SCIENCE RESEARCH PRIORITIES

2001-02 to 2003-04

A NOTE FROM THE OFFICE OF SCIENCE AND TECHNOLOGY

TO HEADS OF UK HIGHER EDUCATION INSTITUTIONS

Foreword by the Director General of Research Councils

The Government has made investment in public services – and in the science and engineering base – an important part of its programme.

In tandem with funding from the Wellcome Trust, it has committed more than £1 billion over five years to address the serious problems of underinvestment in science research infrastructure in the higher education sector.

The second phase of this investment – the Science Research Investment Fund, which starts in 2002-03 – will be allocated to higher education institutions according to the scale and quality of their existing research programmes. Aside from satisfying itself that the money is to be invested in science research infrastructure, the Government wishes to allow HEIs wide discretion as to what investments should be made.

In making its investment decisions, I hope that your institution will have regard to the priorities that the Research Councils have agreed with me for the years ahead. The success of the Research Councils' plans relies heavily on provision by the higher education sector of the well-found laboratories in which the research that they wish to sponsor can take place.

The Research Councils' strategies and research priorities are brought together and summarised in this note in a way which I hope you will find useful as you consider your investment plans. But a document such as this can only scratch the surface. I would therefore urge you to talk to the Councils directly to find out more.

May I take this opportunity of wishing you well with your Science Research Investment Fund plans.

Dr John Taylor

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Introduction

The 1997 report of the National Committee of Inquiry into Higher Education report of 1997 (the Dearing Report) identified chronic underinvestment in university research infrastructure as one of the more pressing problems facing the sector. Following the Comprehensive Spending Review in 1998, the Government signalled its intention to address the problem by establishing a dedicated three-year stream of funding – the Joint Infrastructure Fund (JIF) - within the dual support system, in partnership with funds from the Wellcome Trust. In the Spending Review which took place in 2000, the Government again recognised the need for further investment in science research infrastructure and established, once more in partnership with the Wellcome Trust, the two-year Science Research Investment Fund (SRIF) which will succeed JIF from 2002-03.

A total of £1 billion has been made available for SRIF, including £225 million from the Wellcome Trust. The Wellcome Trust component of SRIF is beyond the scope of this document and is subject to separate arrangements to the ones described below. Of the remaining £775 million to be invested by Government, £675 million[1] will be available for investment in HEIs. It is this money which this document is concerned with.

Whereas JIF has been run as a series of competitions, SRIF money will be allocated to HEIs by means of a formula based on Institutions' quality related (QR) research income and on their total research income. In order to receive their allocations, institutions are being invited to submit their investment programmes to their Funding Council. Apart from ensuring that the programmes are for the purpose of developing science research infrastructure, scrutiny will not be intrusive. The intention is to leave HEIs with wide discretion to set and implement their own investment plans. Institutions will be required to find from other sources (including their own funds if they wish) 25% of the costs of investments they propose to make using SRIF. This requirement may be waived in cases where HEIs are proposing to collaborate and pool their SRIF allocations in the joint development of shared facilities.

Full guidelines for SRIF have been published by the Funding Councils.[2]

In developing their plans, HEIs will need to think carefully about how best to deploy the funding being made available. Ideally, investments made using SRIF funding should be capable of providing long term financial, intellectual and other benefits to the HEI and so contribute to the further reinforcement of the UK's

[1] This figure includes £375 million from OST's Science Budget for disbursement across the UK and £300 million from HEFCE for disbursement in England. Decisions relating to science research investment by the Funding Councils in Scotland and Wales and by the Northern Ireland Education Department are matters for the respective devolved administrations.

[2] For contact details see the *Further Reading* section at end of this document.

science and engineering base and to the wider regional and national economies. If facilities developed using SRIF funds are to stand the best possible chance of securing grant income an important consideration for HEIs in drawing up their plans will be the research priorities of the Research Councils.

Purpose of this document

This document is designed to provide high-level guidance and signposting for HEIs in order to assist the development of SRIF investment plans. It brings together in one place, summaries of the strategies, research priorities and the consequent investment priorities of the six grant-awarding Research Councils following the allocations made to them from the Science Budget in November 2000 for the next three years (see next section). It also provides contact points in the Research Councils for HEIs to use if they wish to discuss issues further, for example, to learn more about intentions in a particular field of research. HEIs are urged to make use of these contacts.

