

ERAWATCH Country Report 2009

Analysis of policy mixes to foster R&D investment
and to contribute to the ERA

United Kingdom

Paul Cunningham and Aikaterini Karakasidou



EUR 23976 EN/31 - 2009

The mission of the JRC-IPTS is to provide customer-driven support to the EU policy-making process by developing science-based responses to policy challenges that have both a socio-economic as well as a scientific/technological dimension.

European Commission
Joint Research Centre - Institute for Prospective Technological Studies
Directorate General Research

Contact information

Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

IPTS website: <http://ipts.jrc.ec.europa.eu>
JRC website: <http://www.jrc.ec.europa.eu>
DG RTD website: <http://ec.europa.eu/research/>

Legal Notice

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

***Europe Direct is a service to help you find answers
to your questions about the European Union***

Freephone number (*):

00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server <http://europa.eu/>

JRC 53725
EUR 23976 EN/31
ISBN 978-92-79-13338-1
ISSN 1018-5593
DOI 10.2791/ 27728

Luxembourg: Office for Official Publications of the European Communities

© European Communities, 2009

Reproduction is authorised provided the source is acknowledged

Printed in Spain



EUROPEAN COMMISSION

ERAWATCH COUNTRY REPORT 2009: United Kingdom

**Analysis of policy mixes to foster R&D
investment and to contribute to the ERA**

ERAWATCH Network – MIOIR/PREST: University of Manchester

Paul Cunningham and Aikaterini Karakasidou

Acknowledgements and further information:

This analytical country report is one of 33 reports for EU Member and Associated States prepared as part of ERAWATCH. ERAWATCH is a joint initiative of the European Commission's Directorates General for Research and Joint Research Centre. For further information on ERAWATCH see <http://cordis.europa.eu/erawatch>. The analytical framework and the structure have been developed by the Institute for Prospective Technological Studies of the European Commission's Joint Research Centre (JRC-IPTS) in collaboration with DG-RTD and the ERAWATCH Network.

The report has been produced by the ERAWATCH Network (<http://www.erawatch-network.eu/>) in the framework of the specific contract on ERAWATCH Policy Mix Country Reports 2009 commissioned by JRC-IPTS. It makes use of information provided in the ERAWATCH Research Inventory with support of the ERAWATCH Network.

In particular, it has benefited from comments and suggestions of Patries Boekholt, who reviewed the draft report. The contributions and comments of Mark Boden from JRC-IPTS and DG-RTD are also gratefully acknowledged.

The report is only published in electronic format and available on the ERAWATCH website: <http://cordis.europa.eu/erawatch>. Comments on this report are welcome and should be addressed to Mariana Chioncel (Mariana.Chioncel@ec.europa.eu).

Executive Summary

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. This report aims at supporting the mutual learning process and the monitoring of Member States efforts. Its main objective is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The report builds on the analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report deals with the situation relating to research in the United Kingdom (UK).

The actual amount spent on R&D (GERD) in 2006 was €34,037m, contributing 15.9% of the aggregate EU-27 R&D expenditure, estimated by Eurostat as €213,127m in 2006 (€226,119m in 2007). In its ten-year Science and Innovation Investment Framework (SIIF) (2004-2014) the UK expressed the ambition to reach a ratio of Gross Expenditure in R&D (GERD) to GDP of 2.5% by 2014, aiming to increase the size of the research system relative to the economy as a whole (HM Treasury, 2004). Eurostat reported R&D intensity (GERD/GDP) in the UK of 1.76% in 2006, just below the estimated EU average of 1.84% for the same year (estimated as 1.83% for 2007). The figure has fluctuated around this level for more than a decade.

According to the NRP 2008, the UK has experienced a decade of strong growth and job creation and the flexibility of its economy provides a solid platform from which to face the global economic shocks. However, in the face of the global economic downturn and the UK's entry into recession, both the Government and external forecasters expect a slowdown in growth, into negative figures, certainly for 2009 and perhaps beyond. Faced by such challenging economic circumstances, the UK NRP emphasises the importance of establishing macroeconomic stability as a prerequisite for growth and structural reform, as central to the Lisbon strategy and a key element of the EU Broad Economic Policy Guidelines.

Clearly, the recession will also have a major impact with regard to levels of investment in R&D, particularly from the private sector, whilst public finances are also highly likely to be squeezed. Thus, the long-standing challenges faced by the UK research system are likely to be somewhat exacerbated as the effects of the global downturn make themselves felt. According to Government policy documents and supporting official speeches, together with quantitative and qualitative evidence, independent reviews and commentaries, the UK appears to face three major challenges. These challenges may be viewed as the outcomes of barriers that need to be overcome in order to achieve higher levels of R&D investment and concern, namely: a need to increase the intensity of innovation activity in enterprises; a need to strengthen linkages between the public research base and business; a

requirement to match future skills needs and improve the supply of high quality labour. At the same time, there is also a need to maintain the quality of the public research base and its ability to perform world-leading research.

The majority of Government funding for research is targeted at the public sector, with direct support to business (other than in the defence sector) being rather marginal. This is largely because the government believes that it cannot hope to match the level of industrial funding provided by business itself and that its overall goal should be to maintain an environment which is conducive to business innovation activity. Thus, government support tends to focus on framework conditions (including fiscal incentives for R&D) and on improved knowledge linkages and knowledge circulation.

Support to the public sector, outside of the portfolio of specific government departments (notably health and environment), tends to be largely non-thematic and is the mainly the consequence of bottom-up, responsive mode funding allocations through the Research Councils, although these also operate priority programmes to address major global, socio-economic and other issues. Block research funding to the universities is allocated on quality criteria (formerly through a Research Assessment Exercise and in future through a new Research Excellence Framework) and disbursed internally by the universities themselves. The overall strategy for UK research funding is framed in the SIF 2004-2014, which aims to ensure sustainability in research funding, underlining the Government's long-term perspective on research investment within the UK economy, with science and technology a high spending priority. Progress is assessed according to milestones and targets on an annual basis, with published annual reports highlighting areas for policy action.

The UK Government's general approach to promoting private sector investment is to maintain a stable macroeconomic environment and to remove microeconomic barriers that prevent the market from functioning properly. UK Government enterprise policy has, in recent years, focused on increasing the incentives for and removing the obstacles to entrepreneurial activities and promoting an enterprise culture.

The main aim of Government policy is to stimulate innovation and competitiveness, rather than simply support R&D expenditure in its own right. However, the Government utilises a number of microeconomic measures to stimulate R&D in the business sector, including the R&D Tax credits schemes and the range of programmes operated by the TSB.

Overall, the most significant instrument for the support of R&D (albeit based on a very subjective judgement) would appear to be the funding of university research by the Higher Education Funding Councils and the Research Councils. Although this does not intuitively appear to represent a "policy measure" as such, the allocation of the Science Budget to the Research Councils is very much a major part of the policy decision-making process and the Government's Comprehensive Spending Review (CSR). The next largest outlay is for defence R&D: whilst the majority of this funding will be directed to industry, approximately two-thirds of this is spent on development.

In assessing the success of the policy mix in increasing R&D investment, a number of reviews published during 2008 and 2009 report significant progress in a number of areas¹. However, despite substantial and sustained government investments in public expenditure (above EU averages and increasing) and in incentives to stimulate private R&D spending, both the overall expenditure target (2.5% by 2014) and the

¹ Between 1995 and 2005, the growth rate for GERD has been 4.4. As the growth rate for GDP over the same period was 5.4, GERD as a percentage of GDP has exhibited little relative increase.

contribution from industry (two-thirds) are far from being achieved, although slow progress has been made and the target date is a further eight years from the date of the latest figures. It is also clear that the current macroeconomic uncertainty is likely to have an adverse effect on industrial R&D expenditure, which, generally in the UK is seen as a cost to business rather than an investment.

With regards to the effects of the policy mix, it is difficult to make any direct attribution between policies and such gross indicators of aggregate performance. While the Government's sustained investment in the science base will have had an impact on overall R&D spending by the public sector, the impact of policy on industrial R&D spending is harder to assess – increased spending on such policies does not guarantee that industrial expenditure will increase, due to a range of factors not the least of which is macroeconomic stability, which, as noted above, forms a major target of UK government policy. Nevertheless, in the light of evidence presented as a rationale for its various components, the policy mix appears appropriate, even if the anticipated results have not been wholly achieved. On the public R&D investment side, the government appears to be meeting its objectives (which, it should be noted are not to spend money on R&D *per se*, but to maintain the strength and world level quality of the science base), albeit at a very slow rate: from 0.62% GDP in 2001 to 0.67% in 2005.

The main barriers to R&D investment particularly that by business, and the major opportunities and risks within the policy mix are summarised below.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Macroeconomic uncertainty	
Insufficient uptake of ideas from science base into innovative products, processes and services	Strongly performing science base offers opportunities industrial innovation and attractiveness to foreign R&D investment.
	Conflicting objectives of block funding model and university-industry interaction goals

Finally, with regard to the system and policy dynamics from the perspective of the ERA, in general policy terms, the UK is supportive of various EU research developments, including the development of the ERA, whilst also seeking to direct these in order to ensure their optimal performance. UK participation in all the EU research funding frameworks is strongly supported at the policy level and is matched by good levels of participation by UK public sector researchers (notably from HEIs) although business participation is somewhat disappointing in comparison with similar sized EU neighbours. Broadly speaking, although ERA-related issues do not receive major attention in UK policy documents, they are discussed in more focused debates and UK policies in the areas covered by this report tend to be fully consistent with the relevant Integrated Guidelines of the Lisbon Treaty. One caveat is that the UK has set its own target of 2.5% R&D intensity by 2014 as opposed to the 3% target, on the basis of its own analyses.

Thus, in common with several other countries, the main challenges for the UK's R&D system in relation to ERA include the opening up of some national research programmes and the need to increase the share of private R&D spending.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • minor 	<ul style="list-style-type: none"> • UK is open to researchers, a popular location for research and also a major participant in EU programmes • Further moves to open national programmes are underway
Governance of research infrastructures	<ul style="list-style-type: none"> • Potentially significant – UK has several centres of research excellence 	<ul style="list-style-type: none"> • UK's Large facilities Roadmap is complementary to ESFRI
Autonomy of research institutions	<ul style="list-style-type: none"> • Important – but ERA policies are not specified within the broader internationalisation policy configuration 	<ul style="list-style-type: none"> • All UK HEIs are autonomous and free to arrange collaborative agreements with any non-UK country. • Government RIs may be more restricted, although no major constraints have been noted
Opening up of national research programmes	<ul style="list-style-type: none"> • Minor – and not ERA related, specifically 	<ul style="list-style-type: none"> • Strongly national based, although some moves towards opening up to non-UK participants (not specifically to ERA, though)

TABLE OF CONTENTS

Executive Summary.....	3
1 Introduction.....	8
2 Characteristics of the national research system and assessment of recent policy changes.....	9
2.1 Structure of the national research system and its governance.....	9
2.2 Summary of strengths and weaknesses of the research system	13
2.3 Analysis of recent policy changes since 2008	17
2.3.1 Resource mobilisation.....	19
2.3.2 Knowledge demand	22
2.3.3 Knowledge production.....	24
2.3.4 Knowledge circulation	25
2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment	27
3 National policy mixes towards R&D investment goals.....	29
3.1 Barriers in the research system for the achievement of R&D investment objectives	30
3.2 Policy objectives addressing R&D investment and barriers	34
3.3 Characteristics of the policy mix to foster R&D investment.....	35
3.3.1 Overall funding mechanisms.....	35
3.3.2 Policy Mix Routes.....	38
3.4 Progress towards national R&D investment targets	42
4 Contributions of national policies to the European Research Area.....	44
4.1 Towards a European labour market for researchers	45
4.1.1 Policies for opening up the national labour market for researchers.....	46
4.1.2 Policies enhancing the attractiveness of research careers in Europe	47
4.2 Governing research infrastructures	50
4.3 Research organisations	53
4.4 Opening up national research programmes	55
4.5 National ERA-related policies - a summary.....	56
5 Conclusions and open questions.....	58
5.1 Policy mix towards national R&D investment goals.....	58
5.2 ERA-related policies.....	58
References	60
List of Abbreviations	62

1 Introduction

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs.² This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. For the period 2008 to 2010, this focus is confirmed as main policy challenge and the need for more rapid progress towards establishing the European Research Area, including meeting the collective EU target of raising research investment to 3% of GDP, is emphasised.

A central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area (ERA). The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures which a research system has to cope with. The analysis of the ERA dimension still remained exploratory.

The country reports 2009 build and extend on this analysis by focusing on policy mixes. Research policies can be a lever for economic growth, if they are tailored to the needs of a knowledge-based economy suited to the country and appropriately coordinated with other knowledge triangle policies. The policy focus is threefold:

- An updated analysis and assessment of recent research policies
- An analysis and assessment of the evolution of national policy mixes towards Lisbon R&D investment goals. Particular attention is paid to policies fostering private R&D and addressing its barriers.
- An analysis and assessment of the contribution of national policies to the realisation of the ERA. Beyond contributing to national policy goals, which remains an important policy context, ERA-related policies can contribute to a better European level performance by fostering, in various ways, efficient resource allocation in Europe.

² COM(2007) 803 final, "INTEGRATED GUIDELINES FOR GROWTH AND JOBS (2008-2010)", http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf

2 Characteristics of the national research system and assessment of recent policy changes

This chapter refers to a large number of official UK Government documents and other policy reviews, which form a characteristic of the UK approach to research and innovation policy governance. These are presented below, in chronological order as an aid to the policy background.

- Science and Innovation Investment Framework 2004-2014. HM Treasury 2004.
- The Race to the Top' - Sainsbury Review of Science and Innovation, HM Treasury October 2007.
- CREST 3% OMC Science & Innovation Policy Mix Peer Review United Kingdom: Background and Visit Follow-up Reports, February 2008.
- Innovation Nation, DIUS, March 2008.
- Background analysis: strengths and weaknesses of the UK innovation system. DIUS, March 2008.
- ERAWATCH strategic intelligence service – operational phase: Country Reports 2008: United Kingdom. August 2008
- Annual Innovation Report, DIUS, December 2008.
- Science and Innovation Investment Framework 2004-14. Economic Impacts of Investment in Research & Innovation. DIUS, December 2008
- Science and Innovation Investment Framework 2004-2014. Annual Report DIUS and HM Treasury, December 2008.

2.1 Structure of the national research system and its governance

The UK has the third largest population among the EU Member States, with almost 12.3% (60.8 million) of the EU-27 total population of 495 million in 2007³ (Eurostat, 2008).

In terms of economic performance, the UK is among the leading Member States of the EU. In 2006, it was responsible for 16.5% of the total Gross Domestic Product (GDP) of the EU-27 (€11,583b), having a GDP of €1,910b (Eurostat, 2008a). More recent data show a 1.5% decrease in UK GDP during the fourth quarter of 2008, compared with a 0.6% decrease in the third quarter of the same year (Eurostat, 2009). However, the UK is following the wider European trend of economic recession, since the EU-27 GDP also presented a quarterly decrease of 1.5% in the fourth quarter of 2008 (Eurostat, 2009).

A substantial part of the UK's GDP is invested in R&D and innovation⁴. The actual amount spent on R&D (GERD) in 2006 was €34,037m⁵, contributing 15.9% of the aggregate EU-27 R&D expenditure, estimated by Eurostat as €213,127m in 2006 (226,119m in 2007).

³ Figures as of 1st January 2007.

⁴ Unless otherwise stated, all quantitative science and technology indicators are based on Eurostat data.

⁵ According to national statistics published in the 10-year SIIF Economic Impact 2008.pdf and Annual Innovation Report 2008, the UK GERD was €27.84m (£23.2b) in 2006, presenting a 7% increase in cash terms and a 4% increase in real terms from 2005

In its ten-year Science and Innovation Investment Framework (SIIF) (2004-2014)⁶ the UK expressed the ambition to reach a ratio of Gross Expenditure in R&D (GERD) to GDP of 2.5% by 2014, aiming to increase the size of the research system relative to the economy as a whole (HM Treasury, 2004). Eurostat reported R&D intensity (GERD/GDP) in the UK of 1.76% in 2006⁷, which falls just below the estimated EU average of 1.84% for the same year (estimated as 1.83% for 2007). The figure has fluctuated around this level for more than a decade ([Cunningham and Boden, 2009](#)).

Main actors and institutions in research governance

The United Kingdom research system comprises three main types of actors: policy bodies, research funders and research performers, with certain actors combining these functions (see Figure 1 below) ([Cunningham and Boden, 2009](#)).

The last 20 or so years have witnessed the evolution of UK S&T policy into an innovation policy, with S&T issues increasingly integrated into the broader national system of innovation. Following the appointment of Gordon Brown as Prime Minister in June 2007, the role of science in innovation has been given further emphasis. The Department of Trade and Industry (DTI) was replaced by a new Department for Innovation, Universities and Skills (DIUS), which also has responsibility for Further Education (FE), Higher Education (HE) and skills and works closely with the new Department for Business, Enterprise and Regulatory Reform (BERR), which assumed other functions of the former DTI. DIUS plays the lead executive role in research issues, and is the home of the Government Office for Science (GO-Science). GO-Science is headed by the Government's Chief Scientific Adviser (CSA) and plays the lead role in improving the quality of science in the UK. The CSA reports directly to the Prime Minister and the Cabinet.

The CSA also chairs the principal high-level national policy making and coordination body, the Council for Science and Technology (CST), which in turn draws on policy advice from a range of bodies both within and outside the Government structure, including dedicated committees in both the upper and lower houses of Parliament. High-level UK science policy making also places particular emphasis on the use of systemic reviews and evaluations.

DIUS is the major provider of research funds for the public sector, with the Director General, Science and Innovation (DGSI) within DIUS responsible for the allocation of the UK Science Budget. This provides funds for the seven Research Councils, which in turn support R&D both in Higher Education Institutions (HEIs) and in their own institutions with a total annual budget approaching €5b. These provide research grants both for projects and for research students. In addition, they fund research facilities in the UK and abroad for researchers, investing around 60% of their annual budget (€3b) in research in UK universities.

The Research Councils are organised on a broad disciplinary basis, each with its specific separate identity. Using a range of funding mechanisms, they support a highly diversified portfolio of research, comprising the full spectrum of academic disciplines. Research funded ranges from basic, blue skies investigator-led research, through longer-term strategic research, observation and survey, to more applied

⁶ Henceforward referred to as the SIIF.

