The ten-year Science & Innovation Investment Framework Annual Report 2005

July 2005

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INTRODUCTION

1 Science and innovation are key to ensuring the UK's long-term competitiveness in an increasingly knowledge-driven global economy. In all countries, economic activity is shifting towards innovation and knowledge-driven industries, with emerging economies moving up the value chain and challenging the predominance of the advanced economies. In this environment, the UK needs to build on its historical strength in scientific research to exploit new technology-driven and high value-added areas and secure its long-term prosperity.

2 *Long-term global economic challenges and opportunities in Europe*,[1] published alongside Budget 2005, demonstrated that the most successful economies will be those that are able to respond quickly to rapid technological and market changes, promote enterprise, productivity and innovation, and thus move up the value chain. Six key global economic challenges for Europe were identified including the need to take advantage of the increasing rewards from innovation as both global competition and the speed of technological change increase.

3 In July 2004, the Government published a ten-year *Science and Innovation Investment Framework*[2], which set out a long-term vision for UK science and innovation, together with the ambition that public and private investment in R&D should reach 2.5 per cent of GDP by 2014 (from a current level of 1.9 per cent). The ten-year framework was developed in consultation with stakeholders in the research base and the private sector, and business and the scientific community reacted very positively to its publication, welcoming the Government's long-term commitment to invest in this area. The Government also published a comprehensive set of indicators to monitor implementation of the ten-year framework, and made a commitment to report annually on progress against these indicators. This is the first of these annual reports.

4 Overall, the Annual Report shows that a solid start has been made in implementing the ten-year framework in 2004-05, though significant challenges clearly remain, particularly in raising business investment in R&D and increasing the supply of science, engineering, technology and mathematics (STEM) skills. A full list of the indicators and policy measures in the ten-year framework, together with a brief summary of progress against each, will shortly be available on the Office of Science and Technology (OST) website[3]. As this is the first year of implementation, the most recent reporting data available for some of the indicators pre-dates the ten-year framework, and a number of indicators are also still under development. The main report highlights the most significant policy developments and data outturns over the past year, which include:

5 Continuing delivery of **world-class research**, where the UK has maintained its position as second only to the US in global research excellence as measured by citations, and the UK science base remains the most productive among G8 nations. Measures have been implemented this year to improve the strategic management of public research funds through the Research Councils' new performance management framework, which was announced alongside the science budget allocations in March 2005. Further steps have also been taken to improve the Government's own use and management of science and innovation. For example, Government departments have been developing their science and innovation strategies, in collaboration with OST, and in some cases are integrating them within wider research and evidence strategies to ensure that the best evidence is applied to policy-making.

[1] Available at http://www.hm-treasury.gv.uk/documents/international_issues/int_global_index.cfm

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

[3] Available at www.ost.gov.uk/policy/sif.htm

6 Building on the additional resources announced at Spending Review 2004 for the **sustainability** of the UK science base, the Ministers for Science and Higher Education announced in January that Research Councils will pay 80 per cent of the full economic costs of the research they fund. Together with increases in quality-related research funding through Higher Education Funding Councils and continuing support for the renewal of university infrastructure from the Science Research Infrastructure Fund (SRIF), there is now a significant level of investment to help UK research institutions reach a sustainable trajectory.

7 Increasing the **responsiveness of the UK science base** to the needs of the economy was a key objective in the ten-year framework, in line with the recommendations of the 2003 Lambert Review of business-university collaboration[4]. Statistics from 2003 show a mixed picture, with university income from spin-out companies and licences falling in comparison to previous years, but continuing growth in the number of patent applications and income from contract research. However, during 2004, ten university spin-out companies with a combined value of £604 million were floated on stock exchanges in London and New York. Support for knowledge transfer and commercialisation of research from universities in England is being further enhanced through the development of a more predictable, metrics-based allocation process for the Higher Education Innovation Fund (HEIF) from 2006. Investment in regional science and innovation by the Regional Development Agencies (RDAs) is set to reach £360 million in 2005-06, and the RDAs are playing a leading role in facilitating links between the research base and business, most recently through the development of science cities.

8 Raising the level of **business investment in R&D** remains a significant challenge. In 2003 (the most recent year for which figures are available), UK business investment in R&D rose by 2 per cent in real terms, but needs to rise faster than trend GDP growth if the Government's long-term ambition is to be achieved. In Budget 2005, the Government announced its intention to enhance further the support for business R&D delivered via the R&D tax credit, and a discussion paper on this issue is published today. It also announced that Government departments would be obliged to spend 2.5 per cent of their R&D procurement budgets with small- and medium-sized enterprises (SMEs), providing greater support for small innovative companies. A business-led Technology Strategy Board was set up in November 2004 to identify key technology priorities which will be supported through the DTI's Technology Strategy, worth £370 million over 2005-08.

9 The indicators for improving the **supply of scientists, engineers and technologists** show a mixed picture at this stage. There has been a marginal improvement in GCSE attainment for science and mathematics in 2004, but the number of A-level entries in some sciences continues to decline. However, in higher education, the most recent application statistics suggest that interest in STEM subjects is on the rise overall, with significant increases in applications for chemistry, physics and mathematics, although electrical engineering and computer science have decreased. Vacancies for science teachers have fallen by around 40 per cent since 2001 to reach 1.1 per cent of total places in 2005, indicating that recruitment is improving. Other achievements for 2004-05 included the establishment of regional Science Learning Centres to provide professional development courses for science teachers; the setting up of the UK Resource Centre for Women in Science, Engineering and Technology (SET); and the launch of a programme in February 2005 to rationalise and enhance the various initiatives funded by Government to support the teaching and learning of STEM subjects.

[4] Available at http://www.hm-treasury.gov.uk/consultations_and_legislation/lambert/consult_lambert_index.cfm

10 Finally, if the UK is to become a world leader in science and innovation, it is essential to support the **public understanding of and engagement with science**. A recent poll conducted by MORI for the Office of Science and Technology found that attitudes towards science were improving, with 80 per cent of UK adults agreeing that science makes a positive contribution to society. However, the Government will continue to work to support an informed public debate on controversial issues such as stem cell research and nanotechnology. In September 2004, the "Sciencewise" programme was launched, providing £1.2 million over 2004-05 and 2005-06 to support public dialogue between citizens, scientists and policy-makers.

11 Priorities over the coming year include fully embedding the new performance management system for Research Councils and making further progress towards covering the full economic costs for research; completing arrangements for the next round of HEIF and announcing allocations by April 2006; continuing to work with business on improving private sector investment in R&D, for example through the UK Science Forum and the Technology Strategy Board; and developing a better understanding of supply and demand for STEM skills to inform future policy.

12 This document follows the structure of the ten-year framework itself. It looks first at funding for the bedrock of our national innovation system, the public research base, and also outlines progress in the effective management and use of science across Government. It then looks at progress in improving the responsiveness of our research base to the needs of the economy. The document then considers progress on private sector R&D, the key contributor to the overall R&D ambition set out in the framework. Finally, it turns to two issues which are key to the delivery of everything else in the framework: the supply of STEM skills, and public attitudes to science.

UK Business R&D performance

This Annual Report largely focuses on the actions undertaken by Government over the past year to implement the ten-year Science and Innovation Investment framework. However, a parallel increase in business R&D is necessary if the ambitions for R&D investment set out in the ten-year framework are to be achieved.

To understand better the challenges facing business, DTI and HM Treasury published a joint paper at Budget 2005 on the UK's business R&D performance[5]. The paper provided an in-depth analysis of sectors and a survey of global trends, bringing together a number of data sources for the first time. The main findings were:

- **overall, the paper found no strong evidence that UK R&D performers have a lower R&D intensity than their international competitors, *in sectors where they are active*;**
- **with the exception of certain sectors, such as pharmaceuticals and aerospace, large UK-owned firms are more likely to be located in sectors with a low R&D intensity. Consequently, there appears to be a relative lack of large UK-owned businesses in traditionally R&D-intensive sectors such as motor vehicles, IT and electronics;**
- **major foreign-owned investors in the UK tend to get their R&D from facilities abroad. However, the internationalisation of R&D may represent an opportunity for the UK, as investors seek to benefit from the UK's reputation for scientific excellence and relative cost-effectiveness; and**
- **several indicators suggest that the number of R&D-intensive SMEs is growing in the UK, including in sectors where the UK has traditionally fared less well (for example IT).**

The findings of this analysis support the broad strategy for improving the UK's business R&D performance set out in the ten-year framework, namely:

- **maintaining or growing R&D where the UK is strong;**
- **attracting international investment into the UK from multinationals in an already highly internationalised system;**
- **increasing R&D intensity in firms or sectors that are lagging behind their peers; and**
- **developing new R&D-intensive sectors through the creation and growth of R&D-intensive SMEs.**

The Director General of the Research Councils will report in more detail on the policy implications of this analysis in September 2005, and the findings will also inform the Government's discussions with UK R&D businesses, including through the UK Science Forum chaired by Sir Tom McKillop.

[5] DTI Economics paper no 11, *R&D intensive businesses in the UK*, available at http://www.dti.gov.uk/economics/economics_paper11.pdf

RESEARCH EXCELLENCE

Ambitions relating to research excellence and sustainability for UK science and innovation 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; and**
- **Retain and build sufficient world class centres of research excellence, departments as well as broadly based leading universities, to support growth in its share of internationally mobile R&D investment and highly skilled people.**

Sustainable and financially robust universities and public laboratories 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.**

To achieve these ambitions, the 2004 Spending Review allocated over £1 billion in additional funding for the science base up to 2007-08, including funding to enable Research Councils to cover a greater share of the full economic costs of research, and dedicated capital funding for the renewal of university infrastructure.

This chapter outlines key achievements over the past year to boost the global competitiveness of UK research, improve the sustainability of the public science base, and boost the effectiveness of the Government's own use of science, in particular:

- **Implementation of the Research Council's new performance management system, to maximise the impact of public investment in research on the UK's global scientific competitiveness and on the achievement of wider economic and social goals;**
- **Announcement by the Research Councils that they will cover 80 per cent of the full economic costs of the research they fund; and**
- **Further progress to improve the management and use of science across Government, including through the development of departmental science and innovation strategies.**

EVIDENCE OF PROGRESS

1.1 UK research starts from a position of strength. However, there is increasing global competition for scientific excellence, and the UK's higher education institutions and public sector research laboratories must be put on a long-term financially sustainable footing if the UK is to maintain its high world ranking for research. The Government must also ensure that a robust framework exists for forward-looking management of the science base, enabling it to respond quickly to new and emerging multi-disciplinary research opportunities. With 95 per cent of world science being performed outside the UK, the Government's aim is for the UK to become the global partner of choice for international science collaboration.