Three years is a relatively short period in relation to infrastructure investment. However, while headline priorities may change, research themes funded through the Research Council system will usually have lifetimes longer than the Government's financial planning horizon. Where possible, therefore, this document tries to look beyond the present funding envelope. Should HEIs find this document useful, OST will update and reissue it from time to time.

Science Budget allocations

Research Councils receive grant in aid from the Government's Science Budget which is administered on behalf of Ministers by the Director General of Research Councils at the Office of Science and Technology. Following the Government's Spending Review 2000, the Science Budget allocations for the period 2001-02 to 2003-04 were published on 22 November 2000 *The Science Budget 2001-02 to 2003-04*.[3] That document sets out allocations to the Research Councils and includes details of three new cross-Council research programmes in Genomics, E-science and Basic Technology (see pages 6 to 7 inclusive). It also describes each Council's strategic direction and objectives for the period covered by the allocations (see pages 8 to 25 inclusive).

[3] See: ***http://www2.dti.gov.uk/ost/whatsnew/index.htm***

Research strategies and priorities

The rest of this document sets out the research strategies and priorities of the Research Councils as determined in the light of the Government's spending review 2000. These priorities are arranged by Council, but an important point for research communities to bear in mind is that an increasing number of research themes cut across Council boundaries and are being run either formally or informally as cross-Councils programmes. This practice has been formalised most clearly in the case of the new Genomics, E-science and Basic Technology programmes which will begin funding research in 2001-02.

Genomics

A programme has been established in genomics which will build on the existing strengths in the UK science and engineering base in this key area of science. A total of £110 million from the Science Budget will be invested in basic research. The programme is being managed by the Post-Genome Co-ordinating Committee which will be chaired by the MRC, but contain representatives from each of the five Research Councils to whom allocations have been made for this programme: MRC, BBSRC, NERC, EPSRC, ESRC. A further £25 million is being invested by DTI to ensure that the fruits of research in this area are properly exploited by the biotechnology industry in the UK.

E-science

The e-science programme will fund research into the next generation of networked computing which science will shortly need in order to enable increasingly large and complex data sets – such as those that will be generated by the Large Hadron Collider at CERN – to be properly processed and analysed. A range of solutions will be needed across the science base at the same time. Each Research Council has been given an allocation from the Science Budget to fund e-science applications research in the areas critical to its mission. In addition, EPSRC has been allocated £15 million over three years to fund a core programme on behalf of all the Councils. This programme will have the following main aims:

- to establish core generic technologies which can be widely deployed across the science base and to minimise unnecessary duplication and fragmentation of individual Councils' work in this area;
- to work with existing infrastructure providers such as JISC and UKERNA;
- to maintain a watching brief on e-science developments in other countries and so ensure that research in the UK fits properly into the global context.

An E-science Director, appointed by EPSRC will run the core programme. A high-level steering group with an independent chair who will report to DGRC and the Research Council Chief Executives will oversee the Director's work. A total of £98 million has been allocated to e-science research from the science budget (including the £15 million set aside for the core programme). In addition to this, DTI has committed a further £20 million to the core programme to ensure that it takes account of the interests of industry and is capable of setting the platform for the next generation of e-commerce. This funding is expected to be matched by industry funds, bringing the total core programme to around £65 million over three years.

Basic Technology

The basic technology programme is designed to encourage research that will generate fundamental new capabilities in areas which will form the basis of the industries of the future. The programme will be run by the Engineering and Physical Sciences Research Council (EPSRC) on behalf of the communities of all the Research Councils. For more information see the EPSRC section on page 17 below.

Medical Research Council (MRC)

Aims

The Medical Research Council is the UK's principal public funder of medical research. Its primary function is to promote and maintain the balanced development of medical and related biological research in the UK with the goal of a better understanding of the causes of disease and delivering improved prevention, diagnosis and treatment of illnesses. Council's mission can be summarised as follows:

- to encourage and support high-quality research with the aim of maintaining and improving human health;
- to train skilled people, and to advance and disseminate knowledge and technology with the aim of meeting national needs in terms of health, quality of life and economic competitiveness;
- to promote public engagement with medical research.