⁷ Measuring the progress towards this goal, the UK Office of National Statistics (<http://www.statistics.gov.uk/pdfdir/gerd0308.pdf>) reported a minor increase in R&D intensity (GERD/GDP) in the UK from 1.74% in 2005 to 1.75% in 2006. The ERAWATCH Country report and inventory give a different figure of 1.78%.

research activities. Funds are awarded to UK universities, the Research Councils' own institutes, other Public Sector Research Establishments (PSREs) and independent research organisations in the form of research grants, based on independent, expert peer review. Each Research Council sets out its research priorities in a strategic plan, developed through extensive consultation with both the academic community and a wide range of users and stakeholders. Established as a strategic and equal partnership between the seven Research Councils, Research Councils UK (RCUK) oversees and coordinates their work.

The UK government provides support to research and innovation activities in the private sector through a number of mechanisms, including tax credits for R&D investment administered via the Treasury, and the work of the Technology Strategy Board (TSB), which has responsibility for the formulation and delivery of the national technology strategy. The TSB has the aim of ensuring that the promotion of technology and innovation in business is led by business and operates at "arm's length" from the government as a non-Departmental government body. Its current focus is the translation of knowledge into innovation and new and improved products and services. It is sponsored by DIUS and, in 2007, targeted funding of €275m to support technology and innovation, largely through collaborative work between businesses or between businesses and academia. The TSB's budget allocation (without the contribution of partners) is expected to reach approximately €310m in 2010/11 (a roughly 35% increase over 2008/09). On the whole, the budget of TSB for 2008-2011 is around €850m, plus aligned funding of €210m from the Regional Development Agencies (RDAs) and a minimum of €140m from the Research Councils. According to the 2007 Comprehensive Spending Review (CSR), the overall budget that TSB will coordinate will reach around €1.25b during the period 2008-2011, including contributions from the Devolved Administrations and Government Departments.

Other Ministries and Departments, particularly the Department for Environment, Food and Rural Affairs, the Ministry of Defence and the Department of Health, also have significant research portfolios within their areas of responsibility, and commission R&D through their own laboratories and institutes (or, in many cases, their former institutes which are now privatised or have intermediate agency status). In overall terms, expenditure on the Science Base (i.e. the Science Budget and Higher Education Funding Council allocations) in 2007/08 amounted to £5,549m (55.5% of total R&D expenditure) while that of Government departments on R&D totalled £4,459m (44.5%).

The institutional role of the regions in research governance

The UK comprises nine English Regions and three Devolved Administrations (Scotland, Wales and Northern Ireland) all categorised at the NUTS 1 level. Regional coordination of science and research is closely linked to that of innovation at the regional level. BERR is aiming to build the capability of regions, with emphasis on regional growth, strengthening the building blocks for economic success and boosting regional capacity for innovation and enterprise. The Government's SIF (2004-2014), includes the aim of developing closer working relationships between the regions and central Government departments in order to ensure the best use of resources at national and regional level. Consequently, certain elements of Government funding are now being managed at the regional level to ensure that business support for innovation, and access to relevant expertise, is tailored to the individual needs of local, innovative businesses.

Main research performer groups

The main actors in the performance of UK public sector research are the HEIs, most of which are universities. The majority of their research funding is provided in the form of grants from the Research Councils, awarded to individual researchers as well as to longer running programmes, units and centres. Other funds, including research funding, in England, Wales and Scotland are provided by DIUS through dedicated non-departmental funding councils. In Northern Ireland, funding for research comes directly from the Department for Employment and Learning, Northern Ireland (DELNI) ([Cunningham and Boden, 2009](#)).

In 2006, the UK HE sector was responsible for €8,892m worth of R&D activities, having a 26.12% share of the total R&D performed in the country and an 18.81% share of the R&D activities performed by the EU-27 HE sector. This represents 0.46% of the country's GDP, above the 0.4% average of the EU-27.

The private sector is both a major funder and performer of R&D. Approximately half of the funds for R&D in the UK come from the business enterprise sector (45.2% in 2006), below the EU-27 average (54.5% in 2005). Moreover, in 2006, the business sector's expenditure on R&D (BERD) amounted to €20,985m contributing to 61.6% of the UK GERD and to 15.3% of the EU-27 R&D performed by the business enterprise sector in 2006 (€137,197m). UK BERD stood at 1.08% of GDP (2006), falling just below the EU-27 average of 1.18% (1.17% in 2007). This ratio had been in gradual decline for more than a decade, although it has levelled out in recent years ([Cunningham and Boden, 2009](#)).

Government sources provide a third of the funds for R&D in the UK (31.9% in 2006), again very close to the EU-27 average of 34.2% (2005). Regarding the R&D performed by the government sector, this represented a share of 10% (€3,401m) of the total UK GERD in 2006, falling behind the EU-27 average of 13.2% for the same year. The intensity of the R&D performed by the government sector (1.18% for 2006) is close to the EU-27 average (0.24% for 007).

The private non-profit sector is also a significant actor in both the funding and performance of R&D. In 2006, the sector performed €759m worth of R&D activities, having a 2.2% share of the total UK GERD and 37.86% of the total R&D performed in the EU-27 by the private non-profit sector. This represents an R&D intensity of 0.04%, higher than the EU-27 average of 0.02%. The non-profit sector is composed of a range of foundations and charities, the largest of which are in the medical and health sector. These charities make a substantial contribution to medical research in the UK, over €1b per year⁸. Finally, an important characteristic of the UK research system is the relatively significant R&D investment financed from abroad (17% in 2006) in comparison to the much lower EU-27 average (9% in 2005).

On the whole, "the UK Government takes the view that adequate levels of investment from both the public and private sector are required to sustain a well-functioning R&D system, which is seen as a vital component of the national research and innovation system and fundamental to national competitiveness" ([Cunningham and Boden, 2009](#)).

⁸ The Wellcome Trust is the major funder of research in the medical and health sector in the UK (annual spend €800m), and is one of the largest charitable foundations in the world, supporting clinical and basic scientific research. In terms of annual volume of research expenditure, the four next largest, foundations and charities are: Cancer Research UK (€300m), the British Heart Foundation (€140m), the Arthritis Research Campaign (€26m) and the Nuffield Foundation (€16m).

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008, which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The Analytical Country Report for the specific country can be found on the [ERAWATCH web site](#).

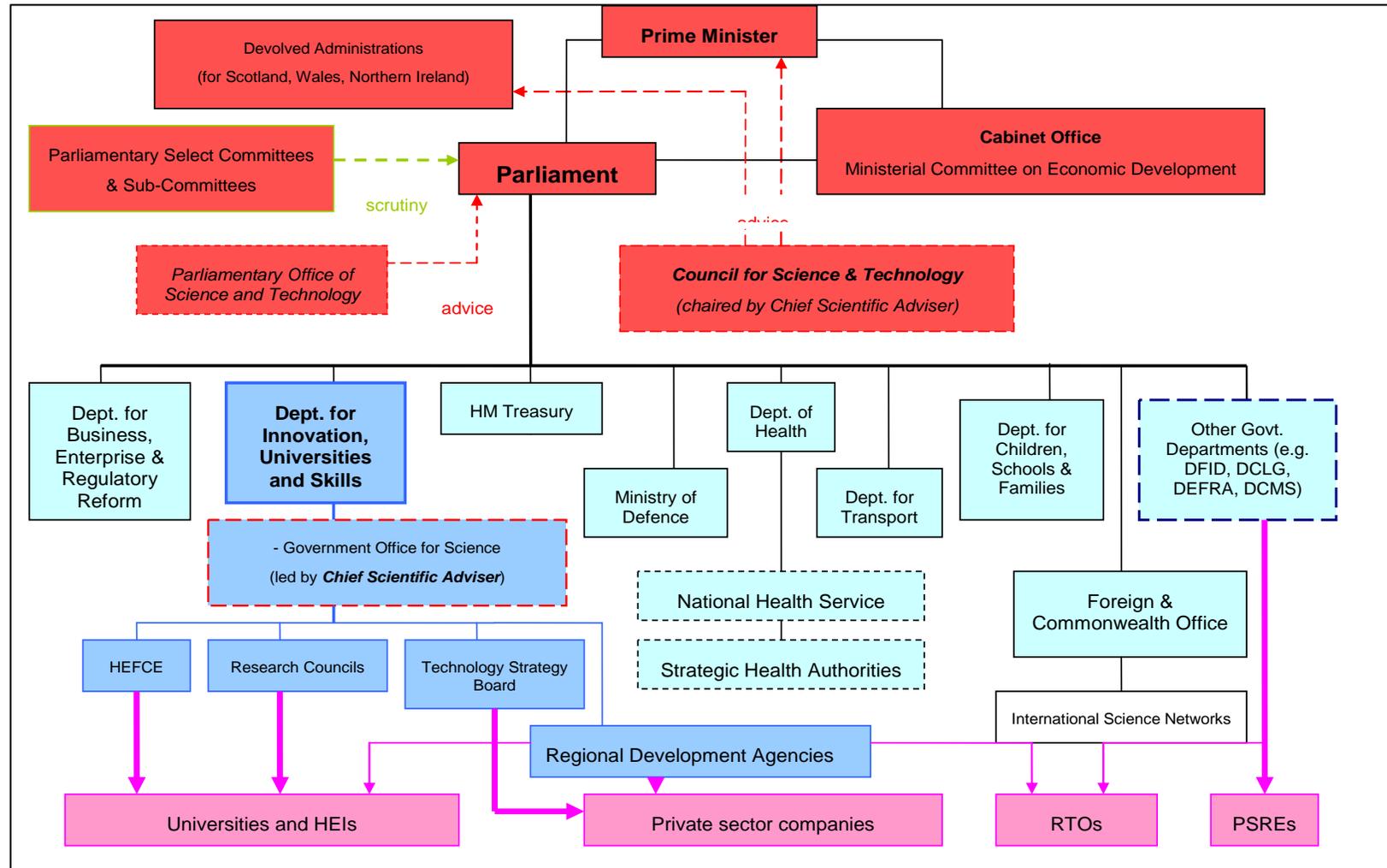
A 2006-07 CREST-sponsored peer review of the UK research and innovation system concluded that the main strengths of the UK system were its capacity for R&D, both within the Science Base and its industrial R&D, its system of innovation policy governance, and, in particular the attention to quality and the measures in place to help achieve this (Cunningham, 2007a). More recent reviews of the UK research and innovation system (notably the Sainsbury Review, the White Paper Innovation Nation and its background analysis report (DIUS, 2008b) also support these broad conclusions.

A key strength in UK resource mobilisation is the core policy emphasis on maintaining and enhancing the high quality of the UK science base, as well as promoting its role in providing both a rich source of innovation potential and the supply of human resources. The UK's system of funding research at universities, based on the dual support system with the competitive allocation of funds and emphasis on excellence, can also be highlighted as a strength, provided long-term infrastructure needs are also adequately met (which should also be addressed by recent policy developments). This is in a general policy context of long term policy planning, backed up by long term funding commitments.

In the private sector, particular areas of strength include high levels of R&D in pharmaceuticals and aerospace, and, more generally, the mobilisation of foreign research investments. Overall, however, the relatively low research intensity of business R&D is a perceived weakness, although this may be partially due to its sectoral composition. In addition, the contribution of R&D in service industries is the subject of some debate as the figures for this may suffer from under-disclosure for a variety of reasons. Direct grant support to firms has a low priority in UK policy, except for the targeted support of SMEs, with a general preference for indirect measures of support and the development of stable and supportive framework conditions. The proportion of R&D personnel in the UK, in both public and private sectors is also low compared to other EU Member States (0.45% of population).

In the articulation of demand, the comprehensive process of review, monitoring progress and the role and value of evaluation all contribute to long term policy planning. While complex, the incorporation of stakeholder views across government, industry and academia, i.e. through topic specific and broader reviews, HM Treasury consultations, House of Lords enquiries, etc., as well as a commitment to stronger public engagement together provide a sound basis for policy decisions.

Figure 1: Overview of the governance structure of the UK's research system



Source: [Cunningham and Boden, 2009](#).

The quality of knowledge production by the UK science base is an evident strength, as is the Government's commitment to build on these strengths. However, despite a long-term policy focus, the UK remains relatively weak at translating this potential into the market. Transfer of knowledge from the science base, however, does benefit from a high position on the policy agenda and from increasing orientation towards collaborative R&D and innovation. This builds on the generally strong international outlook of the UK science base, both in terms of collaboration and education and research training. The attractiveness for "inward investment" in UK HE, in terms of the large number of fee-paying overseas students, also reflects the general attractiveness of the UK for overseas research investments. Within the UK, the science base contributes in a more focused way to economic prosperity at regional level through facilitating and contributing directly to knowledge circulation, such as through science parks.

The main lessons that may be drawn from the recent peer review of the UK's research and innovation policy system can be summarised as follows (DIUS, 2008b):

- The current coordinated approach to policy formulation plays a critical role, although the recent split in responsibilities between the DIUS and BERR may impact upon coordination;
- Clear and realistic long-term targets and goals, together with the production of strategies to reach them clearly communicate the Government's intentions to all actors in the research system.
- There is an open and transparent process of policymaking and implementation.
- A strong governance regime, which gives a prominent role to the processes of review (at the system and sub-system levels), monitoring and evaluation, coupled with good feedback mechanisms for the future implementation of policies.
- Nevertheless, despite long-standing policy attention, the flow of knowledge between the science base and industry remains a point of focus, as does the long-term comparatively low level of R&D investment by industry.

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	Coordinated long term S&T policy framework with associated budgetary process
	Securing long term investment in research	Public sector spending on R&D in the science base has generally increased over last decade although spending on R&D in Government departments has fallen. Business investment in R&D relative to GDP remains consistently low
	Dealing with barriers to private R&D investment	Range of policies in place, coordinated and led by new Technology Strategy Board
	Providing qualified human resources	Increasing overall supply of STEM skills although overall skill levels of population exhibit lags compared to international leaders and there are concerns over numbers of graduates in certain key S&T disciplines
Knowledge demand	Identifying the drivers of knowledge demand	Variety of sources and processes used to assess and address the demand for knowledge
	Co-ordination and channelling knowledge demands	Coordinated long term S&T policy framework and strengthened public engagement
	Monitoring of demand fulfilment	Increased exploitation of publicly funded research, some successful high tech sectors and a sizeable population of high tech SMEs; Strong non technology based innovation in high value added sectors but low demand for university-industry interactions in knowledge transfer and exploitation (cf. competitors) and limited technology diffusion from the research base
Knowledge production	Ensuring quality and excellence of knowledge production	Scientific quality of science base high: strong performance and world ranking in research outputs (publications and citations) UK tends to have proportionately fewer researchers in workforce (UK is sixth in G7), with little change over the last decade Significant minority of non-innovating businesses
	Ensuring exploitability of knowledge	Use of and competence in the evaluation and review, including excellence based funding allocation Rate of business start-up and SME growth still lag behind US Variability in innovation performance and capability across the UK regions
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Comprehensive and long-term policy mix to stimulate knowledge transfer Positive trends in knowledge transfer indicators from science base to private sector but gap remains between production of knowledge and its translation into successfully commercialised products, etc. Success story of UK science parks
	Profiting from international knowledge	Strong, central strategy for international R&D activities Open economy, attractive to FDI and high level of foreign participation by UK researchers
	Enhancing absorptive capacity of knowledge users	Persistent shortcomings in business skills base and general poor demand for skills Poor innovation management skills in majority of business sector There is still a gap between research performance and its translation into commercially competitive products, processes and services

 Source: [Cunningham and Boden, 2009](#).

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore also important to analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

In September 2008, the UK published its second National Reform Programme (NRP) that outlines the most recent challenges that the UK economy is facing, as well as the Government's agenda of economic reforms in response to these challenges. It sets out progress against both EU-level priorities and against the UK comprehensive programme of structural reform, presenting the measures taken in the areas covered by the UK's country-specific recommendations and *points to watch*. The second NRP notes that "as recognised by both the European Commission and the European Council, the UK has been making significant progress towards the Lisbon goals of jobs and growth" (HM Government, 2008). The NRP notes that it is expected that this growth and creation of jobs during the past decade will go some way towards assisting the UK address the challenges that arise from the global economic downturn.

Changes in National Reform Programme regarding the role of research in the broader economic growth strategy

According to the UK's second (NRP), the Government's long-term goals for the 2008-2010 cycle of the Lisbon Strategy are: maintaining macroeconomic stability; sustainable growth and prosperity; ensuring fairness and opportunity for all; creating stronger communities and effective public services; and ensuring an environmentally sustainable world (HM Treasury, 2008).

The 2008 NRP listed the main reform actions addressing the UK's country specific recommendations and *points to watch* (HM Government, 2008). These include new measures to ensure progress towards the UK's R&D intensity target through full implementation of the recent R&D and innovation reviews, emphasising the needs of the services sector. The UK government also seeks to balance the traditional emphasis on supply-side measures with demand-side measures.

The 2008 NRP confirms the delivery of the microeconomic policy reform commitments, through: a review of existing legislation to look for opportunities to exempt small firms; the re-focusing of the Small Business Research Initiative (SBRI) to enable easier access for high-tech SMEs to government R&D opportunities; government investment of more than £210m over the next three years to support enterprise education; and the Innovation Voucher scheme for SMEs to initiate collaborations between SMEs and the knowledge base. Additionally, the rate of the relief of the R&D tax credit was increased from 125% to 130% for large companies from April 2008 and from 150% to 175% for SMEs from 1 August 2008. Moreover, the SME scheme was extended to companies with up to 500 employees from 1 August 2008 after the approval of the EC.

Measures are also taken to ensure that key elements of the UK's innovation infrastructure, such as the intellectual property system and procedures, standards and the National Measurement System, remain world class. Moreover, the establishment of an Innovation Research Centre will ensure high quality innovation research to support policymaking.

New measures are also introduced to improve skill levels and establish an integrated approach to employment and skills in order to improve productivity and increase opportunities for the disadvantaged. These measures include: a rise in the government investment for the Train to Gain scheme to over £1b by 2010-11; the establishment of a UK Commission for Employment and Skills; a Skills Funding Agency (operational from 2010); an integrated employment and skills system fully operational by 2010-11 and more.

Finally, the Research Councils are developing better measures of impact and improving the way they communicate to a wider audience. The Higher Education Investment Fund will rise to £150m (around €200m) per year by 2010-11 supporting universities to invest in infrastructure in order to engage with business and commercialise research. NESTA is developing an Innovation Index to measure UK innovation. The TSB under its new role will continue to make significant progress in developing capability, setting priorities and delivering key objectives, including running competitive calls for proposals, attracting co-funding for initiatives, such as the Innovation Platforms, and coordinating its £1b programme expenditure with the RDAs and Research Councils in 2008-11.

