

DEPARTMENT OF TRADE AND INDUSTRY
SCIENCE AND INNOVATION STRATEGY 2001

| Contents | Page |
|--|-------------|
| DTI Science and Innovation Strategy | 2 |
| Annex A: “Promoting enterprise, innovation and increased Productivity” | 6 |
| Annex B: “Making the most of the UK’s science, engineering and technology” | 12 |
| Annex C: “Developing strong, competitive markets within a regulatory framework which promotes fairness and sustainability” | 16 |
| Annex D: White Paper commitments for science and innovation | 22 |
| Annex E: The place of science and innovation in the UK | 25 |
| Annex F: Departmental issues affecting science and innovation policy | 30 |
| Tables on DTI science, engineering and technology expenditure | 34 |

DTI Science and Innovation Strategy 2001

1.1 The Department of Trade and Industry's high-level objectives are fundamental to its strategy for science and innovation. The majority of DTI's science, engineering and technology (SET) expenditure (see **Figure 1**) is devoted to (a) funding the UK's science and engineering base and (b) supporting the development and use of science and technology in industry, for the benefit of the economy as a whole. Unlike other Departments, the DTI devotes only a relatively small proportion of its total SET expenditure to scientific R&D in support of statutory, regulatory or policy obligations. The Department also promotes innovation and enterprise in a broader sense, although this strategy focuses on DTI support for science and technological innovation.¹

1.2 The DTI's strategy towards science and innovation has been taken a major step forward through policy commitments and initiatives made in two recent White Papers², which are being monitored through published implementation plans. The DTI's Science and Innovation White Paper³, published last year, set a framework for the Government's role as the key investor in the science base; the facilitator for collaboration between universities and business; and the regulator for innovation, including the promotion of public confidence in science. The recent White Paper on Enterprise, Skills and Innovation⁴ emphasised the importance of science and innovation to regional (and national) economic growth, with the need to raise skills as a key issue; again a number of initiatives were announced to invest in innovation and new technologies, including e-business; and foster an environment for enterprise.

The DTI aim, objectives and science and innovation priorities

| |
|--|
| <p>1.3 The DTI's overall aim is to increase competitiveness and scientific excellence in order to generate higher levels of sustainable growth and productivity in a modern economy.</p> |
|--|

1.4 To achieve this, the Department has four high-level objectives⁵, three of which are key to taking forward the DTI's science and innovation strategy, according to the priorities set out here. Many of these priorities cut across all three objectives, since there are common challenges to building strong science and innovation in the UK: the importance of investment in the science base and new technologies; the need to translate this through exploitation and business innovation; and to make sure that this is underpinned by a strong and transparent framework. Details on the Department's activities to take forward these priorities are set out in Annexes A-C.

¹ As quantified in "SET Statistics 2000; a handbook of science, engineering and technology indicators"(CM4902), published November 2000, www.dti.gov.uk/ost/setstats/

² See Annex D.

³ "Excellence and Opportunity - a science and innovation policy for the 21st century" (Cm 4814), published July 2000, www.dti.gov.uk/ost/whatsnew

⁴ "Opportunity for all in a world of change" – a White Paper on enterprise, skills and innovation (Cm 5052), published February 2001, www.dti.gov.uk/opportunityforall

⁵ The fourth is less directly related, and not included in the strategy

Objective I: To promote enterprise, innovation and increased productivity:

DTI strategic science and innovation priorities are to:

- Promote **awareness** of innovation and create a **favourable business climate** for businesses to innovate in the UK;
- **Encourage business innovation**, particularly by facilitating collaboration and exploitation of research, with an emphasis on regional growth;
- Encourage the adoption of **technology** and **business best practice**, both **domestically and internationally**, to improve the way companies develop new products, processes, services and markets.
- Support the development of **new technologies** for growth industries of the future.

Activities are tailored towards specific needs within individual industry sectors, regions, and at a national level. Particular attention is paid to addressing regional priorities and facilitating regional networks, working in partnership with Regional Development Agencies, the Small Business Service and Government Offices, as well as taking into account the needs of small business.

Objective II: To make the most of the UK's science, engineering and technology:

DTI strategic science and innovation priorities are to:

- Invest in the **science base** to reverse years of decline, particularly:
 - investing in the science research **infrastructure**;
 - funding **basic SET research** that advances knowledge for its own sake, playing to the UK's strengths and for the UK's long-term interest, and is also sufficiently flexible for future science and technology options;
 - increasing the pool of talented **people** trained by and working in the science and engineering base, while raising skills and increasing expertise.
- Create incentives and build capacity for **knowledge transfer** to maximise the contribution of the science and engineering base to economic development and quality of life.

Activities are focused towards the Government's role as the lead investor in scientific infrastructure, basic scientific research and the education and skills which influence the strength of the science base. Collaboration between higher education institutes and business is also a priority, to ensure that scientific advances are fully exploited. As in objective 1, there is a strong emphasis on the importance of science, engineering and technology to regional growth and on ensuring that the framework is in place for scientists and businesses to make international links.

| |
|--|
| Objective III: To develop strong, competitive markets within a regulatory framework which promotes fairness and sustainability: |
|--|

DTI strategic science and innovation priorities are to:

- **Build public confidence in science** by ensuring the Department's legal and regulatory work follows **the Guidelines⁶ on the use of scientific advice** in policy-making;
- Administer **Intellectual Property Rights** to ensure that national, European and international systems encourage innovation and competition;
- Create an **infrastructure for information and communication technologies** which gives all firms and individuals convenient and economical access to broadband services, to foster the growth of e-business and an integrated networked society;
- Promote the development and deployment of safe and sustainable **energy** technologies;
- Maintain the UK's **National Measurement System** and ensure that it meets the needs of UK trade, industry, innovation and public policy;
- Support the development of **technical standards** for products, services and quality management, which underpin regulation and which remove technical barriers to trade;
- Access existing **evidence** and procure new research where necessary to improve the Department's understanding of the impact or potential impact of DTI regulatory activity on individuals (e.g. consumers), businesses and the economy as a whole.

These priorities relate to the regulatory framework which is needed to underpin science and innovation, so that firms and the economy can benefit from technological developments, and to ensure that there is public confidence in science.

1.5 In undertaking activities to take forward these priorities, the Department will focus on:

- customer-oriented delivery;
- outcomes, and meeting clear targets;
- and value for money.

These activities will not be taken in isolation: international developments in science, technology, markets and industrial and economic policy will be taken into account.

1.6 The DTI strategy will be used to ensure that the targets and priorities for science and innovation are met, to help deliver DTI objectives, with the ultimate objective of higher productivity and economic growth.

⁶ "Guidelines 2000" on scientific advice and policy making, July 2000, at www.dti.gov.uk/ost/aboutost/guidelines.htm

1.7 The Department's priorities and support for science and innovation are currently being reviewed through two DTI reviews announced by the Secretary of State in June 2001 (DTI's priorities and structure review and DTI business support review).

Department of Trade and Industry
August 2001

Annex A - “Promoting Enterprise, Innovation and Increased Productivity”

Introduction

1.1 Scientific and technological innovation is vital to the future competitiveness of many industrial sectors in the UK. There is a continual need for companies to adapt and change to meet competitive pressures in an increasingly global market. To do so companies need to be innovative in the way they supply and develop markets, manage their business, become more resource efficient, and produce products and services.

1.2 Many of DTI's activities affect innovation in one way or another. While the wider policy and regulatory environment has a huge impact on the climate for and promotion of innovation and growth, this strategy focuses on support for science and technological innovation, and here, business innovation. Similarly, some aspects of innovation lie within the responsibility of other Departments, for example the R&D tax credit for small firms, and the importance of macro-economic stability to encourage businesses to innovate.

Current objectives for supporting business innovation

1.3 DTI's key strategic science and innovation priorities are to:

- Promote **awareness** of innovation and create a **favourable business climate** for businesses to innovate in the UK;
- **Encourage business innovation**, particularly by facilitating collaboration and exploitation of research, with an emphasis on regional growth;
- Encourage the adoption of **technology** and **business best practice**, both **domestically and internationally**, to improve the way companies develop new products, processes, services and markets;
- Support the development of **new technologies** for growth industries of the future.

1.4 While the main thrust of the Department's expenditure for business innovation is directed at the first of the DTI objectives i.e. “to promote enterprise, innovation and increased productivity”, it is not exclusive to it and makes a contribution across the other Departmental objectives. Many activities are closely linked with work to promote the exploitation of science and pull through the work of the science base into industry (see **Annex B**). This includes supporting new technologies for use in industries of the future, for example, genomics, basic technologies (nanotechnology, sensors, quantum computing), biotechnology, e-science and e-business, green technologies, aerospace and space (again, some of these, such as the communications infrastructure and green technologies are fundamental to the DTI's third objective, at **Annex C**). The Department works closely with other key sectors, such as cars and chemicals, where the adoption of new and existing technologies and best practice can help companies to compete and grow.

