LARGE FACILITIES ROADMAP 2008

RESEARCH
COUNCILS UK

The UK Research Councils

▶The seven Research Councils are the UK's biggest public funders of cutting edge research. We support research, training and knowledge transfer in everything from architecture to zoology and support world-class large-scale research facilities. We also promote public engagement in the research we fund. We work in partnership with other research investors including government departments and agencies, charities, industry and the European Commission.

Our collaborations extend across disciplines, organisational boundaries and the world. We work together through Research Councils UK, the strategic partnership of the Research Councils. The Research Councils are independent public bodies funded principally through the UK Government's Science and Research Budget, which is administered by the Department for Innovation, Universities and Skills.

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  www.esrc.ac.uk
- ENGINEERING AND PHYSICAL SCIENCES RESEARCH COUNCIL (EPSRC)
  www.epsrc.ac.uk
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  www.mrc.ac.uk
- NATURAL ENVIRONMENT RESEARCH COUNCIL (NERC)
  www.nerc.ac.uk
- SCIENCE AND TECHNOLOGY FACILITIES COUNCIL (STFC)
  www.stfc.ac.uk

The Science and Technology Facilities Council was formed on 1 April 2007 from the merger of the Particle Physics and Astronomy Research Council (PPARC) and the Council for the Central Laboratory of the Research Councils (CCLRC).

Foreword

It is my pleasure to present here the 2008 Research Councils UK Large Facilities Roadmap. The Roadmap provides a comprehensive picture of the major research infrastructures planned and under construction by the Research Councils, and the facilities that they and their research communities have identified as emerging opportunities for the future. The picture that the document presents is of a vibrant research base supported by a broad array of facilities serving a wide range of researchers, with in all cases the goal of maintaining and developing world class research capabilities for the UK. The Roadmap includes facilities for the physical and for the life sciences, for engineering, astronomy, environmental research, medicine, and the social sciences. These facilities include the familiar large physical installations, but increasingly they also take the form of novel distributed, networked resources that exploit advances in information and communications technology to underpin new collaborative modes of research. The Roadmap contains facilities in the UK and overseas; national and international projects; new initiatives; and upgrades and renewals of existing capabilities. The Roadmap also provides an update on those facilities funded through the Large Facilities Capital Fund (LFCF) since 2005.

The roadmap has benefited from a broad range of inputs. This started with the ongoing process of engagement between the Research Councils and academic and industrial researchers to highlight needs and opportunities, and also took advantage of contacts with our European and international partners, through the European Strategy Forum on Research Infrasructures, forums and strategy groups related to particular subject areas and disciplines, and a wide range of formal and informal contacts. A draft version of this Roadmap was then made available for a public consultation and revised on the basis of the comments received. We anticipate making regular updates to the Roadmap in future.

I hope that this document serves as a useful depiction of the UK's emerging research facility landscape. While funding for many of the facilities described here is not yet secured, the Roadmap should serve as a good indication of the Research Councils' thinking and their expected direction for the future. I hope it proves useful to our international partners, to our research communities and to government.

Professor Ian Diamond
Chair, Research Councils UK Executive Group

"*The Halley Research Station, Antarctica.* *See page 30.*"

Introduction

The Government's vision is that the UK should be the most attractive location in the world for science and innovation, being a key knowledge hub in the global economy, with a reputation not only for outstanding scientific and technical discovery, but also a world leader at turning that knowledge into new products and services.

Fundamental to achieving this vision is the UK's R&D capacity - state of the art facilities and laboratories and excellent skilled people.

The Science and Innovation Investment Framework 2004-2014 sets out the Government's continuing commitment to ensure that UK researchers have access to world leading scientific facilities, either in the UK or abroad. Increasingly science is an international endeavour both in terms of its scale and the need to address global research challenges, and consequently national research facilities are increasingly being replaced by more advanced and technologically complex international facilities.

In this context, it is important that the UK has a clear strategic view of how best to maintain access to world class facilities. The RCUK Large Facilities Roadmap provides a comprehensive picture of planned and future facilities, and provides details of potential large facility and equipment projects that the Research Councils would like to see available to researchers over the next 10-15 years.

As well as articulating the broad scope of the UK's potential requirements, the RCUK Large Facilities Roadmap is used by the Research Councils and the Department for Innovation, Universities and Skills (DIUS) to help decide which large scale facilities or infrastructure they should invest in. The Roadmap also provides a basis for discussions with international partners about future investments.

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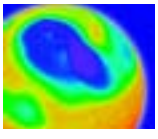







Chapter 1 - Context

1.1 A Vision for World-Class Research

The UK is, and is committed to remaining, a leading nation in the fields of research and innovation. As stated in the Government's ten year Science and Innovation Investment Framework, the UK, with only 1% of the world's population, carries out more than 10% of the world's research and publishes more than 13% of the world's top-cited scientific papers. It is second only to the United States in many metrics. In an increasingly global and competitive world, this strength in research and innovation is the foundation on which our future economic prosperity rests.

To maintain and build on this impressive achievement requires that UK researchers have access to a full range of world-class research facilities and infrastructure. For example, the increasing importance of understanding and manipulating the properties of materials at the atomic and molecular scale requires access to a broad suite of imaging facilities such as neutron sources, synchrotron light sources and free electron lasers to probe and control atomic structures and processes. These capabilities, embodied in facilities like the UK's new Diamond Light Source, enable innovation across diverse and important areas ranging from energy storage technologies to drug development.

The growth of digital and communication technologies and networking has also created emerging opportunities to establish new kinds of facility – interconnected networks of information, resources and of researchers. These create new research opportunities both through their ability to collect, bring together and find patterns and information in large amounts of data, and by bringing together people, resource and expertise to achieve new ways of collaborative work.

Many of the facilities listed in this Roadmap offer multidisciplinary research opportunities or exploit technological strengths that cut across the Research Councils. The Roadmap and the processes used to develop it are a positive indication of the commitment of the Research Councils to work together to provide UK researchers with world-class tools.

1.2 Challenges for the UK Science and Technology Base

The current set of RCUK priority themes serves as excellent examples of the societal and economic challenges which guide the need for the facilities in this Roadmap.

Energy – The challenge is to develop novel, sustainable and lower-impact methods of energy generation, storage and distribution to address the outstanding international issues of climate change and security of energy supply. This will require new materials, new processes and new technologies.

Living With Environmental Change – We need to increase resilience to, and reduce the costs of, environmental change, addressing the associated pressures on natural resources, ecosystem services, economic growth and social progress.

Global Uncertainties: security for all in a changing world – As the focus on issues of security, conflict and uncertainty on the world stage has increased markedly in recent years, so has the need for a research agenda that can address the inter-related global context of crime, terrorism, environmental stress and global poverty. We need to understand the causes, methods of detection and possible interventions to prevent harm.

Ageing: life long health and wellbeing – As the population evolves we will need to continue to target the major determinants of health and wellbeing over the whole lifetime, aiming to cure disease, improve public health and individual quality of life, and reduce dependency in later life.

Digital economy – Highly networked and ubiquitous access to data and computing power continues to revolutionise society. Early adoption of such tools, supported by research capacity and skilled people, will position the country to reap the economic and social benefits of those changes.

NanoScience through Engineering to Application – Nanotechnologies can revolutionise society, offering the potential of transformative changes in electronic materials, optics, computing and in the application of physical and chemical understanding (in combination with biology) to generate innovative self-assembled systems.

Our ability to address these and other important issues rests on:

- The ability to attract, train and mobilise a skilled research workforce
- An excellent research base in fundamental science and technology
- Access to world-class research facilities

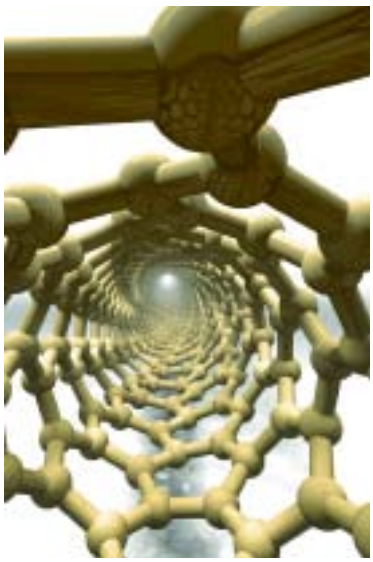
As well as providing solutions in areas of clear societal and economic impact, our facilities play a key role in developing our understanding of the universe, the earth, of materials and of life. While the immediate applicability of this kind of scientific knowledge may not always be clear, the joy of understanding plays a key role in attracting young people into scientific and research careers; in the long term it provides the essential foundation for continued technological and economic development. Examples of the kinds of questions that are addressed by the facilities in this Roadmap range from the fundamental to the applied:

- Why is there a universe?
- Was there ever life on Mars?