The measures set out in the NRP 2008 (HM Government, 2008) aim at further boosting the UK's research and innovation performance and were initially set out as commitments in the *Innovation Nation* White Paper, in response to the recommendations of Lord Sainsbury's Review, both published in March 2008. Many of these reforms have already been implemented. However, in line with the Sainsbury recommendations, few of these reforms resulted in new measures, but related largely to adjustments to the ongoing policy mix. The publication of the first Annual Innovation Report⁹ (AIR) in December 2008 by DIUS further assessed progress made in delivering these commitments and continued the UK's long tradition of reviews and assessments as a tool for policy evaluation, strategic planning and policy-making. In 2008, DIUS and HM Treasury also published the fourth Annual Report on the SIIF 2004-2014 assessing the progress against the six broad themes of the SIIF¹⁰. Alongside the SIIF Annual Report 2008, DIUS published its second Annual Report on the Economic Impacts of the Investment in Research and Innovation, updating the first report published in 2007.

The Devolved Administrations have also been active in reviewing and updating their strategic plans for research and innovation. In April 2008, Northern Ireland launched its Regional Innovation Strategic Action Plan 2008-2011, the third Action Plan under Northern Ireland's Regional Innovation Strategy. This foresees a €510m investment over the next 3 years, including €128m for a new Innovation Fund. The latter, will allocate €15m to increase the uptake of STEM subjects in schools, while the recommendations of a review of STEM are soon to be announced.

The Welsh Assembly Government has set out plans and launched a scoping phase during 2008-2009 for National Research Institutes and for a National Academy of Science to address business and university research capacity and the supply of STEM skills. Furthermore, the new Flexible Support for Business service supports a number of programmes to facilitate innovative knowledge exchange activities between academia and business including a network of Technium Innovation Centres, the Academic Expertise for Business programme for technology transfer

⁹ Source: ERAWATCH Research Inventory and DIUS, 2008.

¹⁰ Referred to in this document as SIIF Annual Report 2008.

from HE and FE institutions, and advice on R&D alongside finance from a Single Investment Fund. The second phase of the service started in October 2008 and regional business centres will be in place by April 2009.

Finally, the Scottish Executive launched a Strategic Framework for Science and a Framework for Innovation in autumn 2008. In April 2008, the Scottish Executive announced and implemented the €14m Saltire Prize for marine renewable energy innovations.

Overall, there have been a large number of policy reports and reviews which have fed into policymaking. However, these inputs have tended to be manifested through incremental changes and adjustments to existing mechanisms rather than through the introduction of new policy instruments. In addition, some minor structural changes (e.g. the creation of an Innovation Research Centre) have occurred.

2.3.1 Resource mobilisation

Despite the significant progress made towards the Lisbon goals for jobs and growth by the UK as confirmed by the NRP 2008, new challenges are posed by the global economic downturn. However, it is expected that the strong growth and job creation of the previous decade will provide a better framework to deal with the new conditions.

The Government's CSR, Budget and Pre-Budget reports contribute to the planning process on resource allocation. The most recent CSR was published in 2007, specifying the UK research funding allocations for the period 2008/9-2010/11, along with the allocations of the Science Budget 2008/9-2010/2011. The funding of the Science Budget increased to almost £4b seeking to maintain the strength of the research base, build an innovation and business-driven UK economy, and address global challenges. The support of the Lisbon Strategy remains a UK policy priority for 2007/2013, with 87% of the UK's allocation to be focused on Lisbon-related activities (HM Government, 2008).

The SIIF 2004-2014 continues to provide a long-term policy context for the prioritisation of expenditure on S&T. Further progress reviews have supported its adaptability through the measurement of the progress achieved and the introduction of changes to be made regarding objectives and priorities in line with progress and in response to emerging challenges. The SIIF Annual Report 2008 reviewed progress against SIIF's six broad themes, concluding that continued good progress has been made (DIUS & HM Treasury, 2008). The scientific excellence and high performance of the UK research base was again reported, supported by rising public investment. Positive trends were also reported for capital investment in research infrastructure. However, real term growth of business R&D investment as an overall percentage of GDP remained static. Thus, the main challenge for the UK under the current economic conditions remains to increase business innovation and the enhancement of the translation of research into innovation and economic growth. Specific steps were identified in the report towards addressing the specified weaknesses, but also towards the reinforcement of the reported strengths, including scientific excellence. The improved role of the TSB is also expected to significantly contribute to the improvement of UK innovation performance, although this cannot yet be reviewed (DIUS and HM Treasury, 2008).

Alongside the SIIF Annual Report 2008, DIUS also published its second Annual Report on the Economic Impacts of the Investment in Research and Innovation

(DIUS, 2008d). This includes performance indicators and evidence on the overall condition of the science and innovation system (the new UK economic impact reporting framework¹¹) and how this delivers economic benefits. The report confirmed the positive overall economic impacts of research and innovation that contributed to narrowing the UK's productivity gap with the US from 24% in 1996 to 19% in 2006.

The UK has the stated ambition of reaching a ratio of R&D spending to GDP of 2.5% by 2014, aiming to increase the size of the research system relative to the economy as a whole (HM Treasury, 2004). Eurostat reports R&D intensity (GERD/GDP) in the UK of 1.76% in 2006¹², just below the estimated EU average of 1.84% (1.83% for 2007). The gap between the UK and its main European competitors is primarily due to a lower share of GDP on R&D performed by the business sector. However, according to the 2008 NRP (HM Government, 2008), recent studies suggest that part of the gap may not be due to the underinvestment in R&D by this sector but due to the sector mix of the economy. In particular, R&D intensive industries account for a smaller share of UK output when compared to the sector mix of other leading EU countries. Additionally, of the innovation expenditure of UK businesses only a small part is spent on R&D.

The 2008 NRP (HM Government, 2008) also emphasised the need to specifically support innovation in the services sector, which accounts for 75% of the UK economy and is considered a key driver of productivity and growth. In August 2008, BERR and DIUS published the Supporting Innovation in Services report specifying potential areas of Government intervention and steps taken.

In 2008, DIUS published the Annual Innovation Report (AIR) 2008, the first report to assess progress made towards the 72 recommendations of Lord Sainsbury's Review and the subsequent commitments of the *Innovation Nation* White Paper. The report (DIUS, 2008a) assessed the UK's overall innovation performance, presenting key indicators and statistics on business innovation, R&D investment, IP protection, venture capital investments, STEM skills, knowledge exchange, inward investment, international collaboration in science and innovation and other crucial issues. Progress towards the implementation of the Sainsbury Review was also reported in the NRP 2008, according to which 20 recommendations are already fully implemented and the rest are under way, with public investment in the science base increasing from £5.4b in 2007-08 to £6.3b by 2010-11.

The AIR 2008 (DIUS, 2008a) also revealed positive findings. The main highlights were: an increase in the proportion of innovative companies from 49% in 2001 to 68% in 2007; a 4% increase (real terms) in total R&D expenditure between 2005-2006 (5% increase for business R&D); and a substantial increase in the overall number of STEM degree level and doctorate qualifiers between 2003-2007. The UK is also the top destination for Foreign Direct Investment (FDI) in Europe (2007) and second globally behind the US. It is third in the world on production of scientific papers, with patent applications doubling between 2000-2006/7. It also has a large

¹¹ This includes indicators on: Overall economic impacts; Innovation outcomes and outputs of firms and government; Knowledge generated by the research base; Investment in the research base and innovation.

¹² Measuring the progress towards this goal, the UK Office of National Statistics (<http://www.statistics.gov.uk/pdfdir/gerd0308.pdf>) reported a minor increase in R&D intensity (GERD/GDP) in the UK from 1.74% in 2005 to 1.75% in 2006. The ERAWATCH Country report and inventory give a different figure of 1.78%.

proportion of its STEM doctoral students and academics coming from overseas. However, the national innovation performance also reveals points for improvement, including the need for more early-stage financing for technology companies.

The AIR 2008 (DIUS, 2008a) presented a detailed description of the innovation activities of Government departments assessing the overall ability of the public sector to promote innovation. It also presented the activities of the RDAs that were found to have spent more than £1b between 2005/6-2007/8 in support of regional innovation. Some recent achievements with particular relevance for the mobilisation of resources are:

- The development of an Innovation Index by NESTA against which UK innovation performance can be assessed. A pilot index will be published in 2009.
- A new Innovation Research Centre has been established, co-funded by DIUS, NESTA, the ESRC, and the TSB as a long-term collaborative research programme with a five-year budget of €7m.
- The TSB will start five new Innovation Platforms over the next three years.
- The SBRI is refocused to help SMEs win government R&D contracts.
- The TSB requested the adoption of an Innovation Procurement Plan from every Government department, placing innovation at the centre of every policy area.
- NESTA supported the establishment of a Public Services Innovation Laboratory launched in March 2009, to examine and improve the dissemination of innovation in the public sector.
- DIUS established 16 National Skills Academies and announced the establishment of another four on IT, power, enterprise and social care.
- A framework for the further expansion of the HE sector, with 20 new HE centres.
- DIUS launched a revenue based FE Specialisation and Innovation Fund to build the capacity of the FE sector businesses to raise their innovation potential.
- DIUS is working to promote greater take-up of STEM subjects at all levels.

Additionally, based on the 2008 NRP, the HEIF is to be allocated wholly by formula based on previous allocations rather than on new competitions, specific knowledge transfer targets have been agreed for each Research Council and the next round of the PSRE Fund will receive co-funding from other organisations (HM Government, 2008). The R&D tax credit increased the SME rate from 150% to 175%, and the large companies' rate from 125% to 130%. Also, the Research Councils have been implementing a Performance Management System, designed to ensure that the Science Budget is appropriately targeted and allocated in line with priorities ([Cunningham and Boden, 2009](#)).

Finally, according to the SIIF Annual Report 2008, during 2008 the Research Capital Investment Fund (RCIF) was established, replacing the Science Research Investment Fund (SRIF) that addressed shortfalls in capital funding for research. Additionally, Research Councils UK undertook a review of the first three years of the full economic costing regime and its impact on UK HEIs. Moreover, attempts are being made to replace the Research Assessment Exercise (RAE) with "a new less resource-intensive Research Excellence Framework" (DIUS and HM Treasury,

2008). The RAE 2008 introduced significant changes¹³ over RAE 2001 affecting the allocation of resources for research.

Overall, the UK in 2008/9 continued to undertake “a series of thorough reviews of the challenges facing the research system (as a key component of the broader national system of innovation) and has developed a comprehensive, long-term yet flexible approach to addressing these challenges. In this regard, there have not been significant policy changes; rather small-scale adjustments have been made within the context of the UK long-term Investment Framework” ([Cunningham and Boden, 2009](#)).

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main policy changes
Justifying resource provision for research activities	<ul style="list-style-type: none"> • Further extensive systemic reviews. • Establishment of an Innovation Index. • Adoption of an Innovation Procurement Plan from Govt. departments. • Performance Management System for allocation of Science Budget by the Research Councils. • RAE 2008; Establishment of Research Capital Investment Fund; and RCUK review of the full economic costing regime.
Securing long term investments in research	<ul style="list-style-type: none"> • Extended support and remit for the TSB. • Maintenance of long-term funding for science base. • R&D tax credit rate increase.
Dealing with uncertain returns and other barriers to business R&D investments	<ul style="list-style-type: none"> • Role of TSB. • Refocusing of the SBRI. • Innovation Platforms. • National Skills Academies. • Launch of FE Specialisation and Innovation Fund.
Providing qualified human resources	<ul style="list-style-type: none"> • National Skills Academies. • Expansion of HE and FE sector capacities. • Focus on STEM skills uptake at school level. • Launch of FE Specialisation and Innovation Fund.

2.3.2 Knowledge demand

The SIIF Annual Report 2008 listed the following key findings regarding the demand for innovation (DIUS and HM Treasury, 2008): one third of UK enterprises rate their clients or customers as a ‘highly’ important source of information; there has been a decrease in the proportion of firms who regard uncertain demand as being an important factor constraining innovation; around 22% of UK firms regard the lack of qualified personnel as a factor of medium to high importance in constraining innovation; knowledge-intensive services show the greatest proportion of employment with graduate level qualifications in science and engineering.

In terms of assessing research demand, DIUS, BERR, the TSB and NESTA continue to work on innovation in the service sector to better understand its role and as a possible input to future policymaking – a requirement that has long been recognised at the academic level. In August 2008, BERR and DIUS published the *Supporting*

¹³ These included: the publication of results as a graded quality profile instead of a fixed seven-point scale to allow funding bodies to identify excellence wherever found; a formal two-tiered panel to ensure greater consistency and international calibration; and explicit criteria in each subject to enable proper assessment of all types of research

Innovation in Services report specifying potential areas of Government intervention and steps taken.

In terms of identifying the requirements for research knowledge demand, the major recent policy change concerns the expanded remit and role of the TSB. The 2008 NRP (HM Government, 2008) reported significant progress despite the very short period since the TSB became a non-departmental executive body. In May 2008, TSB published its new strategic plan *Connect and Catalyse*, specifying its objectives and main priorities that include: addressing current and future societal and economic challenges through business R&D and innovation (challenge-led innovation); help the UK maintain expertise in specific technological areas of high importance (technology-inspired innovation); and build an innovation culture (Innovation Climate).

TSB has a budget of €1,015m for 2008-2011 plus aligned funding from the RDAs of €257m and at least €171m from the Research Councils and will thus coordinate a €1.4b programme during this period. The AIR 2008 (DIUS, 2008a) provided a short review of the activities and performance of TSB since its re-establishment in 2007, highlighting key facts: 889 collaborative R&D projects are being supported with total project costs of €1.7b, involving 3,000 businesses and 98 HEIs; six challenge-led Innovation Platforms are underway, the last launched in October 2008 (by 2011, TSB plans to have established 10 Innovation Platforms). The further development of Innovation Platforms also strengthens the links between user demand and research. The Innovation Platforms along with the 975 Knowledge Transfer Partnerships that are in operation and now extended to the FE sector are expected to address business needs for research in key technology areas. Similarly, the creation of the Energy Research Partnership and the establishment of the Energy Technologies Institute should also go some way in meeting the demands for energy-related R&D.

DIUS is also leading activities to increase demand for innovation, innovation in the public sector and creation of new markets, asking Government departments to produce Innovation Procurement Plans. TSB coordinates the refocused SBRI – which the Ministry of Defence and the Department of Health are piloting – to help SMEs win government R&D contracts. In addition, the first calls for Innovation Vouchers applications were launched after November 2008 providing €3.75m at regional level to overcome barriers to SMEs-knowledge base engagement.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	<ul style="list-style-type: none"> • <i>Supporting Innovation in Services</i> report. • Extensive systemic reviews.
Co-ordinating and channelling knowledge demands	<ul style="list-style-type: none"> • TSB's role. • Innovation Procurement Plans in every Govt. Dept. • Refocusing of the SBRI. • Innovation Vouchers.
Monitoring demand fulfilment	<ul style="list-style-type: none"> • Extensive systemic reviews, including the first Annual Innovation Report 2008 and the fourth SIIF Annual Report.

2.3.3 Knowledge production

Scientific excellence is a key element of the SIIF 2004-2014¹⁴, which sets the target of a 2.5% R&D intensity by 2014. As noted in section 2.1, progress has been made towards this goal, highlighting significant foreign investment in R&D, but also a relatively low amount of business-funded R&D. As mentioned in the ERAWATCH Country Report 2008, the SIIF 2004-2014 places particular emphasis "on further strengthening the UK science base and in promoting and supporting world-class research. This includes sustained increases in investment in the science base by the Research Councils and the Higher Education Funding Councils and with a particular focus on the UK's most research-intensive universities" ([Cunningham and Boden, 2009](#)).

The AIR 2008 (DIUS, 2008a) also revealed positive findings regarding knowledge production including a substantial increase in the overall number of STEM degree level and doctorate qualifiers during 2003-2007. The UK is third in the world on the production of scientific papers, with patent applications doubling between 2000-2006/7. It also counts 975 active KTPs and has a large proportion of its doctoral STEM students and academics coming from overseas. The scientific excellence and high performance of the UK research base supported by rising public investment, was also reported in the SIIF Annual Report 2008. Specific steps were identified towards the reinforcement of scientific excellence. The improved role of the TSB is also expected to contribute significantly to the improvement of UK innovation performance. Moreover, the above-mentioned establishment of a national Innovation Research Centre will ensure high quality innovation research, while the Innovation Vouchers being piloted at the regional level aim to boost the exploitation of knowledge along with the partnering of academia and industry

The Performance Management System, designed to ensure that the science budget is appropriately targeted and allocated in line with priorities, also contributes towards scientific excellence. Based on this, the Research Councils publish delivery plans, scorecards and 'output frameworks' related to the health of the research base and better exploitation of research ([Cunningham and Boden, 2009](#)). These frameworks form the basis of annual reports, the most recent of which was the *SIIF 2004-2014: Economic Impact of Investment in Research and Innovation 2008*. This document reported that the UK is second to the US in terms of number of scientific publications, with around 9% of the world total. It was also second to the US with around 12% of world citations, and with 13% of the most highly cited papers. The UK's citation performance is sustained across disciplines, with the UK in the top three in seven of nine fields.

Investment in world-class infrastructure is a prerequisite for world class research and is thus a key element of the SIIF 2004-2014. Since 2008, further measures have been introduced to ensure that key elements of the UK's innovation infrastructure of particular importance for knowledge production, such as the National Measurement System¹⁵, the UK's IP regime and the UK's standards and accreditation system,

¹⁴ However, it should be noted that given the time lags in publication and their subsequent citation, these are essentially historic measures and it will take time for any policies implemented under the SIIF to have effect. However, they are monitored and assessed on an annual basis.

¹⁵ According to the AIR 2008: "The UK's National Measurement System provides an infrastructure of national measurement standards, facilities, expertise and leading edge science and research programmes which together are key drivers of innovation" (DIUS, 2008a).

remain world class. In spring 2009, DIUS will publish a Strategic Plan for the National Measurement System for 2009–2012 specifying how it will work with the TSB.

The SIIF Annual Report 2008 concluded that good progress has been made during 2008 regarding infrastructure investment. A more strategic approach to capital investment in the research base has been adopted, following the replacement of the SRIF by the RCIF in 2008. The latter will provide €727m funding to support research infrastructure within HEIs, based on Research Council income, over the current spending review period (2008-2013). The RCIF will make sure that previous shortfalls in infrastructure funding addressed by the SRIF do not reoccur. Also, in 2008 DIUS published the Large Facilities Roadmap and the allocation of DIUS’ Large Facilities Capital Fund (LFCF), placing a greater emphasis on the economic impact of facilities and the development of clearer guidance for potential projects. The latter has already made a €337m infrastructure investment. Moreover, RCUK is currently undertaking a review of the first three years of the full economic costing regime and its impact on UK HEIs. Lastly, there are moves to replace the RAE with a new less resource intensive Research Excellence Framework (DIUS and HM Treasury, 2008).