In developing its research strategy, MRC takes account of:

- scientific opportunities;
- importance to health;
- the need to establish critical mass in priority areas;
- the need to maintain a balanced research capacity across the full range of health issues;
- supporting innovation and new approaches.

Research Priorities

Twentieth century biology focussed on the analysis of individual components of complex systems culminating in the human genome sequence. Research in the 21st century will be increasingly geared towards understanding how the whole system works and on how genetic and environmental factors affect health. The MRC will focus on strategic investments in post-genome research to develop the UK's longer-term research potential so that these major advances in knowledge are translated quickly and effectively into improvements in health care. Priorities include:

- translational research, especially in priority areas like cancer and cardiovascular disease;

- fundamental, translational and health services research, in mental health;
- DNA and tissue collections, epidemiology that integrates genetics with other factors, and support for health informatics research and infrastructure;
- translational technologies, such as high-throughput screening, and tissue engineering and repair;
- facilities for high-throughput protein production, crystallisation and analysis to ensure UK biomedical research is able fully to exploit the opportunities for more widespread use of structural analysis;
- research using mouse models to identify important genes and understand function;
- to expand investment in training, methods development, and infrastructure in health informatics as well as bioinformatics.

Infrastructure priorities

In support of the research priorities described above, MRC would welcome investments in associated infrastructure as follows.

Multi-disciplinary, translational disease-oriented teams and centres

- Increased research capacity. MRC considers the highest priority is to expand capacity in major disease areas (ie cancer, cardiovascular disease, diabetes, mental health and neurology). A particular need is to improve the infrastructure for multidisciplinary brain and mental health research in clinical settings.
- Facilities and space to improve the organisation of clinical research and links to healthcare.
- Facilities for genetic and proteomic analysis, sample banking etc.

Population-based research

- Facilities for large-scale studies of gene-environment interaction in human health and disease.
- Centres for primary care research (eg for training, information analysis, networking).

Research into gene function, in vitro, and in model organisms

- Facilities for large-scale screens, sequencing, expression analysis, proteomics.
- Improved housing and transgenesis facilities, and improved methods of phenotype analysis.
- Structural biology facilities.

Bioinformatics and Health Informatics

- Facilities for data capture, cleaning, analysis and storage, and for R&D into technology and methods**.**

Research at the interface between the physical sciences, engineering and biomedicine

- Especially in sensing, imaging, and nanotechnology.

Biotechnology and Biological Sciences Research Council (BBSRC)

The strategy of the Biotechnology and Biological Sciences Research Council (BBSRC) is laid out in its current Strategic Plan (available from the BBSRC web site *http://www.bbsrc.ac.uk/about/strategic_plan/*) and is based on delivery of 10 objectives of which 6 (see box) relate directly to priority research themes. The Council has responsibility for science which underpins three main areas of the UK economy - healthcare, food and agriculture - spanning basic, strategic and applied research. Support for the whole range of biological sciences is required to allow us to benefit from the unique opportunities offered at the present time, particularly in the area of genomics.

Science objectives

• **Genomics**	Exploit the new opportunities provided by the science of genomics.
• **Sustainability**	Promote research underpinning economic and environmental sustainability in production processes.
• **Wealth**	Increase understanding of biological systems and processes and its application in the creation of prosperity
• **Health**	Promote human health and well-being through increasing research underpinning healthcare, food and agriculture.
• **Technology**	Develop and apply technologies and tools for biological research and biotechnological innovation
• **Concern**	Implement research to underpin responsible evaluation of biological issues of public concern, such as animal welfare, food safety and the environment.