- How are the chemical elements created?
- How do cells work?
- How can we design better treatments for cancer?
- Can we create new materials to store energy?
- How do the oceans regulate the Earth's climate?
- What demand will an ageing population place on health systems, on social care, on pensions and public/private savings and on the varying nature of consumer's expenditure?
- What is the impact of genetic endowment and early childhood experience on, for example, later physical and mental health, wellbeing, educational achievement and wealth?

The Research Councils provide a significant contribution to the UK's scientific and research facilities portfolio. Each Council develops a vision and strategy for the research in its area, funds that research, and (working with the other Councils) develops a plan for provision of the facilities that will be needed.

The goal of this Roadmap is to provide an overview of these research facilities.



Facilities have been selected for inclusion in this Roadmap on the basis of their strategic importance to the Research Councils, and their requirement for significant capital investment.

Chapter 2 - Background

2.1 The Purpose of the Roadmap

Investing in leading edge facilities or providing funding to enable access to world class facilities is normally the responsibility of the university or research body where individual researchers are employed. However, as technology has developed, new facilities are increasingly complex and more expensive than those they are replacing. Research, too, is being pursued to a greater degree on an international basis, reflecting the nature of global challenges such as climate change and the scale of major endeavours in areas such as particle physics. Many areas which have up until now been dominated by national facilities are in future likely to be replaced by next generation international facilities.

Increasingly, therefore, there are a range of facilities that fall outside the funding remit or capability of any individual organisation. The types of facility that fall into this class are typically those that are large and very expensive; have long useful lifetimes, e.g. 10-20 years; have multiple users both nationally and internationally; are interdisciplinary; offer unique capabilities within the UK, or more widely; and are potentially jointly funded or suitable subjects for international collaboration.

The UK needs to take a strategic view as to the best way to maintain access for researchers to these large facilities and to manage the investment of public funds. To help address this need, The Research Councils publish a Roadmap of large facilities. The first version of the Large Facilities Roadmap was published in June 2001 and updated in 2005.

This Roadmap includes national and international projects, within the UK and elsewhere.

It should be stressed that the Roadmap does not contain every conceivable facility in which UK scientists might wish to be involved; rather it concentrates on those identified by the Research Councils as being of the highest strategic importance and require significant investment for the Council concerned. The process by which proposals for large facilities are prioritised by individual Councils varies according to the nature of the science and of the facility but will typically involve the following:

- A consideration of the strategic need for the facility in the context of the Council's mission and strategic plan, and usually involving the high-level strategic advisory structure within the Council.
- Input from the scientific and other stakeholder communities (including other Councils) on the need for and use of the facility and the expected quality and application of the research output. In the case of renewal of existing facilities this is likely to draw heavily on reviews undertaken of past and current activity.
- Advice from technical experts on aspects such as design, location, management and operations and capital and operational costs.
- The wider international context and particularly the potential for partnership with others.

Following the recommendations of the report by the National Audit Office, Big Science: Public Investment in Large Scientific Facilities, this Roadmap has been subject to consultation with interested stakeholders.

2.2 The Large Facilities Capital Fund

In the UK funding for large facilities and infrastructure is available from Government Departments, Regional Development Agencies, Devolved Administrations, charities, the private sector, the European Commission, and other international bodies. A particular source of funding is the Large Facilities Capital Fund (LFCF), administered by DIUS.

The Large Facilities Capital Fund, typically £100 million per annum, was established to support Research Councils' investments in large research facilities with capital funding that could not be sensibly accommodated from within Research Council budgets. The LFCF provides a funding contribution to the capital costs of:

- The construction of new facilities either nationally or internationally;
- The expansion or enhancement of existing facilities;
- The upgrading or replacement of existing facilities.

To qualify for LFCF funding facilities must be included in the RCUK Large Facilities Roadmap and satisfy one or more of the following criteria:

- Have capital costs over £25 million;
- Have capital costs representing more than 10 per cent of an individual Research Council's annual budget;
- Serve the research communities of more than one Research Council.

Inclusion of a facility in the Roadmap does not guarantee funding from either Research Councils and/or DIUS via the Large Facilities Capital Fund. Inevitably there are more potential large facilities than available funding. For this reason, Research Councils both individually and collectively are required to undertake a prioritisation exercise. The stages of the prioritisation are:

- **Selection of facilities for inclusion in the Large Facilities Roadmap** – Individual Research Councils, taking into consideration the views of their communities, decide which facilities should be included in the Large Facilities Roadmap.
- **Short-listing of facilities eligible for LFCF** – An initial sift of all the potential facilities that are eligible for LFCF is undertaken individually by Research Councils. The final short-list is agreed collectively by the Research Councils.
- **Prioritisation of facilities for LFCF** – The Research Councils undertake a prioritisation exercise, using an agreed set of criteria, to identify a package of facilities that should be recommended for funding from the LFCF. The assessment criteria are given in Annex 1. The final prioritised list is agreed by the RCUK Executive Group.

Following submission of the final prioritised list of projects, ministers then consider which projects should receive 'ear-marked' funding.

Research Councils will thus be providing advice to DIUS on prioritisation of the use of the finite LFCF budget. This process will be managed by the Research Councils and taken together with consultation responses to this Roadmap, as well as any views expressed to DIUS from representative industry and scientific bodies and individuals, will form the basis of advice to DIUS Ministers for their allocation of the LFCF budget.

Following the prioritisation exercise, there is a general process that is followed before funding is formally committed and released by DIUS. The funding approval process involves:

- **Allocation of resource through the LFCF**
- **Preparation of the Science Case**
- **Preparation of the Business Case - Gateway 1 Review**
- **Procurement Strategy - Gateway Review 2**
- **Consideration by DIUS of the Business Case and submission to Ministers for approval of the commitment of funds**

Annex 2 describes the funding approval process and the Office of Government Commerce's (OGC) Gateway Process in more detail.

The indicative funds available for the 2007 Large Facilities Capital Fund Prioritisation Exercise 2007 is given in Annex 3.

2.3 International Relationships

Excellent science can only be delivered when working with, and benchmarked against, the best scientists in the world. In many circumstances, the UK's interests will be best served by participating in a facility overseas, for example, through international subscriptions or bilateral arrangements with the host country. In this context, the UK needs to take a view on when and how to participate in major new international facilities, considering the potential for the UK to provide global direction and to disseminate UK excellence, as well as enhancing the international collaborative activities of UK researchers.

Provision of research facilities can be undertaken in three main ways:

- As a national (UK) facility;
- Jointly with European partners, either in the UK or elsewhere;
- Jointly with other global partners (such as the United States), either in the UK or elsewhere.

This Roadmap contains examples of all options. The description of each facility, given in Chapter 3, makes clear the nature of international collaboration (if any) that is involved.

The European Strategy Forum on Research Infrastructures (ESFRI) has played a major role in developing a roadmap of research facilities of interest to European states. A substantial fraction of the ESFRI Roadmap facilities are of interest to UK researchers and therefore appear in this RCUK Large Facilities Roadmap, either as potential future facilities that might be constructed in the UK with international collaboration, or as overseas facilities to which access for UK researchers is desirable and UK

contributions therefore may be appropriate. However, it is important to note that in many cases the Research Councils' involvement is dependent on the outcomes of preparatory phase studies, and that in these cases the facilities have been included in the Roadmap for completeness and to acknowledge possible Research Council involvement.

