BIS | Department for Business Innovation & Skills

SCIENCE AND INNOVATION INVESTMENT FRAMEWORK 2004:2014

Annual Report 2009

Contents

1 Executive Summary

1.1 This is the fifth annual report on the *Science and Innovation Investment Framework 2004-2014*[1] (SIIF). SIIF set out the actions which the Government and its partners needed to take to create the right conditions for Britain's knowledge-based economy to grow, and also how this progress would be measured.This report concentrates on progress against the six broad themes[2], including key performance indicators and implementation highlights from the past year.

1.2 Progress on a number of the original Innovation measures in SIIF will be reported on in the second Annual Innovation Report AIR which will be published shortly.

Overall Progress

1.3 At the halfway stage, overall progress has been good. Rising public investment has helped keep UK research second only to the USA in world rankings. Knowledge transfer activity continues on an upward trend, and there has been good progress in attainment levels and take-up for Science, Technology, Engineering and Mathematics (STEM) subjects. There has been less success in increasing the UK's investment in R&D as an overall percentage of GDP and this remains a key challenge for SIIF.

World class research

1.4 UK researchers remain amongst the most efficient and productive in the world. The latest report on the performance of the research base shows the UK maintaining its world leading research position as second only to the USA on citations and highly cited papers. China has now overtaken the UK in terms of total publication output but has a 6 per cent world share of citations compared to the UK's 12 per cent. The 2008 Research Assessment Exercise (RAE) showed that 17 per cent of the research carried out by the UK was classed as being of world quality and 37 per cent internationally excellent. The Government will be spending nearly £6 billion per annum on science and research by the end of the current Spending Review period in 2010/11. Nearly £4 billion is provided by the Science and Research Budget and nearly £2 billion will reach Higher Education Institutions (HEIs) through the Higher Education Funding Councils quality-related (QR) funding streams.

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

[2] World class research, Responsiveness to the needs of the economy, Business R&D and innovation, Supply of scientists, Public understanding and engagement, Science and innovation across Government.

Improved financial sustainability

1.5 Continued good progress has been made on financial sustainability. The plans for moving towards Full Economic Costing (FEC) for research in UK Higher Education Institutions (HEIs) have now come to fruition. The CSR07 settlement is providing resources to complete delivery of the policy that Research Councils should fund research at 80 per cent of full economic costs. A Research Councils UK (RCUK)/Universities UK (UUK) review of FEC published in 2009 found that FEC was having a positive impact on sustainability. A Working Group to follow up the review is taking forward issues around improving the transparency and operation of the system.

Greater responsiveness

1.6 The research base continues to respond to incentives to increase the economic impact of public funded research. Evidence of increases are highlighted in the latest Higher Education - Business Community (HEBCI) and Public Sector Research Establishment (PSREs) surveys which show continued growth against a range of measures including an increase in Higher Education Institutions creating new businesses . Research Councils are also driving up the economic impact of their work and are now working with over 2900 companies in sectors ranging from broadcasting to biotechnology, engineering to insurance

Increased business investment and engagement

1.7 Business Expenditure on Research and Development (BERD) grew in real terms from £15 billion in 2006 to £16.1 billion in 2007 (the latest year for which figures are available). However, it continues to remain relatively static as a percentage of GDP at 1.1 per cent**.** Increasing this remains one of the most difficult challenges of the ten-year framework.

1.8 As stated in 1.2 progress against a number of the original innovation measures in the ten year framework and the activities of the Technology Strategy Board (TSB) will be covered more detail in the second Annual Innovation Report (AIR).

Supply of scientists

1.9 In 2008/09, entries to A level courses in mathematics, further mathematics, chemistry and physics increased significantly whilst individual GCSE science entries show very noticeable increases. The Diploma in Engineering was the most popular of the five Diplomas introduced in September 2008. In Higher Education, first degree entrants showed encouraging rises in science courses with notable increases in physics, maths and engineering subjects. The UK Science and Society strategy has been launched with Expert Groups on Science Learning and Science for Careers set up to advise government on strengthening science and mathematics education and improving science careers information, guidance and advice. The introduction of a new online registration system by STEMNET has showed a significant increase in new people joining the STEM Ambassadors programme.

Science and Society

1.10 This chapter highlights key achievements on building engagement and improving public attitudes to science, including the establishment of five expert groups to take forward key areas of the UK Science and Society strategy on public engagement, media, learning, careers and trust. 2009 also saw the launch of the Science: So what? So everything campaign which aims to show the relevance and importance of science to daily life.

Science across government

1.11 Professor John Beddington, the Government Chief Scientific Adviser (GCSA), promotes the underpinning of Government policy and decision-making by the best science and engineering. The GCSA provides advice direct to the Prime Minister and Cabinet, supported by the Government Office for Science (GO-Science) - a semi-autonomous body based within the Department for Business, Innovation and Skills (BIS). Over the last year, GO-Science has continued to work with government departments so that Government policy and decision-making is underpinned by the latest advances in science and engineering. In particular, the further appointment of Chief Scientific Advisers (CSAs) to major science-using departments, a new Science and Engineering Assurance process to assess department's capabilities in obtaining and using scientific advice, advice to Government from the independent Council for Science and Technology (CST), and the work of Foresight and its Horizon Scanning Centre (HSC) has helped the Government continue to harness and direct science and innovation to improve its own policy decisions and public service delivery.

2 Research Excellence

The original ambitions relating to research excellence and sustainability for UK science were outlined in the ten-year framework as follows:

World class research at the UK's strongest centres of excellence

- **maintain overall ranking as second to the USA on research excellence, and current lead against the rest of the OECD; close gap with leading two nations where current UK performance is third or lower; and maintain UK lead in productivity.**

Sustainable and financially robust universities and research institutes across the UK

- **ensure sustainability in research funding accompanied by demonstration by universities and public laboratories of robust financial management to achieve sustainable levels of research activity and investment.**