Priorities for research and research infrastructure

BBSRC's main priorities for research funding are as follows:

- To maintain and enhance the vitality of the bioscience research base through ***responsive-mode funding*** for high-quality science in priority areas identified by our committees and network groups (see BBSRC's web site).
- To develop the *Centres for* ***Functional Genomics*** and exploit their basic research outputs. These concentrate on a set of representative organisms chosen to span the most important needs of biological science, and involve wide sections of the research community, within both HEIs and Research Council Institutes, covering basic understanding and exploitation for wealth creation. Compared to the US, the UK has been slow in using parallel processing technologies, and thereby making the most of genome sequencing.
- To develop our *Centres for* ***Structural Biology***. By concentrating highest quality resource BBSRC's aim is to remain at the forefront of this area, an area which is vital for progress in genomics and for underpinning both the UK pharmaceutical and emerging biotechnology industries.
- To ensure that BBSRC will enhance those ***areas in which the UK is strong***.
- To facilitate close ***collaboration between biologists and bioscience engineers*** in order to maximise exploitation of the basic science.
- To facilitate close ***collaboration between biologists and the full range of physical scientists***, which will be vital in moving biology into the information-rich, quantitative arena.

In the research fields funded by BBSRC, SRIF could usefully provide the basic infrastructure required for scientific research, and in particular the major facilities and equipment which have turned biotechnology and biological science into 'big' science. The table below summarises the major infrastructure needs associated with each of the main priority areas for research which BBSRC have identified.

Research Areas	**Infrastructure requirements**
Post Genomics • Gene function • High throughput analysis • Technological development	• Imaging and sensing • Resource centres for model organisms • High throughput technologies • Expression analysis facilities
Structural Biology • High throughput protein identification, protein expression and protein characterisation	• Critical mass through structural biology centres • High throughput NMR • X-ray detectors • Remote data collection

Gene Technologies • Stem cells • Gene therapy • Xenotransplantation/tissue engineering • Nuclear transfer	• Mouse clone sets and knockouts • Advanced animal housing • Category II/III containment
Bioinformatics	• Hardware for large scale data analysis, curation and storage • High speed networking for GRID compatibility
Plant Science • Plant genetics • Transformation technology • Responses to environmental stress • Non-food uses	• Glasshouses/growth rooms • Containment facilities • Imaging technologies
Animal Science • Immunology/vaccinology • Functional and comparative genomics • Integrative physiology • Neurophysiology • Ageing	• Animal houses and especially facilities for large animals • Containment facilities • Imaging equipment • Fast throughput behavioural scanning • Electrophysiology facilities • Rodent models
Microbial Science • Food safety • TSEs • Phytopathogens • Bioprocessing • Bioremediation	• Containment facilities • Field facilities for pilot studies in bioremediation
Cell biology and biochemistry • Signalling • Membranes • Enzymology • Gene regulation	• Proteomics • Image and other molecular analysis tools
Genetics and Developmental biology • Comparative and evolutionary genomics • Evolutionary developmental biology • Gene function in development	

Research at the biosciences/physical sciences and engineering interface including: • Drug delivery • Tissue engineering • Bioscience engineering and • Nanotechnology	• Integrated laboratories, incorporating containment facilities • Extensive cross-facility networking • Molecular studies facilities • Advanced computing
Responsive Mode • Principal means of delivery	• Internationally competitive scientists and facilities

Major changes have been made in both the delivery of the science from BBSRC's Institutes. These Institutes offer an essential capability and infrastructure not available in the University sector, and form an important component of the bioscience base. Their output ranges across research in animal health and nutrition, food safety, sustainability of agriculture and land use, microbiology, signalling and cell function which underpins the development of new medicines. BBSRC wish to encourage collaborative research between its Institutes and Universities.

Natural Environment Research Council (NERC)

NERC supports only research and training that is recognised nationally and internationally to be of the highest scientific quality. NERC also aims for the science it supports to be of benefit to society, through meeting specific and generic needs of users, thereby underpinning national prosperity and quality of life.

NERCs integrated science strategy is entitled *Looking Forward*, and can be found at: *http://www.nerc.ac.uk/funding/strategy*. That strategy is composed of three main elements supporting environmental sciences:

- support for basic science;
- support for key science areas;
- support for interdisciplinary science.

Support for basic science

At the heart of advances in environmental science and technology is support aimed at acquiring new knowledge. The investments which provide this support are expected in turn to identify new key science areas. In order to underpin the other two main elements of its strategy NERC will be introducing ways of making support for basic research more flexible, through new initiatives to support longer-term, larger, collaborative and interdisciplinary research projects.