For ease of reference, the ESFRI facilities contained within this Roadmap are summarised in the table below:

ESFRI Facilities Detailed in this Large Facilities Roadmap

Astronomy, Astrophysics, Nuclear and Particle Physics	European Extremely Large Telescope	Page 51
	Facility for Antiproton and Ion Research (FAIR)	Page 57
	Square Kilometre Array	Page 73
Biomedical and Life Sciences	Biobanking and Biomolecular Resources Research Infrastructure	Page 43
	European Advanced Translational Research Infrastructure in Medicine	Page 49
	European Centre for Systems Biology	Page 50
	European Life-Science Infrastructure for Biological Information	Page 52
	Infrafrontier	Page 61
	Infrastructure for Clinical Trials and Bio-therapy	Page 62
	Integrated Structural Biology Infrastructure	Page 65
Materials Science	European Synchrotron Radiation Facility	Page 28
	European X-Ray Free-Electron Laser	Page 55
	Extreme Light Infrastructure	Page 56
	Institut Laue-Langevin	Page 11
Energy	High Power Laser Energy Research Project	Page 60
Environmental Sciences	European Polar Research Ice Breaker (Aurora Borealis)	Page 54
	COmmunity heavy-PAyload Long endurance instrumented aircraft for tropospheric research and geosciences (COPAL)	Page 44
	Euro-Argo	Page 47
	European Multidisciplinary Seafloor Observation	Page 53
	Instrumented Autonomous Global Observing System - European Research Infrastructure	Page 63
	Integrated Carbon Observation System	Page 64
	Life Watch	Page 66
Social Science and the Humanities	Council of European Social Science Data Archives	Page 24
	European Social Survey	Page 27

Chapter 3 – Facility Descriptions

This chapter describes the facilities that are included in this Roadmap. The facilities selected by individual Research Councils for inclusion reflect those that are of high strategic importance, and require significant capital investment for that Council. Further information on other facilities supported by the Research Councils can be found on Research Council websites.

The Chapter is in three sections:

- **Current facilities**. This includes facilities that are already operational or, for international facilities, where there is a UK subscription in place.
- **Renewals and upgrades**. This section includes details of planned or potential renewal of existing capability and upgrades to current facilities.
- **Emerging facilities**. The projects in this section are either entirely new facilities or those that were judged still to be in an advanced planning or concept stage.

Within each section, the facilities have been listed alphabetically.

Census of Population Programme

Background
Since 1801, every 10 years the nation has set aside one day for the census - a count of all people and households. It is the most complete source of information about the UK population that we have. The Economic and Social Research Council (ESRC) Census Programme provides data and support services to allow users in UK Higher and Further Education institutions to access the 1971, 1981, 1991 and 2001 UK censuses. It is the single most important collection of modern UK census data, with holdings and data support which extend well beyond that available from the three separate national census organisations. There are currently over 25,000 registered users.

The programme services have been funded from 2006-11 by ESRC with additional support from the Joint Information Systems Committee (JISC) and encompass data acquisition and specialist data support units. An online registration service ensures easy access for academic users to a full range of census data products, including area statistics, geographical boundaries, interaction data and samples of anonymised records from censuses 1971-2001. The Office for National Statistics (ONS) Longitudinal Study (LS) and the new Scottish Longitudinal Study are also part of the programme but covered by different access arrangements.

Existing capability
The current round of the programme which commenced on 1 August 2006 includes a new Census Portal and a round of research and a series of Census Development Projects aimed at bringing forward innovative solutions in the areas of census dissemination, census data linkage and understanding the impacts of contemporary societal change on the census itself. It is anticipated that these projects will not only enhance the current service but will also help to inform decision making both by ESRC and the census organisations concerning the next census in 2011.

The census datasets are complex but cover a broad range of demographic, economic and household data which form an enormously rich resource central to a wide range of applied social science research, including for example: ageing, ethnicity and religion, social exclusion and neighbourhood policy, migration and regional development, transportation planning, epidemiology and health care management. For many users, the value of the data is increased by successive censuses with the potential to analyse change through time.

The census longitudinal studies provide, in the case of he ONS LS, linked records for a 2% sample of individuals over four decades. This dataset (held in a secure setting with research access supported for approved projects) provides an enormously rich research base covering the past economic, social and geographical circumstances of

individuals in relation to life events. The ONS LS and the new Scottish Longitudinal Study cross-link census responses with vital events data (birth, deaths, and marriages) and cancer registrations.

The census datasets are distinctive in their combination of very high population coverage, detailed socioeconomic information and detailed geography. For example, the Sample of Anonymised Records (SARS) has been an outstanding achievement for social science research. Users have exploited the large sample size and relatively detailed geography to look at social differences between sub-populations (especially ethnic groups) and between geographical areas. There have also been a number of specific policy related users of the SARS in such areas as labour force forecasts, predicting the probability of long-term illness and household projections.

The Programme provides the major channel of consultation between the academic community and the UK census organisations with regard to all aspects of planning and specification of outputs for the 2011 censuses, which is already underway.

Funding & partnerships
The Census programme relies on ESRC working in partnership with the three separate national census organisations. In addition, funding has been provided for the Scottish Longitudinal Study from the General Register Office for Scotland, Scottish Funding Council, the Chief Scientist Office (Scotland) and the Scottish Office.

The next Census will take place in 2011 and ESRC will make strategic decisions about the future of the Programme during 2009.

Estimated cost	£8.4 million
Estimated operational date	2006

Information
http://census.ac.uk/

Economic and Social Data Service

Background
The Economic and Social Data Service (ESDS) is a national data service that came into operation in January 2003. It is a critical part of the UK social science data infrastructure, providing access and support for an extensive range of key economic and social data, both quantitative and qualitative, spanning many disciplines and themes. It includes a number of specialist data services that promote and encourage data usage in research, learning and teaching.

Existing capability
The specialist data services are:

- ESDS Government aims to promote and facilitate increased and more effective use of government datasets. Large-scale government surveys such as the General Household Survey and the Labour Force Survey are key data resources for understanding population structure and change for the UK and its component countries.
- ESDS International provides access to, and support for, a range of international datasets - both macro and micro sources. The macro databanks in ESDS International all contain socio-economic time series data for a range of countries over a substantial period. Many are the current releases of the major statistical publications produced by intergovernmental organisations such as the World Bank, International Monetary Fund or United Nations. Topics covered include national accounts, industrial production, employment, trade, demography, human development and other indicators of national performance and development.
- ESDS Longitudinal promotes and facilitates increased and more effective use of major longitudinal survey datasets. Longitudinal surveys involve repeated surveys of the same individuals at different points in time. They have become increasingly important in the social sciences because they allow researchers to analyse change at the individual level. The service supports a number of the UK's internationally renowned longitudinal studies, including the British Household Panel Study and a number of the British birth cohort studies.
- ESDS Qualidata provides access and support for a range of social science qualitative datasets. The service's focus is on acquiring digital data collections from purely qualitative and mixed methods contemporary research and from UK-based 'classic studies'.

The ESDS is of benefit to social science researchers as it is dedicated to supporting the secondary analysis of social and economic datasets for research and teaching from the novice researcher to the experienced data analyst. This has a positive impact on the social science research community as users benefit from the knowledge and expertise of staff within these services.

The main impact comes from the research which is carried out using the data resources made available by the service. For example, some of the research supported which has been supported by the surveys made available by ESDS include:

- the resources, health and living conditions of older people;
- ethnic differences in family and household composition;
- changing patterns of consumptions, including drinking and smoking;
- gender and ethnic differences in earnings from employment;
- social capital and its relationship to health, employment and earnings;
- comparisons across the countries of the UK and across recent decades.

The ESDS is at the international forefront in developing innovative data access and support systems and in driving up standards for the preservation and cataloguing of social science data resources. It is a leading member of the Council for European Social Science Data Archives (CESSDA).

Funding & partnerships
The ESDS came into operation in January 2003, funded initially for 5 years. ESRC have recently committed to funding the service for a further five years from 2007 to 2012 at a value of £12.3 million.

ESDS is jointly funded by the Joint Information Systems Committee (JISC), who contribute in the region of £2 million to the Service.

Estimated cost	£14.3 million
Operational date	January 2003, Renewal 2007

Information
http://www.esds.ac.uk/

Institut Laue-Langevin

Background
The Institut Laue-Langevin (ILL) is an international research centre at the leading edge of neutron science and technology. Funded by 13 countries, it currently operates the most intense neutron source in the world, together with a suite of 40 high-performance instruments.

Existing capability
The ILL makes its facilities available to about 2,000 visiting scientists from around the world every year. Over 750 experiments, selected by a scientific review committee, are performed at the ILL every year.