EVIDENCE OF PROGRESS

Research Excellence

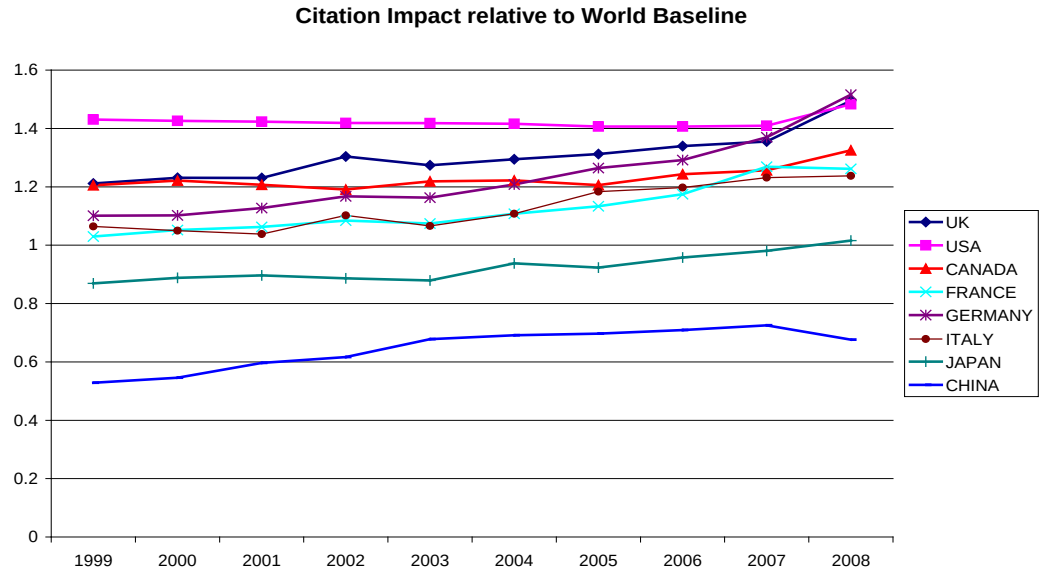
2.1 The 2009 independent annual report on the comparative performance of the UK research base shows the UK continues to retain its world class ranking[3]. The UK has the second highest world share of cited papers at 12 per cent and has increased its share of the most highly cited papers to 14.4 per cent. The USA continues to lead in both. The UK has also sustained a more consistent performance across the range of scientific disciplines than most other countries and retains its lead in the G8 on productivity measures. Although China has overtaken the UK in terms of total publications to claim second place behind the USA it currently receives just 6 per cent of world citations.

[3] http://www.dius.gov.uk/science/science_funding/science_budget/~/media/publications/I/ICPRUK09v1_4

Research Assessment Exercise (RAE) 2008

2.2 In December 2008, HEFCE published the results of the Research Assessment Exercise (RAE) which informed the allocation of £1.6 billion of funding for university research in 2009/10. The RAE confirmed that the UK is maintaining its ability to deliver world class research. 17 per cent of the research carried out by the UK was classed as being world quality and 37 per cent internationally excellent.[4] HEFCE is consulting on behalf of the Funding Councils on the Research Excellence Framework (REF), the successor to the RAE. The REF will continue to incentivise research excellence and HEFCE propose that for the first time research assessment will explicitly assess the impact of past research on the economy and society.

Indicator 1



Indicator 1.09 – Evidence Ltd. Report 'International Comparative Performance of UK Research Base'

2.3 Assessing excellence in research using indicators that are less dependent on absolute numbers of researchers confirms the leading position of the UK. As illustrated above the UK was second in the G8 last year for citation impact, culminating a period of sustained growth only comparable to that of Germany, which is now first in group. This excellent performance is also reflected when disaggregating across broad scientific disciplines where the UK ranks 3rd or higher in all but Social Sciences.

[4] http://www.rae.ac.uk/

Financial Sustainability

Higher Education Institutions (HEIs)

2.4 World class science needs world class infrastructure. A key aim of the Science Research Investment Fund (SRIF) is to ensure that the infrastructure and sustainability of the research base are improved in order to maintain research excellence. Over the last ten years the Government has invested over £1.5 billion in HEI infrastructure through SRIF. An independent evaluation of the benefits of SRIF[5] showed that this investment has enabled universities to lever external funding far greater than the original infrastructure investment amounts**.** In order to provide more stable and predictable funding to support university research infrastructure SRIF was replaced by the Research Capital Investment Fund (RCIF) in 2008. Total investment for this funding stream for the period 2008-11 is £655 million.

Full Economic Costing (FEC)

2.5 The CSR07 settlement is providing resources to complete delivery of the policy that Research Councils should fund research at 80 per cent of full economic costs. As it is four years since Full Economic Costing (FEC) was introduced, RCUK and UUK undertook a review of FEC to examine how the system has bedded down and what changes in its operation might be needed. The review addressed a number of questions including the contribution of FEC to the physical and financial sustainability of UK HEIs, what effects FEC has had on the nature of grant applications to Research Councils and more widely what effects has FEC had on research undertaken for Government, charities, the EU and business. The review reported that there has been a significant improvement in the financial position and sustainability of research in UK universities[6]. The review also recommended continuing with the present FEC model, whilst also suggesting a range of technical improvements. A Working Group comprising the main stakeholders will take forward issues around improving the transparency and operation of the system. It is expected to report back to RCUK and UUK in the spring of 2010.

[5] Science Research Investment Fund: a review of Round 2 and wider benefits, http://www.hefce.ac.uk/pubs/rdreports/2009/rd07_09/

[6] http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/reviews/fec/fecreport.pdf

Indicator 2

Research funding in HEIs 2007/08

	Total UK sector value £000	Total value of HEIs of some concern	Value at HEIs of some concern		
			Groups A & B	Groups C & D	Groups E,F,G,H
Externally sponsored research	3,714,000	0.3%	0	0.1%	0.2%
Main QR grant	1,697,098	0.2%	0	0.2%	0.0%
Total	5,411,098	0.2%	0	0.1%	0.1%

2.6 The sustainability of UK HEIs is assessed biennially by the HE Funding Councils through a set of 18 'trigger metrics' and HEIs individual sustainability plans prepared. The latest assessment shows that in 2007/08 only a small proportion (0.3 per cent) of research was undertaken at HEIs where there were some concerns about the HEIs long-term sustainability.

Public Sector Research Establishments (PSREs)

2.7 A commentary on the third monitoring exercise on the sustainability of Public Sector Research Establishments was published alongside last year's report[7]. A guide on best practice in managing sustainability to help individual PSREs and their parent Departments is being published alongside this report. PSREs continue to make good progress towards overall sustainability**.**

Global Partnerships

Global Science and Innovation Forum (GSIF)

2.8 The Global Science and Innovation Forum brings together Government Departments, funding agencies and learned societies with a major interest in international science and innovation issues. It discusses overall policy and strategic approach to key countries and themes. In 2008-09 it has discussed new opportunities in UK/USA collaboration following the change in US administration, priorities for UK-India science and innovation engagement and early preparations by BIS for the EU Framework Programme 8.