1.5 A technical, legal and design infrastructure is maintained – including the Patent Office, the National Measurement System, support for the setting of technical standards, and the Design Council – which underpins business confidence in innovation (see **Annex C**). These regulatory functions are in fact fundamental to promoting innovation. The system of intellectual property (IP) law, for example, exists to stimulate innovation, enterprise and competition. As well as keeping this purpose at the centre of IP policy formulation, the Patent Office seeks to ensure that the availability of IP rights provides the maximum stimulus to UK innovation in practice. This is done through measures intended to make it as easy as possible to register and enforce rights, and by increasing awareness and understanding of IP in society.

How objectives are met

1.6 DTI activities in support of these objectives are tailored towards specific needs, either at a national level, or within individual sectors or regions. There is a strong emphasis on activities to address regional issues, the needs of SMEs and on improving skills. The Enterprise, Skills and Innovation White Paper⁷ set out a new approach to regional policy to help all regions to respond to change through innovation and enterprise. It also emphasised the need to close the skills gap, particularly in IT and technical skills, and to ensure that all businesses, both large and small, have access to technology and are encouraged to innovate. The Department works closely with other Departments in taking forward these objectives, in particular the Department for Transport, Local Government and the Regions (DTLR), the Department for Education and Skills (DfES) and the Department for Environment, Food and Rural Affairs (DEFRA).

1.7 In April 2000, DTI established the Small Business Service (SBS) to be the focus for the provision of business support to SMEs. In England, Regional Development Agencies (RDAs) have been set up and have been developing regional innovation strategies. In June 2001, the DTI took over sponsorship responsibility for the RDAs from the then Department of Transport, Environment and the Regions. Within DTI, the Business Competitiveness Group is responsible for delivering innovation support to business, working in partnership with these new bodies, to provide support in a way which addresses customer needs. This also involves working closely with the Office of Science and Technology on activities to encourage knowledge transfer from the science base to industry, as set out in **Annex B**.

1.8 The DTI is also setting up cross-functional teams with a broad membership drawn from within and outside the Department, including the regions, to pilot new ways of identifying and tackling barriers to growth. These teams will target practical and measurable improvements in long-term performance against international competitors – using indicators like growth, market share, and intensity of innovation.

1.9 From April 2001, the Department is adopting a more consistent breakdown of activities within the Business Competitiveness Group's budgets along the following lines:

- (i) **Industrial exploitation of science** (through knowledge transfer, collaborative R&D and technology demonstration);

⁷ “Opportunity for all in a world of change” – a White Paper on enterprise, skills and innovation (Cm 5052), published February 2001 at www.dti.gov.uk/opportunityforall

- (ii) **Support for competitiveness** (including best practice and e-business);
- (iii) **Space**
- (iv) **Technical and design infrastructure** (see Annex C)
- (v) **Expert Advice** and other expenditure.

Programme budgets for some SBS activities, such as Smart, were transferred to the Chief Executive of the SBS from 1 April 2001. The balance of expenditure between these budgets is shown in **Figure 2**.

Main Programme areas

(i) Industrial exploitation of science

1.10 One of the key features of a modern economy is that firms and sectors need to master an increasingly wide range of technologies. Whilst some support for R&D is focused on the needs of particular sectors, other support is focused on cross-sectoral issues such as materials and IT.

1.11 DTI support is mainly through **knowledge transfer** programmes. Programmes aimed at creating partnerships between the science and engineering base and businesses, such as Faraday Partnerships, the Higher Education Innovation Fund and the TCS (Teaching Company Scheme) are often jointly funded by the Business Competitiveness Group and the OST through the Science Budget (see **Annex B**).

1.12 LINK, which is managed by OST, is the Government's principal mechanism for supporting **collaborative R&D** between UK industry and the science base. It is mainly managed through programmes covering discrete technology or generic product areas. In response to priorities identified by Foresight, five new LINK programmes, a stand alone project and the Foresight Fund have been announced since September 1999. These include the largest ever LINK programme, Applied Genomics – a £15 million programme to assist healthcare companies to benefit from advances such as the Human Genome Project.

1.13 The CARAD programme supports the aeronautical industry through pre-competitive **research and technology demonstration** to maintain and enhance the UK's position as a world-leading aerospace manufacturer. Increasing emphasis is being given to research to ensure the future environmental sustainability of the industry, with particular emphasis on emissions and noise. The aeronautics sector is a good example of where the UK's success depends crucially on industry's ability to exploit effectively our science and technology base. Major examples of how CARAD has achieved this aim include: Airbus UK's position as the designer and supplier of wing sets for all Airbus aircraft - a business now worth around £1 billion annually to the UK trade balance, and the dominance of Rolls-Royce's Trent aeroengines in their class.

1.14 In the Enterprise, Skills and Innovation White Paper, it was announced that the DTI would be seeking to maintain the UK as the leader in Europe in biotechnology by supporting the harnessing of genomics and promoting a supportive regulatory and fiscal environment in the UK and EU. To complement the Research Councils' basic technologies programme, the White Paper announced £25 million to encourage the

exploitation of basic technologies. The DTI is also to provide support to promote commercial exploitation of research focusing on e-science.

1.15 Programmes to support the construction industry aim to secure an efficient market in the industry, with innovative and successful UK firms that meet the needs of clients and society and are competitive at home and abroad. The Construction Research and Innovation Programme supports research and innovation projects which take forward the ideas and principles set out in *Rethinking Construction* (the report of Sir John Egan's Construction Task Force⁸) and *Building a better quality of life*, the Government's strategy for sustainable construction⁹. It is implemented through work commissioned from the Building Research Establishment (BRE) under framework arrangements agreed at the time of the privatisation of BRE, through the Partners in Innovation scheme which provides around £7 million per annum in support of collaborative projects, and through joint sponsorship of LINK schemes with the Engineering and Physical Sciences Research Council.

1.16 There is a strong **regional dimension** to DTI's aim to increase competitiveness. The Department works through regional organisations to promote enterprise, innovation and increased productivity taking account of regional differences. Business development is often strongest when businesses cluster together, through the stimulation and transfer of innovation, knowledge, shared values and competitive pressures. But the requirements for and provision of science and innovation capacity vary both between and within regions. Promotion of the overall climate for innovation and development of specific initiatives to enhance capabilities or address particular weaknesses must be conducted in the context of these variations. The advent of the RDAs and development of their regional innovation strategies offers a chance to bring a much greater coherence to the range of public and private sector initiatives, intermediaries, support organisations and networks.

1.17 For each region, an overall framework is provided by the Regional Innovation Strategy (RIS) developed by the RDA in conjunction with a range of regional and sub-regional parties. Typical features of a RIS may include recognition and stimulation of:

- industrial sectors of particular significance to the region.
- networks that exist within the region to foster collaboration, exchange of good practice etc.
- the role of universities and research institutions, and the means by which their expertise is made accessible to business, particularly SMEs and those businesses unfamiliar with accessing such capabilities.

1.18 For activities developed specifically at the regional level, the Regional Innovation Fund, valued at £50m/year for the three years FY 2001/02 to FY 2003/04, offers the main source of funding. This funding stream offers the RDAs considerable flexibility to address regional and sub-regional needs in the area of business incubation and local or regional innovative clubs and networks.

1.19 Alongside national expenditure programmes, DTI provides assistance to UK industry and academia to participate in European collaborative research programmes such

⁸ "Rethinking Construction", Sir John Egan's report, July 1998, www.dti.gov.uk/construction

⁹ "Building a better quality of life", April 2000, www.dti.gov.uk/construction

as the EU Framework programme and the EUREKA scheme and to exploit this for UK benefit. The EU's Framework R&D programmes are currently worth about £9.5 billion over four years, some 5% of the total public R&D expenditure across Europe.

(ii) Support for competitiveness

1.20 The Department supports a wide range of activities, at both a national and regional level, aimed at helping industry become more innovative through accessing existing **best practice** and **adopting existing and new technology** from both home and abroad. Much of this activity is targeted at individual industry sectors or supply chains. For example, the Department is expanding the network of Industry Forum Adaptation initiatives, started by the Society of Motor Manufacturers & Traders' Industry Forum, to address skills enhancements, adoption of new technologies and supply chain efficiencies across a range of industry sectors. These activities contribute to the Fit for the Future national best practice campaign, run jointly with the CBI, helping more companies achieve world-class performance. Consultancy studies analysing the competitiveness of the main UK industrial sectors and sub-sectors help determine which areas to support. The Department aims to complete a fresh round of studies by March 2002.

1.21 Best practice is promoted across all industries, including the construction industry. "Rethinking Construction" focuses on bringing change in general construction, in housing and in central and local government construction procurement. DTI also supports the Construction Best Practice Programme which provides a range of information and services to firms wanting to change.

1.22 To achieve the goal of making the UK the best place in the world to trade electronically, efforts are being made to increase the use of information and communications technologies by business, particularly among SMEs. The Enterprise, Skills and Innovation White Paper announced new UK Online for Business activities to enable increasingly sophisticated use of e-business models and a Next Wave Technologies and Markets programme has been launched to stimulate the development of intelligent appliances. The Department is also keen to take action to accelerate the take-up of broadband technology and boost the UK market for digital television.

1.23 An important aspect of competitiveness will be the development of green technologies, products and services. The DTI will continue, through its Sustainable Development Strategy, to work with business to make the UK an international leader in these markets. The Department is working jointly with DEFRA to improve the environment and the sustainable use of natural resources, including by reducing greenhouse gas emissions by 12.5% from 1990 levels and moving towards a 20% reduction in CO₂ emissions by 2010.