The unique neutron-beam instrumentation and the scientific expertise at the ILL is available for commercial R&D in such areas as microstructure in materials, mechanical stress in metals, the behaviour of polymers and colloids, the morphology of surfaces and films, trace element analysis and in situ studies of chemical reactions in industrial products.

New capability
The ILL produced a long term strategy document in the autumn of 2006 called Perspectives and Opportunities. This laid out a 10 year plan to keep the ILL at the forefront of science using neutrons for the next 20 years. The plans identify a major investment programme in infrastructure and new instruments. The strategy identifies niche areas where ILL can excel rather competing with other neutron sources. The investment will also build on a major refit programme that has just been completed which was required by the French authorities to guard against natural disasters (earthquakes).

The four investment programmes are:

- The renewal of key reactor components;
- The provision of new moderators, instruments and techniques;
- The creation of Partnerships for Science and Technology;
- The joint development of the common site shared by the ILL and the European Synchrotron Radiation Facility (ESRF) and the European Molecular Biology Laboratory (EMBL).

Funding & partnerships
Four Associates (France – CEA and CNRS, Germany and the UK) provide the majority of the funding. The UK pays 33% of the Associates' contribution, currently £12 million per year, and for that it receives typically 24% of the allocated beamtime.

It is envisaged that a significant amount of the costs will be met from partner contributions through subscriptions. Some €24 million has been already been committed to the programme by the Associates between 2007 and 2015. However, there is a view from the Scientific Council that the funding requested (€160 million) is insufficient and so a prioritisation process and recosting is currently exercise underway.

€30 million for part (iv) of the upgrade is being sought from local French authorities.

The ILL is a major European facility and the upgrade programme is detailed on the ESRFI roadmap.

Estimated cost	€160 million
Estimated operational date	2017

Information
http://www.ill.eu

Large Hadron Collider

Background
The Large Hadron Collider (LHC) at CERN will start operation for physics in 2008. It will be the world's highest energy particle accelerator and will for the first time reach the energies where our existing models of fundamental particles and forces fail. Discoveries are guaranteed, and may revolutionise our ideas of why the universe is as it is

Existing capability
The UK is contributing strongly to the detectors, to data analysis and to computing and is well represented in the management of the project.

New capability
Significant work to modernise the supporting infrastructure, some of which dates from the 1950s, is now necessary. Around 2010 we anticipate a decision on a potential increase in the LHC collision rate by a factor of 10, which would allow the production of more massive particles and rarer phenomena. This upgrade would require substantial rework of the detectors, and the R&D for such detector upgrades needs to start very soon. We are therefore starting work on a number of technologies relevant to LHC detector upgrades with the goal of the UK playing a leading part in such projects. This will make use of and enhance our underlying expertise in solid-state pixel detectors – which have applications in many other areas (such as Diamond and XFEL).

Discovery oriented accelerators like LHC always benefit from upgrades to the luminosity (collision rate). This allows them to produce more massive particles and rarer phenomena. The LHC accelerator will also need a number of new components for a luminosity upgrade, including new higher-field magnets in the collision regions. The Rutherford Appleton Laboratory is part of a Europe-wide collaboration to develop such magnets but the effort is currently modest.

Funding & partnerships
To get the best from the LHC will require that CERN is adequately resourced and able to operate the facility efficiently and reliably. UK funding for the R&D programme will be through the CERN subscription and from STFC's resources. STFC supports, and has made provision for, a modest increase (by about £3 million p.a.) in the CERN subscription. A UK bid to the LFCF may be made for the construction phase.

The full exploitation of the LHC is the highest priority in the STFC particle physics programme and European Strategy for Particle Physics. The global detector collaborations, comprising 20 member and about 20 non-member states, have begun a focused R&D programme on the technologies required for an upgrade in luminosity.

Estimated cost	£50 million (UK costs)
Estimated operational date	2015

Information
www.cern.ch

Mary Lyon Centre

Background
The mouse is the most commonly used model system to understand the molecular basis of health and disease in humans. To meet the post-genomic challenge and advance understanding of biology and human disease, there is an international effort to generate mouse mutations for every gene in the mouse genome. To facilitate the UK role in this area and exploit economies of scale, a national centre for the development of mouse models of human disease, the Mary Lyon Centre (MLC) was established in 2004 at Harwell, Oxfordshire.

Existing capability
The Centre supports programmes at the Mammalian Genetics Unit (MGU) at Harwell and in the wider UK scientific community. MLC provides a number of services including services to target genes in embryonic stem cells, generate transgenic mice via both pronuclear and blastocyst injections, import, archive and re-derive mouse colonies, induce mutations via chemical mutagenesis, and comprehensively phenotype and supply mouse lines.

The MLC offers state of the art equipment and embraces new technical developments. Services can be tailored to accommodate customer requirements and include regular monitoring of the health status of mice through to pathology services, backcross mapping, inheritance testing and archiving. The National Mouse Microarray Facility at Harwell is also part of the integrated approaches already available to the scientific community at large.

The MLC and MGU are world leaders in the application of ENU mutagenesis as a systematic approach to gene function studies, mouse archiving, application of genome studies to mouse genetics and gene interaction studies. The on-going research programmes at the MGU take advantage of a combination of facilities and expertise available at the MLC that is unique internationally, and builds upon an excellent track record of achievements, particularly in the fields of imprinting, sex determination, mutagenesis and genetics of deafness. Many of these advances have had a profound influence worldwide.

The Centre also has an important role in training and capacity development in mouse model systems and mouse pathology. Improvement of the availability of in vivo skills is a key priority for the pharmaceutical and biotechnology industries in the UK.

Funding & partnerships
The project has been funded by MRC but the expectation is that the Centre will operate on a cost-recovery basis for external users, and that external usage will increase as the benefits of a centralised facility become more widely known among the user community.

The MGU and MLC have been and continue to be involved in several international projects including EUCOMM, EUMORPHIA, EMPReSS, EUMODIC and are partners in the planned ESFRI Infrafrontier project.

Estimated cost	£18 million
Operational date	2006

Information
http://www.mlc.har.mrc.ac.uk/

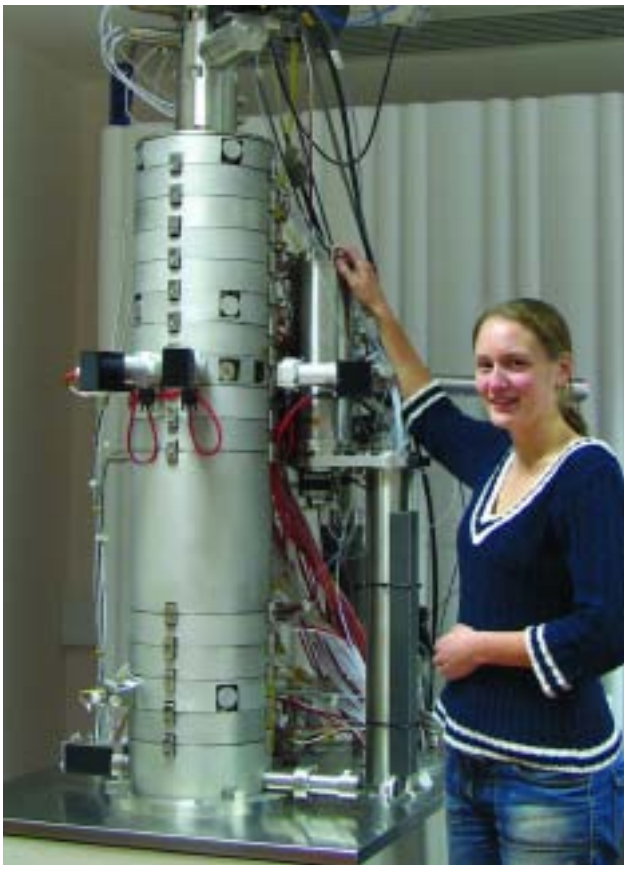
Mesoscale Facility Service Provision

Background
Mesoscale facilities are of a scale where there is limited availability in the UK. This might be because of the relative cost of the equipment (e.g. SuperSTEM), where dedicated equipment is not required for a research project (e.g. Engineering Instrument Pool), because of the expertise needed to operate them or interpret results (e.g. X-ray crystallographic service), or where it makes sense to share information or software (e.g. chemistry national databases).