[7] http://www.dius.gov.uk/~/media/publications/3/3rd%20PSRE%20Sustainability%20Study%20Report

Science and Innovation Network (SIN)

2.9 The International Science and Innovation Network was established by the FCO in 2000 in response to the growing importance of science, technology and innovation for our future. In 2008 the FCO and DIUS - now BIS - strongly endorsed the work of the Network and its cross-Government role, and agreed that they would jointly fund the Network. The Network provides a strong facilitation service for the UK in science diplomacy, bringing together scientists and technologists, businesses and Governments to better enable the UK and its partners to meet future challenges. One of the key ways is through organising visits and events - over 500 in 2008/09 - and technology sector reports - over 500 in 2008. These activities included biobanking, industrial maths, Polar research agreements, developing civil research links, a brain machine interface research, a Global Partnership in Green Energy and a number of low carbon events.

EU Framework Programme

2.10 The UK has remained a strong player in the EU Seventh Framework Programme (FP7), receiving the second largest share of funding, €909 million equivalent to 14 per cent of the total. The UK academic sector continues to lead the way in FP7 as they amount to 61 per cent of all UK participations, UK businesses now account for 23 per cent of all UK participations in FP7 compared with 18 per cent in FP6, although this is still lower than other major EU countries.

European Research Council (ERC)

2.11 UK research institutions have been highly successful in competition for funding through the ERC, which has been established within the Seventh Framework Programme to boost excellence in basic research across Europe; some 20 per cent of grants awarded by the ERC have gone to UK-based researchers. A review of the governance and operations of the ERC was published in July 2009 and its recommendations are currently being considered by the European Commission.

3 Greater responsiveness to the needs of the economy

This chapter looks at the increased emphasis on delivering greater economic impact from UK basic research. Universities and public sector research establishments continue to report progress in realising the benefits of knowledge translation, whilst Research Councils continue to focus on driving up the economic impact of the research they fund.

EVIDENCE OF PROGRESS

HE-BCI

3.1 The Higher Education – Business Community Interaction (HE-BCI) survey helps to assess the volume and development of interaction between higher education, business and the wider community.

3.2 The latest survey results reveal continuing positive trends in knowledge transfer activities (baseline taken as 2000-01). Key findings include:

- HEI's have increased their income from knowledge exchange activities in 2007-08 to over £2.8 billion, an increase of 6.5 per cent from the previous academic year;

- collaborative research income has risen by 4.2 per cent since 2006-07 to over £697 million, with the largest increase in projects with the European Union as the public funder (alongside Research Councils and other Government Departments);

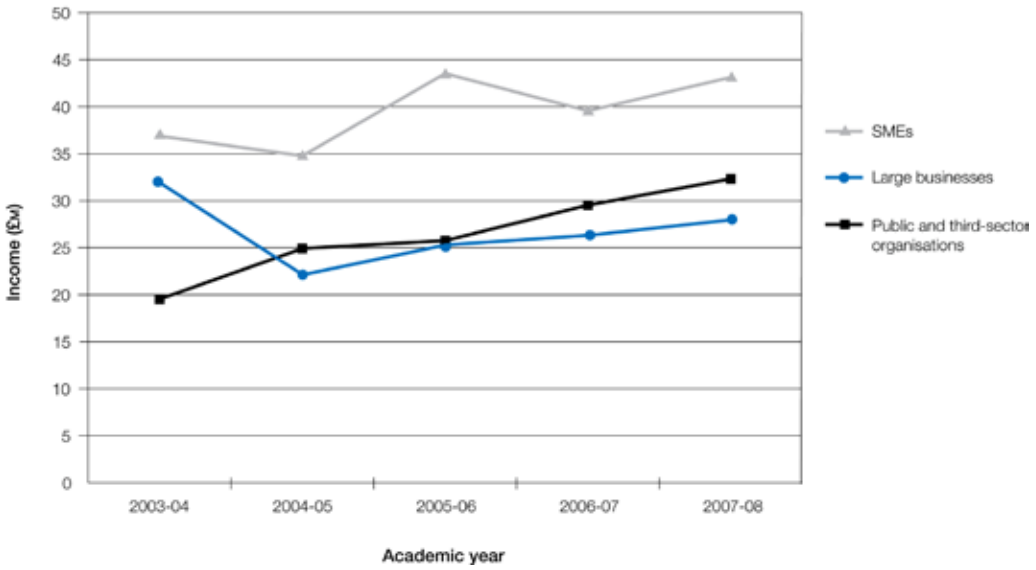
- there is evidence that staff and students of HEIs are being more entrepreneurial by creating new businesses. Since 2006-07 41 and 1,977 companies have been started by staff and students respectively (2006-07 saw 62 and 1,508 companies formed by staff and students). However, both staff and student start-ups in existence for three or more years have risen to 155 and 1,322 in 2007-08 respectively.

Indicator 3

HE-BCI survey (all UK)					
Income from UK HEIs/ £Ms (real terms)	**2000/1**	**2003/4**	**2006/7**	**2007/8**	
Collaborative research	496	599	687	697	
Contract research	n/a	639	804	835	
Consultancy	124	233	296	335	
Equipment services	31	88	95	103	
Regeneration	n/a	239	272	238	
CPD	n/a	326	498	537	
IP income (non-software + software licences)	n/a	34	41	45	
Total IP income (including sale of shares)	n/a	42	60	66	
Outputs from UK HEIs	**2000/1**	**2003/4**	**2006/7**	**2007/8**	
Patent applications	n/a	1,308	1,913	1,898	
Patents granted	n/a	463	647	590	
Formal Spin-offs established	n/a	167	226	219	
formal Spin-offs still active after 3 years	n/a	688	844	923	
% UK HEIs which provide:	**2000/1**	**2003/4**	**2006/7**	**2007/8**	**2008/9**
Enquiry point for SMEs	83%	n/a	91%	91%	93%
Short bespoke courses on client's premises	63%	n/a	84%	83%	88%
Distance learning for businesses	53%	n/a	68%	68%	68%
Required contracting system for all consult'cy	60%	n/a	73%	75%	75%

3.3 World-class facilities continued to strengthen the local community impact of investment in Science and Research as they attract a larger proportion of local smaller businesses than other knowledge transfer activities.

Indicator 4



Income from facilities and equipment (HE-BCI Survey)

Higher Education innovation Fund (HEIF)

3.4 HEIF now worth £100 million per annum has been successful in bringing together HEIs and business. Two evaluations[8] of the achievements of the policy have been produced concluding that the programme had delivered considerable value for money. For every £1 of funding, HEIs had achieved between £4.9 and £7.1 in value for services offered to businesses and the community.

Intellectual Property Office (IPO)

3.5 The IPO is involved in various initiatives to raise awareness and improve rights granting across the globe. Plans are being developed for a system of mutual exploitation of work between patent offices to reduce delays that can be an obstacle to innovation. The UK-IPO's network of Patent Prosecution Highway (PPH) agreements have recently been extended to the Korean Intellectual Property Office (KIPO) which will help speed up the patenting process for UK businesses abroad. The IPO's Patent Informatics Team produced a prototype disruptive technology analysis toolkit, which is gaining recognition across government and internationally, particularly in Knowledge Transfer Networks (KTNs) and sits alongside policy support projects in work-sharing and 'green patent' streams in the drive to help promote innovation in low carbon technologies.