1.2 An assessment of the outputs of UK research published in October 2004 showed that the UK's science base ranks second only to the US on the majority of scientific indicators, and arguably outranks the US on a per capita basis[1]. With 1 per cent of the world's population, the UK is responsible for 5 per cent of world science, publishes over 12 per cent of all cited papers and almost 13 per cent of papers with the highest impact. UK science productivity is at the head

[1] PSA target metrics for the UK research base (Office of Science and Technology, October 2004), available at: http://www.ost.gov.uk/research/psa_target_metrics.htm

of the G8 in terms of both papers published and citations per researcher. Overall, the UK has a good all round performance ranking – second in six of the nine broad scientific disciplines – but we face significant challenges. Since 2001, Japan has overtaken the UK to become the world's second most prolific publisher, and Germany's strong performance is also notable, with the latest data confirming that it is the major research competitor for the UK in Europe.

Table 1.1 PSA target metrics for the UK research base[2]

Research field	World ranking	Trend 94-03
Bioscience	2	↑
Environmental science	2	↑
Social sciences	2	↑
Business	2	↑
Clinical	2	↔
Pre-clinical	2	↔
Mathematics	2	↔
Physical sciences	3	↔
Engineering	4	↓

Highlights:

- UK second overall in citation and high impact shares
- UK very high on citation "productivity"
- Some research fields do better than others

Data issues:

- Time lag of several years – still reflects 1990s funding.

1.3 The Government will continue to monitor the relative international performance of the UK science base. The next data series will be available in October 2005. The Government will also continue to develop the other indicators outlined in the ten-year framework, including investigating the scope for benchmarking research organisations against their international counterparts.

KEY HIGHLIGHTS AND NEXT STEPS

World-class research

Performance Management

1.4 In order to measure the outputs from the Science Budget and the impact of the Government's investment in science and innovation, a new performance management system for Research Councils and Academies was introduced in March 2005. The performance management system is built on measurable outputs derived from the ten-year framework, and will improve the translation of strategic priorities for the research base into specific aims and objectives for Research Councils and Academies. Improved performance management will help to:

- maximise the impact of the Science Budget on maintaining and improving the UK's science and engineering base, and inform the balance of investment across the Science Budget in relation to emerging priorities; and
- encourage the exploitation of research from the Science and Engineering Base to meet national economic and public service objectives.

1.5 Research Councils and Academies are now required to report annually against indicators linked to these objectives, improving performance measurement and promoting and spreading best practice. The measures used by the Research Councils and Academies continue to emphasise and promote multi-disciplinarity through their activities.

[2] Data reflects the number and share of world citations in nine major research fields.

Director General of the Research Councils (DGRC) Strategic Fund

1.6 Flexibility in responding to emerging priorities is key to successful management of the science base. In the 2004 Spending Review, £70 million was allocated for a Strategic Fund administered by the Director General of the Research Councils, which was designed to address emerging strategic priorities. The Director General has since announced that the Strategic Fund will be used to support energy and clinical research, maintaining the health of disciplines, major restructuring, and the promotion of knowledge transfer.

Clinical Research

1.7 The UK Clinical Research Collaboration (UKCRC) brings together the major stakeholders that influence clinical research in the UK, particularly in the NHS. The aim of UKCRC is to take a strategic view of clinical research in the UK, identify gaps in clinical research capability and programmes, and develop co-ordinated approaches between the major funding bodies to fill these gaps. In May 2005, UKCRC partners including the Medical Research Council (MRC), the Wellcome Trust, the Wolfson Foundation, the Department of Health, and the Scottish Executive Health Department announced that funding of £74 million would be made available for a co-ordinated initiative in experimental medicine in the UK to develop new treatments for patients.

Research Councils

1.8 To implement the priorities identified in the 2004 Spending Review allocations process, Research Councils will take the following actions over the next year:

- The Engineering and Physical Sciences Research Council (EPSRC) and HEFCE will grant 20 Science and Innovation Awards to strengthen research capacity in areas of relative weakness such as statistics, physical organic chemistry, structural materials, electronics design, and energy research and development;
- EPSRC will award grants for five new consortia working in wind energy, biofuel cells, energy infrastructure, energy storage, and keeping the nuclear option open;
- The Economic and Social Research Council (ESRC) will allocate 65 new fellowships in Economics, Management and Business Studies and Advanced Quantitative Methods to improve the health of these disciplines; and
- MRC will increase its expenditure on clinical trials so that it increases by £35m per annum by 2007-8.

Financial Sustainability

1.9 Parallel activities are taking place within both higher education institutions and public sector research establishments to ensure the long-term financial health of the UK research base.

Full Economic Costing

1.10 The *Cross-Cutting Review of Science and Research*[3] found convincing evidence that the UK university research base was on an unsustainable trajectory. *Investing in Innovation*[4] informed the Government's decision to invest directly in university science research infrastructure, and increase from 2005-06 the amount that Research Councils contribute to the full economic costs of university research. The Science and Higher Education Ministers announced in January 2005 that Research Councils will pay 80 per cent of the full economic cost on all successful research grant applications received from September 2005. Government departments will pay 100 per cent of full economic costs of the research they commission[5].

[3] *Cross-Cutting Review of Science and Research: Final report*, HMT, DfES, DTI, March 2002. www.hm-treasury.gov.uk/spending_review

[4] *Investing in Innovation: A strategy for science, engineering and technology*, DTI, HM Treasury, DfES, July 2002. www.ost.gov.uk/invest-innov.htm

[5] Further information on Full Economic Costing is available at http://www.ost.gov.uk/research/dualsupport.htm

The Higher Education Funding Council for England (HEFCE) has announced the establishment of a charities partnership fund, which will help to underpin the high quality research funded by charities. £135 million will be available to universities in 2006-07.

1.11 Over the next year, work will continue with Government departments and other funders to embed this phase of the move towards greater sustainability. The implementation of these changes to Research Council funding will be monitored by Research Councils and OST over the coming months.

Funders' Forum

1.12 The Funders' Forum brings together all major funders of research, including representatives from charities, business, Research Councils, Funding Councils and Government Departments, to consider the collective impact of their strategies for the future of the UK research base. Their focus in the last year has been on developing career paths for researchers, improving the health of disciplines (e.g. engineering and physical sciences), and working with Funding Councils and higher education institutions to develop a light touch set of indicators to monitor the move towards sustainability.

Science Research Investment Fund (SRIF)

1.13 World class research needs world class laboratories and equipment. Since 1999 over £2 billion has been allocated through the Joint Infrastructure Fund and the Science Research Investment Fund (SRIF) to build up universities' research infrastructure across the UK.

1.14 The third round of SRIF was announced in July 2004 as a fund of £1 billion for 2006-08, jointly funded by DTI and DfES. Individual allocations to Higher Education Institutions (HEIs) were announced on 31 January 2005, and HEIs had until 30 May 2005 to submit proposals detailing how their allocation will be used. The funding councils have introduced an electronic application process to reduce the administrative burden on HEIs, and proposals will subsequently be subject to a light touch review process, allowing funding to be confirmed as early as possible.

Case Study 1a: MerseysideBIO incubator

The MerseysideBIO business incubator building is a state of the art facility for developing biotech businesses, which provides laboratory and office space for 15 start-up companies and is giving Liverpool University and Liverpool John Moore's University the opportunity to translate leading edge research into commercial activity. The new centre was made possible by a large SRIF 1 grant of £12.5m – the third largest project supported by this fund. The incubator attracted a further £3.5m grant from the European Union. Provexis, a company based at the facility, has developed a drink that could be as effective as aspirin at preventing dangerous blood clots. The orange-flavoured drink contains a clot-busting extract found in ripe tomatoes that has been shown to reduce blood's 'stickiness'.

Shoppers will be able to buy packs of seven 'single-shot' drinks, to help prevent heart attacks and strokes. It is also hoped that airlines will eventually stock the juice on all long-haul flights, to help reduce the dangers of deep vein thrombosis (DVT).

1.15 SRIF is already making an impact on universities across the country. A recent consultancy exercise commissioned by OST gathered 85 case studies from across the UK[6]. Academics reported that SRIF has:

- boosted staff morale;
- attracted new staff from UK and overseas;
- increased student numbers at undergraduate & postgraduate level;

[6] JM Consulting Report 2004 www.ost.gov.uk/research/funding/underinvest/report June 2004.

- established the credibility of the university among the local business community and encouraged greater use of facilities by SMEs; and
- increased involvement of the local community, NHS and schools.

Case Study 1b: Northern Institute for Cancer Research

In February 2005, Sir Bobby Robson, the former England and Newcastle United manager, who himself survived cancer, opened the purpose built Paul O'Gorman Building, which will now house the Northern Institute for Cancer Research (NICR) adjacent to the medical school at Newcastle University. The £10m state of the art centre has been built and equipped thanks to a partnership between more than half a dozen local and national charities, Newcastle University, and £4.5m from the Government's Science Research Investment Fund.

Public Sector Research Establishments (PSREs)

1.16 The 2004 Research Council Institute and PSRE Sustainability Study (RIPSS) report[7] looked at ways to improve the financial sustainability and strategic coherence of PSREs. In order to help Government departments and Research Councils implement the recommendations of the report, the OST, with the support of HM Treasury, will establish a new forum from September 2005, to be known as "Research Establishment Sustainability UK". The forum will bring together Government Department sponsors and Research Councils to discuss matters relating to the sustainability of their research institutes. A contractor has been appointed to provide this committee with an assessment of progress on implementing the recommendations of the RIPSS report by autumn 2005.

Large facilities

1.17 OST maintains a Large Facilities Capital Fund (LFCF). This enables Research Councils to seek additional capital for large investment in infrastructure, ensuring that UK scientists have access to the facilities they need. The fund covers both large national facilities and participation in international facilities located both in the UK and abroad. The Large Facilities Road Map[8] is a 15-year forward look of all large facilities which Research Councils and DTI consider priorities for UK researchers, both national and international, within the UK and abroad. A new Large Facilities Road Map will be published in summer 2005. A prioritization exercise ranking the projects that would potentially benefit from the LFCF will be completed by the end of 2005.

Effective management and use of science and innovation across government

1.18 In the past year, the Government has increasingly worked across departmental and public-private sector boundaries to ensure that its own R&D programmes deliver public service goals and support the translation of research into wider economic benefit.