On the whole, as noted in the ERAWATCH Country Report “the UK is maintaining and enhancing its strong position in relative research excellence, particularly in terms of research outputs and their impact” ([Cunningham and Boden, 2009](#)).

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	<ul style="list-style-type: none"> • Increased investment in the science base by Research Councils and HEFCs in the frame of a long-term SIIF. • Strategic Plan for the NMS for 2009 – 2012. • Replacement of the SRIF by the RCIF. • Publication of the Large Facilities Roadmap and the allocation of DIUS’ Large Facilities Capital Fund. • Innovation Research Centre. • Replacing RAE with less resource intensive Research Excellence Framework.
Ensuring exploitability of knowledge production	<ul style="list-style-type: none"> • SIIF 2004-2014: Economic Impact of Investment in Research and Innovation 2008 and other extensive reviews. • Innovation Vouchers.

2.3.4 Knowledge circulation

The issue of knowledge links between the science base and the business sector forms a longstanding element of the UK Innovation policy and a key parameter in its SIIF 2004-2014. Specifically, under the SIIF 2004-2014 the UK aims to improve its performance in knowledge transfer and commercialisation from public sector research.

So far, important developments are occurring in terms of both inter-sectoral and international knowledge circulation. According to the SIIF Economic Impacts of Investment in Research and Innovation report (DIUS, 2008d), a quarter of UK innovative enterprises source information from HEIs, and a quarter from government or PRIs. Additionally, the latest survey of knowledge transfer activities reported by HEIs shows positive trends. Income from business for UK HEIs has risen to over £1b (€1.25b) in 2006-07. The number of licenses and licensing income from business has exceeded that in the US over the last few years. Additionally, according to the AIR 2008 (DIUS, 2008a) 7,500 staff in HEIs are already employed in commercialisation or

industrial liaison, while the average income generated from research, consultancy and licensing agreements by HEIs increased from £514m (€755m) in 2003/4-2005/6 to £568m (€757m) in 2004/5-2006/7. Patent applications have doubled since 2000 to 1,913 in 2006/7.

Such developments in knowledge circulation are the result of specific policies and are reflected in recent policy measures. The SIIF Annual Report 2008 (DIUS and HM Treasury, 2008), also reported positive trends for knowledge transfer activities and the take-up of STEM skills. It was also concluded that despite a wide-ranging consultation on the relationship between science and society launched in July 2008, the main challenges for the UK under the current economic conditions remain the increase of business innovation across all sectors and the enhancement of the translation of research into innovation and economic growth (DIUS and HM Treasury, 2008). New policy developments attempt to address these challenges.

Recent reviews continue to recommend the support of knowledge transfer, leading to the introduction of new measures such as: doubling the number of KTPs; 10 more Innovation Platforms by 2010 addressing societal challenges by bringing together SMEs, the knowledge base and other stakeholders; support by TSB to more collaborative R&D projects and more participation in European and international innovation projects such as Eurostars; specification of knowledge transfer targets for each Research Council; co-funding of the PSRE Fund; and also a rise in HEIF funding for universities to invest in infrastructure for the commercialisation of research and liaison with industry to £150m (about €176m) per year by 2010-11 and the allocation of the HEIF wholly by formula.

Other measures recently introduced include the Innovation Vouchers that aim to boost the transfer and exploitation of knowledge between academia and industry. The first calls for applications were launched in 2008 (pilots were previously introduced in a few regions), supporting the interaction between SMEs and the knowledge base with a total investment of €3.75m (€5m). At least 500 businesses per year (with an aspiration to reach 1,000 annually) will receive a £3,000 (€3,530) voucher by 2011 to spend on engagements with HE and FE institutions.

As mentioned above, a new Innovation Research Centre has been established to ensure the continuous availability of high-quality innovation research for the wider UK innovation policy community. Furthermore, the National Council for Graduate Entrepreneurship will receive an extra £300,000 to establish a national network of university-business clusters encouraging innovative thinking within academia.

The strengths of the UK research base and other advantages of the research system make it an attractive place for foreign investment in R&D, with 17% of R&D funded from abroad. FDI in R&D is particularly high in the business sector (27% of R&D) raising the challenge of absorption capacity, since the impacts on wider knowledge circulation within the UK maybe more diffuse.

Investment in skills and training is one way of raising absorptive capacity. The uptake of STEM skills is reported to have improved according to the NRP 2008 (HM Government, 2008) and the SIIF Economic Impact of Investment in Research and Innovation 2008 report (DIUS, 2008d), with a rise in 'A-level' entries for STEM in 2007/8 and 11% and 18% increases of STEM graduates and PhDs respectively from 2002/3 to 2006/7. The UK is also second in the G7 based on the number of PhDs awarded per head of population; however it is only sixth in the G7 in terms of number of researchers in the workforce.

Despite the good progress made in line with the targets set in Lord Leitch’s review of UK skills in 2006, skills enhancement remains a central pillar of the NRP 2008. According to the latter, the skills system is being reformed to boost demand and deliver high quality, relevant and responsive training, while active labour market policies continue to be on the Government’s reform agenda. Other new measures for further supporting high-skills according to the NRP 2008 include (HM Government, 2008): more resources committed in the 2008 budget with government funding for Train to Gain rising to over £1b (€1.17b) by 2010-11; an operational UK Commission for Employment and Skills after April 2008; a consultation on a new right for workers to request time to train in June 2008; trial aspects of an integrated employment and skills service between 2008 and 2009; suite of robust operational targets for Jobcentre Plus and Learning and Skills Council set in 2009; a Skills Funding Agency fully operational from 2010; an integrated employment and skills system fully operational by 2010-11; and full participation of all 16 year-olds by 2013 and all 17 year-olds by 2015.

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	<ul style="list-style-type: none"> • Double the number of Knowledge Transfer Partnerships. • 10 more Innovation Platforms by 2010. • Rise in HEIF funding for universities. • Innovation Vouchers. • Innovation Research Centre.
Profiting from access to international knowledge	<ul style="list-style-type: none"> • TSB support to more participation in European and international innovation projects such as Eurostars.
Absorptive capacity of knowledge users	<ul style="list-style-type: none"> • An integrated employment and skills system fully operational by 2010-11. • More active labour market policies. • More resources committed in 2008 for Train to Gain. • Extra funding to the National Council for Graduate Entrepreneurship. • An operational UK Commission for Employment and Skills after April 2008. • A consultation on a new right for workers to request time to train in June 2008. • Trial aspects of an integrated employment and skills service between 2008 and 2009. • Suite of robust operational targets for Jobcentre Plus and Learning and Skills Council set in 2009. • A Skills Funding Agency fully operational from 2010.

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths. It should be noted that the UK government tends to adhere to the policy commitments expressed in its key policy documents. Thus, statements to the effect that additional resources will be committed, further reviews will be conducted and new bodies established tend to be backed up by actions. On the other hand, targets such as “full participation of all 16 year-olds by 2013” are more prone to the vagaries of circumstances.

In terms of challenges relating to the provision of resources, the overarching series of Comprehensive Spending Reviews backed up by a culture that stresses targeted policy reviews and evaluations, appears to provide the UK government with a firm basis for evidence based policymaking. Various new initiatives in this area (Innovation Index, Departmental Innovation Procurement Plans, Research Councils' Performance Management Systems, new research assessment mechanism, RCIF and fEC reviews) are likely to further contribute to this process.

Long-term investment in research have been addressed through the extended budget and remit for the TSB, coupled with sustained support for the Science Base while indirect support has been enhanced through the increase in the R&D Tax Credit allowance. However, the chronic effects of the economic downturn are an area for concern.

A number of barriers to business R&D investment have been addressed through measures such as the enhanced role of the TSB and extension of its programmes (such as the Innovation Platforms), the extension of the R&D Tax Credits, a refocusing of the SBRI (although the impact of this is not clear), the creation of National Skills Academies (which will take some time to come fully on-stream) and the FE Specialisation and Innovation Fund. Again, however, the general uncertainty within the macroeconomic climate could militate against the effectiveness of these measures.

Human resources issues have been addressed through the National Skills Academies, the expansion of HE and FE sector capacities, a focus on STEM skills uptake at school level and the launch of FE Specialisation and Innovation Fund. Again, the impact of these will require time.

Moving to knowledge demand, once again, the use of systemic and targeted reviews is expected to continue to provide effective policy advice, while the role of the TSB, a re-focused SBRI and the rollout of the piloted innovation vouchers scheme at regional level should help to coordinate and channel knowledge demands. The production of departmental innovation procurement plans may be of some utility although the role of procurement in innovation support is still a topic of debate in several academic quarters.

The UK government appears to have a good track record in addressing the challenge of the quality and excellence of knowledge production: increased investment in the Science Base has been sustained according to a long-term strategic framework (the SIIF), while support for research infrastructures is assured through the new RCIF and the Large Facilities Capital Fund. Long-term support for the National Measurement System has also been provided. Further evidence for policy making should be provided once the new Innovation Research Centre and its programme are fully established. However, the shape and potential effectiveness of the replacement for the RAE (the REF) are still very much under debate.

At the strategic level, various reviews of the flow of knowledge between the science base and business are aiming to provide improved policy instruments (of which a number have been in existence for some time) in order to address the challenge of the exploitability of knowledge production, while the implementation of the innovation vouchers is also intended to address this issue. However, this challenge has been a long-standing focus for UK innovation policy and, despite some evidence of increasing success, more remains to be done.

Finally, the area of knowledge circulation still poses a number of challenges. As noted above, knowledge circulation between the research base and the business sector is an enduring issue. Several recent policy changes target this including an increase in the number of Knowledge Transfer Partnerships and Innovation Platforms, increases in the funding of the HEIF and the rollout of innovation vouchers. When fully operational, the Innovation Research Centre is also expected to undertake focused studies on this topic.

The UK is already extremely well integrated with international research at a variety of levels. However, more support will be given to European participation via the TSB.

Several strategic and operational responses have been mobilised to address the challenge of increasing the absorptive capacity of knowledge users. These include more funding to training and entrepreneurship programmes and more services for employment and skills. A number of proposed activities are also due to come on-stream during 2009 to 2011, many in response to the results of the Leitch Review of Skills. The effectiveness of these and their level of realisation, given the economic downturn, are uncertain at the present time.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	<ul style="list-style-type: none"> • Good identification of resource mobilisation issues and challenges • Promoting attractiveness of UK to foreign researchers and foreign corporate investors 	<ul style="list-style-type: none"> • Unstable global macro-economic conditions which may impact research and innovation budgets
Knowledge demand	<ul style="list-style-type: none"> • Strategic identification of issues and challenges in a long term perspective • Role of Technology Strategy Board 	<ul style="list-style-type: none"> • Significant minority of non-innovating businesses
Knowledge production	<ul style="list-style-type: none"> • Policy emphasis on the sustained renovation of research infrastructure • Close monitoring of the social and economic impacts of research • Development of innovation potential and scope to build on the strength of the science and engineering base 	<ul style="list-style-type: none"> • Introduction of Full Economic Costs may discourage industry spending in higher education sector • Uncertainty over long-term supply of human resources for science and technology in key strategic areas
Knowledge circulation	<ul style="list-style-type: none"> • Establishment of and enhanced role for Technology Strategy Board • Rationalisation of Research Evaluation Framework metrics to include knowledge transfer objectives 	<ul style="list-style-type: none"> • Policy focus on UK attractiveness could lead to dependence on high level of (potentially ephemeral) FDI

Source: [Cunningham and Boden, 2009](#)

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP of which two thirds should come from private investment. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence

knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above-mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

According to the NRP 2008 (HM Government, 2008), the UK has experienced a decade of strong growth and job creation and the flexibility of its economy provides a solid platform from which to face the global economic shocks. However, in the face of the global economic downturn and the UK's entry into recession, both the Government and external forecasters expect a slowdown in growth, certainly for 2009 and perhaps beyond. Faced by such challenging economic circumstances, the UK NRP emphasises the importance of establishing macroeconomic stability as a prerequisite for growth and structural reform, as central to the Lisbon strategy and a key element of the EU Broad Economic Policy Guidelines.

Clearly, the recession will also have a major impact with regards to levels of investment in R&D, particularly from the private sector, whilst public finances are also highly likely to be squeezed. Thus, the long-standing challenges faced by the UK research system are likely to be somewhat exacerbated as the effects of the global downturn make themselves felt.

Government policy documents and supporting official speeches, for example, indicate that the UK National Innovation System (NIS) appears to face three major challenges. These challenges have been identified by a series of policy documents, for example, the 2003 Science and Innovation Investment Framework 2004-2014, and subsequent follow-ups, emphasising their systemic nature. In addition, there appears to be sufficient quantitative and qualitative evidence to substantiate them at a more independent level (for example, DIUS 2008b).

These challenges may be viewed as the outcomes of barriers¹⁶ that need to be overcome in order to achieve higher levels of R&D investment and concern, namely:

- A need to increase the intensity of innovation activity in enterprises;
- A need to strengthen linkages between the public research base and business;
- A requirement to match future skills needs and improve the supply of high quality labour, and
- At the same time, there is also a need to maintain the quality of the public research base and its ability to perform world-leading research.

More detailed treatments of these challenges are provided below¹⁷.

Challenge: Increase the intensity of innovation activity in enterprises

This has formed the topic of policy debate and a focus for UK policies for several years. Figures from the Office of National Statistics (2009) BERD Survey indicate that, in cash terms, expenditure on R&D performed in UK businesses shows an overall rise from a figure of £12.5m in 2003 to £16.1m in 2007. In real terms, both civil and defence R&D expenditure by UK businesses increased by 7% over the previous year. Despite these generally positive trends, policy makers have recognised that, in international comparisons, overall investments in business R&D expenditure are low as are levels of patenting. However, to some extent it is thought that this may reflect, in part, the sector mix of the UK economy, a relatively strong tendency towards non-R&D innovation and the use of non-patent based approaches to intellectual property protection. Nevertheless, the Government has noted that such investment needs to rise faster than trend GDP growth if the Government's long-term ambition is to be achieved.

In policy terms, the challenge is a major concern given the UK's relatively stable macroeconomic history, which might be expected to have had positive effects on business confidence. One possible cause may be the absence of a strong, consumer demand-led, market for new and innovative products. Here, the Government has identified the enormous potential driver of public procurement practice, which could be harnessed to create a demand for innovation, and thus increase the intensity of innovation in enterprises. Hence, procurement policy, as a potential adjunct to innovation policy, has formed the focus of much policy debate. In theory, such a coupling would produce a clear "win-win" situation – public spending on goods and services also contributing to business competitiveness. However, the attractiveness of harnessing the public sector's enormous aggregate spend on procurement as a driver for private sector innovation faces significant difficulties, not least due to the need to coordinate the equally enormous diversity of procuring agencies and organisations and the sources they use.

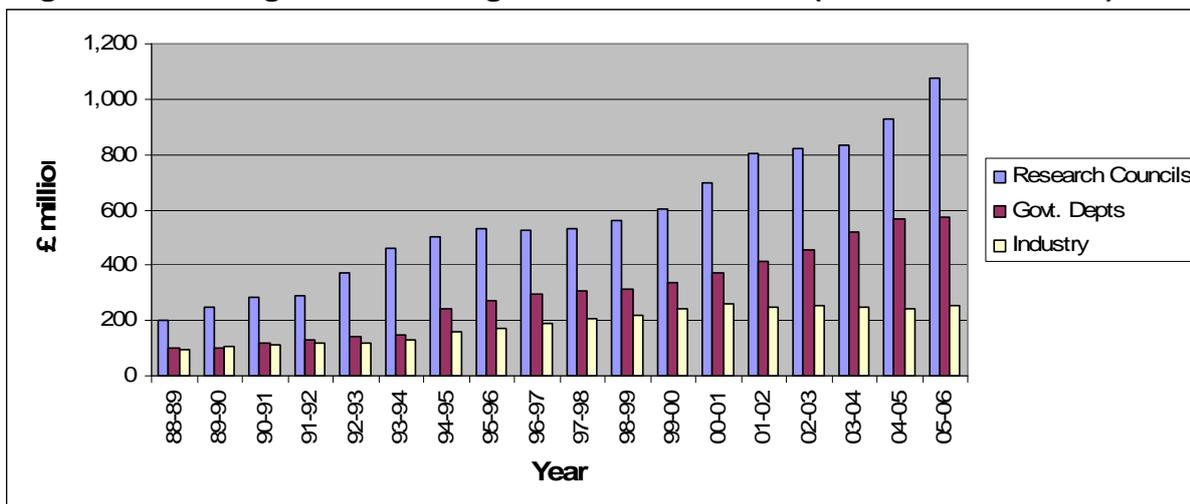
¹⁶ Although the guidelines specify that weaknesses may be seen as barriers, it is often the case that weaknesses (which, when viewed in policy terms, can be synonymous with challenges) are merely symptoms of barriers, which in turn can frequently be complex and diverse. Indeed, it is the complexity of such barriers that preclude the application of relatively straightforward 'policy fixes'.

¹⁷ Taken from Cunningham (2007).

Challenge: Strengthen linkages between the public research base and business

Since the late eighties, business funding for R&D performed in universities has levelled out and even declined slightly in recent years, in contrast to funding from public sector sources such as Research Councils and Government departments which has exhibited a general upward trend, (see Figure 2).

Figure 2: Funding for HEI R&D grants and contracts (1994-05 to 2003-04)



Source: Cunningham, P. 2007b

Despite a strong policy push to increase the level of private funding for university research, the continual decline since 2000 may be considered as a failure in UK innovation policy. Is there a case for saying that the significantly increased public funding has crowded out private funding? Given the broad range of policy instruments in place, which directly and indirectly aim at the promotion of public sector-business interaction, this is particularly worrying. The decline may also be contributing to a crisis in the public research sector, due to inadequate public funding and the assumption that the gap would be covered by private sources. According to the European Innovation Scoreboard, on indicator 2.5, 'Business financed university R&D', the UK performs below average and its trend performance has been strongly below the EU average.

In contrast however, systematic information on various forms of HEI-business interaction show an upwards trend for most indicators (Table 7).