Outreach Programme

3.6 The IPO outreach programme is primarily aimed at helping small businesses, creators and inventors use the IP system to realise the fruits of their creativity. This year saw the business outreach programme launch a major exhibition "Cracking Ideas" at the Science museum in collaboration with Aardman Animations and helps get innovation across to children and their parents in a fun way. An online health-check was launched to enable businesses to understand how IP issues apply to them from a commercial decision-making view-point.

Lambert Tool-Kit

3.7 The Lambert tool-kit for collaborative research was also expanded this year to include a new set of consortium agreements designed for technology collaborations involving several academic and industry partners. The Business-to-Business licensing advice programme plans to launch an extended suite of new materials in December on IP valuation and confidentiality, important for approaching issues about IP arising from research.

[8] The HE to Reach Out to Business and the Community (HEROBC) evaluation and the Public And Corporate Economic Consultants (PACEC) report Both reports are available on the HEFCE website at http://www.hefce.ac.uk

Research Councils

3.8 Research Councils continue to focus on driving up the economic impact of the research they fund monitoring the potential outcomes of their research portfolios, and reporting to BIS through reporting frameworks that cover investment, knowledge outputs, creating new business and delivering highly skilled people to the labour market. The Councils are working with over 2900 companies in sectors ranging from broadcasting to biotechnology and engineering to insurance, and with the Technology Strategy Board, Regional Development Agencies (RDAs) and other government departments to reach more businesses that can benefit from research;

- Research Council Institutes alone brought in £140 million from commercialisation of research[9];
- ESRC/EPSRC Advanced Institute of Management involves a third of the companies in the FTSE 100;
- EPSRC spend over 40 per cent of their budget in collaboration with business (£340 million per annum);
- over 200 businesses, employing over 4000 people, are located in Research Council campuses in Daresbury, Harwell and Cambridgeshire;
- major construction projects such as the Diamond Light Synchrotron at Harwell and the Laboratory of Molecular Biology at Cambridge support thousands of jobs in the construction industry;
- over the last ten years, university bioscience departments funded by BBSRC have generated over 200 spin-out companies, now employing over 1,000 people.

[9] Document 1.17: *Fourth Annual Survey of Knowledge Transfer Activities in Public Sector Research Establishments*, Technopolis (2008)

3.9 The overall scope and dimensions of Research Council economic impacts are too great to be reported in detail here. But examples of business interactions include the following:-.

- The Natural Environment Research Council (NERC) contributes to developing environmental markets, by managing the UK's Earth observation science budget, investing annually around £45m in the European Space Agency (ESA). The government estimates that space science is worth around £6 billion to the UK economy and directly supports 16,000 jobs in the UK. Earth observation research contributes significantly to these headline figures. The British Geological Survey extends the use of environmental science, providing information on subsidence and ground instability data to insurers, developer and planning authorities. NERC scientists build resilience and environmental protection into the economy, for example by measuring and predicting sea-level rise. Information from NERC's Proudman Oceanography Laboratory informs the operation of the Thames Barrier that protects London from flooding. Estimates of the value of this protection to the city reach £30 billion.

- *The Engineering and Physical Sciences Research Council* (EPSRC) supports research and training leading to business benefits through improvements to existing products, services and processes, as well as the creation of wholly new technologies, and to improvements in general business innovation capacity. EPSRC has developed strategic partnerships with a range of industries from large aerospace/defence companies (Airbus, BAE Systems) through to energy (E.ON) and pharmaceuticals (GSK, Pfizer, AstraZeneca). These partnerships provide a framework for supporting new knowledge creation and innovation capacity through research chairs, research projects, research consortia and studentships.

- Commercial use of the Science and Technology Facilities Council (STFC) facilities and technology programmes has grown, there are currently fourteen collaborative projects with industry with a value of £16 million. There are clear examples of new or enhanced products resulting from STFC's Technology and Skills base, via a growing numbers of partnerships between university researchers (30 joint appointments with HEIs) and STFC's laboratory-based staff (105 collaborative projects).

3.10 Many key sectors are heavily dependent on Research Council funded PhDs and demand has been high in pharmaceuticals, aerospace, computing, telecommunications and finance. Global R&D companies such as AstraZeneca recognise the contribution of PhD training to their ability to generate profits.

3.11 Collaboration between the Research Councils and the Technology Strategy Board (TSB) has led to strategic focus on key areas, with mechanisms designed to maximise the exchange of ideas, know-how and people, this has included :-

- TSB and RCs working together on the creation of new Knowledge Transfer Networks including one for the Financial Services sector and one for Creative Industries;

- Low Carbon Vehicles Integrated Delivery Programme (IDP) - a new five-year £200 million programme funded jointly by Government (TSB, DfT, EPSRC, RDAs) and business. A £7 million Strategic Programme led by EPSRC to develop a portfolio of university based research focussed on key longer term technologies for lower carbon vehicles is an important element of the IDP;

- Carbon Crucible – a partnership between NESTA, RC Energy Programme, UK Energy Research Centre and TSB. A new leadership programme for a select group of 30 early stage researchers in energy from business and academia.

Public Sector Research Establishment (PSRE) Fund

3.12 The fund helps Public Sector Research Establishments (PSREs) develop commercialisation teams and provide other technical services required to turn ideas into commercial opportunities; and create seed funds to provide early stage capital for spin out companies and to take them to the next stage where they can secure third party investment.

3.13 The fifth annual survey of knowledge transfer activities in PSREs shows an increase in both the number and value of licensing agreements. During the current year, the Department has continued to work with Partnerships UK to spread best practice among PSREs on the commercialisation of their research, including running well attended and successful workshops on, for example, using digitalisation to facilitate the commercialisation of research and on demonstrating the economic impact of PSREs.

INDICATOR 5

	First annual survey 2003-4	Second annual survey 2004-5	Third annual survey 2005-6	Fourth annual survey 2006-7	Fifth annual survey 2007-8
Business representatives on governing bodies	175	214	247	207	209
FTE staff employed in commercialisation offices	385	368	513	669	486
Number of patent applications	316	335	290	316	379
Number of patents granted	228	148	193	172	188
Number of licensing agreements	621	352	286	604	1136
Income from IP licensing	£33m	£46m	£186m	£116m	£146m
Number of spin-outs	69	84	74	101	89
Income from business consultancy	£36m	£31m	£26m	£43m	£37m

4 Increased business investment and engagement

The ten-year framework set out ambitions to raise investment in R&D to 2.5 per cent of GDP by 2014 and improve business engagement with the UK science base for ideas and talent. This chapter highlights some of the key achievements and actions to increase business investment and engagement in the last year.

