital Economy.

Next-Generation Facility Users

In collaboration with STFC, EPSRC is investing to ensure that maximum value is obtained from the UK's centrally-provided research facilities, including Diamond Light Source and ISIS Target Station 2. We are providing funds to support a balanced portfolio of research with an element of doctoral training in order to develop the next generation of researchers skilled in using these and other facilities.

At the end of 2009 EPSRC's Council agreed a preferred route forward for the provision of High Performance Computing. A draft Cross-Council strategy for HPC has been developed and discussed by Research Council CEOs.

7. Science in Society

The key aims of EPSRC's Science in Society programme are to secure the future supply of people into research, and to engage citizens about the outcomes and processes of science and engineering. We will work with the RCUK Science in Society Unit on those activities which are more effective when delivered collectively, and will collaborate, where appropriate, with key partners such as the learned societies. Council is advised in this by its Societal Issues Panel which helps identify the challenges and opportunities for researchers in early engagement with public views. The Public Engagement programme manages the activities which contribute to this and to attracting young people into research.

Specifically, we will:

- Deploy the Societal Issues Panel to evolve EPSRC's thinking to take fuller account of the societal, political and legislative environment.

Over 2010/11 we plan to engage SIP more fully in the strategic decision making processes of EPSRC including formulation of the next Delivery Plan.

Encourage and incentivise the EPSRC research community to engage with the public, for example by continuing to tailor public engagement support, training and advice and by supporting the HEFCE/RCUK Beacons pilot.

Provide training and support for the EPSRC research community in:

- Science communication and working with the media to reach the public.
- Raising awareness of the societal and ethical implications of research.

We will be working with The British Science Association and the Training Group to run a series of regional workshops, providing guidance for EPSRC researchers wishing to become more involved in public engagement. In 2010/11 we will begin evaluation workshops to enable current EPSRC public engagement grant holders to share learning outcomes and best practice.

Internally, we are developing a long term plan to embed public engagement in EPSRC, so that public engagement becomes a standard stream of activity across EPSRC's portfolio and is linked to priority areas. A programme of associated activity will be undertaken throughout 2010/2011.

- Foster public engagement, dialogue and debate around emergent research, technology and grand challenges.

A series of synthetic biology public dialogue workshops were held around the UK at the start of 2010. We anticipate that outcomes and reports from these dialogues will be available mid 2010. Moving into 2010/2011 we will hold workshops with staff from both EPSRC and other Research

Councils to raise the profile of the dialogue process and encourage staff to consider the societal and ethical implications of their portfolios.

- Enthuse young people to encourage them to pursue a scientific career, for example by continuing to support RCUK activities and further developing the NOISE campaign.

The NOISE campaign continues to provide a platform to train early career researchers in a broad range of public engagement skills, whilst providing opportunities to communicate contemporary research to the media and festival audiences. In 2010/11 we will continue to work with RCUK and national initiatives to increase the critical mass of activity aimed at young people.

The Bloodhound SSC Education programme continues to move forward. Participation in the programme is growing from an ever-increasing number of schools. In 2010/11 EPSRC will contribute to this project by encouraging a broader range of engagement opportunities within this programme.

- Highlight areas where supply shortages have been identified, for example:
 - Computer science (as identified in the International Review of ICT 2006)
 - Engineering, where we will complete the 'Engineering a Better World' project
 - The number of women in engineering and physics, over and above the general shortages in maths, physics and chemistry
- Highlight to the public our priority research themes.

Box 12 – Science in Society: Key Objectives

- Ensure that EPSRC's thinking is informed by public views and by consideration of societal implications;
- Enable researchers to participate in high quality engagement with the public, and to consider societal implications and public attitudes in the conduct and use of research;
- Contribute to sustaining future people flow into engineering and the physical sciences by enthusing young people about the creative process, issues, aspirations and outcomes of research;
- Ensure the public are informed about developments, achievements and impacts of EPSRC-funded engineering and physical sciences research, in order to account for our investment and build public awareness of research.

8. International

World-class research is characterised by a high level of collaboration between leading research groups internationally. International collaboration will be embedded within programmes to ensure strong connectivity with specific research areas where the UK can benefit or offer global leadership. One high-profile example is the Dongtan Eco-city project, where EPSRC is working with Arup to develop a collaborative research programme involving Chinese and UK universities.

Specifically, we will:

- Further develop strategic and focused activities within target countries of China, India, Japan, USA and Europe, linking these to priority themes of Energy, the Digital Economy, and Nanoscience via targeted funding. This will include the continued activities of ring-fenced programmes such as 'INTERACT'.