Cross-Government Collaboration

1.19 Departments and agencies have been developing their own science and innovation strategies, with input from OST. These strategies reflect the priorities for Government research set out in the ten-year framework: to provide input to policy-making and service delivery; to encourage innovation and wealth creation; and to contribute to government-wide knowledge and cross-government challenges. Those departments that have completed or are redrafting their existing strategies are offering best practice guidance to others. By sharing their experience, departments are also contributing to improved exploitation of science and closer co-ordination of their activities.

[7] Research Council Institute and PSRE Sustainability Study, April 2004 http://www.ost.gov.uk/research/psre_sustainability

[8] Further details of the Road Map and the LFCF can be found at: http://www.ost.gov.uk/research/funding/lfroadmap/index.htm

1.20 In the past, departmental Science and Innovation strategies have been weak on innovation. Through Autumn 2004, OST and DTI's Innovation Group worked in partnership to strengthen innovation in departmental strategies and share experiences and best practice across Government.

Case Study 1c: Science and Innovation Strategies – best practice in the Department of the Environment, Food and Rural Affairs (DEFRA)

DEFRA's Science and Innovation strategy was one of the first to reflect the priorities set out in Chapter 8 of the ten-year framework. DEFRA has subsequently made efforts to engage in more joined-up strategy formulation and to map the funding landscape, which offers a benchmark of joined-up thinking at the strategic level. DEFRA has developed a new evidence and innovation strategy for 2005-08, which will be put out to consultation in the autumn. This strategy seeks to embed all analytical disciplines into evidence-based policy making, drawing clear linkages between the mix of evidential bases and the strategic and operational needs of public policy. DEFRA will continue to actively share best practice to improve performance across Government departments.

Science Reviews

1.21 High quality science and scientific research programmes are a fundamental requirement of improved service delivery and policy development.

1.22 The Science Review Team, set up in 2003 in response to the 2002 Cross Cutting Review of Science and Research[9], is now fully operational. The team is undertaking a rolling programme of external scrutiny and benchmarking of the ways in which Government departments use science and manage research and sharing best practice.

1.23 The review of science in the Department for Culture, Media and Sport (DCMS) was published on 14th October 2004[10]. Reviews of the Health and Safety Executive (HSE) and DEFRA are underway and are expected to report in the first quarter of 2006. Work has also started on the review of the Office of the Deputy Prime Minister (ODPM), the fourth in the series.

1.24 The Chief Scientific Adviser published guidelines in 2000 to help departments ensure that scientific analysis is fed through to policy-makers and forms part of the evidence base for decision-makers. The guidelines are currently under consultation and an updated version will be available later in 2005.

Coordination of Research and Analysis Group (CRAG)

1.25 In December 2004, the Coordination of Research and Analysis Group (CRAG) was established, with a remit to set strategy across Government for the provision and coordination of analytical services, including economics, social research, statistics and other forms of evidence alongside scientific evidence. In response to a perceived lack of recognised funding and delivery mechanisms for cross-departmental working, CRAG convened a seminar in June 2005 involving senior policy-makers to consider priorities for cross-cutting research and analysis. Further progress will draw on Ministerial and other senior support to effect change in departmental cultures.

Collaboration between the Public and Private Sectors

1.26 In March 2005, OST launched its new Horizon Scanning Centre. Its aim is to identify and explore emerging trends in science that may raise significant health, safety, environmental, social, ethical or regulatory issues. It will engage with a wide range of stakeholders – Research Councils UK (RCUK), the Prime Minister's Strategy Unit, departmental Chief Scientific Advisers and the private sector – through workshops,

[9] http://www.hm-treasury.gov.uk/media//3A7B0/science_crosscutter.pdf

[10] http://www.ost.gov.uk/policy/sciencereview/reviews.htm

interviews, joint working and through the "Future Analysts Network", a network of public and private sector representatives recently launched by the Chief Scientific Adviser. Two contracts have been awarded to take forward the scanning work – a "sigma scan" (contracted to a partnership between MORI and Outsights) that will look at a broad range of future trends relevant to policy; and a complementary "delta scan" (contracted to the Palo Alto based "Institute for the Future") that will focus more closely on examining trends and emerging issues related to science and technology. These projects will report in December 2005, although pilot work has already informed cross-cutting exercises, such as Grand Challenges and the CRAG spring seminar[11].

Foresight

1.27 Foresight is the Government's science-based think tank, which provides evidence to Government on strategic cross-departmental issues with particular relevance to future policy. A focus of the programme is the development of networks across different Government departments, academic disciplines, and business sectors. New projects are tackling future developments in addiction and cognitive enhancement, detection of infectious diseases and intelligent infrastructures. Networks in research areas related to earlier projects on cognitive systems, cyber trust, flooding and aspects of the electromagnetic spectrum remain active.

Case Study 1d: Flood and Coastal Defence project

The Flood and Coastal Defence project demonstrated an innovative approach to cross-disciplinary and cross-Government working. The project pioneered a new paradigm for combining cutting-edge science and futures analysis to inform policy. In so doing, it has demonstrated the considerable potential of science to inform long-term decisions at the heart of Government.

The findings of the project, published as the "Future Flooding" report in April 2004, were instrumental in informing the DEFRA-led "Making Space for Water" consultation exercise, undertaken in Autumn 2004. This consultation will be at the centre of the development of the new cross-Government strategy for flood and coastal erosion risk in England for the next 20 years and beyond. In addition, the wider stakeholder community, including insurers and landowners, is using the findings of the project to address issues such as land-use management and long-term risk assessment.

Nanotechnology

1.28 In June 2003, the Minister for Science commissioned the Royal Society (RS) and the Royal Academy of Engineering (RAEng) to conduct an independent study and to report on the opportunities and uncertainties surrounding nanoscience and nanotechnologies. Their report[12] was published in July 2004, and the Government's response[13] to that report was published in February 2005, setting out the Government's agenda for the responsible development of nanotechnologies in the UK. As announced in the RS/RAEng report, by the end of 2005, the Government will publish an ongoing and projected nanotechnologies research programme; establish a comprehensive programme for policy co-ordination and public dialogue around the development of nanotechnologies (see Chapter 5); and commission an independent study on the implications of nanotechnologies for environmental regulations. A Nanotechnology Issues Dialogue Group (NIDG) has been formed to take forward the co-ordination of nanotechnologies policy, chaired by the OST and comprising officials from Government departments, Government agencies, and the Research Councils.

[11] The DTI's five-year plan, published in November 2004, included a commitment to "define, at Cabinet level, the 'Grand Challenges' facing public policy, where scientific research can play a major role in establishing the way forward".

[12] http://www.nanotec.org.uk/finalReport.htm

[13] http://www.ost.gov.uk/policy/issues/nanotech_final.pdf

Collaboration between Government and Independent Advisory Bodies

1.29 The Council for Science and Technology (CST), the Government's top level advisory body on science and technology policy issues, has examined a number of challenges associated with achieving the Government's vision for science and innovation. These include raising the level of private sector R&D investment, in particular the electricity sector[14]; how Government could gain broad public support for its S&T policies[15]; and techniques for making better decisions on which technologies to invest in. The Government has welcomed the CST's valuable contributions to these debates and intends to respond formally later in the year. Over the next year, CST will be focussing on the Government's use of personal data; enabling new and exciting science; and the use of scientific evidence about health in policy making across Government more widely.

Global partnerships

1.30 The Global Science & Innovation Forum (GSIF) has met a number of times, chaired by the Government's Chief Scientific Adviser, with representation from across Government. Led by GSIF, OST has started the development of an interim strategy, to focus co-ordinated international activity during the current Spending Review period. In addition, work has started on research, commissioned by OST, to provide evidence to inform the longer term International Strategy. This will explore drivers and barriers to international collaboration in both research and innovation, the benefits of such collaboration, the UK's performance, and the delivery of mechanisms to UK researchers to encourage collaboration. The draft International Strategy will be published in early 2006.

Framework Programme/EU

1.31 EU-financed R&D expenditure is channelled through the multi-annual Framework Programmes for Research. The Seventh Framework Programme (FP7), covering the period 2007-13, is currently under negotiation. Following a formal public consultation, the Government published a UK position paper on FP7 on 30 November 2004[16]. This set out the UK's view that the Framework Programme should focus on three key areas: basic research (including the establishment of a European Research Council), industrial research (which should continue to be the focus of FP funding), and research in support of policy. It also highlighted the need for improved management of the FP to encourage greater participation by business, particularly SMEs. The UK has made it clear that it recognises an a priori case for an increased focus on R&D, within a disciplined EU budget which demonstrates a responsible and prudent approach to spending. Initial negotiations have now begun and the UK Presidency of the EU will take place at a key stage of the FP7 negotiations.

1.32 OST will lead the UK negotiations on FP7 during the UK Presidency of the EU between July and December 2005 (where the UK will chair all meetings at working and Ministerial level), and through 2006. The UK will work with other Member States, the European Commission and the European Parliament to ensure substantial progress is made in the negotiations.