1.24 Within the **small firms'** sector, the importance of science, technology, design and innovation are emphasised as part of a coherent approach to business development. The SBS's strategy is to ensure that both existing SMEs and those wishing to start in business have access to the help and expertise that they need to develop and successfully implement a forward-looking and challenging business development plan. Smart provides grants to help individuals and small businesses in England research and develop technologically innovative products and processes.

1.25 With the help of other departments, the DTI has also been instrumental in introducing a new Government-wide programme, the Small Business Research Initiative (SBRI), which will open up government R&D procurement programmes to small firms. Each participating department will aim to source at least 2.5% of its relevant research procurement requirements from small firms, with an overall target of procuring £50m of research under these programmes from small firms. An example of a programme being opened up in this way is the DTI's £40m per annum expenditure on measurement science under the National Measurement System (see Annex C). As part of the SBS National Gateway service¹⁰, firms will be able to obtain details on SBRI by calling the SBS National Call Centre, by visiting the SBS website or by contacting the Business Link Information and Advice Service¹¹.

(iii) Space

1.26 Public civil space activity within the UK is co-ordinated by the British National Space Centre (BNSC), an organisation led by DTI, and embracing Government, industry and the academic community, including PPARC and NERC (which are also covered in Annex B). DTI spends around £90m per annum on space R&D activities in support of national programmes and programmes through the European Space Agency.

1.27 The UK Space Strategy for the UK¹² was launched in August 1999, and describes detailed objectives and targets for each policy area together with the actions which will be pursued to achieve them.

1.28 Throughout BNSC's space activities, there is increasing scope for public-private partnerships and co-funding of commercially oriented space programmes is increasingly the norm. The space sector has long been dominated by public spending, but in 1996, international commercial expenditure exceeded government spending for the first time and continues to grow. There are now large commercial opportunities for the UK in the international markets for space-based telecoms and navigation services which are expected to be worth some \$150bn a year by 2010. Today's challenges are winning that business, providing affordable services to scientific researchers and adapting the institutional structure of government support to promote maximum success in both.

(iv) Expert Advice

1.29 DTI innovation support also includes a small area of expenditure on expert advice and other ad hoc issues. This primarily consists of a Consumer Safety Programme which is aimed at protecting the consumer and ensuring products sold on the market are safe, together with the run-out of the support for the Sector Challenge programme. Through a separate budget, DTI also supports activities to deepen the Department's understanding of what industry needs in order to improve its competitiveness. To help develop future thinking, the Department has recruited 24 industrial secondees into its Future and Innovation Unit. They provide a valuable role in understanding and working with business, in particular in developing the linkages between innovators and providers of finance, and between industry and education.

¹⁰ www.sbgateway.com

¹¹ www.businesslink.org

¹² The UK Space Strategy 1999-2002: New Frontiers (URN 99/1012) at www.bnsc.gov.uk

Annex B - “Making the most of the UK’s science, engineering and technology”

Introduction

1.1 The science and engineering base has a key contribution to make to the UK economy and way of life through its generation of new ideas and techniques, and the development of skilled people. The UK benefits from having a strong science and engineering base. The Government’s strategy in recent Spending Reviews has been to invest in the science and engineering base to ensure that it is placed to achieve standards of international excellence and maximise its contribution of long-term economic development and the quality of life in the UK. This investment provides access to the global collaboration that is the driving force of scientific advance.

Science Budget objectives

1.2 The key DTI strategic science and innovation priorities are to:

- Invest in the **science base** to reverse years of decline, particularly:
 - investing in the science research **infrastructure**;
 - funding **basic SET research** that advances knowledge for its own sake, playing to the UK’s strengths and for the UK’s long-term interest, and is also sufficiently flexible for future science and technology options;
 - increasing the pool of talented **people** trained by and working in the science and engineering base, while raising skills and increasing expertise.
- Create incentives and build capacity for **knowledge transfer** to maximise the contribution of the science and engineering base to economic development and quality of life.

The Science Budget’s strategic priorities largely relate directly to the excellence of the science base and using knowledge transfer to maximise the contribution of the science base to the wider economy.

The science and engineering base and the dual support system

1.3 The UK science and engineering base is largely made up of universities, research institutes and the Research Councils. Its role is to conduct scientific research, produce highly qualified scientists and engineers, and contribute to UK’s wealth creation and quality of life. The science and engineering base is mostly funded by Government through the ‘dual support system’ i.e. the Science Budget and funding through educational Departments. The two legs of the dual support system have a different emphasis but are complementary:

(i) the Science Budget (see Figure 3) which is managed by the Office of Science and Technology (OST) provides grant in aid to the seven UK Research Councils:

- the Biotechnology and Biological Sciences Research Council (BBSRC);
- the Engineering and Physical Sciences Research Council (EPSRC);
- the Economic and Social Research Council (ESRC);
- the Medical Research Council (MRC);
- the Natural Environment Research Council (NERC); and
- the Particle Physics and Astronomy Research Council (PPARC).
- the Council for the Central Laboratory of the Research Councils (CCLRC – not grant-awarding, rather the custodian of large science facilities used by the research communities of the other Councils.)

The Research Councils are Non-Departmental Public Bodies (NDPBs), originally established by Royal Charter by virtue of an Order in Council under the Science and Technology Act 1965 and responsible to the Secretary of State for Trade and Industry. The objectives of the Councils are defined in their Royal Charters.

(ii) funding provided by the Department for Education and Skills (DfES) and the Education Departments of the devolved administrations through the Higher Education Funding Councils, in support of block grant funding for the higher education infrastructure.

How the Objectives are met

Science Base

1.4 The Haldane recommendations of 1918 represent the real foundation of the science research system. The essence of the Haldane principles is that Government is responsible for science funding policy at the national level, but the initiative for selecting particular research programmes comes from the academic community.

1.5 OST has responsibility within Government for preparing the case for the Science Budget in wider public spending reviews. Following such reviews, it is the responsibility of the Director-General of Research Councils, after consultation with the wider scientific community, to recommend to the Secretary of State how funds should be allocated to the individual Councils. Funding is provided for the promotion of high quality basic, strategic and applied research, and related postgraduate training through grant-in-aid to the seven UK Research Councils. Some important, but smaller programmes are administered by the Royal Society and the Royal Academy of Engineering.

1.6 The importance of science to a modern economy and the impact of globalisation demand that we develop further our understanding of the impact of these issues on science policy. How should international factors be balanced against national or regional priorities? How do we manage exploitation in a global market place? Most importantly, how do we ensure excellence remains at the heart of all aspects of our science policies?

1.7 To illuminate these issues the Government intends to commission further work that takes account of the cross cutting review of science in the Spending Review 2000 and the Higher Education Funding Council for England's recent work. It intends to review, in the light of the above factors, how science priorities should be set, how the dissemination of

the outputs of the science and engineering base should be encouraged and how the outputs and outcomes should be measured.

1.8 The Government has also initiated a quinquennial review of the six grant-awarding Research Councils and, following stage 1 of a separate quinquennial review, is setting in place new funding arrangements for the Central Laboratory of the Research Councils. These reviews will ask whether the Research Council structure is optimised to get the best from the science and engineering base. They will be complemented by the current review of Foresight and the outcome of the transparency review of university funding.

1.9 To meet its objectives concerning the people in the science and engineering base, government is increasing PhD stipends dramatically and, jointly with the Wolfson Foundation, funding a scholarship scheme to enable universities to recruit, reward, and develop researchers of outstanding achievement and potential.

1.10 Universities have a growing mission to play an active role in the economy in terms of developing people with the right skills for the job for the future and encouraging commercial applications for research. The Government is substantially increasing - and placing on a permanent footing - funding for knowledge transfer activities aimed at creating a closer partnership and better diffusion of ideas between the science and engineering communities, industry, commerce, charitable sectors and Government.

Knowledge Transfer

1.11 The Science Budget is used to actively support the commercial exploitation of scientific research findings, which it encourages within the broader context of the process of knowledge transfer from the universities out into the wider community. One of the primary means by which knowledge transfer is achieved is by the movement of postgraduate students from academia to the business community, and thus the application of knowledge gained in the course of research training. The Government has established a new Higher Education Innovation Fund (HEIF) which will be the basis of a permanent third stream of funding for universities' knowledge transfer activities. Other programmes have been established to encourage entrepreneurial activity alongside scientific research, including the Science Enterprise Challenge for the development of centres for entrepreneurship training and University Challenge which provides seed-corn funding for the exploitation of intellectual property arising from academic research. To address concerns that the supply of skilled scientists and engineers may not match business needs, the Government has launched an independent study into the provision of skilled scientists and engineers in the UK, led by Sir Gareth Roberts, which is to be completed by February 2002.

1.12 The Research Councils and Government Departments are working jointly to improve commercialisation of research. The new Faraday Partnerships, supported jointly by DTI, DEFRA, EPSRC, PPARC, NERC and BBSRC offer opportunities to universities, firms and independent research organisations to work together to bring research ideas for new products and processes to the market more quickly.