The International Capacity Fund has been established and has been working to promote additional collaborations between UK and strategic countries. Through this new Capacity Fund we have established new partnerships in advanced manufacturing technologies in Japan

Moving into 2010/11 we will develop a strategy and consultation mechanism with University stakeholders to enable the UK to make a cohesive input to the development of the European Union's FP8.

- Work through RCUK offices in China, USA, and India to forge relationships with counterpart organisations.
- Take forward the Science Bridges programme.

Metrics to be applied to the Science Bridge awards in India, China and the USA have been developed; these will be used to develop an evaluation methodology and structure. In parallel we will develop an evaluation framework for the impact and outputs of the RCUK overseas offices in EPSRC strategic regions.

- Lower barriers to international collaboration by working with funding agencies in target countries. Discussions with the NSF in the USA have already identified sustainable energy, nanoscience and the digital economy as collaboration topics, and ideas-exchange on transformative research.
- Engage in strategic international dialogue to ensure that the agenda for UK science and engineering is represented at appropriate levels (e.g., through the Global Science & Innovation Forum, BIS' Science & Innovation Group and Brussels).
- Work with UK Trade & Investment (UKTI) to help secure inward investment.

Box 13 - Enhancing International Engagement: Key Objectives

- Facilitate 'best with best' research collaboration

- Enhance relationships with target countries: USA, China, India and Japan
- Promote the UK and seek global influence.

Japan has been added to our list of target countries and we continue to target Europe. Here especially we have been working to influence decision making in international research policy.

9. Improving Efficiency and Effectiveness

EPSRC has a strong commitment to ensuring that the public investment in the research base is used wisely. EPSRC will contribute its share of the RCUK efficiency requirements in the CSR period, as described in the RCUK Delivery Plan, including committing to a new cross-Council efficiency delivery programme to collectively deliver at least 3.65% per annum net cashable value for money gains.

We will achieve savings and increased effectiveness via:

- More efficient methods of peer review, e.g. greater use of outline proposals and a revised approach to project reporting, achieving £6 million savings over the period.

There has been a phased approach to introducing changes to the peer review system to increase efficiency and effectiveness whilst upholding EPSRC's mission to support world class research, improving quality of life and promoting economic impact. From April 2009 EPSRC no longer accepted uninvited resubmissions and from April 2010 repeatedly unsuccessful applicants will be constrained to one full application to EPSRC in a twelve month period. Throughout 2009/10 EPSRC has been providing best practice and guidance to institutions and will continue to do so. We will also be monitoring the impact of these changes and plan to carry out a review of the effects of these policies in safeguarding peer review in approximately spring 2011.

- Increased leverage on public investment by securing additional contributions from industry through, for example, additional strategic partnerships with companies.
- Reducing the proportion of budget spent on administration to below 2.9% by 2010-11.

We have continued in our contribution to the RCUK efficiency delivery programme, reducing the percentage of our budget spent on administration and increasing levels of co-funding of research and training. Targets set for 2009/10 have been met. In 2010/11 targets for the administration percentage will be maintained whilst we aim to increase our co-funding targets by £2 million.

- Working with other Research Councils e.g. on pay harmonisation and the Shared Service Centre (SSC), restructuring to be fit for purpose post-SSC.

Finance and operational Procurement were transferred to SSC and went live as planned in December 2009. This is planned to be completed in 2010/11 by migration of grants processing to SSC.

- Increasing the co-funding of research and training across our programme.
- Adding value to research management by deploying staff in creative and flexible ways (e.g. sector-focused teams, IDEAS factories).

Annex 1 - Economic Impact Baseline

Delivering Impact from Excellence

Achieving the government's goal for a step change in economic impact arising from EPSRC's investments is only possible with a cutting-edge, highly-creative, internationally-leading portfolio.

Delivering Highly-Skilled People into the Wider Economy

EPSRC delivers a significant impact through the **provision of trained people into industry and the wider economy**:

- We spent nearly £150 million in 2006/07 supporting ~7,700 PhDs.
- One third of our PhD graduates take up initial employment in business and public services.
- On average, the lifetime premium (relative to 2+ A-levels) for PhD graduates in engineering and physical sciences is estimated at £198 thousand¹⁰. For the current cohort of EPSRC-supported students this will amount to collective additional lifetime earnings of ~£1.5 billion at current levels.

User-orientated training helps to satisfy the requirements of employers. EPSRC invests in a significant level of training with user involvement:

- Around 40% of EPSRC research student training involves the participation of industry.
- We support over 1,700 PhD students in collaborative training partnerships with industry.
- Currently 230 user organisations are engaged in collaborative PhD training.
- Industry currently contributes £56 million to EPSRC postgraduate training.