[14] *An Electricity Supply Strategy for the UK*, May 2005

[15] *Policy through dialogue*, March 2005

[16] Available at http://www.ost.gov.uk/ostinternational/fp7/fp7ukposition.html

2 Greater Responsiveness to the Needs of the Economy

The 2003 Lambert Review of business-university collaboration concluded that the UK was strong in research, but less effective at translating the products of research into social and economic benefits. The ten-year framework therefore set out to encourage greater responsiveness of the publicly-funded research base to the needs of the economy and public services, focusing especially on two targets:

- **Continue to improve UK performance in knowledge transfer and commercialisation for universities and public laboratories to world leading benchmarks; and**
- **Research Councils' programmes to be more strongly influenced by, and delivered in partnership with, end users of research**

The ten-year framework included the Government's response to the Lambert Review, and announced increased support for knowledge transfer from universities in England through the Higher Education Innovation Fund (HEIF). This chapter highlights key achievements over the past year to increase knowledge transfer and innovation from universities and public laboratories, in particular:

- **The development of a new metrics-based allocation system for the next round of HEIF, to help universities plan their knowledge transfer activities more effectively;**
- **The development of knowledge transfer plans by Research Councils, to increase the impact of public investment in research on the wider economy and society;**
- **Enhanced responsibility for the Regional Development Agencies to support business-university collaboration and regional innovation; and**
- **Implementation of the Lambert Review recommendations on intellectual property management and university governance.**

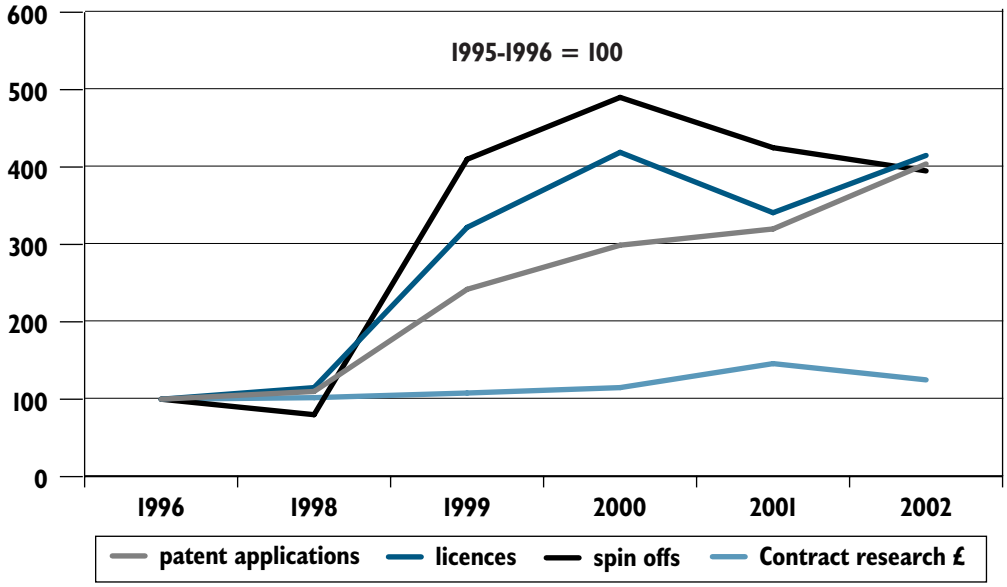
EVIDENCE OF PROGRESS

2.1 Between 1997 and 2004 the Government invested £500 million in schemes to help increase knowledge transfer and interaction between universities and business. To support the development of future policy and funding streams for knowledge transfer, OST commissioned an evaluation of knowledge transfer programmes funded by Government between 1999 and 2004. The final report was presented in January 2005 and concluded that while the full impacts of these programmes will not be felt for a considerable time, significant changes have been noted in the way that universities and PSREs have been able to interact with business[1]. The impact of knowledge transfer funding will be evaluated again in surveys of PSRE and university activities before April 2006.

2.2 The ten-year framework identified a basket of indicators to assess the impact of UK knowledge transfer programmes. Results available to date show that there are positive trends in knowledge transfer activities. This is illustrated by data from the university sector (Chart 2.1), which predates the ten-year framework. The PSRE and Higher Education Business and Community Interaction (HE-BCI) surveys show positive trends in knowledge transfer overall, although the most recent statistics (from 2003) show a more mixed picture, with university income from spin-out companies and licences falling in comparison to previous years, but continuing growth in the number of patent applications and income from contract research. The 2004 Pre-Budget Report introduced new legislation to remove tax barriers to the formation of spin-out companies, which is intended to restore spin-out activity to a higher level. During 2004, ten university spin-out companies with a combined market value of £604 million were floated on stock exchanges, both in London and New York.

[1] Further information on this study is available at http://www.ost.gov.uk/enterprise/knowledge/index.htm

Chart 2.1: Relative Changes in University Knowledge Transfer 1996-2002



Source: Annual HE-BCI surveys 2001-2005.

KEY HIGHLIGHTS AND NEXT STEPS

Higher Education Innovation Fund (HEIF)

2.3 HEIF provides funding to universities in England to develop technology transfer activities, entrepreneurship training, and seed funding for commercial ventures. The Government is committed to building HEIF as a dedicated "third stream" of funding to support knowledge transfer, as recommended in the Lambert Review. To help universities plan their long-term knowledge transfer activities more effectively, the allocation of funds under the next round of HEIF will move from a wholly competitive allocation to a system which is 75 per cent formulaic (i.e. driven by indicators of universities' success in knowledge transfer) and 25 percent competitive, making allocations more predictable for institutions. The total amount available for HEIF3 is £218 million over a two-year period from August 2006 to July 2008. Consultation over the detailed arrangements will begin in July 2005, but extensive informal discussions on the shape of the formula have already taken place. For example, universities from across the UK met on 27 June 2005 to share and develop good practice. Allocations for the next rounds of HEIF and the Public Sector Research Establishment (PSRE) fund will take place by April 2006.

Caste study 2a: Medical and industrial applications of swirling blood flow in veins

Research undertaken by Imperial College's department of bioengineering revealed that human veins join together with a twist, and that this stops blood clots forming at the join. Imperial Innovations, a commercialisation organisation from Imperial College which is funded through HEIF, have now facilitated the setting up of two spin-out companies from the university to apply this concept more widely. "In the body", Veryan Medical is commercialising a number of valuable surgical devices and implants that will save lives. "Out of the body", Heliswirl is looking at opportunities to apply this research in industries such as off-shore oil extraction.

Research Councils' Knowledge Transfer Plans

2.4 Plans for increasing knowledge transfer and interaction with business have now been written by each Research Council. These plans cover a range of different activities, reflecting the different nature of the Research Councils and their work. For example, the Engineering and Physical Sciences Research Council (EPSRC) aims to increase the amount of collaborative research from 43 per cent currently to 50 per cent – much of this in the form of grants to universities for work that is collaborative with business. The newly-formed Arts and Humanities Research Council (AHRC) will be defining new models of knowledge transfer for the creative industries and the arts and humanities research base. The Medical Research Council (MRC) intends to expand their commercialisation arm (MRC Technologies), and expects increased income from licensing.

2.5 OST has earmarked £15 million to give an additional boost to the delivery of Research Councils' Knowledge Transfer Plans, which will be supplemented by other funds from the Research Councils. In addition, £5 million has been set aside for knowledge transfer capacity building to be distributed equally between the Research Councils and Regional Development Agencies (RDAs). This will increase professional capability in knowledge transfer, enabling these organisations to interact more effectively with business when negotiating collaborations or the exploitation of research findings.

Case Study 2b: Treating industrial waste waters with microbes

The Centre for Ecology and Hydrology Oxford, a Natural Environment Research Council (NERC) institute, has developed a waste treatment system for used metal working fluids, which uses microbes and cutting edge molecular techniques to treat waste. The system has proven to be at least 90 per cent more effective than current biological waste treatment systems. The driver of the project is legislative pressure to develop more sustainable disposal methods that avoid the need for landfill. Research was funded by the Biotechnology and Biological Sciences Research Council (BBSRC), DTI, Ford and Castrol-BP, plus several SMEs. A spin-out company has been established to exploit the work.

Research Assessment Exercise 2008 – Recognising Applied Research

2.6 The Research Assessment Exercise (RAE) remains the key measure of HE research excellence. Arrangements for RAE 2008 are currently under development and will provide better recognition of excellence in all its forms. For example, panels will include representatives of research commissioning organisations, to ensure that applied research is treated on an equal footing with other forms of research; and research outputs such as patents and copyrights will also be considered. The Funding Bodies have made good progress on preparations for RAE 2008, and have completed the selection of members for the panels and sub-panels which will conduct the assessment. Assessment criteria for the panels will be published in July 2005, and a consultation on these is planned for the summer.

Regional Development Agencies

2.7 Significant discrepancies in total public and private investment in R&D and innovation continue to exist among the regions. However, the RDAs have recognised the importance of science and innovation to economic growth in all regions, and are increasingly reflecting this in their Regional Economic Strategies. The RDAs announced plans to spend £360 million in this area in 2005-06, a 50 per cent rise compared to 2003. In line with the recommendations of the Lambert Review, RDAs have been given an enhanced role in strengthening business-university links, and have set specific targets for the number of regional collaborations they will facilitate between businesses and the research base. All RDAs have set up, or are in the final stages of establishing, Science and Industry Councils: these regional bodies strengthen relationships between businesses and researchers, promote innovation, and provide strategic advice on regional science and technology. The Government has also welcomed plans by the RDAs to develop science cities, which will provide a focal point for businesses seeking to collaborate with world-class research establishments in the regions. Science city plans are currently being developed in Manchester, Newcastle, York, Birmingham, Bristol and Nottingham.

Regional Skills Partnerships (RSPs)

2.8 Regional Skills Partnerships bring together a range of partners (including the RDAs, the Learning and Skills Council, Jobcentre Plus, the Small Business Service and the Skills for Business network) to deliver a better skilled workforce within each region to support the achievement of Regional Economic Strategies. They were tasked in the recent Skills White Paper – '*Skills: Getting on in business, getting on at work*' – with reviewing how higher education could best be integrated into the work of Regional Skills Partnerships[2]. This includes encouraging support for research and innovation to enable knowledge and technology transfer from higher education to business.

Public Sector Research Establishment (PSRE) Fund

2.9 The PSRE fund supports growth in commercialisation activity from PSREs and has been steadily increasing in size since it was introduced in 2001. Up to £25 million is available for the third round of the competition, which will be launched in September 2005. In preparation for the third round of the fund, OST has been working with Partnerships UK to mentor PSREs with significant capacity to commercialise their research, but which currently lack the expertise to manage their knowledge transfer effectively.

Taking forward the Lambert Review

2.10 The Lambert Review identified a need for clearer guidance on Intellectual Property (IP) issues for businesses and universities seeking to collaborate on research. The Government welcomed the establishment of an "IP Working Group", chaired by Richard Lambert, to develop a range of model contracts representing a variety of approaches to the ownership and exploitation of IP, which would reduce the time and cost involved in securing IP agreements. Five model contracts (the "Lambert Agreements") and a toolkit for users were published in February 2005[3].

2.11 The Lambert Review also recommended that universities should develop codes of conduct to prevent conflicts of interest when collaborating with business, and a concise code of governance to improve management across the sector. In November 2004, the Committee of University Chairmen published a guide for members of higher education governing bodies, and a governance code of practice[4]. These set out a comprehensive range of best practice recommendations, and reflect the draft guidance originally developed in the Lambert Review. The Committee of University Chairmen will be surveying universities before the end of 2005 to assess how many are implementing the new governance guidelines.

Cambridge-MIT Institute

2.12 The Cambridge-MIT Institute (CMI) is a unique collaboration in UK higher education, aimed at developing innovative models for knowledge transfer and business-university collaboration[5]. CMI has developed "Knowledge Integration Communities", covering such areas as developing a "silent aircraft" and the next generation of drug discovery, which bring together Government, academic researchers and industry to tackle particular challenges. Sectoral investment groups are being set up to provide an environment where members can work together on the key challenges facing their business sectors and exchange ideas on potential solutions. Sector groups convened so far include Property & Construction and Passenger Transportation, and others are currently in development.