Support for key science areas

Looking Forward provides a synthesis of the research challenges for NERC for the next 3-5 years grouped around 5 key science areas:

- biodiversity;
- environmental risks and hazards;
- global change;
- natural resource management;
- pollution and waste.

Support for interdisciplinary science

The recent Spending Review outcomes illustrate advances made in promoting interdisciplinary approaches. This will remain a key feature of NERC's future strategy towards delivery of science objectives.

Future developments

NERC's new single Science and Technology Board (STB) has confirmed the robustness of the above descriptors and approaches as part of NERC's vision to promote Earth System Science. The STB is also examining the need to implement new research challenges more opportunistically and on a faster time-scale. For example NERC will also address the following new priorities from within its own resources:

- *Abrupt climate change in NW Europe* will investigate the likelihood of rapid cooling of Europe following changes in Atlantic Ocean circulation;
- establishment of a virtual centre for atmospheric sciences to enhance co-ordination and synergy within the diverse UK research and user communities;
- technology for sustainability and energy, leading cross-Council collaboration.

Environmental research relies upon facilities and services such as supercomputers, research vessels, analytical facilities and equipment pools. The way in which the research community successfully reacted to the opportunities presented by the Joint Infrastructure Fund (JIF) to enhance or replace leading-edge, community-wide capabilities is encouraging. NERC would like to see this spirit of partnership approach continued through SRIF.

Engineering and Physical Sciences Research Council (EPSRC)

The primary role of Engineering and Physical Sciences Research Council is to generate new knowledge in, and people skilled at research in, engineering and the physical sciences and to ensure that these contribute to national wealth creation and the quality of life of the citizens of the UK. This is achieved in large measure by investing in research projects in universities, where the successful pursuit of the research will depend on the "well-found laboratory" being in place. Almost 40% of EPSRC's research projects are in collaboration with industry or other users.

The EPSRC research portfolio is delivered through ten programmes each under the control of a Programme Manager. These programmes are Mathematics; Chemistry; Physics; Engineering; Innovative Manufacturing; Infrastructure and Environment; Information Technology and Computer Science (ITCS); Materials; the Life Sciences Interface; and Basic Technology (operated by EPSRC on behalf of all research councils).

The level of new EPSRC grant investment to universities planned for financial year 2001-02 is £368 million (including facility tickets and cross-council activities; see below). In addition £62 million will be invested in postgraduate training via Doctoral Training Accounts and Masters Training Packages. Across the portfolio some two-thirds of EPSRC's research investment is represented by grants awarded in the responsive mode, where the proposer has full choice of subject matter in identifying the research that is to be investigated (although this percentage varies significantly between programmes).

Although EPSRC provides some support targeted specifically at the health of the fundamental research disciplines, increased emphasis is now being given to multidisciplinary opportunities where many research breakthroughs occur. Multidisciplinary partnerships can often be secured around items of advanced equipment. A renewed emphasis is also being given to adventurous (high risk, potentially high return) research.

Within the various programmes the following priorities can be emphasised (where the figures in brackets after each programme name represent the new research grant investment planned for that programme in 2001-02):

Mathematics (£11 million)

- Maintaining the UK's pre-eminence across the broad spectrum of mathematics.
- Enhancing the connectivity of mathematics with other research disciplines (with particular interest in improving the connectivity with Engineering, Information Technology, and the Life Sciences).
- Providing a focal point for the promotion of multidisciplinary opportunities through the UK national Isaac Newton Institute, and a focal point for industrial organisations to access academic mathematics competencies through the Smith Institute for Industrial Mathematics and Systems Engineering Faraday Partnership.

Chemistry (£46 million)

- Supplying world-class excellence in core chemistry; this requires the "well-found laboratory" to be provided with modern equipment in a safe environment.
- Increasing collaboration within chemistry and with other areas - especially the life sciences, engineering and materials.
- Investing in equipment and instrumentation, and developing the expertise to use it effectively. Where appropriate, developing shared access and collaboration with equipment manufacturers and industry.
- Promotion of:
  - analytical science through strengthening the research base and development of key application areas;
  - combinatorial chemistry – with wider application of combinatorial techniques, and development of techniques and equipment jointly with industry;
  - green chemistry, including strengthening collaborative research both with other disciplines and with users.