The **Engineering Doctorate** (EngD) is a good example of highly successful vocational training well-suited to the needs of industry. Currently EPSRC supports 620 EngD students. Benefits identified in a recent case study¹¹ include:

- A positive impact on business performance worth possibly £10's millions annually through the creation of new products, processes or services.
- Lifetime salary benefits of £100-300 thousand (which also has a wider impact on the economy) compared to standard Physical Science PhD graduates.

¹⁰ Estimate derived from HESA data on PhD student gender balance in EPS subjects (2004/05) combined with lifetime earnings differential data (2002 prices, net of taxes, excl. Scotland) published by O'Leary and Sloane 2005: The Return to a University Education in Great Britain Nat. Inst. Ec. Rev. v.193 pp 75-89 (July 2005)

¹¹ RCUK: Study on the Economic Impact of the Research councils 2007

A significant proportion (over 20%) of EPSRC-funded research assistants take up employment in business and public services: currently we support over 4,300 RAs.

Delivering Benefits to Business through the Exploitation of Excellent Research

EPSRC delivers **economic impact through support of basic research**. Broadly, the rate of return from academic research has been estimated to be 28%.

- EPSRC spent £420 million on research grants in 2006/07, which is expected to yield returns to the economy of approximately £540 million.
- EPSRC-supported research reported 159 licences and patents and 104 spinout companies¹².
- A recent review of EPSRC investment in polymer research concluded that, from an initial investment of ~£16 million, impacts of the order of £200 million have been identified, arising primarily from new businesses or products.

Working in Partnership with Users

The involvement of users in research, either directly on collaborative research projects or through strategic partnerships with EPSRC, facilitates and accelerates transfer and exploitation of the knowledge generated. The EPSRC portfolio has significant engagement of users in research:

- Approximately 40% of the research portfolio is collaborative with over 2,000 private and public organisations and charities.
- Over £90 million was contributed by user organisations to research projects supported by EPSRC grants completed in 06/07.
- In a recent EPSRC survey of research collaborators 77% of users were satisfied with the EPSRC-financed research project in which they had been involved.
- EPSRC investment in research in collaboration with the Technology Strategy Board totals £24 million.

EPSRC has developed **strategic partnerships** (i.e., formal arrangements for mutual financial support of targeted research programmes or research chairs) with key R&D intensive companies:

- Currently 28 organisations engage with EPSRC through Strategic Partnership agreements.
- A previous EPSRC strategic partnership in the area of combinatorial chemistry led to new chemistry which underpins ongoing research activity in major pharmaceutical companies, enhanced the competitiveness of a UK SME, and contributed to the position of pharmaceuticals as one of the UK's most dynamic industries.

¹² Numbers reported on completed EPSRC research projects assessed in 05/06 and 06/07

Commercialisation

Another key element is the **promotion of commercialisation and enterprise** through focused programmes such as the Follow-on fund, Business Plan Competition etc.

- EPSRC invested about £1.3 million on commercialisation programmes in 2006/07.

Delivering Benefits to Government and Public Services

EPSRC also provides inputs across a wide range of Government policy and delivery, and supports better healthcare, improved transport, flood control, crime prevention, anti-terrorism, and combating climate change, for example, through reduction in carbon emissions. EPSRC works effectively with partners across the public sector:

- Our partnership with the Department for Transport covers transport technology research and transport and land use planning, both of which have attracted co-funding from other key stakeholders such as the TSB, Rail Research UK, and the East of England Regional Development Agency.
- Our crime portfolio also features extensive end-user collaboration including Home Office Agencies, Police Services, Local Authorities as well as industry.

Summary of Economic Impact Baseline

Delivering highly skilled people into the wider economy

- 34% EPSRC-supported PhD students take up initial employment in business and public services i.e. over 2,500 of our current students.
- 1,700 PhD students are supported in collaborative training partnerships involving 230 user organisations.

Delivering benefits to business through the exploitation of excellent research

- 159 licences and patents and 104 spinout companies have arisen from EPSRC research assessed over the last two years.
- Over 2,000 user organisations are currently collaborating on EPSRC research grants.
- 77% of users were satisfied with the research grant partnership in which they had been involved.
- 28 organisations engage with EPSRC through Strategic Partnership agreements.

Delivering benefits to government and public services

- Benefits include: better healthcare, improved transport, flood control, crime prevention, anti-terrorism, and combating climate change.