Table 7: Trends in selected indicators of HEI-business interaction, UK

Indicator	2000/2001	2002/03	2005/06
Income from business (contract research and consultancy) (£ million)	362	457	536
Number of spin-outs	248	197	187
Number of graduate start-ups	516	974	1172
Number of patents granted	250	377	577
Licensing income (£ million)	18	37	58

Source: HE-Business and Community Interaction Surveys (cited in DIUS (2008b)).

Table 8: Indicators HEIs 2000/1 – 2006/7

Indicator - HEIs	2000/1	2001/2	2002/3	2003/4	2004/5	2005/6	2006/7
Number of new patent applications filed by Higher Education Institutes (HEIs)	896	960	1,222	1,308	1,649	1,537	1,913
Number of Patents granted	250	198	377	463	711	576	647
Number of licensing agreements	728	615	758	2,256	2,099	2,699	3,286
Income from licensing intellectual property (£ million)	18	47	37	38	57	58	58
Number of spin-outs	248	213	197	161	148	187	226
Income from business (value of consultancy contracts) (£ million)	104	122	168	211	219	236	288
Number of full time equivalent staff employed in commercialisation/ industrial liaison offices	1,538	1,836	2,283	2,706	3,077	3,448	7,440

Source: DIUS and HM Treasury, 2008.

Information from DIUS (2008b) notes that there are insufficient data to judge whether there is a similar trend in business engagement among PSREs. Data limitations also preclude an assessment of the comparative effectiveness of UK HEIs in engaging business relative to HEIs elsewhere in the world. Although few UK institutions seem to match the depth and breadth of engagement shown by leading US institutions, the very large numbers of HEIs in the US demonstrate greater heterogeneity.

UK Innovation Survey data indicate that the principle sources of information for business' innovation activities are other businesses. Only around one fifth of businesses mentioned HEIs and government research institutes, etc. The proportion of businesses rating universities or HEIs of high importance as an information source was 1% in 2007 (27% of businesses rated clients or customers of high importance). As noted in DIUS (2008b), these findings do not necessarily point to a failure in the innovation system as the proportion of businesses requiring access to leading edge scientific knowledge may be limited at any point in time. Moreover, the above data focus on the direct transmission of knowledge and would underestimate the total contribution of research-based knowledge to business innovation (from additional indirect flows such as publications, the operation of consultancies, codified standards and the movement of people).

Challenge: Matching future skills needs and improving the supply of high quality labour

Government reviews¹⁸ have highlighted the finding that productivity and employability are hindered by poor skills and that the UK is particularly weak in basic and intermediate skills. These cause delays in innovations and investment programmes or the slowing down of the transfer to full product development. Particular weaknesses were found in high-tech manufacturing, whilst knowledge-intensive services fared better. This issue was addressed in a "Skills White Paper"¹⁹ which set out to assess the Government's Skills Strategy launched in July 2003 and to build on

¹⁸ For example: HM Treasury, Department for Trade & Industry and Department for Education and Skills, *Science & innovation investment framework 2004-2014*, July 2004, ISBN: 1-84532-031-X.

¹⁹ <http://www.dfes.gov.uk/skillsstrategy/index.cfm?fuseaction=content.view&CategoryID=6>

the infrastructures put in place by previous policies. The UK education system was identified as one area for improvement, particularly in the light of future potential competitive challenges posed by countries such as India and China.

Although this challenge may be considered of peripheral concern to the issue of R&D investment, it is noteworthy that the Skills Strategy pays attention to the UK Government's objective of attaining a target for R&D expenditure of 2.5% of GDP by 2014 and is thus considered a relevant policy concern.

Challenge: Maintaining the quality of the UK's public research base

Whilst the quality of the UK's science base, as measured by indicators such as publications and citations, is an acknowledged strength of the UK research system, significant policy attention is given to maintaining the level of this quality in order for the UK to remain competitive worldwide. To this end, the Government has identified the need to put in place a sustainable investment into the UK science base (see section 3.3)

3.2 Policy objectives addressing R&D investment and barriers

The UK Government's main objectives concerning R&D policy are very much an integral part of its broader policy on innovation and relate closely to the barriers identified in the previous section. Over the last decade or so there have been a number of relevant policy documents produced which set out the Government's priorities in this area. Overall, in terms of broad policy objectives, the Government's priorities have not altered considerably and tend to focus on the relationship between skills, innovation and enterprise in raising productivity.

The overarching strategy on UK research and innovation policy was set out in the Government's "Science and Innovation Investment Framework 2004-14", which formed the outcome of an extensive consultation exercise launched in March 2004. According to this, the Government's overall long-term objective for the UK economy is to increase the level of knowledge intensity (expressed as R&D as a percentage of GDP) from its then current level of around 1.9% to 2.5% by around 2014.

The Ten-Year Framework has been subsequently updated on an annual basis and progress against its stated objectives has been reported, together with any revised actions. The following areas were and continue to be designated as priorities:

- "World class research at the UK's strongest centres of excellence:
 - Maintain the UK's overall ranking... on research excellence, and its current lead against the rest of the OECD; close the gap with the leading two nations where current UK performance is third or lower; and maintain the UK's lead in scientific productivity.
 - Retain and build sufficient world class centres of research excellence... to support growth in its share of internationally mobile R&D investment and highly skilled people.
- Greater responsiveness of the publicly-funded research base to the needs of the economy and public services:
 - Research Councils' programmes to be more strongly influenced by and delivered in partnership with end users of research.

- Continue to improve UK performance in knowledge transfer and commercialisation from universities and public laboratories towards world leading benchmarks.
- Increased business investment in R&D, and increased business engagement in drawing on the UK science base for ideas and talent:
 - Increase business investment in R&D as a share of GDP from 1.25% towards a goal of 1.7% over the decade.
 - Narrow the gap in business R&D intensity and business innovation performance between the UK and leading EU countries and US performance in each sector, reflecting the size distribution of UK companies in the UK.
- A strong supply of scientists, engineers and technologists by achieving 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 SET subjects in post-16 education and in higher education.
 - The proportion of better qualified students pursuing R&D careers.
 - The proportion of minority ethnic and women participants in higher education.
- Sustainable and financially robust universities and public laboratories across the UK.
- Confidence and increased awareness across UK society in scientific research and its innovative applications”.

In the specific context of R&D investment, these priorities may be summarised as:

- Support for high quality research and scientific productivity.
- Promotion of the flow of research results and ideas from the Science Base into the commercial environment and public services.
- Increased business investment in R&D, and engagement with the Science Base.
- Ensuring the supply of scientists, engineers and technologists.
- Continued support for the Science Base infrastructure.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

Overall, it is clear that the majority of Government funding for research is targeted largely at the public sector, with direct support to business (other than in the defence sector) being rather marginal. This is largely because the government believes that it

cannot hope to match the level of industrial funding provided by business itself and that its overall goal should be to maintain an environment which is conducive to business innovation activity. Thus, government support tends to focus on framework conditions and on improved knowledge linkages and knowledge circulation.

Public sector funding of R&D

Support to the public sector, outside of the portfolio of specific government departments (notably health and environment), tends to be largely non-thematic and is the mainly the consequence of bottom-up, responsive mode funding allocations. Although the Research Councils do have specific research foci and operate priority programmes, to address major global, socio-economic and other issues (Climate change, aging, etc.) these are formulated with substantial stakeholder engagement and also take account of the research communities they address. Thus, there is a balancing of supply and demand in research resources. Block research funding to the universities is allocated on quality criteria and disbursed internally by the universities themselves. Thus, thematic funding is not a major feature of the UK system.

UK Government funding (including that for research) is allocated through the triennial Comprehensive Spending Review (CSR). This sets fixed three-year Departmental Expenditure Limits and defines the key improvements that the public can expect from these resources. The mechanism provides longer-term stability for expenditure planning by public bodies and ensures that public money is being spent, efficiently and effectively, according to defined priorities. Public Service Agreements (PSAs) are used to set performance targets, leading to improvements in service delivery and outcomes. Funding on R&D or S&T purposes is subject to broad PSAs.

The overall strategy for UK research funding is framed in the SIIF 2004-2014 (HM Treasury, 2004). This aims to ensure sustainability in research funding, underlining the Government's long-term perspective on research investment within the UK economy, with science and technology a high spending priority. Progress is assessed according to milestones and targets on an annual basis, with published annual reports highlighting areas for policy action.

Business sector R&D

The UK Office of National Statistics²⁰ estimates indicate that some 11,000 companies are engaged in R&D in the UK. In 2007, UK BERD stood at 1.1% of GDP, a ratio that had been in gradual decline for more than a decade, although this has levelled out in recent years. In 2006, total expenditure on R&D performed within UK enterprises was around €25b, an increase of 11% on the previous year. In 2007, 64% of BERD was financed by industry itself (Office of National Statistics). Almost one quarter (23%) of business sector research funding comes from abroad. In 2006, around 8% of UK BERD was accounted for by businesses with fewer than 100 employees, 31% by firms with less than 1000 employees and only 18% by firms with 5000 or more employees. More generally, SMEs represent a very important part of the UK economy (particularly in the services sector) and account for half of total employment and turnover in the UK.

²⁰ In April 2008, the Office of National Statistics was replaced by the UK Statistics Authority, an independent body accountable to Parliament.

The UK Government's general approach to promoting private sector investment is to maintain a stable macroeconomic environment and to remove microeconomic barriers that prevent the market from functioning properly. UK Government enterprise policy has, in recent years, focused on increasing the incentives for and removing the obstacles to entrepreneurial activities and promoting an enterprise culture.

The Government utilises a number of microeconomic measures to stimulate R&D in the business sector, although it should be noted that the main aim of Government policy is to stimulate innovation and competitiveness, rather than simply support R&D expenditure in its own right. In this sense, the main policies are the R&D Tax credits schemes and the programmes operated by the TSB.

Broad balance of public R&D policy

The Government's commitment to support the research base is exemplified by the fact that, since 1997, the Government's science budget has more than doubled and is currently around €5.5b²¹. UK government funding is split between government departments, the Higher Education Funding Councils (which provide block grant funding to UK universities) and the Research Councils (which fund research, again largely in universities and in their own in-house institutes). Almost half of government funded R&D is currently performed in the higher education sector and 20% by the private sector (see also Section 2). A general overview of the major R&D funding streams and their objectives is provided in Table 9. It should be noted that not all categories are necessarily mutually exclusive.

Table 9: Overview of major R&D funding streams and objectives

Primary objective/ Source	Programme name / objective	Target	Amount £m 2005-06
Science base support			
Higher Education Funding Councils	HEI support (block funding)	HEIs	1,544
Research Councils	general support to HEIs and postgrads	HEIs	331
	Research Grants	HE researchers	1,073
Government Departments	Research contracts	researchers	576
Government ²²	Defence R&D (mainly development)	mainly industry	2,519
	Health R&D	mixed	628
	Other R&D (total civil excl. health)	mixed	1,093
Intramural Govt	Contracts with RC institutes etc.	RC Institutes	227
	Support of departmental missions	Government labs etc.	2,233
	Energy Technologies Institute	Mixed	(50) ²³
	PSREs Fund (commercialisation)	PROs	25 ²⁴
Collaborative R&D	Innovation Platforms	Mixed	20+ ²⁵
	Collaborative R&D		112 ²⁶
	Knowledge Transfer Networks (KTN)	Mixed	19 ⁶
	Knowledge Transfer Partnerships (KTP)	Ind/HE	32
	CASE (part of R C support)	HEIs	
	HEIF (England only)	HEIs	110 ²⁷

²¹ £3.451b in 2007-08: based on €1 = £0.63.

²² These categories are not mutually exclusive from the Intramural Government category

²³ £500m to be invested between 2006 and 2016 (from department expenditure)

²⁴ £30m in 2008

²⁵ Two pilot studies only

²⁶ 2008/2009 forecast

²⁷ £150m by 2011

Primary objective/ Source	Programme name / objective	Target	Amount £m 2005-06
Private R&D	Grant for R&D (England)	Industry	28
	Small Firms Loan Guarantee Scheme	SMEs	c.200
	Tax incentives	Industry	670 ²⁸
Start-up promotion/SME support	Enterprise Investment Scheme	start-ups/SMEs	87 ²⁹
	Enterprise Capital Funds	start-ups/SMEs	50
	Venture Capital Trusts	start-ups/SMEs	45 ³⁰
	Regional Venture Capital Funds	start-ups/SMEs	80
Attraction of foreign FDI	UKTI international R&D strategy	Mixed	9

Sources: various

Overall, the most significant instrument for the support of R&D (albeit based on a very subjective judgement) would appear to be the funding of university research by the Higher Education Funding Councils and the Research Councils. Although this does not intuitively appear to represent a “policy measure” as such, the allocation of the Science Budget to the Research Councils is very much a major part of the policy decision-making process and the Government’s CSR. Moreover, for several years, successive Government innovation policy statements have noted the importance of maintaining a strong and viable Science, Engineering and Technology Base. The next largest outlay is for defence R&D: whilst the majority of this funding will be directed to industry, approximately two-thirds of this is spent on development.

3.3.2 Policy Mix Routes

The “Policy Mix Project” identified the following six ‘routes’ to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one ‘route’, the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

Whilst the promotion of new indigenous R&D performing firms is a key element of UK innovation policy, in terms of the major components of the policy mix it assumes a *relatively* low importance (although it is not insignificant). The main measures aimed

²⁸ Based on 6,600 claims (figure for 2006/07)

²⁹ Estimated (scheme has raised £6.1b over 14 years, on 20% tax relief)

³⁰ Estimated (Scheme has raised £3.2b over 14 years, on 20% tax relief)

specifically at promoting the creation of start-up and spin-off companies are the Enterprise Investment Scheme, the Venture capital Trusts and the Regional Venture Capital Funds. These measures are fiscal incentives, offering tax exemptions and capital gains tax reductions in order to stimulate the flow of equity finance to newly established companies. Tax incentives for start-up firms, including for R&D activities, have also increased the incentives to start new businesses, together with improvements to the regulatory environment. Initiatives to reduce barriers to enterprise have focused primarily on access to finance, especially for early-stage businesses. The Small Firms Loans Guarantee scheme also stimulates the creation of start-ups, although its primary purpose is the support of existing SMEs. In addition, the Government has made significant progress in creating one-stop-shops for business start-ups and support services, as well as in improving SMEs' access to public procurement contracts.

Route 2: Stimulating greater R&D investment in R&D performing firms

As noted in the challenges section above, increasing the amount of R&D carried out by established companies forms one of the Government's major policy objectives. Clearly, this overlaps with Route 5, thus several of the measures described under this Route are also relevant. The UK government operates a grant scheme for R&D in SMEs (Grants for R&D), although the main emphasis is on the use of indirect measures to promote and stimulate civil industrial R&D. However, Government funding for defence-related R&D does constitute a considerable proportion of UK GOVERNMENT (almost 50% of total government R&D expenditure).

Access to debt finance and total private equity funds invested in the UK have increased over the last decade, although venture capital remains relatively difficult for early-stage businesses to obtain (see under Route 1). Strengths in entrepreneurship training and in improving regulation for small businesses have been reinforced, and the UK is committed to reduce administrative burdens by 25%. The aim of the Business Support Simplification Programme (BSSP) is to make it easier for companies and entrepreneurs to understand and access government funding and advice to help start and grow their business. The aim is to reduce the current 3,000 plus schemes to around 100 by 2010 ([Malik, K. et al, 2008](#)).

In 2000, the Government introduced an R&D tax credit for SMEs, extending the scheme to large companies two years later. The aim of the scheme is to encourage greater R&D spending. The 2007 Budget announced an increase in the rates of the relief from 150 to 175% for SMEs, and from 125 to 130% for large companies to take effect from April 2008. The 2007 Finance Act included legislation to extend the SME scheme to companies with up to 500 employees, also subject to EU approval. The scheme has shown strong take-up with over 22,000 claims received by early 2006 – around 19,000 under the SME scheme and 3,000 under the large companies' scheme - amounting to a total of around €2.6b of support claimed. Recent figures show that over 6,600 small firms claimed the small firms R&D Tax Credit in 2007/8 (DIUS, pers. Comm.)

Route 3: Stimulating firms that do not perform R&D yet

The stimulation of R&D investments by non-R&D performing firms cannot be said to play a major role in the policy mix – although it does open up the debate on the role of the service sector in innovation, for example, and on the broader definition of R&D. In this context, efforts are concentrated on identifying the degree to which service

sector companies undertake R&D – particularly through exercises such as the Annual R&D Scoreboard.

Route 4: Attracting R&D-performing firms from abroad

The attraction of R&D performing firms from abroad forms an element of a broader and more complex interplay of policies including those concerning the supply of skills, the strengths of the research base, fiscal regimes, macroeconomic stability, employment regulations and laws, planning laws, ethical regulations, etc. However, the UKTI Strategy specifically targets foreign companies in order to attract them to undertake R&D in the UK.

In terms of UK Government policy, the attraction of overseas R&D funding is a key policy target – the UK already receives around 17% of its total R&D funding from overseas sources. The R&D Scoreboard also notes the significant role of multinational investment in the UK, with the top ten foreign-owned UK companies accounting for just over half of the €7b (i.e. one-third of the total) R&D performed by foreign-owned UK companies. Eight of the 2006 top ten UK companies have higher R&D intensities than their overseas parents, which emphasises the advantages of the UK as a location for corporate R&D activities.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The promotion of the interaction between the research base and the business sector forms another major goal of UK research and innovation policy. Essentially, it seeks to capitalise on public investment through Route 6 by promoting greater engagement and the increased flow-through of research outputs (together with more subtle interactions) to the private sector and thus forms, logically, a third major priority in the policy mix.

Consequently, the UK has a range of schemes in place to support collaboration in R&D between the science base and industry (and other actors such as RTOs and intermediaries), some of which are relatively long-lived. These include the schemes run by the TSB, namely Collaborative R&D, the KTPs (formerly the Teaching Company Scheme), Knowledge Transfer Networks and the Innovation Platforms. In addition, the Research Councils fund the CASE (Cooperative Awards in Science and Engineering) and Industrial CASE studentships schemes, while the Regional Development Agencies now have responsibility for the allocation of funds under the HEIF, which provides a so-called ‘third leg’ of funding to HEIs in England.

Route 6: Increasing R&D in the public sector

As already noted, maintaining the strength and quality of the science base represents a third key policy challenge in the UK (although this is not the same as ‘increasing R&D in the public sector’). The largest proportion of R&D in the public sector is undertaken by the Higher Education sector, primarily the universities. These receive funding through the so-called dual support system (although, more recently the HEIF has been introduced as a third-leg, as noted above). The dual support system comprises block funding from the Higher Education Funding Councils (HEFC) and related bodies in England and the Devolved Administrations of Scotland, Wales and Northern Ireland. Although the HEFC stream is actually used largely for the support of academic staff salaries, it is allocated on the basis of a research assessment exercise (to be replaced by a Research Excellence Framework) which considers

university research outputs. In addition, a further substantial stream of support emanates from the Research Councils largely in the form of responsive mode grants for individuals, teams and centres.