Priorities for the future

1.13 The UK needs to maintain its world lead in the fields where it is strongest and develop a lead in new areas, while maintaining the capacity to do science which is recognisably world class across the board. Over the next few years, there are a number of key opportunities for the UK science and engineering base, in particular the following, all of which have a high profile with the Foresight Panels, and have been identified as priorities for funding from the new funds made available under the SR2000 Science Budget settlement. These are relevant also to increasing business innovation and will be key to the growth industries of the future (see **Annex A**).

- **Post-genomic research.** The next stage of scientific research following the decoding of the human genome is to identify the function of genes. This will be a key step in understanding many diseases, including cancer and heart disease. The UK has a strong industrial base from which to exploit research results in this area.
- **E-science for e-business and informatics.** There is an urgent need for radically new hardware and software solutions to permit the processing, communication, storage, analysis and visualisation of the huge expansion of data now being produced by global teams of scientists. This new generation of 'e-science' infrastructure will underpin the next generation of e-business technology used across the board later this decade.
- **Basic technology.** This combines elements both of pure research and the early stages of technological development. It covers that R&D which contributes to both scientific knowledge and useful technological knowledge. In many cases it provides a stage in the process by which scientific advances lead to novel products and processes but often involves the development of the skills and technologies which underpin future research. Currently basic technology embraces areas such as nanotechnology, quantum computing, photonics and sensors, each of which will form the basis of new industries of the future. Basic technology is usually multi-disciplinary involving more than one Research Council community.

International collaboration

1.14 To play a full part in modern science and to bring its benefits to the UK we also have to co-operate internationally. The UK is committed to creating closer contacts and stronger links between researchers and research organisations internationally. We are doubling the network of science and technology attaches in Embassies abroad. The EU proposals to create a European Research Area (ERA) offer new opportunities to strengthen our ability to compete, as a union, in global markets. The OST leads for the UK on ERA and is playing a key role in shaping international negotiations on the next EU Framework Programme of R&D (Framework 6 2002-2006) which will be a key tool for its realisation. The Council of Ministers and European Parliament are currently negotiating the next Programme, based on a Commission proposal for a 17.5 billion Euro investment, that is due to begin in 2002. The bulk of this Community money will be given a welcome degree of focus. It will aim to create a critical mass in a small number of crucial areas, for example biotechnology, nanotechnology, information technology and cleaner energy technologies, which will be key to the EU's ability to compete on the world stage in these prosperity-generating areas.

Annex C - “Developing strong, competitive markets within a regulatory framework which promotes fairness and sustainability”

Introduction

1.1 The Department’s science and innovation activities can contribute to creating strong and competitive markets, while at the same time strong competitive markets can themselves stimulate science and innovation activities in industry. It is important also to have a strong and transparent framework for science and technology. This is directly related to building public confidence in science, without which it will be difficult for society and the economy to fully benefit from science. The overall framework is also vital, from using the intellectual property rights system to foster innovation, to providing measurements and standards support, and creating the right infrastructures for technologies of the future, such as communications and energy (see **Annex A** also).

Objectives

1.2 The key DTI strategic science and innovation priorities are to:

- **Build public confidence in science** by ensuring the Department’s legal and regulatory work follows **the Guidelines on the use of scientific advice** in policy-making;
- Administer **Intellectual Property Rights** to ensure that national, European and international systems encourage innovation and competition;
- Create an **infrastructure for information and communication technologies** which gives all firms and individuals convenient and economical access to broadband services, to foster the growth of e-business and an integrated networked society;
- Promote the development and deployment of safe and sustainable **energy** technologies;
- Maintain the UK’s **National Measurement System** and ensure that it meets the needs of UK trade, industry, innovation and public policy;
- Support the development of **technical standards** for products, services and quality management, which underpin regulation and which remove technical barriers to trade;
- Access existing **evidence** and procure new research where necessary to improve the Department’s understanding of the impact or potential impact of DTI regulatory activity on individuals (e.g. consumers), businesses and the economy as a whole.

Scientific advice

1.3 The revised **Guidelines on the use of scientific advice in policy making**¹³ place greater emphasis on the need to involve stakeholder groups in the development of scientific evidence-based policy and the need to be open about the degree of uncertainty attached to a piece of advice. Other key messages are the early identification of issues, obtaining advice from a wide range of sources, and publication of the scientific advice and relevant papers. A **Code of Practice for scientific advisory committees** is also under development, to ensure that committees maintain both their independence and high levels of transparency in carrying out their work. DTI is committed to following these guidelines and to assessing, managing and communicating risk¹⁴ as part of the policy-making process.

Intellectual Property Rights

1.4 The Patent Office¹⁵ is an executive agency of the DTI, responsible for administering and developing a clear and effective framework of Intellectual Property Rights (IPR) domestically and at European and international levels. The rapid pace of scientific and technological change poses enormous challenges to the IPR system - are the traditional boundaries for what is patentable and what is not still right? where do the boundaries lie between scientific discovery and technological invention? how is copyright enforced in the internet era? In addressing these strategic issues it is essential to keep sight of the fundamental aim of the IPR system - to stimulate innovation, enterprise and competition.

1.5 Patent information offers a wealth of scientific and technological information. The accessibility and use of this information is a key issue for further stimulating innovation. The Patent Office is also taking forward work to simplify and reduce the costs of patent procedures in the UK, and internationally to make it easier and cheaper to obtain and enforce patent rights.

1.6 Priorities for the Patent Office for the future include:

- reviewing existing consultation processes and explore new ways to reach the widest possible range of interests¹⁶;
- the introduction of an affordable Community patent;
- ratifying an international treaty to harmonise and deregulate the formal requirements for the acquisition and enforcement of patent rights;
- working for early introduction of a world wide system for electronic trading in IPR and invest in IT to automate the UK IPR system; and
- working with the Small Business Service to ensure SMEs have ready access to information to help them obtain the protection they really want.

¹³ Published by OST in its trans-departmental role "Guidelines 2000 – Scientific Advice and Policy Making", July 2000, at www.dti.gov.uk/ost/aboutost/guidelines.htm

¹⁴ Government policy on risk assessment was confirmed in its 1999 White Paper "Modernising Government". DTI is a member of the Interdepartmental Liaison Group on Risk Assessment, chaired by the Health and Safety Executive, which develops policy on and promotes the practical application of risk assessment and risk management.

¹⁵ www.patent.gov.uk

¹⁶ a new consultative body, the Intellectual Property Advisory Committee, was announced by DTI on 1st August 2001.

Communications Infrastructure

1.7 The development of an efficient and effective information and communications infrastructure is essential if UK business is to be competitive in an increasingly global marketplace. The Government's recent White Paper "A New Future for Communications"¹⁷ sets out proposals for a new regulatory framework for the electronic communications sector. The central proposal is to create a new unified regulator (OFCOM) responsible for the communications sector which will replace several existing regulators. The objectives of the new regulatory framework are:

- to make Britain home to the most dynamic and competitive communications and media market in the world;
- to ensure universal access to a choice of diverse services of the highest quality;
- to ensure that citizens and consumers are safeguarded.

1.8 DTI's overall aim on e-commerce is to make the UK the best place in the world to trade electronically. This is being measured by the cost of Internet access and the extent of business-to-business and business-to-consumer transactions carried out over e-commerce networks. The Department's targets for the period 1999-2002 which relate directly to e-commerce are to increase the number of UK SMEs wired up to the digital market place from 350,000 to 1.5 million by 2002 and to make the UK the best place in the world to trade electronically by 2002.

1.9 The Department, in dialogue with industry, is developing a Next Wave Technologies and Markets programme. 'Next Wave' technologies comprise a host of intelligent appliances that can communicate with each other and the outside world and will create new markets for products and services tailored to the individual. The centrepiece of the programme will be an Interdisciplinary Research Centre for manufacturers and researchers to explore the possibilities and characteristics of intelligent appliances.

Energy markets

1.10 Investment in the development and deployment of safe and sustainable energy technologies is vital to ensure the long-term provision of secure, diverse and sustainable supplies of energy in the UK, both in terms of our environmental emissions commitments and the likely long-term decline in the availability of fossil fuels. The importance of which became more than apparent during last year's fuel crisis. The Energy Group within DTI will launch a consultation exercise on future policy for energy-related technology development in 2001. The themes of the proposed consultation are reflected in the strategy outlined below. The strategy for funding will be designed to set the direction and scope for R&D and related activities over the longer term, and will aim to be sufficiently dynamic to respond to changes in political priorities and energy market requirements.

1.11 The UK energy sector has many strengths on which to build; there are, however, a number of weaknesses across the sector that, if not addressed, could seriously limit options for developing future energy policy and fully exploiting business opportunities at home and overseas. These include low levels of R&D funding and subsequent exploitation by

¹⁷ www.communicationswhitepaper.gov.uk

both Government and industry, high level of investment required in ageing infrastructure, rapidly reducing expertise in nuclear plant design and construction.

1.12 Climate change concerns should be seen as a major business opportunity, and there is a need to reduce the environmental impact of using energy across all sectors to contribute to the UK's emissions targets. The UK is, however, facing a number of threats, such as higher investment levels overseas and over-dependence on gas imports, that could impact on its ability to capture an appropriate share of available UK and global business. This could limit the scope for Government to develop policy options to ensure long term energy security and low costs to consumers.