Physics (£41.5 million)

- Supplying world-class excellence in the physics activities falling within the EPSRC remit; increasingly physics requires specialist laboratories with clean rooms, and state-of-the-art test equipment.
- Providing equipment to underpin high quality research activities in physics and at its interfaces with other disciplines.
- Enhancing multidisciplinary opportunities, with priority being given to linking physics with the life sciences, healthcare, and engineering.
- With ITCS and Materials, supporting a balanced portfolio of photonics research, spanning fundamental physics, through to devices and systems.

Engineering (£58.8 million)

- Nurturing the health of the engineering research base. The quality of infrastructure in many engineering laboratories is below what could be reasonably expected in the well-found laboratory.
- Promoting the opportunities arising from working across the traditional engineering disciplines.
- Fostering collaborations with Mathematics, ITCS, Materials, Chemistry, Physics and the Life Sciences.
- Considering with the Mathematics Programme and other Engineering programmes ways to increase the mathematical skills of UK engineers.
- Providing equipment to underpin high quality research activities, with increased attention being given to shared equipment with researchers in industry and elsewhere.

Innovative Manufacturing (£25 million)

- Focusing the programme by concentrating support at up to 20 Innovative Manufacturing Research Centres, and emphasising evaluation and dissemination of outputs, and technology transfer.
- In the transport, healthcare and construction sectors, working with the Infrastructure and Environment programme to combine the wealth creation and environment portfolios into a common research agenda.
- Working with DTI and other agencies to draw up a coherent and unified approach to supporting the manufacturing sector.

Infrastructure and Environment (£20 million)

- Focusing on the key aspects of engineering relevant to quality of life and sustainable development, with particular emphasis being given to:
    - sustainable technologies (including low carbon technologies and waste management);
    - bioremediation and contaminated land;
    - urban sustainability;
    - renewable energy.
- Working with other programmes, research councils, government departments and agencies to provide appropriate multidisciplinary funding opportunities in fields often driven by legislation and societal concerns.

ITCS (£67.5 million)

- Supplying world-class excellence in IT and Computer Science, by focusing resources on leading groups.
- Increasing the connectivity between industry and academic groups in order to develop a long-term research agenda, especially in Computer Science, and provide outlets for effective dissemination and take up of research results and skilled people.
- Increasing the connectivity of ITCS to all other research programmes, with particular emphasis on:
    - system Integration (with Engineering);
    - photonics (with Materials and Physics);
    - bio-, Chemo-, and Healthcare Informatics (with Life Sciences Interface and Chemistry).
- Funding of new opportunities relating to Grid technologies, including Grid test-beds across the EPSRC remit (£17 million of the above figure refers to these activities).

Materials (£44.4 million)

- Supplying world-class excellence in materials science and engineering.
- Promoting research in:
    - materials processing (with Engineering);
    - predictive Materials Modelling (linking materials composition to final performance);
    - Life Cycle analysis, and Environmental Impacts of Materials from cradle to grave;
    - photonics (with ITCS and Physics);
    - nanotechnology – two multi-Council Interdisciplinary Research Collaborations (IRCs) are being launched. Other institutions will be encouraged to link to core IRC activities.

Life Sciences Interface (£15.9 million)

The Life Sciences Interface programme links the whole EPSRC research portfolio to the life science activities of other research councils, and seeks to engage research leaders in the engineering and physical sciences with the exciting new opportunities emerging from the life sciences. As part of the SR2000 Genomics activity, the programme will fund research in:

- bioinformatics;
- new technologies for functional genomics;

- stimulation of the process engineering base to address genomics research challenges.

Basic Technology (£21.0 million)

Basic Technology is a joint-council programme, managed by EPSRC on behalf of all councils (see page 7 above 'Research Strategies and Priorities'). Basic technology refers to new capabilities in research, for example to work at a new size scale, manipulate matter in a different way, or sense and image in a novel manner. The programme is run on the basis that those applying should be able to see a genuine inter-council, inter-disciplinary activity unconstrained by any traditional single council affiliations. Basic Technology will be delivered through a number of "flagship" activities for which individual calls for proposals will be made – in such fields as nanotechnology, sensor systems, imaging systems, biomimetic materials, smart optics, surface probes, intelligent control, etc.