On the government side, considerable funding is also allocated intramurally in support of departmental missions, while substantial amounts support research contracts in industry and research council institutes. Particularly large amounts of funding are devoted to defence R&D, whilst expenditure on health R&D (notably through the National Health Service R&D programme) is also a major item.

In the 2004 CSR, an additional €1b funding was allocated for the Science Base until 2007, including dedicated capital funding for the renewal of university infrastructure, then perceived as a major priority. Since then a permanent capital funding stream, the RCIF, has been put in place. In addition, progress has been made towards the introduction of a new methodology for costing research and to ensuring that research funders (notably the Research Councils) pay a greater proportion (80%) of the full economic costs (FEC) of research. The 2004 CSR also included a €104m Strategic Fund to provide targeted support for energy and clinical research, which has been taken through, for example, by the creation of the Energy Technologies Institute (see below) and Research Council programmes. The 2007 CSR continued to underpin this investment, with a planned 2.7% real terms increase over the three-year period covered until 2010.

The issue of centres of excellence does not assume much prominence in UK policy except in two contexts. The latest RAE outcomes have indicated that, in addition to the major research-led universities, pockets of internationally renowned research excellence are located in a large number of the smaller, less research-intensive universities. By March 2009, it was not clear what type of allocation formula the government would use for the disbursement of funds, i.e. a formula that concentrated funding on a restricted number of universities (centres of excellence) that had achieved international standing in a number of research areas or a formula that spread resources more equitably between all the high achieving university departments and research centres, irrespective of their location. At the time, it seemed that the prevailing government view was that, in order to maintain its level of international research performance, the UK needed to reinforce its key internationally renowned universities, possibly at the expense of the more isolated pockets of research excellence.

Related to this issue is the government's decision, in March 2006, to establish an Energy Technologies Institute. The then DTI agreed to provide matched funding of up to £500m, creating the potential for a £1.1b Institute over 10 years. According to the ETI prospectus, the Institute aims to: increase the level of R&D funding devoted to meeting the UK's energy goals; undertake R&D (and possibly demonstration) that facilitates the rapid deployment of cost effective low carbon energy technologies; provide a better strategic focus for commercially applicable energy-related R&D; connect and manage networks of the best scientists and engineers (within the UK and overseas) to deliver focused energy R&D projects; and build R&D capacity in the UK in the relevant technical disciplines to deliver UK energy policy goals. Current industry partners include EDF Energy, Shell, BP, E.ON UK, Caterpillar and Rolls Royce, each of whom commits up to £5m (€6.25m) per year.

The importance of education and innovation policies

Education and innovation policies in the UK are closely tied to those affecting research, whilst research forms a major element of the overall innovation policy, as clearly shown by the above set of programmes and funding streams. In reality, the three sets of policy are closely entwined and cannot be easily segregated. Thus, increasing the skills level of the UK workforce (and hence both its capacity to absorb research outputs and to generate research outputs of its own) forms an element of innovation policy, while increasing performance on STEM skills within schools, clearly an element of education policy, is seen as a contributor to the UK research system and also as a key element of broader innovation policy.

Thus, education and non-R&D innovation policy issues are dealt with under broader innovation policy and are accordingly addressed in UK policy strategies and documents. Likewise, mechanisms such as broad stakeholder engagement and the use of broad innovation policy reviews in the development of innovation policy take account of these particular policy domains. As such, they probably form an aspect of Route 6, although, as the routes specifically address R&D goals, the question is hard to answer.

Assessment of the importance of policy mix routes and their balance

Table 10: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	Relatively minor. Entrepreneurship receives some policy attention and there is support for early stage finance.	None
2	Major focus – several direct measures plus well-funded tax credits schemes.	None
3	Minor focus – not directly addressed other than through general encouragement and potential incentive of R&D tax credits.	None
4	Not addressed directly – raising profile of UK as a good place to do research is a broader policy goal.	None
5	Major policy focus – encouragement of science base-industry interaction is long standing priority.	None
6	Maintenance of quality of public sector research is a major goal.	None

3.4 Progress towards national R&D investment targets

It should be noted that much progress has been reported in a number of reviews published during 2008 and 2009: these are presented in Section 2.

The Science and Innovation Investment Framework 2004-2014 specified a target for GERD to represent 2.5% of GDP by 2014. Industrial spending was expected to contribute around two-thirds of total investment. The most recent spending figures (derived from Eurostat) are presented in the table below. (Note: due to national revisions, the figures for the UK in this table can be regarded as provisional only).

Table 11: Main R&D investment indicators for the UK

	2005	2006	2007	2008	EU-27 (latest year)	
					Average	Year
GERD (euro million)	31707	34037	na	na	<i>226120</i>	2007
R&D intensity (GERD as % of GDP)	1.73	1.76*	na	na	1.83	2007
GERD financed by government as % of total GERD	32.7	31.9	na	na	34.2	2005
GERD financed by business enterprise as % of total GERD	42.1	45.2	na	na	54.5	2005
GERD financed by abroad as % of total GERD	19.3	17.0	na	na	9.0	2005
GBAORD (euro million)	<i>13062</i>	<i>14124</i>	na	na	<i>87639</i>	2007
GBAORD as % of general government expenditure	1.62	1.65	na	na	1.55	2007
BERD (euro million)	19464	20985	na	na	<i>144089</i>	2007
Business sector R&D intensity (BERD as % of GDP)	1.06	1.08 [†]	na	na	1.17	2007
BERD financed by government as % of total BERD	8.3	7.6	na	na	7.2	2005

 Source: Eurostat ³¹

Clearly, despite substantial and sustained government investments in public expenditure (above EU averages and increasing) and in incentives to stimulate private R&D spending, both the overall expenditure target and the contribution from industry are far from being achieved, although some slow progress has been made (see above table) and the target date is a further eight years from the date of the latest figures. It is also clear that the current macroeconomic uncertainty is likely to have an adverse effect on industrial R&D expenditure, which, generally in the UK is seen as a cost to business rather than an investment.

With regards to the effects of the policy mix, it is difficult to make any direct attribution between policies and such gross indicators of aggregate performance (even if it is assumed that they are the appropriate indicators to use). It is self-evident that the Government's sustained investment in the science base will have had an impact on overall R&D spending by the public sector. However, the impact of policy on industrial R&D spending is harder to assess – increased spending on such policies does not guarantee that industrial expenditure will increase, due to a range of factors not the least of which is macroeconomic stability. The UK government's macroeconomic framework has been designed to maintain long-term economic stability: the UK economy continued to perform strongly in 2007, growing by 3% over the previous year - the fastest growth rate among the G7 economies. However, in the first half of 2008, growth slowed substantially reflecting the significant challenges faced by the UK and other countries from the twin global shocks of the dramatic disruption in financial markets and the increase in commodity prices. This macroeconomic framework, the government notes, should place the UK in a good position to capitalise when the economy enters an upswing, although the amount of public debt accumulated as a consequence of the government's financial support of the banking sector may undermine this potential for recovery.

Overall, in the light of evidence presented as a rationale for its various components, the policy mix appears appropriate, even if the anticipated results have not been wholly achieved. On the public R&D investment side, the government appears to be

³¹ Note: Values in italics are estimated or provisional. Those in bold are national sources
 na = not available, * revised in 2006 to 1.75, † revised in 2008 to 1.1

meeting its objectives (which, it should be noted are not to spend money on R&D *per se*, but to maintain the strength and world level quality of the science base.

The issue of gaps in the policy mix presupposes comparison with an ideal policy mix (which does not exist) or a failure to sufficiently address key innovation system challenges (the premise of the DG RTD Policy Mix study), rather than an optimal combination of routes. In the UK case, as noted above, the routes and policy mix composition are appropriate to the context. However, there is one area where the interaction of two elements of the policy mix may be in conflict. The HEI block research funding is based on Research Assessment Exercise (RAE) criteria (see Section 4.3) which place much emphasis on academic publication activities. As university incentives are strongly driven by RAE objectives, this may decrease the attractiveness of collaboration with private sector actors, in contradiction to government priorities for greater HEI-industry collaboration. Similarly, the arguments against the pressure to engage in research of a more applied, short term due to the adverse effects on long-term, blue skies research are well rehearsed. However, it should be noted that the primary aim of the RAE is to maintain and increase the quality of research performed in UK universities towards world-class standards, a goal which can be regarded as having been achieved.

Table 12: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Macroeconomic uncertainty	
Insufficient uptake of ideas from science base into innovative products, processes and services	Strongly performing science base offers opportunities industrial innovation and attractiveness to foreign R&D investment.
	Conflicting objectives of block funding model and university-industry interaction goals

4 Contributions of national policies to the European Research Area

ERAWATCH country reports 2008 provide a succinct and concise analysis of the ERA dimension in the national R&D system of the country. This Chapter further develops this analysis and provides a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA³² which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers

³² Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final
(See http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

The UK science base is considered as one of the country's strengths having a good international reputation in terms of both the volume and quality of publications and high levels of participation in international cooperation activities, particularly the European Commission's Framework Programmes ([Cunningham and Boden, 2009](#)).

According to the European University Institute (EUI) (2008), based on findings from the Academic Career Observatory the liberalised UK system that inspired and represents the Anglo-Saxon model in HE, offers the highest degree of openness and competition to external researchers and has by far the highest rate of non-national academic staff. Since the UK system views all levels of foreign scholars and researchers as key elements for its success, it offers relatively open and transparent recruitment procedures and equal rights for national and foreign researchers and academics. Thus, in 2007, data and estimates from the Research Councils and the Higher Education Statistics Agency (HESA) reveal that: 50% of UK PhD students are non-UK nationals; and 40% of UK research staff are non-UK nationals³³.

Generally, the UK performs well in terms of inward student and graduate mobility, attracting a high number of foreign-born students, particularly in terms of their participation in advanced research programmes. In 2004/05, just over half (52%) of masters students were non-UK domiciled, the proportions being 39% for doctorates and 12% for first degrees (Royal Society, 2008). High numbers of highly qualified UK-educated people are resident in other OECD countries. This reflects the quality and attractiveness of the UK education system but also implies an outward flow of high-level human resources. Moreover, there is no guarantee that a significant number of the foreign-born researchers will not become a 'foot-loose' resource and eventually return to their country of origin or other countries" ([Cunningham and Boden, 2009](#)).

Openness and competition contributes to the UK system's renown for both its quantity and quality of research outcomes, being fourth at world level and first in the EU (according to the Academic Ranking of World's Universities made by the Shanghai Jiao Tong University (EUI, 2008)).

The contracts of academics and researchers in the UK HE sector are usually tenured compared to the more permanent contracts offered by the government sector. However, the freedom offered to the researchers to perform their tasks, the high quality infrastructure and research outputs make the UK an attractive destination for researchers. Moreover, UK HE salary levels are among the highest in Europe, even

³³ International research collaboration: opportunities for the UK higher education sector. Report by Technopolis for Universities UK, cited in Cunningham and Karakasidou, 2009.

though they still lag behind the US. Although entry level salaries are relatively low, the high rate of increase that the researchers experience throughout their career via promotions, contribute to the attractiveness of the UK research system (see also 4.1.1 and 4.1.2).

From the demand side, UK investment in R&D has been high for several years, implying a relatively high availability of research positions in both the public and private sectors. It is expected that this continuous growth and creation of jobs during the past decade will assist the UK address the challenges of the global economic downturn.

However, as noted in the ERAWATCH Country Report 2008, less than half of UK engineering and physical sciences graduates go on to pursue science related careers, including research, and there are strong concerns that the demand for qualified researchers, in both academia and industry, will not be met by the supply. However, overall graduate numbers in STEM disciplines have increased in recent years. In 2005/06 about 42% of all first degrees were in STEM subjects, a proportion that has been relatively stable, although the pattern has not been uniform across all subjects (DIUS, 2008b).

On the whole, the success of the Anglo-Saxon and UK system depends “on a mix of factors including a healthy competition between universities, decent career prospects in exchange for hard work, high levels of mobility and openness to non-nationals, all of which creates a more vibrant academic community. Finally, the fact that English is the lingua franca of academia forces the continental European countries even more onto the defensive” (EUI, 2008).

4.1.1 Policies for opening up the national labour market for researchers

Current and future UK research and innovation strategies and policies clearly reflect the willingness of the UK to preserve an open and flexible science base. As the 2008 NRP (HM Government, 2008) clearly states, the UK supports the objectives of the Bologna and Ljubljana processes and welcomes their focus on researcher mobility and careers issues.

The UK has a large range of national mobility initiatives, operated by a number of agencies. These vary by size, scope, direction and mechanism of operation. Some are bilateral, while others target a range of countries. The initiatives address a range of rationales, including: promoting the inflow of high-quality students, raising the profile of the UK as a place to study and conduct research, raising the quality of researchers in partner countries (i.e. development objectives) and to act as seed activities from which more extensive collaborations may be developed. A primary rationale is that lack of finance represents an obstacle to mobility, particularly at the early stages of a researcher’s career. In general, the schemes are intended to be facilitative.

Some schemes provide substantial amounts of research support, and may cover long term stays, whilst others are more limited, covering the costs of travel and subsistence only. Many are co-funded and operated in conjunction with equivalent overseas bodies. Most appear to receive significant total budgets. All appear to be subject to some form of monitoring and many have been evaluated (sometimes by independent evaluators). Overall, the results of such assessment tend to be positive (hence the longevity of several of the schemes) and have also impacted on the longer term management and operation of the schemes.

Several national mobility initiatives are operated by the Research Councils, the Royal Society, the British Council and the Foreign and Commonwealth Office. Research Council support for international mobility is also generally included either within specific research grants or as generic contributions to international facilities' subscriptions, for example.³⁴

More specifically, international collaboration forms an important aspect of the work of Research Councils. In addition to supporting basic research, the Research Councils promote mobility and joint programmes and initiatives in basic research. In this respect they promote the UK as a place to undertake research and encourage UK researchers to spend time overseas.

There is also strong encouragement from a variety of government levels for UK researchers to participate in European research initiatives, such as COST, Eureka and the Framework Programmes. In addition, the UK Research Councils and Government Departments are involved in a wide range of ERA-NET activities and projects with partners in the EU and other associated countries.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

The SIIF 2004-2014 has among its targets "a strong supply of scientists, engineers and technologists" including achieving a step change in the proportion of minority ethnic and women participants in higher education³⁵. In this context, UK has introduced several policies to enhance the attractiveness of STEM education and research careers. For example, to address the issue of strategically important research areas that have been identified as 'at risk', the Government has launched the Science and Innovation Awards scheme. This provides large, long-term grants (typically €5-8m over 5 years) to support staff in research groups, on the condition that the host institute continues to provide support at the end of the grant. These awards are funded jointly by the EPSRC, and the Higher Education funding bodies in England, Wales, Northern Ireland and Scotland.

As a further element of its support for 'strategic subjects' (i.e. high cost subjects that are strategically important for the economy but subject to low student demand) HEFCE is providing over €100m of extra resources over 2008-09 to prevent closures of vulnerable university departments. The extra funding increases HEFCE teaching grants for the vulnerable subjects by 20% (equivalent to €1,500 per student). HEFCE has also launched a Research Capability Fund, which supports research in emerging subject areas where the research base is currently not as strong as in more established subjects. The scheme will run until 2008-09, with an annual allocation of around €31m.

Uptake of the Charter of Researchers

The UK HE sector supports the objectives and action lines of the Bologna Process and has been engaged in all related activities. A Europe Unit survey of UK HEIs'

³⁴ Taken from Cunningham and Karakasidou, 2009.

³⁵ Emphasis is placed on the need for improvements regarding: The quality of science teachers and lecturers across the educational system; the results for students studying science at GCSE level (16 years old); the numbers choosing SET subjects in post-16 education and in higher education; the proportion of better qualified students pursuing R&D careers; and the proportion of ethnic minority and women participants in higher education.

European activity in 2005 indicated that one third of respondents already issue the Diploma Supplement, a key Bologna requirement, and 50% planned to do so in 2006 or 2007³⁶. UK experts were also closely involved in the development of the European Charter for Researchers and the Code of Conduct for their recruitment.

A UK sector-wide expert group led by Universities UK and RCUK (2005) carried out a mapping exercise to identify areas where the UK does not align with the Charter and Code recommendations. This revealed that, based on existing legislation, guidelines and good practice, in most cases the UK already meets the requirements through initiatives such as the QAA Code of Practice, the Research Careers Initiative, the Concordat on CRS Career Management and the implementation of the Roberts' recommendations in 'SET for success'. The Concordat to Support the Career Development of Researchers³⁷ sets out the expectations and responsibilities of researchers, their managers, employers and funders. It has been signed by all the major UK HE sector stakeholders³⁸ and aims to increase the attractiveness and sustainability of research careers in the UK and improve the quantity, quality and impact of research for the benefit of UK society and economy.

Generally, existing UK employment law, especially its anti-discrimination legislation, and sector-specific guidance such as that of the Joint Negotiating Committee for HE Staff (JNCHES) on work-life balance, allows the UK to fulfil and in some cases exceed the European Charter and Code's requirements. The gap analysis also recognised that many UK HEIs "will also have their own internal policies that will cover many aspects of the European Charter and Code, although it is unlikely that every aspect is addressed in a single document" (Universities UK and RCUK, 2005).

Thus, no major conflicts with existing practices in the UK or barriers for HEIs wishing to adopt the European Charter and Code were identified. However, some needs for clarification were highlighted (considered as part of the updating of the UK's Researchers Concordat). Also recommendations were offered to HEIs wishing to formally adopt the European Charter and Code. On the whole, the UK HE sector supports the voluntary status of these documents as instruments to support reform across Europe, even though moves to link the Charter and Code with a label or seal or to funding are unwelcome by the HE sector. UK HEIs are encouraged to engage with the principles in the Charter and Code through the intergovernmental Bologna Process.

Remuneration policies

According to an EC 2007³⁹ report on the remuneration of researchers in the public and private sectors, the average total annual salary of a researcher in the UK was €56,048 in 2006, exceeding the EU-25 average of €37,948, placing the UK among

³⁶ http://www.europeunit.ac.uk/resources/Guide_to_the_Bologna_Process_-_Edition_2.pdf

³⁷ <http://www.researchconcordat.ac.uk/>

³⁸ The signatories of this Concordat are: the Universities UK, GuildHE, RCUK, the Royal Society, the British Academy, the Royal Academy of Engineering, the Wellcome Trust, HEFCE, HEFCW, the Scottish FE and HE Funding Council, the Department for Employment and Learning Northern Ireland, the National Institute for Health Research, the Department of Health, the Scottish Government Health Directorates, the British Heart Foundation and the TSB.