4.1 Whilst the share of national income in R&D investment remains relatively low compared to other leading industrialised nations, this is largely due to the UK's industrial mix: UK companies generally show similar R&D intensities to others in their sectors, but the UK is also specialised in less R&D intensive industries. Research undertaken in BIS[10] highlights that most of the difference in R&D intensity between the UK and leading competitors can be explained by the sector mix. The study notes that R&D is but one component of innovation-relevant investment: firms engage in multiple modes of investment in innovation. Many innovating firms do not do R&D as it is traditionally defined – 59 per cent of innovating firms in the 2007 UK Innovation Survey did no R&D as defined normally. This does not mean that they do not use R&D results – rather they access external R&D and innovate in a wide variety of different ways. Knowledge transfer activities are therefore very important in the UK, and are an important focus of policy for both the Research Councils and the Technology Strategy Board.

EVIDENCE OF PROGRESS

UK Innovation Survey

4.2 Results from the most recent UK innovation survey indicate that the share of innovation active businesses in the UK reached 68 per cent in 2004-2006, up from 49 per cent in 1998-2000. The sectors with the highest incidence of innovation active firms are engineering-based manufacturing (equipment) and knowledge intensive sectors (research, financial and telecoms). A minimum of three quarters of firms in these sectors report innovation activity, either introducing a new product or service, or attempting to do so, or investing in R&D.

[10] "Business Innovation Investment in the UK" DIUS Research Report 08 http://publications.dcsf.gov.uk/default.aspx?PageFunction=productdetails&PageMode=publications&ProductId=DIUS-RR-08-13&

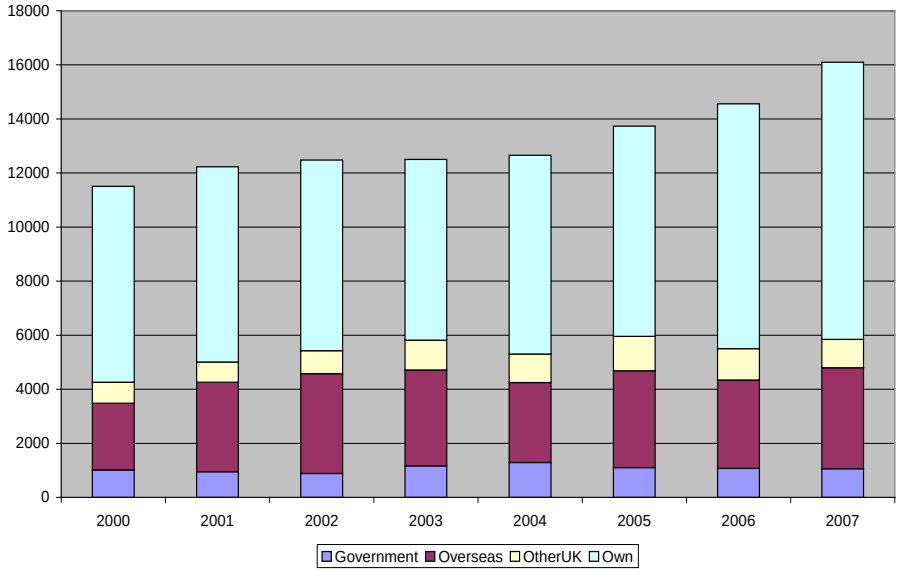
4.3 These same sectors are also those with the largest incidence of collaboration with Universities and Government/PSREs. Furthermore partnerships with Universities and Government/PSREs are highly complementary with one another but substitutes with collaborations with private partners[11], indicating that these public funds fulfil an independent role in the process of innovation.

Business R&D

4.4 In 2007, £16.1 billion was spent on total R&D performed in UK businesses. In real terms this was a 11.1 per cent increase on 2005**.** Because output was also growing sharply, the business R&D/GDP ratio remained constant at 1.1 per cent.

4.5 The industry with the largest investment in R&D was Pharmaceuticals, accounting for 28 per cent of the total, followed by Aerospace (13 per cent) and Telecommunications (10 per cent). Business R&D is predominantly intramural funded with own resources, with the government contributing around 7 per cent only in 2007. Indicator 6 demonstrates that, although relatively low in comparison with collaborating countries, total domestic investment has been increasing over time.

INDICATOR 6



Sources of funds for R&D performed by UK businesses

[11] "Innovators and the Research Base" DIUS Research Report 09-10. http://www.dius.gov.uk/science/science_and_innovation_analysis/~/media/publications/D/DIUS_RR_09_10

4.6 The Government's strategy for supporting business R&D investment in the UK is based around four priorities:

- maintaining or growing R&D in sectors where the UK is strong;
- attracting more R&D investment to the UK from abroad;
- increasing R&D intensity in firms or sectors that are lagging behind their peers; and
- creating new R&D intensive sectors through the creation and growth of R&D intensive SMEs.

4.7 The past year has seen further reforms to improve the UK environment for business R&D and make progress against these priorities, including an enhanced role for the Technology Strategy Board and changes to the R&D tax credit.

4.8 The product with the largest R&D was Pharmaceuticals, accounting for 28 per cent of the total, followed by Aerospace (13 per cent) and Telecommunications (10 per cent). Business R&D is predominantly intramural funded with own resources, with the government contributing around 7 per cent only in 2007. However, when separating between Civil and Defence research, UK Government funds make up for 39 per cent of Defence and 1 per cent of Civil research performed by UK Businesses. Although relatively low in comparison with collaborating countries, total domestic investment has been increasing over time.

Technology Strategy Board (TSB)

4.9 The TSB supports UK advanced technology capability via

- frontier technology development, aimed at supporting core technologies of advanced manufacturing and services:
- emerging industry support, supporting rapidly evolving technologies in high growth new industries;
- innovation platforms, that integrate business, universities and government in societal challenge oriented advanced projects;
- Knowledge Transfer Networks that facilitate knowledge flows to industry.

4.10 More details of the activities of the TSB are contained in the second Annual Innovation Report due to be published later this year.

R&D Tax Credits

4.11 The R&D tax credit schemes are the Government's most important policy in support of R&D investment by companies in the UK In 2008, the Government introduced further improvements to the R&D tax credit schemes. From 1 April 2008, the enhanced deduction available through the large companies scheme for qualifying R&D expenditure increased from 125 per cent to 130 per cent. From 1 August 2008, the enhanced deduction available through the SME scheme for qualifying R&D expenditure increased from 150 per cent to 175 per cent.