1.13 In the current financial year the Energy Group is forecast to spend over £40 million in supporting sustainable research and technological development in the areas of new and renewable energy, cleaner coal, oil & gas extraction and in the nuclear industry. In addition, the Cabinet Office Performance and Innovation Unit is currently investigating options for the allocation of the £100m funding for renewable energy announced by the Prime Minister earlier in the year.

1.14 In addition to funding referred to above, energy-related R&D activity attracts funding through the Science Budget, primarily through the Engineering and Physical Sciences Research Council (EPSRC). Between £15-37 million per annum of the EPSRC budget spend is on energy-related topics. Funding for energy-related technology developments is also available through LINK programmes and the Smart scheme on a project by project basis, and through various European programmes such as Framework 5. There are also a number of generic programmes supported by DTI that may impact on a number of Energy Group programmes e.g. materials issues.

1.15 Recent studies by the International Energy Agency suggest that energy technology policies should recognise two distinct phases in bringing technology developments to commercial maturity. The first phase is direct R&D support to initiate research on uncertain technology options, which present a high investment risk; the second is public pre-competitive demonstration expenditure to seed the industry R&D process.

1.16 With hindsight, the UK has arguably not focused sufficient attention on the second phase, i.e. the need to follow through successful R&D with effective deployment programmes. This is in large part due to the not-inconsiderable public funds required to support demonstration and related deployment. While the UK has not got the resources to do everything, there is a need to ensure that support for priority areas includes both R&D and deployment activities in order that the full benefits of investment and the potential commercial opportunities may be fully exploited UK industry. Given that support for demonstration and deployment of energy technologies has substantial implications for public expenditure, a key aspect of the Energy Group's strategy in this area is the requirement for a rigorous review of options to encourage deployment, in addition to grant aid support on a case by case basis.

1.17 For renewable technologies, the way forward for assisting deployment is through a combination of an obligation on electricity suppliers to utilise renewables and capital grants for the less commercial renewable technologies, such as offshore wind. However, lessons learnt from overseas deployment and demonstration programmes would suggest that support for demonstration projects does not necessarily lead to commercialisation of

technologies and other market barriers to deployment are equally, if not more important, to address.

Technical and Design Infrastructure

1.18 Measurement technology is an indispensable component of a modern economy and a building block of the globalisation of commerce. The United Kingdom **National Measurement System** (UK NMS) is the infrastructure of laboratories¹⁸ and services which ensures that users can be confident that their measurements and those of their customers and suppliers are consistently traceable back to nationally and internationally accepted primary reference standards - and are therefore both valid and fit for purpose.

1.19 The UK NMS is underpinned by the DTI funded NMS Research Programme (approx. £40m per annum) to meet the needs of UK trade, industry, innovation, and public policy. Much of the research is long-term and aimed at improving accuracy in the expectation that both industrial and regulatory measurement will become more demanding. Some is more directly applicable to improvements in instrument or sensor technology. Part of the DTI funding is spent on dissemination programmes aimed at the spread of best measurement practice. The Department also funds legal metrology and international programmes to promote research collaboration and inter-comparison between national institutes. Current NMS research programmes cover a wide range of measurement topics, for example - electrical, time & frequency, chemical, biological, ionising radiation, acoustics, mass, length, flow, optical, thermal, and materials testing.

1.20 **Technical standards** cover a wide range of specifications that are used for manufactured products, services and quality management. They make a vital contribution to improving UK competitiveness and the dissemination of technical and other innovations and best practice. Public standards co-exist with private specifications (such as consortia or industry standards). Whilst standards development is primarily market driven, the Government seeks to ensure both prioritisation of that activity and a balance of stakeholder interests (so that no one interest can predominate or make the activity exclusive). Standards are also used to underpin regulation – indeed they help simplify regulation and reduce regulatory burdens; and for public procurement. Standards are a key to removing technical barriers to trade and thus also contribute to the Department’s third objective to create strong and competitive markets.

1.21 Technical standardisation is facilitated in the UK by the British Standards Institution (BSI), a Royal Charter body independent of Government. BSI is the UK's representative in the international and European standards bodies: its participation is determined by priorities set by BSI's major stakeholders, especially business. DTI provides direct funding to BSI itself as well as supporting volunteer participants in standards development.

1.22 The wider and better use of **design** throughout the UK economy is promoted by the Design Council, a Non-Departmental Public Body with a Royal Charter, which is funded by grant-in-aid from the DTI (£6.6 million in 2001-2002). It is the Design Council’s mission to inspire British business to understand the central role design can play in the development of world-class goods and services, and to enable business to do so.

¹⁸ in particular, the National Physical Laboratory, the National Engineering Laboratory and the Laboratory of the Government Chemist.

Evidence-based policy

1.23 Across all of its legal and regulatory activities it is important that policy-makers draw on existing **evidence** and procure new research where necessary to improve their understanding of the impact or potential impact of DTI regulatory activity on individuals businesses and the economy as a whole e.g. this is already done in consumer affairs. Making best use of appropriate and timely scientific and technological evidence clearly has an important role to play, and is an area the Department will take a fresh look as it strives to fulfil its commitment to evidence-based policy.

Annex D - White Paper commitments for science and innovation

The Government has made a number of commitments relevant to science and innovation in two recent White Papers: the Science and Innovation White Paper “Excellence and Opportunity – a science and innovation policy for the 21st Century”, July 2000; and the Enterprise, Skills and Innovation White Paper “Opportunity for all in a world of change”, February 2001. A number of these commitments have already been completed – details of the state of play of each can be found in the respective implementation plans:

Science and Innovation White Paper Implementation Plan –
www.dti.gov.uk/ost/whatsnew

Enterprise, Skills and Innovation White Paper Implementation Plan –
www.dti.gov.uk/opportunityforall

I. INVESTMENT

Science and Innovation White Paper commitments:

- invest in a new £1 billion programme (in partnership with The Wellcome Trust) to renew the infrastructure for science;
- give a £250 million boost to research in key new areas that will shape life in the 21st century: genomics, e-science and basic technologies;
- provide additional funding to increase (over three years) the basic support for post-graduate research students to £9,000 a year;
- launch (in partnership with The Wolfson Foundation and The Royal Society) an initial fund of £4 million a year to assist in the recruitment of up to 50 top researchers;
- make 2001/2002 Science Year and run a new Science Ambassadors Programme to capture children's imagination and encourage them to take-up careers in science and engineering.

Enterprise, Skills and Innovation White Paper commitments:

- provide a further £90 million (to complement recent investment) to promote the commercial exploitation of research focusing on genomics, basic technologies and e-science.

II. FACILITATION

Science and Innovation White Paper commitments:

- establish a Higher Education Innovation Fund of £140 million over three years (incorporating the Higher Education Reach-Out to Business and the Community

fund) to build on universities' potential as drivers of growth in the knowledge economy;

- launch a new Foresight fund, initially up to £15 million, to get the best ideas from Foresight 2000 put into action fast;
- run one further round of the University Challenge competition to provide seed venture funding for knowledge transfer;
- double the number of new starts for Faraday Partnerships, from four to eight a year, to link the science base to business networks;
- put £15 million more into Science Enterprise Centres to bring business skills into the science curriculum;
- create new Regional Innovation Funds worth £50 million a year to enable Regional Development Agencies to support clusters and incubators and new clubs of scientists, entrepreneurs, managers and financiers;
- support 20 Business Fellows who will lead their academic colleagues in working with business;
- publish Science and Innovation Strategies for Government departments;
- introduce a Small Business Research Initiative to open up to small firms R&D procurement worth up to £1 billion, with a target of procuring £50 million of research from them;
- change the rules for Government funded research so that research bodies own the Intellectual Property Rights; issue new guidelines on incentives and risk-taking for staff in public sector research establishments; and provide £10 million to commercialise research done in the public sector, including the NHS;
- double the number of International Technology Promoters from 8 to 16 and link their work closely with British Trade International and other UK agencies overseas to help UK universities and businesses make new partnerships across the world; extend the network of science attachés in embassies abroad.

Enterprise, Skills and Innovation White Paper commitments:

- establish new University Innovation Centres and Technology Institutes in the regions to boost research and development, innovation and technology transfer and to provide the regions with skills in ICT and high technology;
- boost enterprise in all regions by launching a new £75 million Incubator Fund and developing £50 million of new funding to provide early stage money for new and growing businesses;

- give special support to the manufacturing industry by establishing a new Manufacturing Advisory Service;
- promote the growth of successful clusters;
- remove constraints to growth by inviting Regional Development Agencies to develop strategies for success in their regions;
- accelerate the take-up of broadband technology by businesses and households and, as a first step, is providing £30 million for innovative schemes to meet local requirements;
- take action to boost digital TV which will transform the communications services available in the home and open-up new markets and service opportunities;
- take action to stimulate the development of content for digital technologies;
- provide a further £30 million to increase awareness and understanding among all businesses of the challenges and opportunities of e-business;
- encourage development and take-up of more resource efficient and environmentally friendly products and energy systems by promoting markets for new technologies which reduce waste and by embarking on a major initiative with industry and others to achieve a UK Solar Photovoltaic Demonstration Programme in line with those of our main competitors.