2.13 CMI has also been active in developing new educational models. A suite of six multi-disciplinary MPhil courses has been created, combining science and engineering with business and entrepreneurship modules. The PRAXIS courses for technology transfer professionals have also been highly acclaimed.

[2]See http://www.dfes.gov.uk/publications/14-19educationandskills/

[3]http://www.innovation.gov.uk/lambertagreements/

[4]http://www.shef.ac.uk/cuc/pubs.html

[5]See http://www.cambridge-mit.org for further information

2.14 In line with the recommendations of the Committee of Public Accounts and the National Audit Office, OST will undertake an ongoing assessment and evaluation of all CMI's work. OST is currently working with CMI and its stakeholders to identify opportunities for CMI to compete for funds to help sustain and further develop its key activities, and to disseminate effectively the models of knowledge exchange it is developing so that others benefit from CMI's experience. Beyond that, there are opportunities for CMI's work to be embedded in the wider academic community. Indeed, the success of the CMI experiment will be determined by the uptake of their ideas by universities (including Cambridge) and by CMI successfully attracting funding from a variety of sources. Funding for CMI from OST will run for a further 18 months, during which time CMI will position itself for a new phase of activity.

3 Increased Business Investment and Engagement

A key determinant of the success of the Government's science and innovation goals over the ten-year framework period, particularly the ambition that overall levels of R&D in the economy should reach 2.5 per cent of GDP, will be the level of commitment from the private sector to increase its investment in R&D and its links to the science base. Following the actions from the Innovation Report[1], the ten-year framework set out ambitions to raise business investment in R&D, and improve business engagement with the UK science base for ideas and talent:

- **Increase business investment in R&D as a share of GDP from 1.25 per cent towards a goal of 1.7 per cent over the decade; and**
- **Narrow the gap in business R&D intensity and business innovation performance between the UK and leading EU and US performance in each sector, reflecting the size distribution of companies in the UK.**

The ten-year framework outlined a range of support measures to encourage greater business investment in R&D, including the R&D tax credits and the DTI's Technology Strategy. This chapter highlights key achievements over the past year to build on these measures, in particular:

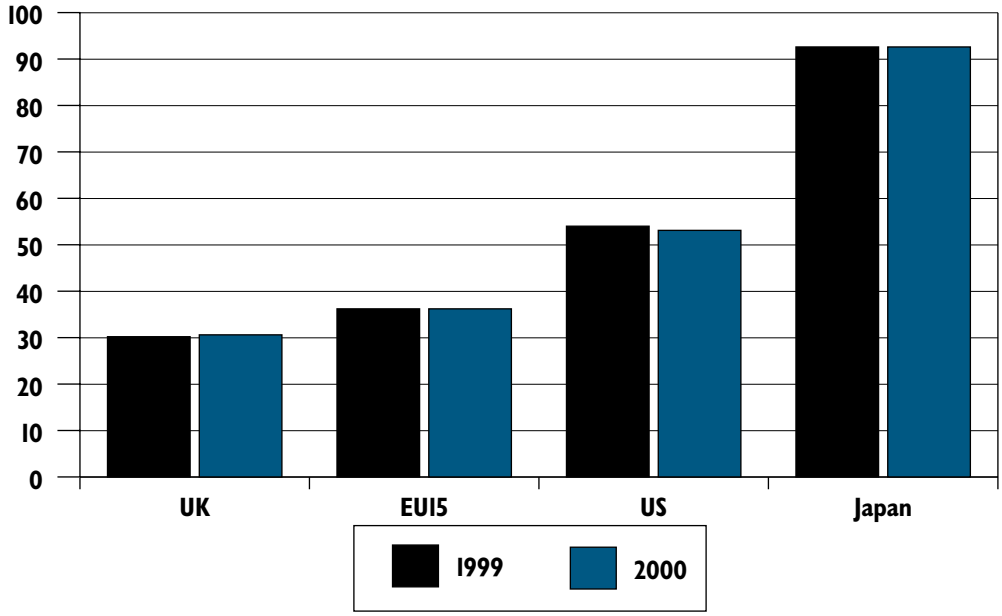
- **Publication today of a discussion paper on ways to further enhance the R&D tax credits;**
- **The establishment of a Technology Strategy Board to provide direct business input to funding priorities for the DTI Technology Strategy;**
- **The establishment of an obligatory target for Government departments and agencies to place 2.5 per cent of their extra-mural R&D contracts with SMEs, to support small innovative companies; and**
- **The creation of a high-level UK Science Forum to bring together Government, business leaders and scientists in support of the UK's R&D and innovation goals.**

EVIDENCE OF PROGRESS

3.1 The latest data show that between 2002 and 2003, UK business R&D increased by 2 per cent in real terms. Real GDP, however, increased at a slightly faster rate, and as a result the business R&D to GDP ratio remained flat at 1.23 per cent of GDP in 2003, compared to 1.24 per cent in 2002. According to the most recent statistics, the UK's relative level of patenting has also been flat (Chart 3.1).

[1] see http://www.innovation.gov.uk/innovationreport/ for an update on actions.

Chart 3.1: Number of triadic patent families by priority year, 1999-2000[2]



Source: OECD Science, Technology and Industry Outlook 2004.

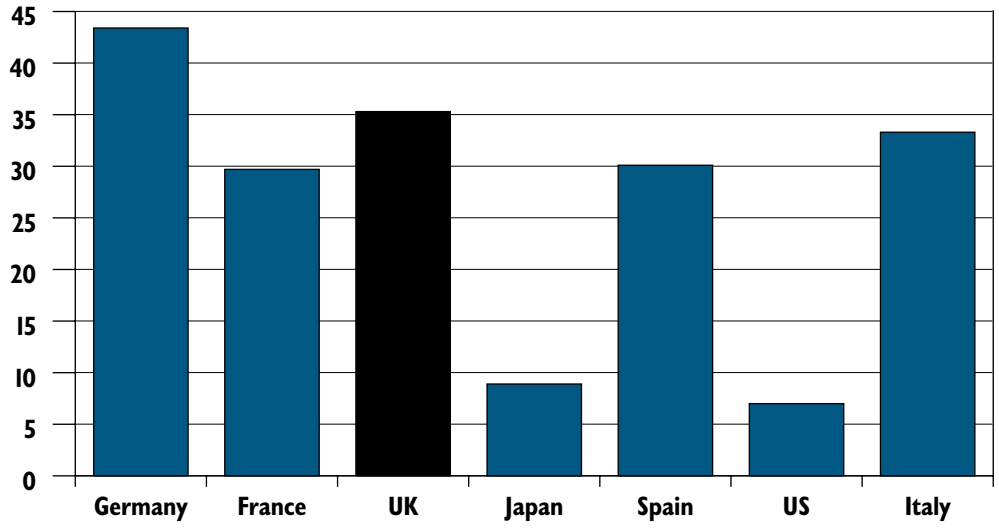
3.2 A recent analysis[3] of the UK's business R&D performance, published alongside Budget 2005, suggested that the UK's business R&D performance is largely due to a lack of firms, particularly large ones, in very R&D intensive sectors. Although the UK has particular strengths in pharmaceuticals, and aerospace and defence, most UK R&D performing businesses tend to be concentrated in less R&D intensive sectors. Ministers have asked the Director General of the Research Councils to identify the policy implications of this analysis, and he will report to Ministers in September 2005. (See the text box on p. 4 for more details).

3.3 Many highly successful UK businesses are in sectors where traditional measures of technology development, R&D and patenting are less prevalent, for example business and financial services and the creative industries. They may, however, be significant users of technology, and so data on other forms of intellectual property protection may be more relevant, e.g. European registration of designs and trademarks (see Charts 3.2 and 3.3).

[2] A triadic patent family is a set of patents registered at all of the three largest patent offices, namely the European Patent Office (EPO), the Japanese Patent Office (JPO), anf the US Patent and Trademark Office (USPTO). The priority year, as defined in the Paris Convention, is twelve months from the date of initial filing.

[3] DTI Economics paper no 11, *R&D intensive businesses in the UK*, available at http://www.dti.gov.uk/economics/economics_paper11.pdf

Chart 3.2: Designs per million people (1999)

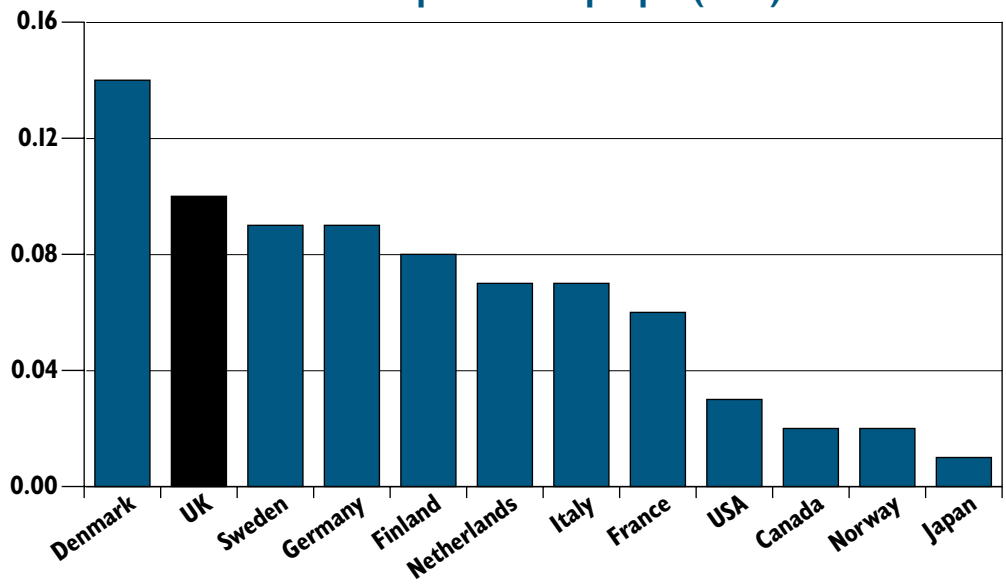


Source: Office of Harmonisation for the Internal Market (OHIM)

3.4 It is clear from this assessment that the traditional measures of innovation, such as business spend on R&D and patent applications, show little movement in the last year. The major challenge of increasing business investment and engagement is to ensure that the importance of innovation in strengthening performance and competitiveness is understood and acted upon. The analysis published alongside Budget 2005 indicates that these measures of performance should be supplemented by other measures in order to give a more complete picture of innovation in the UK. The Government will be looking to improve the measures of innovation, especially in services, in order to establish a more detailed evidence base.