³⁹ European Commission (2007): Remuneration of Researchers in the Public and Private Sectors. Study implemented by Carsa for DG RTD, E.C., under Service Contract REM01. <http://www.cipur.it/Varie/Forum%20DDL112/Study%20remuneration%20researchers.pdf>

the highest paying countries for researchers⁴⁰. However, when considering the cost of living, the position of the UK deteriorates with the average salary decreasing to €52,776, while the average EU-25 salary improves to €40,126. Nevertheless, this still keeps the UK in the range of countries with high remuneration level (€40,000-60,000). However, researchers' salaries in the UK are still far behind those in the US (€60,156 or €62.793 when considering the living cost).

Another characteristic of the UK system is that while entry point salaries are usually low, a significant increase in remuneration throughout a researcher's career is usually expected, providing a powerful incentive. Hence, the UK ranks thirteenth among the EU-25 and Associated Countries based on the salary of younger researchers (0-4 years of experience), but rises to sixth based on the remuneration of experienced researchers (more than 15 years in the research profession). This increase represents an impressive increment of 235.42% during the researcher's career. These salaries are independently determined by UK HEIs, based on market demand and supply, competition, and on their strategies and available resources. Although there are overall guidelines for pay, mediated by a number of academic staff unions, UK universities are autonomous in the determination of academic and research pay scales and employment conditions. Remuneration and employment conditions for both national and foreign members of staff are controlled by the same regulations, with most universities operating equality and diversity policies offering equal opportunities for all members of staff.

Promotion of women

Based on Eurostat data presented in the "She Figures 2006" report (EC, 2006) in 2003, 42% of UK PhD⁴¹ graduates were female, below the EU-25 average of 43%. However the growth rate of female PhD graduates in the UK was double that of male PhD graduates between 1999-2003 (10% versus 5%), and above the EU-27 average (7% for female and 2% for male). Similarly, the proportion of female researchers in 2003 was 43% in the UK HE sector and 32% in the Government sector compared to the EU-25 average of 35% for each sector⁴². The growth rates for the two sectors are also higher for female researchers⁴³.

The "She Figures 2006" report⁴⁴ also analysed the gender pay gap, placing the UK fourth among the EU-25 with the widest gaps presenting a 22% difference between the male and female researchers' salaries in 2004 and falling by just 1% since 2002. The EU-25 average gap was 15% in 2004 falling from 16% in 2003. Another report on the remuneration of researchers (European Commission, 2007), confirmed that male researchers in the UK are better paid, with a 25.59% difference over their female colleagues (the average weighted total annual salary of the former was

⁴⁰ Along with Austria, Cyprus, Israel, Luxembourg, the Netherlands and Switzerland

⁴¹ ISCED 6

⁴² The proportion of female scientists and engineers in the total UK labour force in 2004 was 1.1%, below the EU-25's 1.4%. Male scientists and engineers represented a much greater percentage of the labour force for both the UK (4.2%) and the EU-25 (3.3%).

⁴³ 5% growth rate in the HE sector in the UK compared to 2% for men, with the EU-25 percentages being 4% and 2% respectively between 1999-2003. For the government sector the pattern is similar with 3% growth rate for women and just 1% for men following the EU-25 growth rates of 3% and 0% respectively.

⁴⁴ European Commission (2006): She Figures 2006, Women and Science Statistics and Indicators. DG RTD. http://ec.europa.eu/research/science-society/pdf/she_figures_2006_en.pdf

€58,907 compared to €43,830). This gender pay gap places the UK somewhere in the middle of the EU-25.

Generally, “the highly competitive UK system can hinder the career advancement of women due to the apparent trade-off between a woman’s investment in a time consuming career and that on maternity and gender-biased family life duties” (European University Institute, 2008). In this respect, the UK’s ten-year SIIF aims amongst others to achieve a step change in women participation in higher education, placing strategic emphasis on the matter. In this frame, several initiatives have been introduced to support women participation in STEM education, research and professions.

The Women into Science and Engineering (WISE) scheme⁴⁵ is one of the initiatives attempting to change the attitudes of young girls towards Science, Engineering and Technology (SET) and ultimately improve the participation of women in research and in SET careers in general. The WISE campaign collaborates with industry and the education sector, provides advice to policy-makers and assisting the delivery of relevant actions. Initiatives undertaken by the scheme have contributed to the doubling of female engineering graduates from 7% in 1984 to 15% in 2008.

Following the publication of “*A Strategy for Women in Science, Engineering and Technology*” by the Government in April 2003, the UK Resource Centre for Women (UKRC)⁴⁶ was established in 2004 to provide practical help and support to women in SET education or careers. The report addressed the issues outlined in Baroness Greenfield's 2002 report, *SET FAIR* and provided recommendations for the Government to overcome the barriers that prevent women from entering, staying and succeeding in SET education and careers. According to the SIIF Annual Report 2008 “43 organisations have now signed the UKRC CEO Charter, where a company’s top management make a public commitment to support the increased participation of women in SET” (DIUS and HM Treasury, 2008), while UKRC has assisted over 1,700 women return or progress in their SET careers.

4.2 Governing research infrastructures

The UK hosts a large number of national and international research facilities and is also involved in many facilities in Europe and the rest of the world (DIUS, 2008d), including the Diamond Light Source in Harwell, ISIS at the Rutherford Appleton Laboratory, the Laboratory of Molecular Biology (LMB) in Cambridge, the Large Electron Positron Collider (LEP) in the French/Swiss border, the Cassini-Huygens Mission to Saturn and many more.

Funding for large facilities and infrastructure in the UK is available from the Research Councils, Government Departments, RDAs, Devolved Administrations, non-profit organisations (charities), private sources, the European Commission and international bodies. Since 2000, the Government has allocated over €1.14b to construct ten large scientific facilities, while another €385m has been allocated to five future projects (House of Commons Committee of Public Accounts, 2007).

Generally, the UK recognises at strategic level that investment in world-class infrastructure is a pre-requisite for world-class research. Thus, a key commitment in

⁴⁵ http://www.wisecampaign.org.uk/about_us.cfm

⁴⁶ <http://www.ukrc4setwomen.org/>

the SIIF 2004-2014 is to ensure access for UK researchers to leading edge facilities either in the UK or abroad. As Chapter 2 presented, since 2008, additional measures were introduced to ensure that key elements of the UK's innovation infrastructure remain world-class. Apart from the physical scientific infrastructure, the UK's innovation infrastructure also includes the National Measurement System (NMS), the academic IT network, the UK's intellectual property regime and the UK's standards and accreditation system. Thus, in addition to funding physical infrastructure, DIUS also funds and collaborates with the British Standards Institution and the UK Accreditation Service (UKAS) and manages the NMS on behalf of the Government.⁴⁷

The UK's priorities for large scientific facilities are set out in the biennial Large Facilities Roadmap. The most recent update was published in 2008 by RCUK following an open consultation period. This covers all scientific disciplines and provides an overview of strategically important national and international scientific facilities under construction in the UK or abroad and details on potential projects for future facilities over the next 10-15 years. According to AIR 2008 (DIUS, 2008a), the 2008 Roadmap places greater emphasis on the economic impact of facilities and on developing clear guidelines for potential projects.

The 60 facilities included in the 2008 Roadmap cover most scientific fields but the RCUK priority themes highlight specific challenges for the UK S&T base guiding the final selection. These include Energy; Environmental Change; Security; Ageing; Digital economy; and NanoScience. Thus, this edition specifically focuses on facilities for physical and life sciences, engineering, astronomy, environmental research, medicine and social sciences.

The Roadmap offers policy makers, mainly DIUS and the Research Councils, not only a prioritisation tool for their national investments, but also a basis for discussion with international partners for future investments. Specifically, it sets the UK's strategy for investment in research infrastructure not only at national but at European and international levels. The incorporation of the international dimension in the UK strategy for scientific infrastructure stems from the firm belief that in a highly globalised world where science is becoming increasingly internationalised and complex, national capabilities are insufficient for a country to successfully compete and excel. Thus, according to the 2008 NRP, the UK Government "looks forward to engaging on the feasibility of joint calls, on intellectual property issues and on working together to develop a shared approach to international scientific collaboration with third countries".

The Government's Global Science and Innovation Forum has helped the UK develop an international science and innovation strategy to ensure that it takes advantage of international opportunities including opportunities to host international scientific facilities. In this context the UK places particular emphasis on the application of the Open Method of Coordination and the role of the EU's Scientific and Technical Research Committee (CREST).

The 2008 Roadmap also aligns with the European Strategy Forum on Research Infrastructure (ESFRI) Roadmap, including a substantial number of facilities that are of interest for UK researchers. These include either potential international projects that might be constructed in the UK, or overseas projects for which UK participation is regarded as beneficial. However, their actual implementation depends on more

⁴⁷ The NMS provides the infrastructure through which measurements are traceable to international standards.

extensive preparatory studies. Most of the 24 ESFRI facilities included in the 2008 Roadmap cover mainly biomedical and life sciences and environmental sciences, plus astronomy, astrophysics, nuclear and particle physics, materials science, energy, social science and the humanities. The UK Research Councils are developing specific strategies to contribute to both the RCUK Roadmap and the ESFRI Roadmap. Moreover, the UK subscribes, inter alia, to CERN and the ESA that are leading European space and particle physics research and are producing their own roadmaps.

The Research Councils also support infrastructures through the provision of equipment funding. Moreover, a number of the Councils have their own institutes with research laboratories and are responsible for maintaining their infrastructure. These institutes undertake long-term and strategic research and complement the research undertaken by HEIs, providing national capability and specialist facilities in strategically important areas including molecular biology, animal health and geological sciences⁴⁸.

Research Councils support the provision of access to leading edge international experimental facilities, often through international subscriptions or joint funding. The Research Councils are responsible for funding major international subscriptions or brokering bilateral arrangements to enable UK researchers to use such facilities. The Science and Technology Facilities Council (STFC) has a particularly active role in facilitating such arrangements. STFC is expected to invest €1.1b in 2008-2009.

Following the publication of the 2007 budget, STFC announced the reduction or termination of some research programme funding, including some international collaboration in astronomy and particles physics, thereby affecting a number of projects in the RCUK Roadmap.

The Large Facilities Capital Fund (LCFC) is administered by DIUS and is the main source of funding for large facilities in the UK. It provides capital investments in new and existing facilities and infrastructure that the Research Council budgets cannot cover. The LCFC is annually around €142m and contributes to the capital costs of the construction of new facilities either nationally or internationally; the expansion or enhancement of existing facilities; and the upgrading or replacement of existing facilities. To be eligible for LCFC funding the facilities must be included in the RCUK Large Facilities Roadmap and satisfy a list of criteria. Due to the high demand for LCFC funding Research Councils are responsible for advising DIUS on prioritisation through a biannual process managed by RCUK.

For HEIs, capital funding for the establishment or refurbishment of research facilities and for equipment procurement, was provided mainly via the Science Research Infrastructure Fund (SRIF) administered by DIUS and the Higher Education Funding bodies in England, Wales, Scotland and Northern Ireland until 2008. SRIF was established to address past under-investment in research infrastructure across the UK. After 2008, SRIF was replaced by the Research Capital Investment Fund (RCIF), a permanent source of capital funding that aims to prevent previous backlogs in HEIs infrastructure investment from reoccurring. RCIF uses a formula to provide capital funding for research and infrastructure but also learning and teaching during 2008-2011 to eligible HEIs that have satisfied the requirements of the Capital Investment Framework (CIF) or have applied for capital grants. The RCIF will provide €730m to

⁴⁸ The financial sustainability of the institutes and their different governance arrangements have been reviewed by the OST (now OSI) in 2002 and 2005 respectively.

support HEIs' research infrastructure based on Research Council income, over the current spending review period (2008-2013) (DIUS and HM Treasury, 2008). At regional level the RDAs make a significant contribution to the funding and governance of research infrastructure. According to the AIR 2008, it is estimated that during 2007-8 from the €370m spent by the RDAs on innovation, the largest expenditure was spent on innovation infrastructure establishment (DIUS, 2008a).

Apart from funding, support is provided regarding the planning and delivery of infrastructure projects by the National Audit Office (NAO) in collaboration with DIUS and RCUK. A good practice guide has been published to assist research teams better understand the planning, prioritisation and delivering system for large scientific facilities. The guide followed a report published by NAO in 2007 examining the prioritisation and selection system of the RCUK Roadmap, revealing positive attitudes and satisfaction regarding its clarity and fairness.

On the whole, the SIIF Annual Report 2008 notes that good progress has been made during 2008 regarding infrastructure investment. The replacement of SRIF by RCIF led to the adoption of a more strategic approach to capital investment in the research base. The investment backlog in university scientific infrastructure has been largely addressed by RSIF and the new RCIF will ensure that it does not re-occur. With the 2008 RCUK Roadmap and the allocation of the LFCF, greater emphasis is being placed on the economic impact of facilities and the development of clearer guidance for potential projects. Finally, the SIIF 2004-2014 Economic Impact report (DIUS, 2008d) finds that STFC facilities were used by high excellence university departments (5 and 5* rated) over the past three years (2005-2008), while the international usage of facilities hosted in the UK is at a continuous good level, both contributing to world class scientific knowledge production.

4.3 Research organisations

As of August 2008, there were 169 HEIs in the UK of which 109 were universities (this includes federal universities such as those of London and Wales, which are counted as a single entity). The representative body and membership organisation is Universities UK, whose membership is comprised of the executive heads of the UK's universities. As noted by Universities UK, UK HEIs are international organisations with growing numbers of international staff and students and links with higher education institutions around the world, overseas governments and international agencies. International students make up 13% of the full-time student population in the UK, while 36% of postgraduate research students in the UK are international students (Cunningham and Karakasidou, 2009).

The UK has four national education systems, and four ministries of education, in England, Wales, Scotland, and Northern Ireland. Several institutions deal with the implementation of the Bologna Process: DIUS, Universities UK, the 'UK HE Europe Unit', and the QAA.

Universities UK makes a significant contribution to UK policy on higher education through the collection of statistics and by commissioning specific studies⁴⁹. In

⁴⁹ For example: "Attracting International Students to the European Higher Education Area: A Comparative Analysis of National and Institutional Approaches in 8 countries"; The UK higher education sector's Europe and International Units have commissioned the [Observatory on Borderless Higher Education](#) and Kingston University to examine European national and institutional approaches to attracting international students (campus-based and transnational). The

addition, the HE Europe Unit is a sector-wide body which “aims to raise awareness of the European issues affecting UK higher education and to coordinate the UK’s involvement in European initiatives and debates”. In particular it seeks to strengthen the position of the UK higher education sector in debates on the Bologna Process and EU policy.

Funding for UK universities is delivered through four complementary pathways which, in turn: support the direct costs of research staff engaged in specific basic and strategic research projects and programmes (competitive grants from the Research Councils); provide broader underpinning support to cover the costs of permanent academic staff and research facilities (HEFC block funding); offer support to upgrade and improve universities’ research infrastructure which has suffered as a result of historic under-investment (RCIF); and provide an incentive for universities to develop their capacity to engage with business and the wider community (HEIF).

UK universities are autonomous bodies, with charitable status, and are free to seek funding from a variety of sources. However, the majority of their funding comes via the dual support system, which comprises the block funding from the HEFCs (with allocations based on the RAE – see below) and that from the Research Councils which provides funding for projects (including salaries of contract researchers), research training and centres (which is allocated on a competitive peer-reviewed basis). The other principal funding source for research is the charitable, non-profit sector, notably the medical and health charities, and the business sector.

The UK Research Assessment Exercise (RAE) is the mechanism whereby university block funding for the support of research (i.e. to meet infrastructural costs, etc.) is allocated. After some 22 years, the government announced in 2007 that it intends to replace the RAE with a Research Evaluation Framework (REF) which will be based on a mix of panel review, bibliometrics and other indicators - depending on the subject area under consideration. The move was prompted by growing dissatisfaction with the former RAE and also based on claims that it has achieved its original purpose - to drive up the quality of research performed in UK universities. Currently, HEFCE is consulting and commissioning studies on the precise form that the REF will take. The final RAE submissions took place in 2007 and the allocation of funds based on these will take place in 2009. Once the funds are allocated, universities are free to distribute them internally according to their own priorities – the Government has no say on this process.

In recent years, greater emphasis has been placed on the 'Third Mission' of universities, i.e. greater engagement with businesses and local communities. To this end, the HEIF represents the main policy stimulus, although HEIs individually and collectively engage in a variety of 'outreach' activities and several regional and trans-regional consortia have been set up to address this activity. In addition, several sources of funding – some of which are quite long-lived - are in place to stimulate interaction with the business sector.

From the governance perspective, universities are headed by a Vice-Chancellor (or Principal), the equivalent of a chief executive in a company. The Vice-Chancellor provides strategic leadership and management and acts as the principal representative of the university in the wider world. The Chancellor is the non-

report will analyse the potential impact(s) of political processes (Bologna, Lisbon, and the Schengen Area) into the relative attractiveness of these countries for the recruitment of international students from outside Europe. The research outcomes will be published in 2009.

executive head of a university, although their role varies from institution to institution, from that of a figurehead to having a more hands-on involvement. Generally, they are well-respected public figures, often with a strong prior link to the university or its region. The university governing body is usually known as the university council or board of governors and is responsible for the effective management and future development of the affairs of the institution. Membership generally comprises a range of lay figures who may represent local, regional and business interests, members of the academic staff and representatives of the student body.

4.4 Opening up national research programmes

For its size and stage of development, the UK is a relatively open economy. It has the largest FDI inflow of any OECD economy, a pattern accentuated in technology-based markets and for knowledge flows. Data also suggest that UK-based companies are prominent investors in R&D overseas. For example, UK firms patenting pharmaceuticals and chemicals were more likely to be exploiting inventions developed overseas than similar firms in France or the US (DIUS 2008b).

Research Council funding (the largest element of 'programmatic' research funding in the UK) is restricted to researchers from UK HEIs, Research Council Institutes and designated Independent Research Organisations (although the latter do include non-UK organisations such as the Marie Curie Institute, the European Bioinformatics Institute and the European Molecular Biology Laboratory). Although the Research Councils operate few specific mechanisms for collaboration and much of their activity is delivered through generic mechanisms, a significant proportion of 'Responsive Mode' funding is performed in collaboration with organisations or academic institutions overseas.