III. REGULATION

Science and Innovation White Paper commitments:

- implement stronger guidelines from the Chief Scientific Adviser on how scientific advice should be used in drawing up Government policy;
- publish a Code of Practice for all Scientific Advisory Committees committing them to high levels of openness and transparency in their work.

Enterprise, Skills and Innovation White Paper commitments:

- significantly relax insolvency rules;
- adopt a more commercial approach to company rescue proposals put to Government by companies in short-term financial difficulties;
- give the Office of Fair Trading a new pro-competitive role to spot existing and proposed regulations which hold back dynamic and competitive markets;
- drive forward the Small Business Service strategy “Think Small First”.

Annex E - The place of science and innovation in the UK

Introduction

1.1 Competitiveness represents the ability of the UK to sustain a high and rising standard of living while continuing to pay its way in the World. Given the increasing globalisation of the World Economy and the growing intensity of competition both from other advanced industrial countries and those countries which are in the process of industrialisation, we can only remain competitive if UK firms are constantly upgrading their products and processes and vigorously exploiting new commercial and technology opportunities.

1.2 The increased emphasis on time to market has led to the concept of the "innovation system." This is loosely defined as the interaction at local, national and international levels of the specific actors involved in innovation (enterprises, universities, the public sector), each of whom has an effect dependent on their individual innovation performance. Globally, innovation systems are adapting to needs of the knowledge economy. Strong similarities are emerging between innovation systems in different countries - a trend being re-enforced as administrations look to the successful US system for examples of good practice.

1.3 The key factors in innovation performance set the broad framework for most innovation systems:

- investment in knowledge creation;
- the transfer and exploitation of scientific research, knowledge and know-how;
- entrepreneurial activity; and
- the supply of appropriate human resources.

1.4 In addition we are seeing a growing emphasis on regional economic development and the development of networks linking regional clusters of innovation at national and international levels. This development reflects the emerging recognition that global competitiveness is increasingly based on local co-operation, which distant rivals find hard to replicate.

1.5 No longer is it enough to encourage investment in R&D. Increasingly, inefficiencies need to be addressed in other parts of the innovation system arising from, for example, inflexible institutions, communication gaps, lack of finance and networks, or lack of mobile skilled labour.

1.6 It is often these complementary changes which the UK has found difficult to achieve successfully, which explains that while our performance at scientific research and the development of novel technology appears excellent, our record at innovation often falls short of that of our principal competitors. The UK seems to generate plenty of new ideas, but we are much less good at the difficult and often protracted task of implementing them successfully.

UK Strengths and weaknesses

1.7 There are widely recognised structural and institutional strengths and weaknesses of the UK economy that condition or affect directly the motives and ability of enterprises to innovate effectively. The relative position of the UK can be judged from comparative indicators such as:

- Managing National Innovation Systems, OECD 1999;
- Stimulating Creativity and Innovation in Europe, UNICE 2000;
- UK Competitiveness Indicators, DTI 2000; and
- European Innovation Scoreboard, CEC 2000.

1.8 UK strengths include:

- A world class academic **science base**. With only 1 per cent of the world's population, the UK funds 4.5 per cent of the world's science and produces 8 per cent of the world's scientific research papers;
- Many strengths in **science-based industries** such as pharmaceuticals, financial services, computer games, mobile telephone software and services;
- Well-developed **communications infrastructure** placing us in a strong position for internet development;
- A number of high-tech **clusters** of importance, and the largest **venture capital** industry in the EU;
- Strong **inward investment** of an increasingly high-value, high-tech character;
- a world class national **standards body**, as a source of technical knowledge for innovation.

1.9 However many weaknesses persist, for example:

- Weak **investment in R&D** compared to international competitors;
- **Skills shortages** in, for example, the supply of trained craftsmen/technicians/IT specialists and some other specialist groups;
- Qualified scientists and engineers' apparent lack of **certain management and leadership skills** due to over-specialisation in their specific field;
- **Insufficient understanding** of the importance of science and technology amongst business managers with a non S&T background;
- Lack of **strategic commitment** to innovation and organic growth by larger UK companies and weaknesses in the management of the innovation;
- Gaps in the capital market's coverage of the **financing needs of growth oriented SMEs**. Despite the strong venture capital industry, relatively little UK venture capital goes into early-stage and technology-based investments compared with Germany and the US.

Opportunities and Threats

1.10 As the **stock of S&T knowledge expands**, its scope to be applied to less high-tech products and markets increases. This offers a potential advantage to countries like the UK who have a strong science and engineering base, providing we can improve the ability of companies in these sectors to access and exploit scientific knowledge.

1.11 **Globalisation of S&T** and the rise of Internet trading (which will lower costs of accessing new markets) plus earlier globalisation of trade, finance and investment together with the emergence of developing economies providing UK based firms with a massive expansion in business opportunities overseas. The growth in **internet usage** in the UK allows more and more companies access to huge amounts of information and codified knowledge. The opportunities afforded by rapid digitised knowledge transfer and **e-commerce** appear immense.

1.12 **Sustainability** is set to become a major business driver. Stricter **environmental standards**, be they mandatory and/or consumer driven, have the potential to provide a stimulus for domestic innovation, especially as many UK companies are at the forefront of environmental technologies.

1.13 It is vital that UK firms, as well as embracing developments in S&T and investing in the relevant skills and knowledge, appreciate the need to change **management and organisational practices** required to successfully adopt new technologies and to thrive in a market place where consumers and competitors have instant access to a wealth of critical market information.

1.14 The **globalisation of markets and the rapid projected growth of E-commerce** provide a great competitive threat to many companies who have, to date, been used to competing mainly with domestic (and a limited number of foreign) rivals. Only if companies respond promptly will it be a positive driver for UK innovation.

1.15 The UK is increasingly faced with fierce international **competition to produce the best research**. Other nations, such as USA and Japan, are systematically increasing their investment levels in basic S&T, with the clear expectation of reaping commensurate economic benefits. **Inadequate understanding of S&T** and the inability to cope with technological change may slow progress.

1.16 In developing policy for the Science and Innovation White Paper published last year, the Department's economists produced an assessment of the UK's innovation performance, strengths, weaknesses, opportunities, threats and main problems. A full summary of their analysis is available at <http://www2.dti.gov.uk/tese/ecslist.htm>.

1.17 The **Foresight** programme¹⁹, run by the Office of Science and Technology, facilitates thinking across professional boundaries and is a key tool in helping to identify opportunities and threats and build shared visions of the future. In December 2000, the results of the Foresight Panels' studies on key priorities for the UK were published, listing key recommendations for action. The Foresight Steering Group will shortly publish an over-arching report drawing on the Panel reports to set out the key challenges facing the UK over the coming decades. The focus from now until mid-2002 will be on implementation. Businesses will be supported in accessing the programme, and in developing their own strategies for future innovation and growth, through close collaboration between the Small Business Service and Regional Development Agencies and the Foresight programme. The Chief Scientific Adviser is currently conducting a review of Foresight to ensure that the programme builds on the work done so far and is

¹⁹ www.foresight.gov.uk

properly focused to face the challenges ahead. A clear vision for the future of Foresight is expected by the end of October 2001, with implementation commencing in April 2002.

Rationale for DTI support

1.18 Government should only be involved where market failure inhibits the ability of firms to undertake necessary or useful activities by themselves and where the Government has the knowledge and capability to act effectively. Market failure often occurs where research has no immediate commercial return or where the costs are too high for 100% private investment. Thus although the significance of innovation and technology development in the economy as a whole is much greater than that of scientific research, government's role in the latter is inevitably much greater than in the former. Government funding of R&D is based on the premise that social rates of return on some activities are higher than private rates of return.

1.19 DTI strategy towards science, technology and innovation should aim at securing a balanced allocation of resources to these activities in society as a whole. In particular, the Department needs to strike a balance between the funding of scientific research to meet all our future needs with measures to ensure that the UK is capable of exploiting the results.

1.20 The case of Government support for science and innovation cannot rest on "market failure" alone. Government must also be able to act effectively and with a reasonable chance of getting value for the taxpayers' money. In addition if we are to get the best value from DTI support for science and innovation, it needs to be formulated in context of an overall strategy. The criteria set out below have therefore been established to test whether support is justified in specific circumstances:

- Funding should support the delivery of the Department's policy aims and objectives;
- Funding should add to the scientific knowledge base and/or contribute to wealth creation, productivity and jobs;
- Discussions about R&D and other funding should reflect themes or opportunities identified by Foresight;
- All support for research should pass the test of scientific and technological excellence. Second rate scientific research is of little use to anyone;
- As far as possible the Department should not support R&D and other activities which would otherwise have been funded by the private sector in the same form and within the same timescales;
- Wherever possible, and to our advantage, the UK should seek to collaborate with other countries in funding R&D in order to enjoy economies of scale and scope. Unnecessary duplication of R&D being undertaken overseas should be avoided.
- Funded projects and programmes should state clearly how the results will be exploited, by whom and in what form and timescale and how that exploitation will contribute to wealth creation and social well being. As far as possible they should incorporate a

strategy for fostering exploitation²⁰;

- All support should be subject to appropriate monitoring and evaluation which should reflect the view of users, and in the case of scientific research, peers.