3.5 It should also be noted that the UK continues to attract high levels of foreign R&D investment. Figures from the UK Inward Investment Report 2004-05, published in June, show that total R&D projects were up by 22 per cent to 101 compared to the previous year[4].

Chart 3.3: Trademarks per million people (1999)



Source: Office of Harmonisation for the Internal Market (OHIM)

[4]http://www.invest.uktradeinvest.gov.uk/investmentreport/index.cfm

KEY HIGHLIGHTS AND NEXT STEPS

Technology Strategy

3.6 The Government's Technology Strategy was launched in 2004 to provide a business-led framework for identifying and supporting emerging technologies which could deliver significant economic, social and environmental benefits, where the UK has the potential to become a world leader. A Technology Strategy Board was established to give a direct business steer to the Technology Strategy programme (worth £370 million over 2005-08). Over the last 12 months, four calls for proposals have been made, together worth £245 million. Topics covered include nanotechnology, renewable energy, advanced materials, computing, and bioprocessing. The Technology Strategy Board's first annual report, due for publication in November 2005, will provide a review of the impact of the changes the Government has made in support for business R&D. The Government will continue to work with the business-led Technology Strategy Board to focus intervention on the technologies and sectors with most potential to contribute to future UK prosperity.

Case Study 3a: R&D Knowledge transfer in the Department for the Environment, Food and Rural Affairs (DEFRA) – technologies to reduce our environmental impact

Through the Technology Strategy, an additional £50 million in funding is being made available to help businesses improve their resource efficiency, minimise waste, and to move towards the Zero Emission Enterprise. This funding has been contributed to the Technology Strategy from DEFRA through their Business Resource Efficiency and Waste programme. Knowledge Transfer Networks will further support this agenda through a range of activities, including technology translators able to assess the technology needs of individual businesses; advice to those conducting public procurement on potential innovative solutions; and regional activities working with the RDAs.

Small Business Research Initiative

3.7 The Small Business Research Initiative (SBRI) aims to raise productivity and business innovation by providing R&D contracts to technology-based small businesses, helping to provide early revenue and a route to market for firms that typically face barriers to funding their early development. Budget 2005 announced a mandatory target for those departments participating under the initiative: at least 2.5 per cent of the value of departments' and agencies' extra-mural R&D contracts will now be placed with SMEs. This requirement will further encourage SMEs to enter bids for public sector work, while maintaining value for money and quality of procurement. The Small Business Service (SBS) will work with the Office of Government Commerce (OGC) and HM Treasury to deliver the new SBRI regime. The Government will also work with Lord Hollick, who has been appointed to work with the OGC to embed the use of innovation in public sector procurement policy.

R&D tax credits

3.8 Since their introduction in 2000, R&D tax credits have shown strong take-up by business. Over 17,000 claims have been received, representing over £1.3 billion in support to date.

3.9 Budget 2005 announced further improvements to the administration of the credit, to maintain its success. HM Revenue and Customs (HMRC) and the SBS have jointly developed an introductory guide which will help small R&D firms make a claim, complementing internal measures to ensure that claims are dealt with on a consistent basis. The guidance has been piloted with SME representatives and other professional bodies to ensure it addresses the concerns of business and will be released later this year, once their views have been considered.

3.10 Budget 2005 also announced that, following consultation, the Government intends to enhance the R&D tax credit, giving further support to the UK's emerging innovative firms of the future. A discussion paper is being published today, opening a dialogue with business on these issues[5].

Box 3.1: R&D tax credits discussion paper

There are a number of reasons why firms may under-invest in R&D. R&D tax credits form part of a wider package of measures to increase innovation in the UK. They seek to address a key market failure that causes companies to under-invest in R&D because the public returns exceed the gain to the company itself.

Following extensive consultation with business, the Government introduced the R&D tax credit in 2000 for SMEs and extended the scheme to large companies in 2002. The straightforward system in the UK compares well with more complex systems in other countries, and strong take-up figures for the UK tax credits, particularly the SME credit, suggest that they are already having significant impact.

The discussion paper outlines the steps the Government has taken to ensure that the claims process remains simple, is applied consistently, and provides certainty to claimants so that the administrative burden is kept to a minimum. The paper invites views on next steps within this framework.

The pattern of R&D investment is changing, with the emergence of pockets of R&D intensity in new and overlapping sectors and groups – often outside the traditionally innovative industries. The world-leading R&D-intensive large firms of the future will emerge from these groups. The discussion paper sets out the Government's desire to support the emergence of these future R&D winners, whilst maintaining the integrity of the current tax credit system. The paper seeks the views of business on whether the Government is correct to focus attention on the 'emerging winners' at this stage in the development of the tax credit, and asks for more information on the characteristics of these firms and the issues they face. Finally, the discussion paper seeks early views on the efficacy of tailoring further support for the emerging winners within the tax credit system.

The discussion paper continues the Government's policy of consulting with business at each stage in the development of R&D tax credits. In the past, major business organisations, trade bodies, academics, and accountancy and finance professionals have all contributed views and influenced the design of the credits and the definition of R&D for tax purposes.

Foreign investment in R&D

3.11 The Foreign and Commonwealth Office (FCO), DTI and UK Trade and Investment are actively promoting the UK as the partner of choice for international R&D and facilitating inward investment and outward trade. This will be strengthened by the strategy for international engagement in science and innovation being developed by the Global Science and Innovation Forum (see chapter 1).

UK Science Forum

3.12 Following a recommendation of the 2003 Lambert Review, the Government announced the creation of a high-level forum between Government, business leaders and scientists to support the UK's R&D and innovation goals and contribute to evidence informing future spending decisions. The Science Forum is chaired by Sir Tom McKillop and is holding its inaugural meeting on 20 July 2005.

[5] *Supporting growth in innovation: enhancing the R&D tax credit*, HM Treasury, DTI and HMRC, July 2005.

Cox Review of Creativity

3.13 In the 2005 Budget, the Chancellor asked Sir George Cox to explore how creativity and design could be used more effectively by UK businesses to increase value added in the global economy, especially in SMEs and manufacturing. A parallel study of the impact of creativity on the economy is being carried out by the DTI. Both studies will be complete by this year's Pre-Budget Report.

Animal Rights Extremism

3.14 Action to tackle the threat to bioscientific research by animal rights extremists is a very high priority for the Government. On 1 July, legislation in the Serious Organised Crime and Police Act 2005 came into effect to strengthen police powers to deal effectively with extremist campaigns. These new powers are intended to address the campaign of intimidation and harassment directed at the supply chain of animal research organisations with the intent of preventing companies from carrying out their legitimate business. The Act also strengthens the Protection from Harassment Act 1997 and introduces further powers to enable the police to tackle protests outside people's homes. While Government respects individuals' rights to legitimate protest, it will take vigorous action against campaigns of violence and intimidation by animal rights extremists.

4 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 a step 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 science at GCSE level;**
- **The numbers choosing science, engineering and technology (SET) 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.**

The ten-year framework set out a comprehensive set of measures to improve the teaching and learning of science, technology, engineering, and mathematics (STEM) subjects. Building on those announcements, the key achievements highlighted in this chapter include:

- **Implementation of training bursaries and Golden Hellos to attract more science teachers into the profession;**
- **Support for the continuing professional development of science teachers, including through the establishment of Science Learning Centres in each region;**
- **The launch of a cross-cutting programme to rationalise and increase the effectiveness of the range of initiatives supported by Government and its partner organisations to promote interest in STEM subjects at all levels; and**
- **Creation of a Women's Resource Centre to work in partnership with business to increase the opportunities for professional women in science, technology and engineering.**

EVIDENCE OF PROGRESS

4.1 There are a variety of initiatives being pursued at all levels of the education system which contribute towards meeting the skills shortages in the labour market. There has been good progress in some areas over the past year, for example in primary school science, but other areas have yet to show a clear improvement. The Government is working to build up the evidence base on the supply and demand of science, technology, engineering and mathematics (STEM) skills to inform future policy.

4.2 Data from the 2003 National Employer Skills Survey (NESS 2003) provides the most appropriate baseline for monitoring demand for SET skills and identifying where the skills gaps and shortages are. The NESS is a regular[1] survey of skills needs across a representative sample of employers in England. NESS 2004, expected to be published in late July 2005, would build on the 2003 analysis, but would still not indicate the impact of the ten-year framework because the data was gathered at the same time that the framework came into effect (July 2004). NESS 2005, together with statistics collected by the Higher Education Statistics Agency (HESA) on the supply of SET graduates, will provide the earliest indication of impact in 2006. Stakeholders, including central Government departments, the Learning and Skills Council (LSC), and the Sector Skills Councils, will be working together on the subsequent annual reviews to monitor the market.

[1]The survey was first conducted in 1999, and then annually since 2001. In 1999, only employers with more than 5 employees were sampled, but from 2001 it is representative of all employers. The NESS's predecessor, the *Skills Needs in Britain* survey, goes back as far as 1990.

Quality of science provision in schools

4.3 OFSTED's latest annual report covering the school year 2003/04 gives evidence of continuing improvement in primary science. The quality of teaching and learning in science is now good or better in 67 per cent of schools; the figure was 58 per cent in 2002/03, although it remains weaker than the teaching of english and mathematics. At secondary level, the overall quality of provision in science is satisfactory in over nine schools in ten, and good or better in over seven in ten. The quality of teaching is better in Key Stage 3 (to year 9/age 14) than in Key Stage 4 (year 11/age 16). The expansion of the Key Stage 3 Strategy into the Secondary Strategy will provide an opportunity to carry forward successful practices and teaching approaches to ensure higher standards throughout the secondary phase of education.

4.4 Attainment in GCSE science has been improving marginally over time. There has been some improvement in the percentage of pupils who achieve A*-C GCSEs in any science: 47.6 per cent in 2001; 47.9 per cent in 2002; and 48.2 per cent in both 2003 and 2004. There has also been an improvement in mathematics GCSE attainment from 51 per cent A*-C in 2001 to 53 per cent in 2004. By contrast, there has been a decline in the number of A level entries in some sciences. From 1997/98 to 2004/05, biology fell by 7.4 per cent, chemistry by 12.2 per cent, and physics by 14.7 per cent.