Current capability
EPSRC supports a number of these mesoscale facilities for use by engineering and physical science researchers across the EPSRC remit.

The current facilities are:

- National Crystallography Service (Southampton/Daresbury)
- Chemistry Database Service (Daresbury)
- Mass Spectrometry Service (Swansea)
- Electron Paramagnetic Resonance (Manchester)
- Computational Chemistry Service (Southampton)
- Solid State NMR (Durham)
- National Centre for Electron Spectroscopy and Surface Analysis (NCESS)
- SuperSTEM (Daresbury)
- National III-V Centre (Sheffield)
- Ion Beam Facility (Surrey)
- Polymer Characterisation (RAPRA)
- Engineering Instrument Pool (RAL)
- Laser Loan Pool (RAL)
- Medium Energy Iron Scattering (Daresbury)
- Isaac Newton Institute (INI) (Cambridge)



Most services are free at the point of access with the benefit of administrative efficiency. Some services are supported on a 'core plus' model through tickets. This mechanism gives service operators a degree of stability to enable long term planning and retention of key staff (the core), while also providing a degree of tensioning as users have to request tickets through research grant funded projects.

Most services provide some level of training for users including both the use of equipment and interpretation of data.

UK industry also benefits directly from the enabled research programmes through links with the university user groups, as well as direct contact with the facilities, through knowledge transfer and marketing activities.

Funding & partnerships
In most cases EPSRC is the sole funder of the service, thereby guaranteeing 100% of available time for its users.

Current cost	£9.8 million per annum
Estimated operational date	In operation

Information
http://www.epsrc.ac.uk/ResearchFunding/FacilitiesAndServices/OtherEPSRCSupportedServices.htm

National Centre for e-Social Science

Background
The National Centre for e-Social Science (NCeSS) is funded by ESRC to investigate how innovative and powerful computer-based infrastructure and tools developed over the past five years under the UK e-Science programme can benefit the social science research community. This infrastructure is commonly known as the 'Grid'.

E-social science refers to the use of Grid infrastructure and tools within the social sciences. The role of NCeSS is to investigate specific applications of e-social science, develop tools to support them and to advise on the future strategic direction of e-social science and e-science. NCeSS also provides information, training, advice, support and online resources to help the social science research community adopt e-social science. The centre is also responsible for providing advice to ESRC on the future strategic direction of e-social science.

Existing capability
The centre consists of a co-ordinating hub at the University of Manchester, seven research nodes and 12 small grant projects. The research programme includes applications of e-science in both quantitative and qualitative social sciences, and studies of issues relevant to promoting the wider adoption of e-science.

The NCeSS has been established with the aim of ensuring the social sciences are able to exploit the full capabilities of next generation of research infrastructure, known as the 'Grid' or 'e-infrastructure'. Exploitation of this infrastructure is essential in order to address some of the exciting opportunities and challenges currently facing the social sciences.

For example, improving the re-use of existing data collections, simplifying the linking of confidential social, medical, transactional and administrative datasets, and meeting the challenges of the 'data deluge' arising from a profusion of new, 'naturally occurring' sources of both quantitative and qualitative social data is essential if the UK is to retain its position as a centre of excellence in social and economic research. Meeting this challenge will require better tools for archiving, describing, locating and accessing data, cleaning it, maintaining its confidentiality and combining datasets. e-social science can deliver such tools. Easy-to-use but powerful analysis tools – both quantitative and qualitative – will be essential if researchers are to harness the mass of varied digital data that is becoming increasingly available and analyse it in ways that provide a better understanding of complex, large scale and dynamic social and economic processes in finer detail and with greater precision. Researchers will need better tools to support the management and execution of the research lifecycle, from literature review and hypothesis formation, through to the publication of new data and results. Again e-social science can deliver such tools.

As society changes at an ever rapid rate, so researchers are being asked increasing searching questions. Such questions are increasing multi - or interdisciplinary and international in their scope and reach. Therefore addressing these questions will require the creation of research programmes that are more collaborative, multi- or inter-disciplinary in their methods, large scale, long term and cross national boundaries. E-social science can provide the infrastructure required to facilitate effective collaborative working both within individual projects and within the wider research community, including more powerful ways to share data and research findings, interoperable tools and virtual research environments.

Funding & partnerships
The Centre was established in 2004, with funding of £8.4 million to date. Following a review of the centre's activities in 2007/08 ESRC will renewing its funding for the centre for a further 5 years.

The centre has also been successful in securing funding for a number of projects to develop e-infrastructure for the social sciences. Funding has come from EPSRC, JISC, EU and the e-science institute.

Estimated cost	£10.5 million
Estimated operational date	2007/2008 renewal

Information
http://www.ncess.ac.uk/

National Centre for Research Methods

Background
The mission of the National Centre for Research Methods (NCRM) is to provide a strategic focal point for the identification, development and delivery of an integrated national research and training programme aimed at promoting a step change in the quality and range of methodological skills and techniques used by the UK social science community.

The NCRM's research programme aims to stimulate imaginative new developments in methods and be responsive to new needs and opportunities that arise. It is based on three kinds of project:

- Node-based projects, focusing on innovative methodological development within the context of substantive research problems and applications, with an emphasis on transferability to other disciplines and research fields.
- Short-term projects, catalysing projects, stimulating research and debate on new methodological challenges; synthesising projects, reviewing developments within specific methodological fields.
- Affiliated projects, other methodological innovative research projects invited to affiliate to the Centre and participate in its activities.

The NCRM's training and capacity building programme has two broad aims:

- upgrading the quality and range of the methodological skills base across the general social science community;
- facilitating the diffusion of cutting-edge methodological expertise to a new generation of social scientists.

The training programme includes face to face training opportunities as well as mentoring schemes, placements, on-line training materials, and expert seminars and workshops. The centre also acts as a general resource for the UK social science community, providing up-to-date information and on-line resources of a wide range of methodological issues.

Existing capability
The NCRM consists of a co-ordinating hub at the University of Southampton and a number of nodes based at various UK universities.

The centre forms a key part of the ESRC's broader strategy aimed at enhancing the capacity of the UK social science community to deliver high quality quantitative and qualitative research, and promoting a step change in the quality and range of methodological skills and techniques used by the UK social science community.

The key objectives of the NCRM are:

- To advance methodological understanding and practice;
- To enhance the UK international profile in the methodological excellence and to ensure that the UK is at the forefront of international developments in social research methodology;
- To play a strategic role in the promotion of high quality research methodology that involves inter-agency initiatives, including, but not limited to, those funded by ESRC;
- To co-ordinate and add value to the existing investments of ESRC that are concerned to enhance the methodological sophistication and techniques and skills of current and future generations of social researchers.

Funding & partnerships
The hub of the centre was established in 2004 for a five-year term and the nodes in 2005 for three year terms. Funding for the initial period (2004 to 2009) was £6.5 million.

Following a review of the centre's activities, ESRC is currently in the process of renewing the hub contract for a further five year period and commissioning another round of centre nodes. £12 million has been allocated by ESRC for the renewal of the centre.

Estimated cost	£12 million
Estimated operational date	2008

Information
http://www.ncrm.ac.uk

Oceanographic Research Ship RRS James Cook

Background
The oceans play a pivotal role in the functioning of the Earth system; for example the possible rapid collapse of the Atlantic Ocean's thermohaline circulation would lead to severe and rapid climate change in north west Europe. Seagoing science is an essential element of Earth system science.

Existing capability
Although remote sensing continues to be very important for improving our understanding of the oceans, these techniques are generally only able to provide quantitative data from the first few centimetres of the ocean's surface. They cannot be used to study the majority of the ocean's volume, the sea floor and solid Earth beneath it. Other new and improved technologies, such as remotely operated and autonomous underwater vehicles (e.g. AUTOSUB), deep ocean observatories and moorings, offer new ways to observe ocean processes and/or parts of the ocean. These technologies require access to research ships for their deployment, retrieval and maintenance, and it is anticipated that their use will increase the requirement for ship-time.