The Collaborative R&D programme, which forms part of the Technology Programme operated by the TSB, may be used by UK applicants to fund their share of the participation costs for Eureka. However, funding for non-UK nationals is not available. In fact, one recent criticism of UK industry support schemes is that larger companies wishing to participate in Eureka must apply via the Collaborative R&D scheme, whilst SMEs with the same ambition must apply via the Grant for R&D scheme, i.e. via two separate pathways run by separate agencies.

National research programmes in the UK are predominantly not open to foreign participation, although there may be mechanisms by which such participation may be accomplished, albeit on a very low level. Very recent indications, however, are that international activities are a developing area for the TSB, which is currently looking at integrating international thinking into all of its activities. Particular aims include strengthening the international role of the Knowledge Transfer Networks and looking at providing support for international KTPs. One rationale for this move towards greater internationalisation is the broad view stated by Lord Sainsbury in his review of the UK science and innovation system (October 2007) that while the UK is responsible for 5% of the world's scientific activity, by implication, 95% of such activity takes place overseas. Thus, the UK needs to tap into this activity by as many routes as possible. A second rationale is that of adding further value to and of obtaining greater benefits from UK participation in activities such as Eureka and the Eureka networks. Nevertheless, overall it appears that, with regard to the major streams of national R&D funding, the research costs of non-UK nationals are not supported and UK programmes have not been opened up to foreign participation (Cunningham, P. and Karakasidou, A.).

One further recent exception is the participation of the UK Research Councils in the Money Follows Researcher scheme operated through Eurohorcs.

Typical barriers to the opening up of national R&D programmes to overseas participants include matching co-funding and the issue of double jeopardy (i.e. the need to ensure complementarity and agreement between differing peer review mechanisms and processes), whilst for collaborations with industry, issues such as IPR and differing legal regimes are also significant hindrances.

4.5 National ERA-related policies - a summary

As demonstrated by several available indicators, the UK has a very strong record in international collaboration, both with countries inside Europe and with those further afield. Relevant indicators include inward and outward flows (academics, researchers, students), numbers of collaborative R&D projects and participation levels, scientific outputs (jointly authored publications) and scientific impact (citation rates) (Cunningham and Karakasidou, 2009).

Hence, UK researchers are active participants in European research programmes, notably the Framework Programmes and Eureka. Of a total science base⁵⁰ expenditure of some €8.5m in 2003-04 about 8% originated from overseas: about half of this was from EU bodies. Figures from a 2004 review⁵¹ state that UK organisations took part in 6,613 out of 16,251 (40.7%) projects funded under FP5 – a level of involvement higher than any other Member State. In addition, UK participants received a total of €2,047m of EC funding (16% of the total). Moreover, UK organisations coordinated 19% of all FP5 projects, again the highest share of any Member State. Most UK participations were undertaken by HEIs (46%) or by the UK enterprise sector (27%) and about half of the EC funding received by the UK went to HEIs, with just under a quarter going to the enterprise sector.

In addition, the UK Research Councils and Government Departments are involved in a wide range of ERA-NET activities and projects with partners in the EU and other associated countries.

International collaboration assumes a high level of policy importance in the UK, as exemplified by the existence of an overarching strategy for international collaboration (and, more importantly, the existence of a forum in which key stakeholders discuss and share information on international collaboration priorities). However, of particular relevance to the ERA it is worth noting that within this strategy, the EU is treated as a single entity with regards to international cooperation.

The general UK view is that collaboration in R&D with researchers within the EU (and associated countries) can be adequately addressed and coordinated within the existing set of frameworks, (e.g. Framework Programme, Eureka, ERA-Nets, CERN, EMBO, ESA) and that these provide a sufficiently rich and diverse set of opportunities for intra-EU R&D cooperation, without recourse to the establishment of further mechanisms. Consequently, much of the support for collaborative R&D activities tend to focus on support for mobility (especially for young UK researchers, or for young, high quality or more senior eminent foreign researchers) in order to facilitate the interchange of ideas to the UK science base and to disseminate the influence of UK science abroad. Much of the collaborative R&D in which UK

⁵⁰ Essentially comprising the HEI and public research organisations.

⁵¹ Technopolis, 2004: http://www.technopolis.co.uk/fpuk/UK_FP_Participation.pdf

researchers are involved is guided through a bottom-up responsive mode process, either on the basis of individual researchers or research groups or through the collaborative arrangements and agreements established by UK universities. In addition, the UK engages in a number of collaborative international R&D programmes, which are generally managed by the Research Councils, and UK researchers make extensive use of international research facilities.

Hence, from a European perspective, top down initiatives to promote UK collaborations are uncommon and represented by a limited number of interagency agreements. Here too, these are not necessarily restricted to European actors.

There is strong encouragement from a variety of government levels for UK researchers to participate in European research initiatives, such as COST, Eureka and the Framework Programmes. However, the drive to engage in international research activities comes from the highest UK policy levels (e.g. the GSIF) down to the grass roots level of individual researchers. At all levels, the priorities for collaboration (in terms of sectors, countries, disciplines, etc.) are formulated according to specific strategic needs.

It is also not relevant to talk about the Europeanisation of the UK research system – rather the UK research system can be better described as strongly internationalised. Although researchers from the UK have a strong presence in EU-level initiatives, there is little evidence to suggest that EU-level policies significantly influence the design of national policies for research. While participation in these initiatives is strongly encouraged, and is supported through mechanisms and structures for the dissemination of research opportunities and the provision of advice (on the formulation of research proposals, for example), there is no major support through specific policy initiatives.

With regard to the following Table (Table 13), it should be noted that ERA-related policies form a subset of a range of much broader internationalisation policies.

Table 13: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • minor 	<ul style="list-style-type: none"> • UK is open to researchers, a popular location for research and also a major participant in EU programmes • Further moves to open national programmes are underway
Governance of research infrastructures	<ul style="list-style-type: none"> • Potentially significant – UK has several centres of research excellence 	<ul style="list-style-type: none"> • UK's Large facilities Roadmap is complementary to ESFR1
Autonomy of research institutions	<ul style="list-style-type: none"> • Important – but ERA policies are not specified within the broader internationalisation policy configuration 	<ul style="list-style-type: none"> • All UK HEIs are autonomous and free to arrange collaborative agreements with any non-UK country. • Government RIs may be more restricted, although no major constraints have been noted
Opening up of national research programmes	<ul style="list-style-type: none"> • Minor – and not ERA related, specifically 	<ul style="list-style-type: none"> • Strongly national based, although some moves towards opening up to non-UK participants (not specifically to ERA, though)

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

The **main barriers to private R&D investments** faced by the UK are, as set out in Section 3, the long-standing low innovation intensity on the part of UK businesses, as measured by the intensity of R&D expenditure. The precise reasons contributing to this barrier are complex and diverse, although the major problem facing the UK economy is better expressed as a problem of productivity, and its relatively low growth in comparison to important competitors and comparators. More specifically, the UK may be considered to have a relatively poor track record for commercially successful innovation (Miles and Daniels, 2007). Thus, low R&D expenditure is only part of the problem, factors such as the translation of knowledge and research results into commercial products, process and services are also significant.

With regard to the **balance of the policy mix and its contribution to the achievement of national R&D investment objectives**, despite substantial and sustained government investments in public expenditure and in incentives to stimulate private R&D spending, only slow progress can be reported on both the overall expenditure target and the contribution from industry. Whilst the UK's target date is still eight years away, the current macroeconomic uncertainty is likely to have an adverse effect on industrial R&D expenditure and will decelerate this rate of progress. It is difficult to make any direct attribution between policies and such gross indicators of aggregate performance although the Government's sustained investment in the science base will have had an impact on overall R&D spending by the public sector. However, the impact of policy on industrial R&D spending is harder to assess – increased spending on such policies does not guarantee that industrial expenditure will increase, due to a range of factors not the least of which is macroeconomic stability. Nevertheless, in the light of evidence presented as a rationale for its various components, the policy mix appears appropriate, even if the anticipated results have not been wholly achieved. On the public R&D investment side, the government appears to be meeting its objectives (which, it should be noted are not to spend money on R&D *per se*, but to maintain the strength and world level quality of the science base).

The principal **imbalances and policy risks** arising from the current UK policy mix are not evident: the policy mix appears appropriate to the challenges it is designed to address – there is an overall balance between support to the science base, support for the flow of ideas into the private sector and in policies that aim to encourage business innovation directly and through creating a framework conducive to such innovation.

5.2 ERA-related policies

The **ERA and ERA-related policies** do not assume major significance in the overall national research policies and strategies in the UK. Although participation in European initiatives by public and private sector researchers alike is strongly encouraged by the government (with perhaps a better level of facilitation being provided for public sector research collaboration), there is little evidence of any developments that focus on greater cooperation with the ERA (in comparison with more general internationalisation strategies).

The **main components of national strategies to the ERA** appear to be the general high level of integration of the UK research base in European activities and the overall openness of the UK to foreign research collaboration (with the exception that no major national programmes, as yet, offer funding for non-UK nationals) and its attractiveness to external researchers. The openness of the UK economy in general is also a major strength.

It is not possible to identify any **main challenges for the national R&D system in relation to ERA development**. Most UK policy, in terms of international activities, focuses on target countries or regions, depending on specific policy goals, or is broadly based and not geographically specific.

References

- Cunningham, P.N. (2007a): CREST 3% OMC Science & Innovation Policy Mix Peer Review United Kingdom: Background and Visit Follow-up Reports.
- Cunningham, P.N. (2007b): Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments: The "POLICY MIX" Project: Country Case Study: United Kingdom. European Commission, November 2007.
- Cunningham, P.N. and Boden, M. (2009): ERAWATCH Country Report 2008, An assessment of research system and policies: United Kingdom <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=home.downloadFile&fileID=944>
- Cunningham, P. and Karakasidou, A. (2009): Monitoring progress towards the ERA: UK Report. Report to the ERAWATCH ASBL.
- DIUS (2008a): Annual Innovation Report 2008. http://www.dius.gov.uk/policy/annual_innovation_report.html
- DIUS (2008b): Background analysis: strengths and weaknesses of the UK innovation system. Available at: http://www.dius.gov.uk/publications/innovation_nation_docs/Background_analysis.pdf
- DIUS (2008c): Innovation Nation, March 2008. Available at: <http://www.dius.gov.uk/publications/ScienceInnovation.pdf>
- DIUS (2008d): Science and Innovation Investment Framework 2004-14. Economic Impacts of Investment in Research & Innovation. December 2008, http://www.dius.gov.uk/publications/documents/Science/Science/2008_Economic_impact_report.pdf
- DIUS and HM Treasury (2008): Science and Innovation Investment Framework 2004-2014. Annual Report 2008.
- European Commission (2007): Remuneration of Researchers in the Public and Private sectors. <http://www.cipur.it/Varie/Forum%20DDL112/Study%20remuneration%20researchers.pdf>
- European University Institute (2008): Towards an Open and Competitive European Area for Research Careers, Some basic findings from the Max Weber Programme Academic Careers Observatory, Report 2008. <http://www.eui.eu/MaxWeberProgramme/AcademicCareers/ACODocument2008.pdf>
- Eurostat (2008a): Europe in Figures, Eurostat Yearbook 2008. Luxembourg: Office for Official Publications of the European Communities. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001/EN/KS-CD-07-001-EN.PDF
- Eurostat (2008b): Statistics in Focus: R&D Expenditure and Personnel. Issue 91/2008. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-091/EN/KS-SF-08-091-EN.PDF

- Eurostat (2009): Euro-Indicators: Gross domestic product - volumes - Percentage change t/t-1 – SA.
<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=0&language=en&pcode=na010q1>
- HM Government (2008): Lisbon Strategy for Jobs and Growth: UK National Reform Programme. September 2008. http://www.hm-treasury.gov.uk/d/lisbon_strategy_pu591_nrp_290908.pdf
- HM Treasury (2004): Science and Innovation Investment Framework 2004-2014. London: The Stationery Office.<http://www.berr.gov.uk/dius/science/science-funding/framework/page9306.html>
- HM Treasury (2007): ‘The Race to the Top’ - Sainsbury Review of Science and Innovation, October 2007. Available at: http://www.hm-treasury.gov.uk/media/5/E/sainsbury_review051007.pdf
- HM Treasury (2008): Lisbon Strategy for Jobs and Growth UK National Reform Programme. London: The Stationery Office. http://www.hm-treasury.gov.uk/d/lisbon_jobs131005.pdf
- House of Commons Committee of Public Accounts (2007): Big Science: Public investment in large scientific facilities.<http://www.publications.parliament.uk/pa/cm200607/cmselect/cmpubacc/521/521.pdf>
- Malik, K., Gagliardi, D. and Cunningham (2008): P. INNO-Policy TrendChart - Policy Trends and Appraisal Report, United Kingdom, August 2008. http://www.proinno-europe.eu/extranet/upload/countryreports/Country_Report_United_Kingdom_2008.pdf
- Miles, N. and Daniels, R. (2007): The State of the Innovation Economy in the UK - 2007 Problems, Opportunities and Solutions. A Brief Overview. September 2007
- Office of National Statistics (2009): UK Business Enterprise Research and Development, 2007. January 2009.
- Parliamentary Office of Science and Technology (2008): Large Scientific Facilities. Postnote. June 2008, Number 313. <http://www.parliament.uk/documents/upload/postpn313.pdf>
- RCUK (2008): Large Facilities Roadmap 2008. <http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/publications/lfroadmap08.pdf>
- SET Statistics Table 3.1 Net Government expenditure on R&D by departments in cash terms.
- Universities UK and Research Councils UK (2005): The European Charter for Researchers and Code of Conduct for the Recruitment of Researchers: A UK HE gap analysis.

List of Abbreviations

AHRC	Arts and Humanities Research Council
AIR	Annual Innovation Report
BBSRC	Biotechnology and Biological Sciences Research Council
BERD	Business Enterprise Expenditure on R&D
BERR	Department for Business, Enterprise and Regulatory Reform
BSSP	Business Support Simplification Programme
CBI	Confederation of British Industry
CCLRC	Council for the Central laboratory of the Research Councils
CERN	European Organisation for Nuclear Research
CIF	Capital Investment Framework
CIHE	Council for Industry and Higher Education
CREST	EU Scientific and Technical Research Committee
CSA	Chief Scientific Adviser
CSR	Comprehensive Spending Review
CST	Council for Science and Technology
DAs	Devolved Administrations
DCLG	Department for Communities and Local Government
DCMS	Department for Culture, Media and Sport
DEFRA	Department for Environment, Food and Rural Affairs
DELNI	Department of Education and Learning Northern Ireland
DFID	Department for International Development
DGSI	Director General, Science and Innovation
DH	Department of Health
DIUS	Department for Innovation, Universities and Skills
DTI	Department of Trade and Industry
EIRF	Economic Impact Reporting Framework
EIS	European Innovation Scoreboard
EPSRC	Engineering and Physical Sciences Research Council
ERA	European Research Area
ERP	Energy Research Partnership
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructure
ESO	European Southern Observatory
ESRC	Economic and Social Research Council
ESRF	European Synchrotron Radiation Facility
ETI	Energy Technologies Institute
EU	European Union
FCO-SIN	Foreign & Commonwealth Office – Science and Innovation Network
FDI	Foreign Direct Investment
FE	Further Education
FEC	Full Economic Costing
FP	European Framework Programme for Research and

[Technology Development](#)

G7	Group of seven industrialised nations
GBAORD	Government Budget Appropriations or Outlays for R&D
GDP	Gross Domestic Product
GERD	Gross Expenditure on R&D
GO-Science	Government Office for Science
GOVERD	Government Expenditure on R&D
GSIF	Global Science and Innovation Forum
HE	Higher Education
HE-BCI	Higher Education-Business and Community Interaction
HEFC	Higher Education Funding Councils
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institutions
HEIF	Higher Education Innovation Fund
HERD	Higher Education Expenditure on R&D
HM Treasury	Her Majesty's Treasury
ICT	Information and Communication Technologies
ILL	Institut Laue-Langevin
IPTS	Institute for Prospective Technology Studies
IT	Information Technology
JRC	Joint Research Centre
KTN	Knowledge Transfer Network
KTP	Knowledge Transfer Partnership
LCFC	Large Facilities Capital Fund
LEP	Large Electron Positron Collider
LMB	Laboratory of Molecular Biology
MoD	Ministry of Defence
MRC	Medical Research Council
NAO	National Audit Office
NCGE	National Council for Graduate Education
NERC	Natural Environment Research Council
NESTA	National Endowment of Science Technology and the Arts
NRP	National Reform Programme
NSA	National Skills Academy
OECD	Organisation for Economic Co-operation & Development
ONS	Office for National Statistics
OSI	Office of Science and Innovation
OST	Office of Science and Technology
PPARC	Particle Physics and Astronomy Research Council
PRO	Public Research Organisation
PSA	Public Service Agreement
PSRE	Public Sector Research Establishment
R&D	Research and development
RAE	Research Assessment Exercise
RCIF	Research Capital Investment Fund

RCUK	Research Councils UK
RDA	Regional Development Agency
REF	Research Excellence Framework
RIS	Regional Innovation Strategy
RTO	Research Technology Organisations
S&T	Science and Technology
SBRI	Small Business Research Initiative
SBS	Small Business Service
SET	Science, Engineering and Technology
SFLG	Small Firms Loan Guarantee
SIIF	Science and Innovation Investment Framework
SME	Small and Medium-sized Enterprise
SRIF	Science Research Investment Fund
STEM	Science, Technology, Engineering & Mathematics
STFC	Science and Technology Facilities Council
TSB	Technology Strategy Board
UK	United Kingdom
UKAS	United Kingdom Accreditation Service
UKTI	UK Trade and Investment

European Commission

EUR 23976 EN/31

**Joint Research Centre – Institute for Prospective Technological Studies
Directorate General Research**

Title: ERAWATCH Country Reports 2009: Analysis of policy mixes to foster R&D investment and to contribute to the ERA: United Kingdom

Authors: Paul Cunningham and Aikaterini Karakasidou

Luxembourg: Office for Official Publications of the European Communities
2009

EUR – Scientific and Technical Research series – ISSN 1018-5593

ISBN 978-92-79-13338-1

DOI 10.2791/27728

Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in United Kingdom.

How to obtain EU publications

Our priced publications are available from EU Bookshop (<http://bookshop.europa.eu>), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

The mission of the Joint Research Centre is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies. As a service of the European Commission, the Joint Research Centre functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