4.12 Additionally, the size of company that can qualify for the SME scheme also increased, from 250 employees to up to 500 employees, with the associated limits on balance sheet value and turnover also doubling. Increasing the value of the schemes displays the Governments continued commitment to helping innovative UK companies invest to grow.

British National Space Centre (BNSC)

4.13 The period since the last framework report has marked a highly successful year for the British National Space Centre (BNSC). The year began with a European Space Agency (ESA) Council meeting at Ministerial level where the Minister for Science committed roughly €924 million of funding to new and ongoing space R&D projects. Over the next five years UK companies can expect to win contracts as a result of UK's participation in a variety of ESA programmes under the "*juste retour"* principles. This will place the UK space community in a strong position to face the effects of the economic downturn.

4.14 The UK's relationship with ESA was further strengthened with the opening of a new ESA Research Centre based on the Science and Innovation Campus at Harwell. Agreement for the centre had been secured during the Ministerial. The centre will grow over the next few years bringing the UK even closer to ESA and placing the UK at the heart of the global space industry. The long term goal is to attract national and international industry and academia to the site, in order to build an innovation hub for UK space activity.

5 Supply of scientists, engineers and technologists

The ten-year framework highlighted the importance of a strong supply of scientists, engineers and technologists to the long-term health of the science base and the wider UK economy, and set clear ambitions to achieve change in:

- **the quality of science teachers and lecturers in every school, college and university, ensuring national targets for teacher training are met;**
- **the results for students studying at GCSE level; the numbers choosing STEM subjects in post-16 education and in higher education;**
- **the proportion of better qualified students pursuing R&D careers; and**
- **the proportion of minority ethnic and women participants in higher education.**

Science and Innovation Investment Framework: Next Steps included a range of further commitments to:

- **raise further pupil attainment and the quality of school teaching in science and mathematics;**
- **promote more collaboration between schools and higher education institutions in the teaching and learning of STEM subjects; and**
- **review and evaluate the changes to the curriculum to ensure science continues to enthuse and inspire pupils.**

EVIDENCE OF PROGRESS

5.1 Key Stage 3 data in 2008 showed that the proportion of pupils reaching the expected level (Level 5) for 14 year-olds in mathematics had risen to 77 per cent in 2008 compared to 76 per cent in 2007. In science, this was 71 per cent - down from its highest ever level of 73 per cent in 2007.

5.2 In 2009, number of entries to A level courses in mathematics, further mathematics, chemistry and physics increased significantly, although there was a small drop in biology.

INDICATOR 7

	2008	2009	Increase
Mathematics	57618	64553	(12%)
Further Mathematics	8447	9449	(11.9%)
Chemistry	36328	37174	(2.3%)
Physics	24703	25643	(3.8%)
Biology	48,397	48024	(-0.8%)

5.3 At HE level the number of STEM first-degree entrants in 2009/10 increased by 7.2 per cent for Physics, 7.9 per cent for Maths, 6.7 per cent for all engineering subjects and 1.9 per cent for Biology, compared to 2008/2009 entrants.

5.4 First Degree STEM qualifiers increased by 4.2 per cent between 2006/07 and 2007/08 (compared to a 5.5 per cent increase in non-STEM qualifiers), with increases in Chemistry (6.0 per cent), Engineering (2.8 per cent) and Mathematical Sciences (3.2 per cent).

5.5 In May 2009, BIS (then DIUS) published a Strategy for Science and Society in the UK, setting up five expert groups to review key issues which emerged from a consultation in 2008, including a group on Science and Learning to advise government on strengthening science and mathematics education and another looking specifically at the issues around scientific careers.

Schools

5.6 There has been further progress in the last year in the measures identified in *Science and Innovation Investment Framework 2004:2014: Next Steps* to increase the number of qualified STEM teachers, changes to the curriculum changes and improve careers advice.

Teacher recruitment

5.7 The Training and Development Agency for schools rolled out nationally accredited courses to give existing science and mathematics teachers without a physics, chemistry or mathematics specialism the deep subject knowledge they need to teach these subjects effectively. From September 2009 the Training and Development Agency is piloting a mentoring scheme to support newly qualified science and mathematics teachers.

Curriculum

5.8 In September 2008 the Government introduced an entitlement for all pupils achieving at least level 6+ at key stage 3 to study triple science to support its commitment to encourage more young people to study triple science. This and the statutory entitlement to study at least two GCSE's will be reinforced in the new pupil guarantee set out in the White Paper: *Your child, your schools, our future: building a 21st century schools system*[12] published on 30 June 2009.

5.9 A Further Mathematics support programme has been introduced to support the teaching of A level Further Mathematics and mathematics in Diplomas. The 'Stimulating Physics Network' is also being established to encourage more pupils, especially underrepresented groups such as girls, to study A level physics.

5.10 The Science and Learning group, led by Sir Mark Walport, Director of The Wellcome Trust, will make recommendations to the Department for Children, Schools and Families (DCSF) and BIS by the end of 2009 on how the curriculum, assessment framework and teaching workforce can be developed to provide the best possible education and training for the UK's scientific workforce, as well as what more Higher Education and industry can do to improve their relationships with schools and young people.

14-19 Diplomas

5.11 From September 2008 the Diploma in Engineering was one of the first 14-19 Diplomas to be available in schools and colleges. Available at three levels (1, 2 and 3), 2,800 learners took up a place in September 2008, making it one of the most popular of the first Diplomas to be delivered.

After school clubs

5.12 The STEM Clubs Network has been launched in response to Lord Sainsbury's "Race to the Top" report, in which it was recommended that there be a Science and Engineering Club in every secondary school over the next five years. STEMNET is working with other Club resource providers so that the new network adds value to all affiliating clubs and schools.

[12] http://publications.teachernet.gov.uk/eOrderingDownload/8357-DCSF-Parent%20Guarantee.pdf

STEM Careers

5.13 The Science for Careers group, led by Diana Garnham, Chief Executive of the Science Council, is considering what action is needed around Careers Information, Advice and Guidance (IAG). Three sub-groups are focussing on issues such as promotion and communication of STEM careers; Careers IAG services - who will deliver this and how; and improving employer/universities and schools interface with STEM.

5.14 Since its launch in March 2008, the DCSF STEM Communications Campaign has been advertising the scienceandmaths.net site on TV, radio and cinema throughout 2009.

5.15 DCSF have commissioned the development of comprehensive support for teachers focusing on how they can increase young people's understanding of the nature of STEM careers.