NERC has two dedicated research ships (the RRS James Cook and the older RRS Discovery) for multidisciplinary ocean science cruises and continued investment in these facilities is required to ensure that the UK remains in the first division of seagoing science nations. The RRS James Cook went into full service as a research ship in spring 2007. It will operate worldwide from the tropics to the edge of the ice sheets, enabling leading edge multidisciplinary research. The vessel will undertake both continental margin and deep ocean projects. The ship's design will enable it to work in higher sea-states than NERC's other dedicated research vessels. It is more manoeuvrable, and has more scientific berths and advanced technical facilities.

A replacement for RRS Discovery is a planned facility on this Roadmap. Despite on-going improvements in the marine technologies that are used to sample the oceans, NERC will, for the foreseeable future, continue to require access to two dedicated research ships and the instrumentation that they contain.

Funding & partnerships
NERC is currently heavily involved with the bartering of marine facilities with its partners in the United States, Germany, France, the Netherlands and Norway. These barter arrangements promote a more efficient and cost effective use of each country's marine facilities by allowing the scientific communities access to a wider range of technical facilities and geographical areas in a given year than would have otherwise been possible. Continued access for the UK research community to barter facilities is contingent on there being on-going modernisation of NERC's research fleet and an enhancement of its facilities.

Funding for RRS James Cook came from the Large Facilities Capital Fund and from NERC. It was delivered to time and budget and became operational early in 2007.

Cost	£40 million
Operational date	2007

Information
http://www.noc.soton.ac.uk/nmf/

Research Complex at the Rutherford Appleton Laboratory

Background
The Research Complex at the Rutherford Appleton Laboratory (RAL) provides essential laboratory facilities for both life and physical scientists to undertake new and cutting-edge scientific research using Diamond, ISIS, the Central Laser Facility and other user facilities on the site. These national facilities (Diamond and ISIS) provide a unique staging ground for innovative multidisciplinary research. Synergy between scientific disciplines and the Research Complex will enable a vibrant scientific culture of multi-facility working and generate an excellent environment for training.

Existing capability
The Research Complex will play a vital role in ensuring that the infrastructure investment made on the RAL site, and the scientific opportunities they afford, are maximised. The UK Government's vision for UK science, set out in its Government Science & Innovation Investment Framework 2004 – 2014, is to build on current strengths in research, and to ensure the UK has state-of-the-art facilities and laboratories, and the skilled workforce, necessary to make the UK the best location globally for research. The UK is a world leader in structural biology and these facilities will enhance the UK's standing in this field and help to increase national capabilities in weaker areas such as physical sciences and engineering.

If Diamond is to fulfil its anticipated potential as a UK flagship, attracting both national and international multidisciplinary user communities and generating exciting research and development discoveries, it needs to be complemented by essential scientific facilities and infrastructure support. Some of the areas of strategic importance where more work is needed, and where advances could have enormous impact and high pay-off (e.g. for drug design), could be:

- structural studies on membrane proteins
- biological imaging
- catalysis
- drug development and delivery
- matter under extreme conditions
- chemical processing
- surface and nanoscience,
- energy research.

Users will increasingly want to do more complicated experiments. Many users' programmes will be completely transformed by access to high-grade facilities for sample preparation and characterisation, both before and after analysis. For example, experience has shown that research facilities close to the source have allowed visiting and resident research teams to achieve remarkable advances, benefiting from close collaboration with the beamline scientists and other technical experts at the facility.

Funding & partnerships
BBSRC, EPSRC, MRC, NERC and STFC are partners in this project. MRC is leading the project on behalf of its partner Councils.

Funding from the LFCF has been approved.

Estimated cost	£26.4 million
Estimated operational date	2009

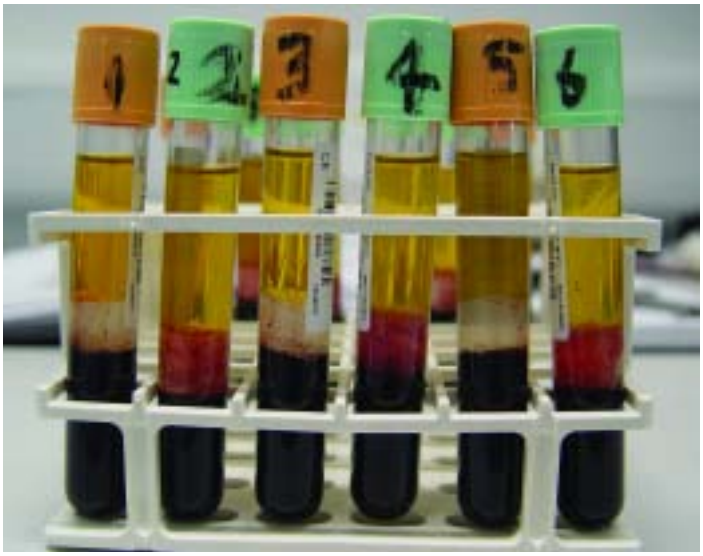
Information
http://www.diamond.ac.uk

UK Biobank

Background
Understanding the role of genetic disposition, lifestyle and environmental factors in common, multifactorial diseases is key to developing new disease treatments, earlier diagnosis and prevention of disease and improving human health throughout society. However, understanding the complex interplay of these factors in common diseases requires research on large collections of well-documented, up-to-date epidemiological, clinical and biological information and accompanying material from large numbers of patients and healthy persons, so-called biobanks.

UK Biobank will be a unique resource, recording lifestyle and environmental information, medical history, physical measurements and biological samples from about 500,000 people in the UK aged 40-69. Their health will be followed for many years through medical and other health records.

Existing capability
UK Biobank is a long-term project. Use by the wider research community is unlikely to begin in earnest until 2015 but is expected to continue for a further 20-30 years. As research takes place, the scientific value of the dataset is expected to increase as research findings are fed back into the dataset to enrich it.



UK Biobank will enable research that investigates a wide range of effects of the relationships between different exposures and outcomes. It is anticipated that the resource will be used by a wide variety of researchers across all aspects of health need, whether from academia or industry in the UK or overseas.

In its developmental stages UK Biobank has already become a leader within the field of large scale epidemiology studies and others will build on the experiences of this resource. The resource has established ground-breaking systems for data collection and management, and sample storage and handling. An International Review Panel said that the approach to ethical oversight and governance was 'exemplary and would be held up as a gold standard across the world'.

The scientific benefits of UK Biobank will be derived from more detailed scientific understanding of the processes to health and illhealth, the progression of disease, the development of new public health prevention strategies and the development of new and better therapeutics and improved targeting of their use.

The central co-ordinating centre is based in Manchester and works with 6 regional collaborating centres, representing universities across the UK. Recruitment is planned to take place in a phased manner throughout the UK and aims to recruit a sample generalisable to the whole population.

Funding & partnerships
The development and recruitment phase of UK Biobank has been funded by MRC, Wellcome Trust, Department of Health, Scottish Executive and the North West Development Agency The total cost, to date, is £61 million.

Costs for the post-recruitment, follow-up phase (2010-2015) have not yet been allocated, but are estimated at approximately £12.4 million for 5 years. There are also plans for enhancement of the dataset, through intensive phenotyping with more detailed questionnaires and measures, which will also require additional resource.

UK Biobank and many of the academics involved in its development are involved in large international activities including P3G and ESFRI projects (e.g. BBMRI) as well as other large studies undertaken across the world.

Estimated cost	£74.4 million
Estimated operational date	2010

Information
http://www.ukbiobank.ac.uk/

UK Household Longitudinal Study

Background
The UK Household Longitudinal Study (UKHLS) is a major new study of the UK population being commissioned by ESRC. The study, consisting of some 40,000 households, will be the largest of its type in the world.

The study will provide valuable new evidence about the people of the UK, their lives, experiences, behaviours and beliefs, and will enable an unprecedented understanding of diversity within the population. It will inform research on issues of importance to a wide scientific community of interest and will assist with understanding the long term effects of social and economic change, as well as of policy interventions designed to impact upon the general wellbeing of the UK population.

Key features will include:

- an ethnic minority booster sample of over 3,000 households;
- incorporation of the British Household Panel Survey (BHPS);
- interviews from all household members aged 10 and above, 100,000 individuals in all;
- links to supplementary data, such as neighbourhood information;
- the collection of health indicators and biomarkers;
- a platform for the collection of qualitative data;
- an innovation panel for methodological research.