1.21 In the case of support to industry or for industry/university collaboration, compliance with these criteria is set out in a ROAME²¹ statement which defines the mechanisms for new expenditure programmes. ROAME statements are analogous with a business plan but reflect the particular circumstances in which Government acts to support science and industry.

²⁰ In the case of R&D programmes aimed purely at increasing scientific knowledge this would be covered by the dissemination requirements laid down by Research Councils.

²¹ Rationale, Objectives, Appraisal, Monitoring and Evaluation.

Annex F - Departmental issues affecting science and innovation policy

Communication across government and with stakeholders

1.1 As part of the Modernising Government Agenda²², DTI is firmly committed to open communication both within Government and with its stakeholders. A key role for the OST is maintaining contact with all relevant departments and Research Councils involved in science and innovation across Government. This is aided by the Chief Scientific Adviser's Committee, where representatives from 15 departments and devolved administrations meet regularly to discuss issues of common concern. Right across DTI, officials regularly discuss both policy and programme formation with a wide variety of individuals and organisations across the business and scientific environment.

1.2 Overseas contacts also form an important part of developing strategy and programmes. Strong bilateral links are maintained with key overseas administrations to transfer good practice and better inform national policy formulation. International collaboration enables UK researchers to exchange ideas with research teams in other countries and benefit from economies of scale and scope, often permitting the UK scientific community to participate in programmes whose costs to any one country might otherwise be prohibitive. Creating the capabilities to exploit the results of successful R&D carried out overseas is a key part of the UK strategy.

1.3 DTI's information and communication technology infrastructure was extensively updated in 1999-2000 and provides an effective tool for communication both across Government and to the outside community. The Department remains on track to meet its target for all key services to be electronically available by 2005 and is working with a number of other departments and bodies and contributing to central initiatives such as the UK Online programme.

1.4 In partnership with the Wellcome Trust, and with the assistance of a number of its stakeholders, OST has undertaken a major review of science communication in the UK, including a baseline survey of public attitudes to science and engineering. The results of this work, published in December 2000 and entitled "Science and the Public - A review of Science Communication and Public Attitudes to Science in Britain"²³ will be of great value to those organisations involved in science communication, not least the OST itself.

S&T expertise within the DTI

1.5 DTI's requirement for scientific and technological expertise reflects the nature of its responsibilities and the goals it is trying to achieve, and can be categorised broadly as follows:

- (i) the management of R&D and technology procurement programmes;
- (ii) the management of technology support programmes for business; and
- (iii) the provision of advice in relation to specific regulatory tasks.

²² The first Modernising Government annual report, *Citizens First*, was published on Wednesday, 13 September 2000 – <http://www.cabinet-office.gov.uk/moderngov/>

²³ Marketing Dept, The Wellcome Trust Tel: 020 76118651 - ISBN 1 841290 25 4

1.6 The weight of DTI's HQ requirements for scientifically qualified staff falls in the first two categories, i.e. for those who manage the activities of others, rather than directly engaging in research or laboratory work. The main requirement in these areas is for "technology generalists" who are able to understand the nature of the S&T questions at issue, but do not themselves need leading edge specialist knowledge.

1.7 The Department still has a large cadre of scientifically trained staff well able to manage procurement and technology support programmes, many of whom were originally recruited to the Department's laboratories which were privatised or contracted out in the mid-1990s. But, given that this channel of recruitment has now ceased, the number is inevitably declining as people retire. In the longer term the Department may therefore have difficulty in maintaining a cadre of sufficiently qualified staff. It will therefore need to keep under review the balance of supply and demand and, if necessary, target such expertise in future staff recruitment exercises.

1.8 In addition, over the last 10 years or so, DTI has participated in special fast stream arrangements aimed at attracting those with S&T backgrounds. This has been successful in recruiting staff with S&T backgrounds to help fill the Department's needs for "technology generalists" – but not for particular specialisms. The Department will keep this line of recruitment under review to ensure that it sustains an element of scientific and technical expertise in its future senior management.

1.9 There are however some jobs which require specific expertise not available in present staff, for which recruitment is sometimes difficult e.g. regulatory jobs dealing with oil and gas production technologies, and reservoir engineering. In these cases the Department seeks to recruit staff from outside, either from other Government Departments or the open market. The Department also has an extensive programme of exchanges with private industry. This can also be used to fill posts where special experience is needed and can be particularly useful in fast-moving areas where up-to-date commercial experience is needed (e.g. in the IT sector).

Commercial exploitation of departmental research

1.10 DTI (excluding OST and the Research Councils) no longer has any of its own research establishments and therefore does not undertake any research itself. Only a small proportion of DTI's total S&T spend is directed towards research commissioned by the Department. This mainly relates to its support for metrology under the National Measurement System (NMS). Of the £40m annual expenditure, approximately 70% is spent on research and development activities. The balance provides for maintenance of standards, dissemination of knowledge and standards, and management and formulation of programmes.

1.11 The National Physical Laboratory (NPL) is the largest single supplier for the NMS programmes. Although it remains Government owned, NPL is now operated on behalf of the Secretary of State by a private sector contractor. Intellectual property from NMS programmes at NPL is vested in the Secretary of State as owner of the Laboratory. But the operating contractor has a licence to exploit all past and future intellectual property at NPL and the benefits of doing so accrue to the operating contractor. In the case of other suppliers, intellectual property rights from NMS programmes is formally vested in the Secretary of State in accordance with the Department's standard terms and conditions. But

a duty is imposed on the suppliers to make their best efforts to exploit intellectual property generated in the course of the work. The benefits of exploitation accrue to the suppliers, though subject to the Department having a right to a share in the proceeds. Following an independent review of the NMS programme, in which the needs of innovators were a key consideration, DTI believes that there is considerable scope for improving the benefits derived from the investment in this work. The Department is implementing plans to ensure that DTI spending on research, development and dissemination through the NMS programme contributes more to innovation in the UK, for example improving the diffusion of NMS results by direct involvement of industry when NMS programmes are being drawn up and by pursuing more industrial partnerships.

1.12 The OST are currently working with HM Treasury and the Patent Office to develop some guidelines on intellectual property issues for Public Sector Research Establishments (PSREs). This arises from a report by John Baker “Creating Knowledge, Creating Wealth”²⁴, which recommended ways of increasing the rate of exploitation of research undertaken by PSREs. The report identified a lack of a more risk-taking culture as being a serious deterrent to PSRE commercialisation. The Government has accepted most of the report’s recommendations and is working on their implementation.

1.13 Other areas of DTI innovation spend are intended to lead to successful exploitation to the benefit of the UK economy, whether it is access for companies to new technology, management best practice or business information. Standard offer letters make this clear and officials clarify, in arranging the support, how the results are intended to be exploited. When projects have been completed, project officers are required to maintain contact with the organisations concerned to ensure that exploitation of the results occurs.

Evaluation

1.14 DTI has a well-established system of evaluation, which starts with the genesis of a new initiative and runs until some years after the initiative has ended. The foundation of the system is the ROAME statement, which defines the Rationale, Objective and Appraisal, Monitoring and Evaluation mechanisms for expenditure programmes, and which attracts international interest. Any programme involving significant resources, such as total expenditure over £1m, must have an agreed ROAME statement before expenditure can be incurred. Moreover, every proposal for funding, however large or small, must include key factors likely to be included in an evaluation. Evaluation work has several benefits: most commonly, it helps improve and refine particular programmes of support; occasionally, but quite rarely, it produces results which lead to the abandonment or sharp curtailment of a particular programme.

1.15 The main responsibility for evaluating Science Budget funded research has been delegated to the Research Councils. They conduct *ex ante* appraisal of research proposals, a minority of which are funded, and then *post hoc* evaluation of the outcome of research through examination of end of project reports. At project and programme level, the peer review system grades the scientific quality of research by evaluation of final research reports. The Research Councils also evaluate the research conducted at their own

²⁴ “Creating Knowledge, Creating Wealth – realising the economic potential of public sector research establishments”, August 1999, at www.hm-treasury.gov.uk

institutes. OST's role is to ensure that such processes are in place, to evaluate the outcome of central initiatives, and to monitor the overall situation.

1.16 DTI's Strategic Evaluation Committee (SEC) was set up last year to bring a greater strategic focus to all DTI's evaluation activity. The aims of the SEC are:

- to ensure that the Department takes a strategic and outcome focussed approach to evaluation in order to help underpin policy, assist resource allocation decisions and help to achieve the Department's objectives; and
- to draw out policy lessons and promote better use of evaluation evidence in policy making, in line with the Modernising Government agenda.

1.17 The SEC has drawn up plans to develop an evaluation programme which focuses on assessing performance against Public Service Agreement targets and compares the relative effectiveness of different activities in meeting them. The SEC will also be supported by a Cross Departmental Research Network, which will provide an overview of research across different areas of the Department. The aim is to ensure that knowledge is shared, duplication is avoided, and that results with cross-cutting relevance are drawn out and can be used effectively in the Department's evaluation work and policy analysis.