BIS Manufacturing Strategy

5.16 As a follow up to recommendations in the 2008 BIS Manufacturing Strategy 'New Challenges, New Opportunities'[13], an independent organisation, Manufacturing Insight, has been set up by Industry, in partnership with Government. It will play a key part in helping to challenge and change public perceptions of the sector, including campaigns in schools to build enthusiasm for careers in manufacturing. Manufacturing Insight has collaborated with STEMNET on the "Manufacturing the Future" schools campaign to promote manufacturing career prospects to young people. As a first step, teacher support material has been issued to 10,000 STEM teachers.

STEMNET and STEM Ambassadors

5.17 The community of STEM Ambassadors, now at 19,000 continues to grow. Since the launch of the new online system in August 2009, over 8000 people have applied to join the Programme. There has also been a significant increase in the number of requests to STEMNET for Ambassador assistance from schools across the UK.

5.18 The 'Leading Lights' Exhibition featuring photographic portraits of young STEM Ambassadors representing cutting-edge STEM careers is touring nationally at venues including science centres, museums, art galleries and shopping centres and has generated significant media coverage.

[13] http://www.berr.gov.uk/files/file47660.pdf

5.19 STEM Ambassadors were also key to the delivery of the 'Science by the Seaside' initiative held during the summer in 2009 as part of the Science: [So what? So everything] campaign, bringing real science to children and families.

Further Education

Teacher Recruitment

5.20 The 2006 FE Reform White Paper announced a series of strategic recruitment initiatives aimed primarily at improving the supply and quality of the FE teaching workforce:

- the 'Pass On Your Skills' campaign has recently targeted the STEM sector, amongst others, to attract people who might consider the opportunity to teach on a full or part-time basis.

- the 'Business Interchange' programme continues to encourage and support FE teachers in undertaking placements or exchanges with local businesses to refresh their subject knowledge and skills/techniques and feed this back into their teaching practice.

- the FE Bursary and FE Golden Hello schemes in 2009/10 continue to feature Science and Maths amongst the priority subjects attracting higher payments.

Continuing Professional Development (CPD)

5.21 All FE teachers are now required to undertake 30 hours CPD per year to maintain their professional standing.

Higher Education

5.22 In August 2009 the Higher Education Funding Council for England (HEFCE) launched their £20 million National STEM Programme to increase the number of graduates with skills in these disciplines, building on four pilot projects: Chemistry for our Future, Stimulating Physics, London Engineering Project and More Maths Grads.

5.23 In October 2008 HEFCE's review of the Strategically Important and Vulnerable Subjects, led by Sir Brian Follett, endorsed the Funding Council's approach to key subjects such as STEM and enhanced the role of the Strategically Important and Vulnerable Subjects Advisory Group to include an annual review of graduate supply and demand across these important disciplines.

Post Graduate Review

5.24 A review of Postgraduate education was launched in July this year and is due to report in Spring 2010. The review, led by Professor Adrian Smith, Director General of Science and Research in BIS, will principally investigate: global competitiveness of UK provision; the benefits of postgraduate study; the needs of employers; and issues surrounding participation in terms of access and diversity.

Research Careers

5.25 Since the launch of the revised Concordat to Support the Career Development of Researchers in June 2008, a Research Concordat Strategy Group has been formed and is taking forward a number of benchmarking and implementation activities.

5.26 Alongside the launch of the Concordat, Vitae[14] has:

- built an online programme to promote and champion the skills and career development of researchers;
- developed and launched new training programmes for HEIs;
- published a number of reports analysing the range, impact and perceptions of researcher careers.

Women in Science, Engineering and Technology

5.27 Between September 2008 and September 2009 the UK Resource Centre for Women in Science, Engineering and Technology (UKRC) has developed links with 428 new companies, advising and supporting on recruitment, retention and progression best practices for women scientists and engineers.

5.28 The UKRC has directly supported 737 women who have returned back into employment, training or further study.

[14] http://www.vitae.ac.uk/

6 Public engagement with scientific research and its innovative applications

The ten-year framework highlighted the importance that the Government attaches to greater public confidence and improved engagement in scientific research and its innovative applications. The ten-year framework set an objective to:

> **"demonstrate improvement against a variety of measures, such as trends in public attitudes, public confidence, media coverage, and acknowledgements and responsiveness to public concerns by policy-makers and scientists".**

During 2008/2009, the Government led a wide ranging consultation and outlined a new strategy for Science and Society. The strategy offers a shared vision of the kind of relationship needed in order to see science, in its broadest sense, restored to its proper place in UK culture. Five independent expert groups have been set up to take forward the key areas which emerged from the consultation: public engagement, media, learning, careers and trust.

This chapter describes the work carried out in the areas of public engagement, media and trust, providing evidence of the Government's progress against the measures outlined in the ten year framework. The areas of learning and careers are dealt with in chapter five.

EVIDENCE OF PROGRESS

National Science and Engineering Week Activities

6.1 National Science and Engineering Week (NSEW) in March 2009 involved over 3500 events and around 1.5 million participants. A grants scheme, managed by the British Science Association, provided a total of £100,000 directly to around 500 schools with either a high proportion of pupils from disadvantaged backgrounds or from ethnic minority communities, to enable them to run some sort of activity or event for NSEW 2009.

6.2 The Big Bang Fair, the UK's first Young Scientists and Engineers Fair, was held as a prelude to National Science and Engineering Week. The Fair attracted around 9,000 people and saw the culmination of the UK's first National

Science Competition with two young people selected out of 200 students named as UK Young Scientist and UK Young Technologist of the Year.

Science: [So what? So everything]

6.3 The Science: So what? So everything campaign was launched in January 2009 by the Prime Minister backed by an impressive line-up of celebrity science ambassadors. The campaign aims to show the relevance and importance of science to daily life, and aims to increase and widen public participation in science. Its core audience can be defined as the people who would not voluntarily access science stories in the media or regard science as being 'for them' whether as a general interest, a subject to study or a career to pursue.

6.4 In its successful attempt to 'put the science stories in the people pages' the campaign reached 25 million adults in the UK, over half the adult population The campaign has produced a wide range of media coverage.

6.5 A particular highlight of the campaign has been "Questions Kids Ask" – featuring poll findings on the difficult questions that kids ask their parents and providing the answers. This generated huge media interest becoming the third most read story on the BBC news website in two days.

6.6 As well as involving high profile supporters from outside the world of science, another tactic that the campaign employs is to create an information or event-based focus for public and media interest. The Science By the Seaside tour in August 2009, in which 'science buskers' met holiday-makers at six UK resorts, exemplified this approach. The tour was successful both in getting in front of families and sparking an interest in science through a range of visual stunts and at the same time achieving significant local coverage.