Existing capability
The UKHLS will provide valuable new evidence to inform research on issues of importance to a wide scientific community of interest and will assist in understanding the long-term effects of social and economic change, as well as providing a key evidence base for policy and practice interventions designed to impact upon the general wellbeing of the UK population. Its academic as well as economic and societal impact potential is therefore significant.

The economic and societal impact of the UKHLS will be generated through two channels:

- the direct use of this unrivalled evidence base by the public, private and voluntary sector. There is a huge potential for major impacts on public policy-making.
- the indirect use of the evidence-base through the world-class research on economic and societal issues, the findings of which will inform the development of public policy.

The UKHLS dataset will revolutionise the capacity to study our society, in such key areas as household and demographic change, poverty, migration, labour market dynamics, crime and ageing. The dataset will open up major new opportunities for more in depth and informed policy and national and regional analysis on such key topics as the provision of public services, tax and pensions, crime, health and education.

The UKHLS will also open up exciting prospects for advances at the interface between social science and biomedical research. It will provide the opportunity to assess exposure and antecedent factors of health status, understanding disease mechanisms (e.g. gene-environment interaction, gene-to-function links), household and socioeconomic effects and analysis of outcomes using direct assessments or data linkage.

Funding of the UKHLS will help to ensure that the UK commands the most advanced social science data infrastructure in the world, sustains its top two international ranking in social scientific research, strengthens its position as a global leader in such areas as e-social science, commands an unrivalled evidence base to meet the national and regional and demands of the wide range of policy makers, and attracts world leading researchers to work in the UK.

Funding & partnerships
ESRC has committed £15.5 million (£12.5 million committed from the 2005 Large Facilities Capital Fund) over the period April 2007 - March 2012 to conduct the first two waves of data collections. Co-funding is also being sought from a range of other Government Departments and funding bodies.

Estimated cost	£15.5 million
Estimated operational date	2008

Information
http://www.iser.essex.ac.uk/ukhls/

Understanding Society
THE UK HOUSEHOLD LONGITUDINAL STUDY

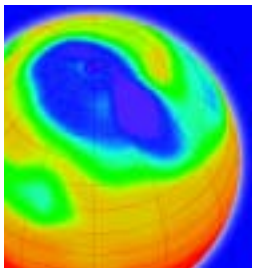
Atmospheric Research Aircraft

Background
A modified BAe146 aircraft is operated by the Facility for Airborne Atmospheric Measurements (FAAM, part of NERC's National Centre for Atmospheric Science) as a collaboration between the Met Office and NERC. It provides an aircraft measurement platform for use by the UK atmospheric research community on campaigns throughout the world.

FAAM is a shared facility to provide an atmospheric measurement capability from an instrumented aircraft for the benefit of the NERC-funded and Met Office research community. The aircraft operates around the globe on major international projects, providing vital support to Met Office and NERC community science programmes. Applications include: radiative transfer studies in clear and cloudy air; tropospheric chemistry measurements; cloud physics and dynamic studies; dynamics of mesoscale weather systems; boundary layer and turbulence studies; remote sensing: verification of ground based instruments; satellite ground truth: radiometric measurements and winds; and satellite instrument test-bed.

The broader impact of the facility is demonstrated by the two flights made to measure the extent and properties of the smoke from the Buncefield (Hemel Hempstead) Oil Terminal fire on the two days following the explosion in 2005.

New capability
The current lease ends in 2015 and there is the possibility of an extension for up to a further 10 years. Should there be no agreement on an extension, thus resulting in withdrawal of the current aircraft from service, a suitable airframe, conversion and securing a suite of core instruments will need to be procured.



Funding & partnerships
FAAM is a partnership between NERC and the Met Office, which share the management and operating costs.

UK research aircraft contribute to international programmes around the globe, often alongside research aircraft from other nations. In addition, there is bartering through the European Fleet for Atmospheric Research (EUFAR).

Estimated cost	£25 million
Estimated operational date	2015

Information
http://www.faam.ac.uk/

British Election Study

Background
The British Election Study (BES) has been conducted at every General Election since 1964, making it the second oldest election study in the world and one of the longest running academic time series in the UK. Its main aim is to understand why people vote, and why they vote the way they do. The BES covers political preferences and values, dispositions to engage in different forms of political activity, and individual and socio-demographic changes.

The purposes of the BES are:

- to study long-term trends in British voting behaviour
- to explain the election outcome
- to explain party choice
- to explain election turnout
- to examine the consequences of elections for the operation of democracy more generally.

The last study took place in 2005 and retains all the key questions that are part of the long-run series since 1964, the long-standing questions of ideology, economic perceptions and issue positions that were introduced after 1979, as well as questions added in 2001 to explain turnout and to explore attitudes towards elections, parties, and the democratic process. The 2005 BES also included innovative internet experiments aimed at developing better survey measures and ways of assessing media effects.

Existing capability
The British Election Study is a well established and important research tool used by both the academic and non-academic communities. BES data are used by a variety of stakeholders: British and international academics, journalists and government bodies (such as the Electoral Commission). They are also used extensively for teaching on courses in British politics, elections and parties, as well as more general courses on quantitative methods.
The addition of questions in the 2001 and 2005 studies aimed at exploring the decline in turnout since 1992 (especially among the young) has meant that the BES has evolved from a 'mere' election project into a more wide-ranging study of political engagement in Britain. The BES now permits an assessment of the ways in which British citizens think about democracy and the way that such perceptions relate to the democratic process. These concerns are likely to become more important over coming decades.

The 2005 BES found that large numbers of British voters are (still) very strongly influenced by their sense that it is their civic duty to vote. However, the distribution of this sense of duty is very heavily skewed towards middle and old age. Therefore, the single most powerful way in which turnout in British General elections could be increased would be to increase the sense of civic duty among the young, particularly the under 40s.

In 2006 ESRC commissioned an independent review of the 2001 and 2005 British Election Studies. The review found that the BES has consistently generated high quality data, which is straightforward to use and available to users in a very short time. It found that BES data make a significant impact and are an important tool for both UK-focused and comparative research. The BES results in a large number of high quality publications which are well regarded by users. The report noted that interviewees view the BES as contributing to some of the best electoral analysis in the world.

The British Election Study has established an international reputation as an authoritative source of information which is widely respected and consulted across the user spectrum, from politicians to the media. Newsnight, the Guardian and the Financial Times all used BES findings regularly during the 2005 election.

Funding & partnerships
The BES in 2005 was co-funded by the Electoral Commission, who contributed £95,000.

The ESRC, through a variety of mechanisms has also funded studies into the devolved elections in Scotland, Wales and Northern Ireland since 1997.

In 2008 the ESRC agreed funding of the next British Election Study which will take place between 2008 and 2010.

Estimated cost	£1.5 million
Estimated operational date	2008 - 2010

Information
http://www.essex.ac.uk/bes/

Centre for Longitudinal Studies

Background
The Centre for Longitudinal Studies (CLS) is an ESRC resource centre based at the Institute of Education, University of London. The Centre houses three of Britain's Internationally renowned birth cohort studies, the 1958 National Child Development Study (NCDS), the 1970 British Cohort Study (BCS70) and the Millennium Cohort Study (a cohort of children born in 2000-01). The three cohort studies involve multiple surveys of large numbers of individuals from birth and throughout their lives. They include information on education and employment, family and parenting, physical and mental health, and social attitudes. Because they are longitudinal studies that follow the same groups of people throughout their lives, they show how histories of health, wealth, education, family and employment are interwoven for individuals, vary between them and affect outcomes and achievements in later life. Through comparing the different generations in the three cohorts, we can chart social change and start to untangle the reasons behind it.

Existing capability
Having all three cohorts in one Centre brings considerable economies of scale, and also enables the Centre to make important contributions to debates regarding advancements in survey methodology, data collection and deposit, and ethics.

Findings from the studies housed at the Centre have contributed to debates and inquiries in a number of policy areas over the last half-century including: education and equality of opportunity; poverty and social exclusion; gender differences in pay and employment; social class differences in health; changing family structures; and anti-social behaviour.

The studies were key sources of evidence for a number of government inquiries such as the Plowden Committee on Primary Education (1967), the Warnock Committee on Children with Special Educational Needs (1978), the Finer Committee on One Parent Families (1966-74), the Acheson Independent Inquiry into Inequalities in Health (1998) and the Moser Committee on Adult Basic Skills (1997-99). A study of working mothers and early child development helped shift the argument for increased maternity leave. Another study on the impact of assets, such as savings and investments on future life chances, played a major part in the development of assets-based welfare policy, including the much debated 'Baby Bond'.