Department of Trade and Industry
August 2001
URN 01/1172

Figure 1: DTI total S&T expenditure (excluding the Science Budget)

| Subject area | £M | 1999/00 Outturn | 2000/01 Working Provision | 2001/02 Plan | 2002/03 Plan | 2003/04 Plan |
|--|----|--------------------|---------------------------------|-----------------|-----------------|-----------------|
| Innovation Budget (of which): | | 172.5 | 201.0 | - | - | - |
| Innovation Promotion & Support | | 64.5 | 90.6 | - | - | - |
| Knowledge Transfer & Collaboration | | 36.1 | 42.5 | - | - | - |
| Standards, Statutory & Regulatory | | 61.2 | 61.6 | - | - | - |
| Sector Challenge | | 10.7 | 6.3 | - | - | - |
| Y2K Century Date Change | | 14.8 | 0.5 | 0 | 0 | 0 |
| Aeronautics | | 19.8 | 19.7 | - | - | - |
| Space (of which): | | 87.2 | 89.1 | - | - | - |
| National Space Programme | | 11.0 | 25.3 | - | - | - |
| European Space Agency | | 76.2 | 63.8 | - | - | - |
| Innovation Expenditure (of which): | | - | - | 338.1 | 343 | 345 |
| Industrial Exploitation of Science | | - | - | 58.3 | 71 | 88 |
| Support for Competitiveness | | - | - | 87.3 | 81 | 74 |
| Space | | - | - | 90.0 | 90 | 90 |
| Technical & Design Infrastructure | | - | - | 76.4 | 76 | 69 |
| Expert Advice & Other Expenditure | | - | - | 3.8 | 3 | 3 |
| Construction industries | | - | - | 22.3 | 22 | 21 |
| Smart | | - | - | 28.0 | 28 | 28 |
| Future & Innovation Unit (FIU) & Skills | | - | - | 6.5 | 6 | 6 |
| Non-nuclear Energy (of which): | | 16.3 | 18.1 | 24.3 | 29 | 29 |
| Offshore Oil & Gas | | | | | | |
| - Industrial/Technology Support | | 0.7 | 0.8 | 0.8 | 1 | 1 |
| - Enhanced Oil Recovery | | 1.1 | 1.2 | 1.2 | 1 | 1 |
| Renewables | | 11.6 | 12.5 | 18.0 | 19 | 19 |
| Clean Coal Technology | | 2.9 | 3.6 | 4.3 | 8 | 8 |
| Nuclear Energy (of which): | | 17.9 | 17.9 | 18.3 | 18 | 18 |
| Fusion | | 14.4 | 14.3 | 14.3 | 14 | 14 |
| Safety & Acceptability | | 3.4 | 3.5 | 4.0 | 4 | 4 |
| OST Administration | | 6.6 | 6.8 | 7.0 | 7 | 7 |
| TOTAL DTI S&T EXPENDITURE | | 335.1 | 353.1 | 422.2 | 431 | 433 |
| Launch Aid (net) | | -134.5 | -98.8 | 14.6 | 20 | 147 |

Note 1: The Innovation Budget has been abolished with effect from 31 March 2001 and some other lines have moved to reflect the new structure for innovation expenditure. From 1 April 2001, (i) Aeronautics is included within Industrial Exploitation of Science; (ii) Space is a single line within Innovation Expenditure; (iii) Smart, funded by the Small Business Service, is shown as a separate line (previously included within Innovation Promotion & Support); (iv) Future & Innovation Unit & Skills is shown as a

separate line (previously included within Innovation Promotion & Support); and (v) Y2K Century Date Change Programme was completed by 31 March 2001.

Note 2: Responsibility for Construction passed to DTI in June 2001 (from the then DETR). Expenditure on Construction S&T is currently shown as a single line under Innovation Expenditure, but will later be merged into the Industrial Exploitation of Science, and Support for Competitiveness budgets.

Note 3: Figures are shown on a cash basis up to 31 March 2001 and on a resource basis with effect from 1 April 2001, following the Department's move to resource accounting.

Figure 2: DTI Innovation Expenditure (from April 2001)

| £ million | 2001/2 (resource) | 2002/3 (resource) | 2003/4 (resource) |
|--|----------------------|----------------------|----------------------|
| Industrial Exploitation of Science (includes: CARAD (aeronautics), knowledge transfer, LINK, international R&D) | 58.3 | 71.2 | 87.8 |
| Support for Competitiveness (includes: technology transfer, best practice, environmental technology, UK Online and e-commerce, sponsorship support) | 87.3 | 81.4 | 74.4 |
| Space (includes: national space programme, European Space Agency) | 90.0 | 90.0 | 90.0 |
| Technical & Design Infrastructure (includes: materials metrology, National Measurement System, design, standards) | 76.4 | 76.3 | 69.1 |
| Expert Advice and other expenditure (includes: support for consumer safety and residual Sector Challenge projects) | 3.8 | 2.7 | 2.7 |
| Construction industries | 22.3 | 21.8 | 21.0 |
| TOTAL | 338.1 | 343.4 | 345.0 |

Note 1: This table shows DTI's innovation activities as re-structured from April 2001. The figures except for those for construction were first published in DTI Expenditure Plans Report (Cm 5112), March 2001.

Note 2: Responsibility for Construction passed to DTI in June 2001 (from the then DETR). Expenditure on Construction S&T is currently shown as a single line, but will later be merged into the Industrial Exploitation of Science, and Support for Competitiveness budgets.

Note 3: Figures are shown on a resource basis with effect from 1 April 2001, following the Department's move to resource accounting.

Figure 3: Science Budget allocations

| | 1999-2000 | 2000-01 | 2001-02 | 2002-03 | 2003-04 |
|---|----------------------|--------------------------------|--------------------|--------------------|--------------------|
| £million | Outturn ¹ | Working Provision ² | Plans ³ | Plans ³ | Plans ³ |
| Total OST expenditure on science | 1406.3 | 1603.1 | 1743.3 | 1887.3 | 2132.3 |
| of which: | | | | | |
| Biotechnology and Biological Sciences Research Council ⁴ | 194.2 | 213.5 | 216.2 | 234.8 | 252.4 |
| Economic and Social Research Council ⁴ | 70.9 | 71.8 | 73.6 | 83.0 | 91.7 |
| Engineering and Physical Sciences Research Council ⁴ | 404.8 | 413.6 | 441.0 | 466.4 | 494.7 |
| Medical Research Council ⁴ | 304.5 | 319.7 | 347.8 | 370.1 | 385.4 |
| Natural Environment Research Council ⁴ | 176.7 | 185.4 | 187.9 | 200.4 | 211.8 |
| Particle Physics and Astronomy Research Council ⁴ | 186.7 | 205.8 | 206.9 | 221.0 | 232.9 |
| Council for the Central Laboratory of the Research Councils | 2.0 | 4.1 | 4.3 | 5.0 | 6.9 |
| Research Councils' Pensions Scheme | 21.3 | 25.6 | 27.0 | 28.5 | 29.7 |
| Royal Society | 23.9 | 24.6 | 25.9 | 28.7 | 29.2 |
| Royal Academy of Engineering | 3.7 | 4.0 | 4.3 | 4.8 | 5.3 |
| DIAMOND Synchrotron | - | 4.1 | 20.0 | 20.0 | 20.0 |
| Joint Infrastructure Fund | 1.6 | 88.1 | 125.0 | - | - |
| Science Research Infrastructure Fund | - | - | - | 125.0 | 250.0 |
| Capital Yet to be allocated | - | 0.9 | - | 34.0 | 34.0 |
| Science Enterprise Challenge Scheme | 13.2 | 15.8 | - | 5.0 | 10.0 |
| Cambridge/MIT Institute | - | 10.1 | 14.0 | 14.0 | 14.0 |
| University Challenge Fund ⁵ | - | 0.6 | - | 5.0 | - |
| Higher Education Innovation Fund | - | - | 15.0 | 20.0 | 40.0 |
| Exploitation of Discoveries at PSREs | - | - | 6.0 | - | - |
| Foresight Challenge | - | - | - | 3.0 | 5.0 |
| OST Initiatives | 3.0 | 8.2 | 5.5 | 3.1 | 3.4 |
| Exchange Rate and Contingency Reserve | - | 8.4 ⁶ | 22.8 | 15.5 | 16.0 |

Notes.

1. 1999-2000 data are cash based, and are taken from the Appropriations Accounts and reflects net grant in aid.
2. 2000-2001 figures, also cash based, are the net provision in the Spring Supplementary Estimates and include Joint Research Equipment Initiative (JREI) and Foresight Link allocations in the Councils' figures.
3. 2001-2002 onwards figures are resource budgets (excludes EU attributed expenditure)
4. 2001-2002 onwards figures include JREI
5. A resource provision of £1,000 will be included in the 2001-2002 Main Estimate for University Challenge, however, £10 million End Year Flexibility carried forward from 1999-2000 is to be taken up at the Summer Supplementary Estimate.
6. Non-voted expenditure reserved for programmes in 2001-02 through End Year Flexibility carry over.

Published in DTI Expenditure Plans Report (Cm 5112), March 2001. See also "The Science Budget 2001/2 to 2003/4", November 2000, at www.dti.gov.uk/ost