Take-up of university science

4.5 There is a mixed picture for take-up of science subjects at university level. Between 2002/03 and 2003/04, undergraduate entrants for chemistry dropped by 5 per cent, engineering and technology by 2.2 per cent and computer science by 11.1 per cent, while physics rose by 2.3 per cent and mathematics rose by 4.9 per cent. Undergraduate qualifications obtained between 2002/03 and 2003/04 show that chemistry has dropped by 6 per cent, but engineering and technology has stabilised (0 per cent) while physics has risen by 1 per cent and mathematics by 2 per cent. The latest UCAS application figures for higher education show increases in applications to full-time undergraduate STEM courses in both 2004 and 2005. As of March 2005, there was an 11 per cent increase in mathematics, a 10 per cent increase in chemistry, and a 12 per cent increase in physics compared to March 2004, although electrical engineering and computer science fell by 7 per cent and 3 per cent respectively.

Supply of science teachers

4.6 On the supply of teachers, table 4.1 below shows that science vacancy levels have been falling consistently from a rate of 1.6 per cent in 2001 (400) to 1 per cent in 2004 (230). Provisional figures for 2005 show a slight increase, to 1.1 per cent (250), but final figures will be published in September. The trend so far does suggest that increased recruitment has been contributing to an improvement in supply, although there is still scope for further improvement.

Table 4.1: Vacancy rates and numbers of recruits for training as classroom science teachers

	2001	2002	2003	2004	2005
Vacancies as % of teachers in post	1.6	1.4	1.2	1.0	1.1*
Number of vacancies	398	383	313	233	250*
Number of science recruits to ITT	2410	2590	2700	2870	2810
Number of employment based routes (including Graduate Teacher Programme) starts for science	170	460	520	660	unavailable

*2005 figures are provisional

KEY HIGHLIGHTS AND NEXT STEPS

Schools

4.7 Measures relating to schools are aimed at increasing the take-up of STEM subjects at all levels; improving the supply of qualified science teachers; and enhancing the teaching and learning of STEM.

Participation in Science

4.8 The 14-19 Education and Skills White Paper, the Key Stage 3 Curriculum Review and the new Science GCSEs are all intended to encourage greater participation in science after age 16. The Key Stage 3 Curriculum Review will streamline the curriculum and make it more relevant and engaging. The review will also ensure that students are given the opportunity to catch up where required and stretch those who are more able. The Qualifications and Curriculum Authority will submit advice on the Key Stage 3 Curriculum Review to Ministers by the end of 2006. The Government has a clear expectation that at least 80 per cent of students should take at least two science GCSEs, and new statutory arrangements will be put in place for all students to study science programmes leading to at least two GCSEs. The Institute of Physics has independently commissioned research into girls' uptake of physics; the findings are due to be published later in summer 2005, and further information will be provided to schools in the autumn term 2005.

4.9 In schools and sixth form colleges, a key issue over the next year will be the introduction of the new programme of study at Key Stage 4 for science, which will focus on scientific literacy and provide options for further study and links with other subjects. The new specialised Diplomas outlined in the 14-19 White Paper will also provide access to high quality broad-based education that combines academic and vocational learning, including for ICT and engineering.

Teacher supply

4.10 The conventional Initial Teacher Training (ITT) candidates doing a PGCE at any higher education institution (HEI) receive a £6,000 training bursary, as an incentive to attract more people into the profession. Those going on to teach in a shortage subject can receive a £4,000 Golden Hello after successful completion of induction. Payments for these will be increased by £1,000 each for mathematics and science candidates starting training from September 2005. A further rise in the bursary to £9,000 will come into effect in September 2006. It is too early to say what difference the increased bursaries and Golden Hellos will make. In 2003/04, 87 per cent of allocated places on the ITT scheme for science were taken up, compared with 89 per cent in 2003/04.

4.11 For the second main route to teacher training, the Graduate Teacher programme (GTP), the trainees are employed by the schools in which they train, and numbers of people training depends heavily on demand both from trainees and from the schools. Shortage subjects (mathematics, science, english, languages, design and technology and information technology) get priority in the allocation of places. From 2005/06 the Teacher Training Agency will pay providers a premium if they recruit mathematics and science trainees. Trainees enter at various points through the year, so complete 2004/05 statistics are not yet available, but there were an estimated 455 starts so far in 2004/05, compared to a total of 489 in 2003/04. The final GTP data is expected to be available in August 2005.

4.12 Research is being done by the National Foundation for Educational Research (NFER) to establish the patterns of use of mathematics and science teachers at school in relation to their qualifications and specialisms. This should enable the Government to better determine whether there is a skills shortfall among existing science teachers, and a draft report will be received in November 2005.

STEM initiatives

4.13 Government and its partner organisations are responsible for a wide range of initiatives aimed at promoting interest in STEM subjects at all levels. A cross-cutting interdepartmental programme is currently underway to rationalise and bring greater coherence to these initiatives, building on the evidence gathered in the 2003 STEM mapping review. A new High Level Strategy Group to head the programme was launched in February 2005 under the joint chairmanship of the Ministers for Science and Higher Education. Early findings and initial proposals will be submitted to Ministers by the end of July 2005.

Quality of science teaching

4.14 Work is in progress to improve the quality of science teaching and support the continual professional development (CPD) of science teachers. Regional Science Learning Centres have now been established in each region and are delivering CPD courses. There are limited results so far. Initial take-up has been slow, although approximately 2,200 teacher training days have been delivered from opening in autumn 2004 up to March 2005. Feedback from those attending has been very good. DfES will monitor take-up closely over the next year.

High Level Teaching Assistants and Student Associate Scheme

4.15 Other measures from the Science and Innovation Investment framework designed to increase the number of science teachers include generating a new group of specialist High-Level Teaching Assistants (HLTAs) by 2007/08. The HLTA pilot providers were recruited by mid-June and the pilot begins in Autumn 2005. It will aim to recruit 200 each of mathematics and science specialists. The Student Associate Scheme (SAS), for undergraduates currently uncommitted to a teaching career, also enables them to explore the possibility of teaching and gives them a taste of life in a school. Actual SAS placements for 2003/04 were 478, and the forecast for 2004/05 is currently 826. The overall target of increasing SAS participation by 40 per cent was thus exceeded, and within that target, 26 per cent were from science. For the Aimhigher programme (designed to increase higher education participation from under-represented groups), the actual science placements for 2003/04 were 180 and the forecast for 2004/05 is also up on last year, at 243.

Further Education

4.16 In Further Education (FE), activities over the past year have focused on providing incentives to attract more science teachers into the sector.

Analysis of the FE workforce

4.17 The Learning and Skills Council's data show that in July 2003 there were about 9,300 teachers of science and mathematics in colleges. There is currently no data on how many additional teachers of these subjects are needed, and on why teachers join and leave the sector. DfES is undertaking a sample survey on joiners and leavers, and results are due by the end of July 2005. The new sector skills council, Lifelong Learning UK, is responsible for ensuring that systems are in place to collect, collate, analyse and disseminate information on the workforce.

Golden Hellos

4.18 The budget for FE Golden Hellos will be increased to £5 million for 2005-06, and new guidance on which subjects count as "science" is being produced. The Government wants to see a higher proportion of Golden Hellos going to science teachers in 2005-06 (the current rate is 4 per cent). Teachers of science subjects taking jobs in FE colleges from September 2005 will be eligible for the increased Golden Hello of £5,000. This will ensure that the sector continues to be at least as attractive to potential science teachers as the schools sector.

4.19 The budget for the FE trainee teachers' bursary scheme is £11.3 million, which allows for some 1,900 bursaries a year. Research early in 2004 showed that about 8 per cent of recipients were mathematics and science teachers. The Government has increased the budget for 2005/06 by £200,000, to allow for 200 science and mathematics teachers to receive the higher bursary of £7,000 from September 2005, and wants to see a higher proportion of

bursary recipients training to teach shortage subjects and then taking jobs as science teachers in colleges. The Government also wants to avoid competition between the incentives available in the schools and college sectors. These schemes are being reviewed over summer 2005, in order to see how the available resource can be used to best effect in tackling shortage areas. A report is expected in the autumn.

Continuing Professional Development

4.20 In further education, as in schools, there is difficulty in releasing mathematics and science teachers for training and professional development. Alternative training routes through the new Subject Learning Coaching Programme are being designed to give reduced contact time and a wider range of accredited outcomes. DfES and the Learning and Skills Development Agency are exploring marketing strategies and approaches that better meet the needs of teachers.

Higher Education

4.21 Measures in Higher Education (HE) have focused on attracting more students into STEM subjects in order to meet the future skills needs of the economy and the UK science base.

Supply and demand in HE

4.22 In Higher Education, although there has been some improvement at the end of the supply chain (for example, a 1 per cent rise in physics qualifications and a 2 per cent rise in mathematics qualifications within the last year), the task of matching graduates of specific courses (supply) to employer vacancies (demand) is not an exact science. Stakeholders on both the supply and demand sides of the labour market plan to work together on how closely this matching can be done through subsequent annual analysis. This will include an assessment of the nature and scale of employer vacancies through the annual NESS on the one hand, and an assessment of the supply route from school to graduate level on the other, as well as consideration of how stakeholders can best generate the supply of the right skills to meet existing and potential vacancies.

Science and Engineering Graduate Scheme

4.23 The Science and Engineering Graduate Scheme (SEGS) was set up in October 2004 to help address the skills gaps in science and engineering, by allowing non-EEA science graduates from UK HE and FE institutions to seek work in the UK for one year after graduation. Since the scheme was launched, over 1,000 overseas students have been granted leave to remain in the UK.

Research Careers

4.24 The 2004 Spending Review allocations included a further £85 million to improve the experience, conditions and attractiveness of career paths in research. This will be used to fund the remaining recommendations of the Roberts Review, including increasing the PhD stipend in line with inflation over the SR period, and providing funds to increase the average duration of the Research Council-funded PhD to three-and-a-half years. The Research Councils have allocated funding to universities for the provision of two weeks of transferable skills training per year for PhD students and postdoctoral researchers. This strengthening of transferable skills is intended to improve both employment prospects, by meeting the needs of industry, and the expectations of potential students

Academic Fellows

4.25 The first cohort of Academic Fellows is now in place. This cross-Research Council programme provides a permanent academic appointment at the end of a five-year fellowship scheme, and will make 1,000 awards in total – 200 a year over five years. The first awards were made in August 2004, with the first 251 fellows already in place and a further 147 due to start in the next academic year. The awards reflect a good mix of disciplines and regional spread, with 80 per cent of the awards going to science and 20 per cent to arts, humanities and the social sciences. Research Councils will provide the OST with an interim report on the effectiveness of the Roberts measures on improving the recruitment and retention of scientific talent at the beginning of 2006.