Multidisciplinary activities across the EPSRC portfolio (beyond those specifically identified above), and linking the portfolio to activities cognate to the EPSRC's remit, are encouraged.

In addition to the programmes listed above EPSRC co-ordinates a core e-science activity on behalf of all councils (with £10 million of research grant investment planned for 2001-02). A key component of the e-science activity is the provision of a computing "grid", for which appropriate (LAN, MAN) university infrastructure will be required. The EPSRC will be procuring a teraflop-level computing capability during the year to operate alongside the existing CSAR service.

Particle Physics and Astronomy Research Council (PPARC)

UK research within the PPARC scientific remit has been confirmed as world-class or world leading by a recent review[4]. Prioritisation within the PPARC remit is by scientific excellence and not by subject area.

Research in particle physics and astronomy is intrinsically international because of the cost and scale of the experimental facilities needed to make leading-edged discoveries. Scientists in these fields are constantly having to invent or develop demanding new technologies to enable the basic research to be driven forward. Collaboration, particularly on facilities, is essential. The pace of research and the funding levels for projects are therefore set by international standards. To remain competitive in these fields, the UK has to invest in human and material resources at, or near, these standards. This applies equally to the "well-found laboratories" within which the research is carried out as well as to the facilities on which the research depends.

The Joint Infrastructure Fund and the Joint Research Equipment Initiative have made a significant contribution to the effectiveness of the PPARC research programme.[5] SRIF provides the HEI sector with the potential to continue this, by making sure that UK HEI-based research groups have the necessary core infrastructural facilities to remain competitive by international standards. In PPARC's view the best value for SRIF investment in particle physics and astronomy will come from the provision of or the refurbishment of up-to-date instrumentation and IT equipment to provide the core of "well-found laboratories"**.**

High-level aims

These are:

- supporting excellent research, with output measured against international standards;
- extracting maximum scientific benefit from existing facilities such as the Hawaiian telescopes and ESA space missions;
- investing in future facilities such as LHC at CERN or ALMA through ESO (European Southern Observatory);

[4] International Perceptions of UK Research in Physics and Astronomy, IoP, May 2000

[5] The Liverpool semi-conductor detector centre serving the research needs in Liverpool for high energy physics, nuclear structure and astrophysics, and a world leading computer facility using novel architectural computers supporting a consortium of UK universities in collaboration with Columbia University to simulate Quantum Chromodynamics (QCD).

- carrying out long term, novel and demanding technological R&D programmes in preparation for future investments.

Pursuit of the second and fourth items in this list can require the construction of large scientific instruments, often on the critical path of billion-dollar scale international investments.

Priorities for new investment by PPARC and HEIs

PPARC will invest its own resources in the following priorities:

- a far reaching programme of E-science, part of the cross-council E-science programme and essential for the PPARC scientific programme. This will also benefit the Science and Engineering Base, commerce and industry (£26 million over 3 years from SR2000 augmenting some £10 million of existing funds);

- an R&D programme in sensors, detectors, optics and accelerator technology, linked to the Basic Technology cross-council programme (using some £15 million of existing funds augmented by bids into the Basic Technology programme to be managed by EPSRC);

- UK Participation in major new experiments, missions or facilities, such as the CERN LHC, ESA/NASA Planck/FIRST, and ESO, VLT and ALMA (more than £100 million from existing funds).

To enable the UK to get the best value from this investment, PPARC would like to see investments made in the establishment of well-found laboratories in the HEI sector. This means, in particular, the refurbishment of laboratories and the provision in them of up-to-date instrumentation and IT equipment. Specific suggestions include the provision of:

- high speed networks, both within the laboratories and connected to the outside world;

- clean rooms and assembly, handling and test equipment for microelectronics, sensor and detector development;

- advanced optical, infrared and submillimetre equipment (Very Large Telescope, Gemini, Next Generation Space Telescope, Atacama Large Millimetre Array);

- space qualified assembly and test facilities.