6.7 Other PR activities are planned throughout 2009/2010, but an important off-shoot of media campaigning will be the engagement of all sectors in supporting the 'Science: So What? So everything' campaign, through case studies and with event and other promotional opportunities.

Science and the Media

6.8, Lord Drayson and Ben Goldacre, clinical researcher, author of Bad Science and a Guardian columnist, discussed the quality of science in the media in front of a full house at the Royal Institution. The debate, chaired by broadcaster Simon Mayo, sold out in 90 minutes and became a global trending topic on twitter with over 1000 tweets during the debate alone.

Sciencewise Expert Resource Centre (ERC)

6.9 The Sciencewise Expert Resource Centre on Public Dialogue in Science & Innovation continues to build capacity across government for quality dialogue on key science and innovation issues.

6.10 In 2008/2009, three projects were completed: Stem Cell Dialogue (BBSRC/MRC), Public Perception of Industrial Biotechnology (BERR) and

Community Level Carbon and Energy Savings (DECC). Sciencewise – ERC contributed a total of £741,000 towards these projects and the associated Government Departments/agencies contributed £467,000.

6.11 Policy makers from the Research Councils and Government departments have already used the results from the Stem Cell Dialogue in decision-making, for example in developing guidelines for consent and informing policy on cord blood banking. Another recommendation from this study is that public engagement in stem cell science should be an ongoing, two-way process. This recommendation for continuous dialogue will be incorporated into future Sciencewise - ERC dialogue work with other government departments/agencies.

6.12 Two Sciencewise-ERC projects were initiated in 2008/2009: Public Engagement on the Severn Tidal Power Feasibility Study (DECC) and Synthetic Biology (BBSRC/EPSRC). Sciencewise ERC has committed £450,000 to the projects and the Government Departments/Agencies involved have committed a further £700,000. More projects are in the pipeline.

6.13 Six research reports were published to provide practical tools and guidance for policy makers on different areas which are perceived to pose particular challenges when planning and delivering a public dialogue project. These tools will help policy makers and scientists to improve acknowledgement and responsiveness to public concerns through dialogue.

7 Science and innovation across Government

The challenges currently facing the UK mean that it is vital that Government harnesses and directs science and innovation to improve its own policy decisions and public service delivery. In addition, the science and innovation that it uses must be robust, relevant and of high quality.

EVIDENCE OF PROGRESS

Chief Scientific Advisers

7.1 The further appointment of Chief Scientific Advisers (CSA) means that there is now a CSA in all major science-using departments, to ensure that science and innovation are at the heart of decisions within and across government.

7.2 The Core Issues Group of CSAs has worked with the GCSA on major and cross-cutting issues, including a review of the handling of challenging scientific issues arising as part of the Severn Tidal Power feasibilty project, and a peer review of a key Renewable Fuels Agency report on biofuels sustainability, which helped shape UK and EU biofuels policy.

Science Reviews

7.3 Science Reviews of the Department of Health and the Food Standards Agency have been completed and published. Government is now implementing a new, faster, light-touch, Science and Engineering Assurance, process with a view to completing a benchmark review of all remaining departments by March 2011.

Food Research and Innovation

7.4 A new government food research and innovation strategy is being set up to strengthen links and the coherence and impact of research investments across the public sector, centred on the Government's goal for a sustainable, healthy, safe and equitable food system, in the UK and internationally.

Nanotechnology

7.5 A major public evidence gathering exercise has been held to identify the areas and issues that must be addressed in the UK Strategy for Nanotechnology.

7.6 Infrastructure UK has been launched, this will be an independent advisory body to help Government on cross-cutting infrastructure issues and priorities - following the recommendations in the Council for Science and Technology (CST) report 'A national infrastructure for the 21st century'.

7.7 Government has welcomed the recommendations in the CST report 'Improving innovation in the water industry: 21st century challenges and opportunities', not least in terms of better co-ordination of R&D in the water industry, and has urged Ofwat to seek to encourage innovation where this contributes to the achievement of sustainable development.

Government Science & Engineering (GSE) community

7.8 The Government Science & Engineering (GSE) community has continued to grow in strength, and now has over 2,000 members. The GCSA, in his role as Government Head of Science and Engineering Profession (HoSEP), has developed a strategy, underpinned by key deliverables, to drive forward the network of Heads of Science and Engineering Profession across Government.

7.9 Following the recommendations of the CST report *How academia and government can work together*[15], the Government has published a 10 point action plan to strengthen and promote effective approaches to engagement between academia and government policy making .

Futures Work

Foresight

7.10 The Foresight project **'Infectious Diseases: Preparing for the Future'** has played a leading role in the establishment of a £55 million government investment in the research and development of diagnostic techniques, through the Technology Strategy Board's 'Identification of Infectious Agents' Innovation Platform.

7.11 Foresight reports have been launched on :

- **Mental Capital and Wellbeing** which is demonstrating a clear case for action across society - by Government, companies and individuals - to boost both mental capital and wellbeing;

[15] *How academia and government can work together,* Council for Science and Technology, October 2008, available at http://www2.cst.gov.uk/cst/reports/files/academia-government.pdf.

- **Powering Our Lives: Sustainable Energy Management and the Built Environment** which is exploring how the UK built environment could evolve to manage the transition, over the next five decades, to secure sustainable, low carbon energy systems that meet the needs of society, the requirements of the economy, and individuals' expectations;

- **Global Food and Farming Futures** is taking a global view of the food system to 2050 and beyond. The main drivers of change have been identified - including production inputs and outputs, climate change, population; competition for resources, economic and trade issues - and reviews commissioned. Six regional case studies are tackling specific issues in Asia, Africa, South America and Europe;

- a new Foresight project has recently been started on the **global impacts of migration arising from environmental change**.

Horizon Scanning Centre

7.12 The Foresight Horizon Scanning Centre has run 10 major horizon scanning projects for 9 separate Government Departments, with many more involved as stakeholders. These have, for example, input to the National Security Strategy and a set of world trade scenarios which are helping government to prepare policy for different possible world trade futures. The Horizon Scanning Centre has also continued to run training courses and other events to encourage the use of futures analysis in policy making across government.

- in Nov 2008 the Horizon Scanning Centre published an updated version of its "Sigma Scan" - www.sigmascan.org - containing over 250 futures papers designed to challenge assumptions and spark ideas. The Scan identifies future issues and trends across the entire public policy spectrum.

- to support this agenda, the Government recently published 'Science and Engineering in Government'[16]. This sets out, for the first time in one place, the Government's approach to the management and use of science and engineering within government including how it is ensuring that departmental science and engineering effort contributes to innovation wherever possible.

[16] http://www.dius.gov.uk/~/media/publications/GO-Science/GO-ScienceSEG

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