Women's Resource Centre

4.26 The UK Women's Resource Centre, based in Bradford, was launched in September 2004. The Centre exists to work with British business to help maximise the opportunities for professional women in SET and close the skills gap that is damaging UK competitiveness. In its first year, it has developed projects and programmes to deliver the Government's strategy, working closely with employers. These include: developing an expert women's database and a returners package, which includes courses at the Open University; the SET for Work Scheme to fund grants to HEIs; and setting up an Employers Award and Recognition scheme. The total commitment under this contract is £2.69 million.

Case Study 4a: Computer Clubs for girls

The DfES is funding e-skills UK over the next three years to deliver Computer Clubs for Girls (CC4G), which teach ICT skills through practical fun projects to enthuse girls to take up ICT. Total funding from DfES for national delivery of the clubs is £8.4 million.

Skinners' Company's School for Girls in East London, has been running CC4G since February 2005. The club is currently offered to 24 girls at Level 7 (age 11) and is already proving extremely popular. The course has potential for extension to other class levels as from September, with plans to incorporate Level 8 and Level 9 into the programme. Students are able to participate in a wide range of interesting projects developed to stimulate interest in technology, within a fun environment. For example, pupils at the school have just completed the Celebrity module of the course, which allows them virtually to produce their own TV show and go behind the scenes to see how it operates. The module was so popular that the course co-ordinator has arranged for the pupils to visit the set of Blue Peter – to see how their work links to reality.

Case Study 4b: SET for Work

The 'SET for Work' scheme was launched by the Women's Resource Centre in October 2004. The programme is aimed at the retention of female undergraduates on SET courses and their progression into the SET labour force. The fund bidding process was completed in March 2005, and 13 HEIs have been allocated grants totalling £170,120 to run their projects aimed at female SET graduates, with a view to increasing significantly the number who then go on to take up SET professions.

Regional Advisory Groups and strategic subjects

4.27 Regional Advisory Groups, including RDAs, Government Offices and funding bodies such as the LSC, have been established by the Higher Education Funding Council of England (HEFCE). These meet regularly with HEFCE to discuss policy initiatives and advise on funding allocations where there is an appropriate regional focus. HEFCE has also given wider consideration to falling science provision as part of its work to develop advice for Ministers on strategically important subjects. The Advisory Group on Strategically Important and Vulnerable Subjects published its final report in June[2]. The Government thanked HEFCE for their report and welcomed the finding that "university science departments are not in crisis". The Government will now consult with universities, employers and other stakeholders before responding later in the year.

[2]http://www.hefce.ac.uk/pubs/hefce/2005/05_24/

Information on academic provision

4.28 A key feature of the new HE quality assurance system is emphasis on the availability of accurate information about quality and standards of HEIs' academic provision. This information, by institution and subject area, and including the results from the first ever independent national student survey of their view on the quality of their course, will be published through the Teaching Quality Information (TQI) website[3]. The complete site will be launched in September 2005. TQI information will provide a valuable information resource to STEM applicants and other disciplines, enabling them to make more informed decisions about what and where to study.

[3] http://www.tqi.ac.uk

5 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. Greater engagement will identify public aspirations and concerns regarding the health, safety, environmental, ethical and social issues related to science and technology. It will help to inform Government policy and decision-making, and will also build understanding and appreciation of the wider benefits of science and technology to society.

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**

Achieving this objective is a long-term challenge and one of the biggest faced by both Government and the scientific community. In order to meet this, it is important to acknowledge that the public largely forms its opinions on the basis of issues that impact on their own experience. Action is therefore taking place across Government to establish meaningful indicators that are relevant to the public, scientists and policy-makers alike.

The ten-year framework announced that funding for science and society issues will more than double, from £4.25 million per year in 2005-06 to over £9 million in 2006-07. This chapter highlights key achievements over the past year on understanding and improving public attitudes to science, including:

- **Commissioning of a MORI poll on a range of issues related to science, engineering and technology, to obtain a snap-shot of current public attitudes; and**
- **Launch of the Sciencewise programme of grants for public engagement activities.**

EVIDENCE OF PROGRESS

5.1 During the autumn of 2004, MORI Social Research Institute, on behalf of OST, undertook a programme of qualitative and quantitative research among the general public to explore attitudes towards a range of issues related to science, engineering, medicine and technology. The work examined attitudes to public engagement with science; trust in scientists; and awareness of, and interest in, issues related to science and technology.

5.2 The research was published in March 2005, and key findings included clear evidence for increasingly positive attitudes to science and technology among the UK population. Also, a very large majority expressed support for public consultation on science-related issues, where consultation is followed by actions on the outcomes.

5.3 Opinion research is valuable in being able to provide a snap-shot of current attitudes towards science and technology. However, the Government recognises the need to identify the underpinning reasoning behind stated opinions. Consequently, building on the MORI survey, OST has commissioned further work to refine our understanding of how members of the public think about trust and confidence in relation to science and technology. This will inform the further development of indicators in this area, and OST will report on progress by the end of 2005. During 2006, OST will work with interested parties to define and commission a wide-ranging programme of policy-relevant social research to explore these attitudes in more detail.

Table 5.1: Key results from the *Science in Society* survey (MORI 2005)

Statement	per cent agree 2002	per cent agree 2004	change
Science makes a good contribution to society	80%	85%	+5%
Science will make our lives easier	72%	82%	+10%
Scientists tell the truth	65% (2003)	69%	+4%
Scientists should listen more to what ordinary people think	67%	74%	+7%
The media sensationalises science-related stories	64% (2000)	71%	+7%

KEY HIGHLIGHTS AND NEXT STEPS

Openness, dialogue and effective communication with the public

Sciencewise programme

5.4 The Minister for Science launched the *Sciencewise* public engagement programme at the British Association for the Advancement of Science Festival of Science in September 2004. Following an open call for proposals, grants worth £0.55 million were awarded to seven projects, each attracting matched funding from other sources. The projects will enable open, constructive and informed dialogue between scientists, citizens and policy-makers on a range of topics, including: nanotechnology, the use of animals in medical research, climate change, trust in the use of the internet, education about risk issues, and building wider capacity for public dialogue on science and technology. Priorities for funding for 2005-06 are being developed.

Public Engagement Impact Assessment

5.5 On 28 October 2004, the Director General of the Research Councils (DGRC) convened a meeting of recipients of Science Budget funding for public engagement with science and technology, with the Natural History Museum and the National Museum of Science and Industry (both funded through the DCMS) also present. Following the meeting, a working group was established to develop a set of measures to assess the impact and value for money of these programmes, which will inform the DGRC in his consideration of science budget allocations and performance measures. The plenary group will meet again in December 2005.

Council for Science and Technology

5.6 In March 2005, the Council for Science and Technology published its report *Policy through dialogue: informing policies based on science and technology*[1]. This report examined ways to promote cultural change within government with regard to the way that it handles public engagement and dialogue on science-driven issues. The report made a number of recommendations, and the Government's response is expected to be published in September 2005.

5.7 In addition, CST members worked with the Government's Chief Scientific Adviser and others to develop a proposed statement of good practice for scientists: *Rigour, respect and responsibility: a universal ethical code for scientists*[2].

[1] Available at http://www.cst.gov.uk/cst/reports/#8

[2] See http://www.cst.gov.uk/cst/business/files/ethical-code-letter.pdf

Responsiveness to public priorities and concerns

5.8 The RS/RAEng report on nanotechnologies (see Chapter 1) set out explicit recommendations for social and ethical research and public engagement on issues raised by the development of nanotechnologies. In its response, Government restated its commitment to promoting constructive public dialogue on nanotechnologies, and to ensuring that researchers from across the spectrum of natural and social sciences and the arts and humanities are involved in this endeavour. The *Sciencewise* public engagement programme will be one of the main vehicles for delivering this. OST has commissioned the *Involve* group to establish a Nanotechnology Engagement Group (NEG) to help bring about a step-change in both thinking and acting on public engagement in the development of nanotechnologies. The NEG will be the link between the diverse set of public engagement activities in this area, and will report to the Government's Nanotechnology Issues Dialogue Group (NIDG) – the vehicle for taking forward the commitments made in the Government's response to the RS/RAEng report. An outline programme for public engagement on nanotechnologies will be published shortly, with a comprehensive programme later in the year.

5.9 Meanwhile, the new OST Horizon Scanning Centre has begun work which will help to inform future public engagement priorities. It will work with others in Government and a broad range of stakeholders, aiming to identify and explore emerging trends in science that may raise significant health, safety, environmental, social, ethical and regulatory issues.

Conclusion

1 The indicators and actions outlined in this Annual Report show that a good start has been made over 2004-05 to implement the ten-year Science and Innovation Investment Framework. While it is too early to assess the impact of many of the long-term policies set out in the ten-year framework, there are many positive signs of progress: the UK has successfully maintained its position as second in the world for research excellence in the face of intense global competition; the sustainability of the UK science base has been significantly improved through additional funding and the introduction of full economic costing, with a total of £1 billion for sustainability over the next three years announced as part of the science budget allocations in May 2005; and a range of indicators (detailed in Chapter 2) show that there has been a step change in knowledge transfer and commercialisation activity from the science base over the past five years. The Government intends to build on these achievements over the coming years, through the policy measures detailed in this Annual Report.

2 One of the most significant challenges to the achievement of the ambitions set out in the ten-year framework remains increasing the level of business investment in R&D. The Government will monitor closely the impact of recent measures to stimulate business R&D, such as the R&D tax credits and the Technology Strategy, and will continue to work in partnership with business to develop policy in this area, including through the high-level UK Science Forum, and the stakeholder consultation on the R&D tax credits discussion paper published today. The supply and demand of STEM skills is also an area where progress has been mixed. Measures outlined in this Annual Report will further enhance the teaching and learning of STEM subjects and the recruitment and retention of science teachers and researchers, to underpin the future needs of the science base and the economy.

3 Finally, as this is the first year of implementation for the ten-year framework, there are a number of indicators for which metrics and baselines are still being established (details of these can be found on the OST website)[1]. The Government will work to develop these indicators fully over the coming year. In line with the reporting arrangements set out in the ten-year framework, a more detailed evaluation of progress will be published next year, to inform future decisions on public spending.

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[1] www.ost.gov.uk/policy/sif.htm

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