Economic and Social Research Council (ESRC)

The Economic and Social Research Council's role is to promote the UK's capacity to undertake independent social science research of the highest quality. ESRC have four long-term strategic objectives:

- to focus economic and social research on scientific and national priorities;
- to enhance the capacity for excellence in social science research;
- to increase the impact of ESRC's research on policy and practice;
- to deliver ESRC's activities and effectively and efficiently as possible.

The Thematic Priorities

The first of these objectives is realised largely through the Council's Thematic Priorities. Based on national consultations and scientific reviews, the Thematic Priorities provide the scientific framework for selecting our research programmes and research centres, representing a significant strategic investment in UK social science research.

Capacity building and infrastructure is also a major issue for the themes and applications to SRIF are very much encouraged to consider these Thematic areas. The UK needs to have the capacity to undertake research on these nationally important areas. The current seven Thematic Priorities are fully described in the ESRC publication *Thematic Priorities 2000* which is also available on the ESRC website.[6]

The seven Thematic Priorities are:

- Economic Performance and Development
- Environment and Human Behaviour
- Governance and Citizenship
- Knowledge, Communication and Learning
- Lifecourse, Lifestyles and Health
- Social Stability and Exclusion
- Work and Organisation

[6] See *Further Reading* section at the end of this document for a list of Research Councils, and web site addresses.

Capacity for Excellence

The second of the strategic objectives involves establishing and maintaining research facilities and resources in social science, and training the new generation of social science researchers. Targeting these activities will promote the UK's capacity for undertaking the highest quality social science research.

Such work includes building up comprehensive datasets, which cover all the major areas of life in the UK as it changes over the longer term. The UK has a growing international reputation for cohort and longitudinal surveys such as the British Household Panel Survey, the British Crime Survey, and others covering employment, health, population census and education. The capacity to undertake analysis of the data produced by these surveys is also vital, and this is one area where postgraduate training needs to produce the necessary skills.

Applications to SRIF are encouraged to address requirements for providing skills, resources and facilities in social science which will help ESRC achieve rigorous and scholarly academic research in these areas. Issues of particular note:

- the establishment and maintenance of UK arms of large international and comparative datasets, including those within EU context;
- the establishment and maintenance of important national datasets in the key Thematic Priority areas, including cohort and longitudinal studies;
- the establishment and maintenance of regional and local datasets, particularly in the context of devolved administrations and RDAs;
- ensuring the provision of high-quality, dedicated and high-capacity computing facilities for social science which provide capacity for multi-level analysis of data, modelling and advanced level training for researchers;
- the maintenance and development of primary and secondary documentary sources in the key thematic series, including administrative and business related data and documentation;
- the provision and analysis of Census Studies;
- longitudinal surveys, datasets and modelling facilities in the areas of:
    - (i) social and economic aspects of genomics;
    - (ii) education, teaching and learning;
    - (iii) management and business studies.

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Further reading

- *Science Budget 2001-02 to 2003-04,* OST, November 2000
  http://www2.dti.gov.uk/ost/

- *Cross cutting review of science research (SR2000)*
  http://www.hm-treasury.gov.uk/sr2000/report/chap22.html

- *The Research Councils' various strategy documents can be accessed via their individual web sites listed below:*

    - Medical Research Council (MRC)
      http://www.mrc.ac.uk

    - Biotechnology & Biological Sciences Research Council (BBSRC)
      http://www.bbsrc.ac.uk

    - Natural Environment Research Council (NERC)
      http://www.nerc.ac.uk

    - Engineering and Physical Sciences Research Council (EPSRC)
      http://www.epsrc.ac.uk

    - Particle Physics and Astronomy Research Council (PPARC)
      http://www.pparc.ac.uk

    - Economic and Social Research Council (ESRC)
      http://www.epsrc.ac.uk

Funding Councils:

- Higher Education Funding Council for England (HEFCE)
  Tel: 0117 931 7317
  http://www.hefce.ac.uk/

- Scottish Higher Education Funding Council (SHEFC)
  Tel: 0131 313 6500.
  http://www.shefc.ac.uk/

- Higher Education Funding Council for Wales (HEFCW)
  Tel: 029 2076 1861
  http://www.niss.ac.uk/education/hefcw/

- Department of Education Northern Ireland (DENI)
  Tel: 02891 279279
  http://www.deni.gov.uk/