There are many cohort studies across the world and staff at the CLS have an interest in maintaining complementarity of information to enable cross national comparisons. The CLS in particular has links with other cohorts that started around the Millennium and held a conference drawing these together in 2006. A CLS-led international conference entitled 'Life Before and After 50' is planned for 2010 to link up the NCDS with other large scale surveys containing information on this age period.

Funding & partnerships
ESRC has funded sweeps of each of the cohort surveys within the CLS since its establishment as a research council. The current contract totals £11.7 million and covers two sweeps of the Millennium Cohort (at 4 and 7 years) and one sweep of each of the NCDS BCS70 (in 2008). Costs for the Millennium Cohort up around 44% of the ESRC's contract and NCDS/BCS70 combined are around 19%.

The Millennium Cohort is co-funded by a consortium Government Departments led by the ONS, and including the DoH, DFES, Scottish Executive, Welsh Assembly, Collectively, they aim to contribute an equivalent amount to the ESRC's funds for each sweep of the survey funding for sweeps 3&4 combined totals £3.9 million. Institute of Education also aims to contribute £2.7 to the Centre during its current ESRC contract.

Current funding for CLS currently ends in 2010. The Centre will therefore be making an application to the Council during 2008/09 for renewal.

Estimated cost	£17.5 million
Estimated operational date	Renewal in 2010

Information
http://www.cls.ioe.ac.uk/

Council for European Social Science Data Archives

Background
The Council of European Social Science Data Archives (CESSDA) is an umbrella organisation for social science data archives across Europe. CESSDA promotes the acquisition, archiving and distribution of electronic data for social science teaching and research in Europe. It encourages the exchange of data and fosters the development of new organisations in sympathy with its aims. It associates and cooperates with other international organisations sharing similar objectives.

Existing capability
CESSDA has provided networked infrastructure services for the social sciences for the past 30 years, and extends across 21 countries across Europe. Collectively, the organisations serve over 30,000 social science researchers, providing access to over 50,000 data collections per annum. Its portal provides a gateway to many kinds of research data and metadata, including sociological surveys, election studies, longitudinal studies, opinion polls, and census data. Among the materials are international and European data such as the European Social Survey.

Future capability
A proposal for a major for major upgrade to CESSDA Research Infrastructure (RI) has been included on the ESFRI Roadmap. In summary, an upgraded CESSDA RI will work to:

- provide a one-stop shop for data location, access, analysis and delivery across the social science and humanities community of Europe;
- increase the quality of data available by refinements in existing software for data publishing, data linkage, comparison and harmonisation, and by including data held outside the present CESSDA network;
- create a more dynamic knowledge management orientated Web, where knowledge-products are fed back into the metadata supporting the data, thus creating bridges between text in scientific journals and the underlying data;
- expand on present metadata by collecting and disseminating community-produced metadata, and ensure quality data and services through the implementation of best practice resources.

The CESSDA RI is aimed at addressing the major task identified in the ESFRI Roadmap for the social sciences and humanities. That is to 'create pan-European infrastructural systems that are needed by the social sciences … to utilise the vast amount of data and information that already exists or should be generated in Europe. Today the social sciences are hampered by the fragmentation of the scientific information space. Data, information and knowledge are scattered in space and divided by language, cultural, economic and legal and institutional barriers'.

The CESSDA RI already has a critical impact on the social science and humanities research community since it provides access to numerous data collections, enabling European comparative research and contributing to thousands of theses and scientific publications. The major upgrade will make the existing RI more comprehensive, efficient and integrated. The aim will be to enable researchers, not only between disciplines but also between countries to work together, developing leading-edge research methods and efficiently analysing large and complex datasets; in essence, making it possible for researchers to sit at their computer, locate, access, merge and analyse data from a number of different sources, hence facilitating the potential for increased cross-disciplinary and cross-national research.

Funding & partnerships
The upgrade costs are currently estimated at €30m (approximately £20.2 million), covering the upgrading of current technical RI (common standards, tools, instruments and services through the creation of middleware); capacity building (a hub for strategic development, maintenance and coordination); supporting less-developed and less-resourced organisations; and extending and deepening the CESSDA network to new and associated CESSDA members.

ESRC has provided financial support for the UK Data Archive, the national member of CESSDA representing the UK, for almost 40 years. ESRC Council has recently committed to provided funding of £9.4 million (€13.4 million) to the UKDA in order to run the flagship Economic and Social Data Service (ESDS) for the period October 2007 to September 2012.

Estimated cost	€30 million
Operational date	2008

Information
http://extweb3.nsd.uib.no/cessda/home.html

Diamond Light Source – Phase III

Background
The emphasis of the choice of the beamlines in Phases I and II of Diamond was to produce 22 beamlines that meet the immediate needs of the user communities from academia and industry. Phase III of Diamond will produce an additional 10 beamlines which will be constructed much more on the basis of scientific and technical opportunity, and to complement those already constructed in Phases I and II. (Of the order 32 beamlines has long been recognised as the requirement to meet the highest quality demand from users in the Diamond energy range).

The proposed beamlines will extend the user base to new communities in applied areas including archaeology, cultural heritage, food sciences, industrial processing, engineering materials, forensics and environmental and medical science. They will be at the forefront of technology to facilitate new research programmes in ultra fast time resolution (down to picoseconds), inelastic scattering and high resolution imaging. These are areas of great scientific opportunity where the UK community will benefit from a growing activity.

New capability
The core aims of the Phase III programme are to:

- to maximise the return on the original investment,
- to exploit the full capability of the very high brightness of Diamond and to develop new and advanced beamlines,
- to enhance the reach of Diamond in the scientific and industrial landscape of the UK.

The proposal includes both single purpose beamlines with complex instrumentation to create extreme and technically exacting sample conditions, and high through-put (and automated) beamlines where rapid turn-round is essential.

The high-throughput beamlines will allow more rapid analysis of large batches of samples which will be of particular relevance to industries such as the pharmaceutical and materials science sectors. They will produce rapid and reliable data using core techniques (small angle scattering and X-ray powder diffraction) developed to high performance. These beamlines will have automation and provide user friendly access to the non-specialist user.

The Phase III beamlines currently being proposed will have excellent synergies with other major UK facilities (such as ISIS, CLF).

The Phase III plan provides for a detector and instrumentation development programme and building works to ensure that the potential of Diamond is fully realised.

Funding & partnerships
Funding will be sought through the current and subsequent CSR, and from the Wellcome Trust in proportion to previous investment (86 per cent Government, 14 per cent Wellcome Trust).

Diamond is currently beginning collaborations with many other facilities, and has signed Memoranda of Understanding and Collaboration Agreements with a number of facilities in (for example) Japan, France (including Soleil and the ESRF), Germany, Italy and China.

Estimated cost	£78.6 million
Estimated operational date	2015

These figures exclude both inflation and VAT.

Information
http://www.diamond.ac.uk/

English Longitudinal Study of Ageing

Background
The English Longitudinal Study of Ageing (ELSA) is the only study in the UK to provide the data necessary to explore the unfolding dynamic relationships between health and functioning, social participation and networks, and economic position and wellbeing, as people plan for, move into and progress beyond retirement. The survey covers:

- health, disability, healthy life expectancy;
- the relationship between economic position and both physical and cognitive health;
- the determinants of economic position in older age;
- the timing and circumstances of retirement and post-retirement labour market activity;
- the nature of social networks, support and participation;
- household and family structure and the transfer of resources.

The multidisciplinary focus provides a more complete picture of the challenges facing ageing societies than could be provided by a study located within a single discipline. ELSA has an international focus that allows for the examination of institutional and cultural influences. It collaborates with studies in the US (the Health and Retirement Survey), other European countries (SHARE), Mexico (the Mexican Health and Retirement Survey), China (CHARLS), Korea (KLoSA) and with planned studies in many other countries (for example, Japan, India).

Existing capability
Data are collected at regular intervals and by April 2009 will comprise four interview sweeps (two years apart), three biomedical data collections (four years apart), a life history interview and an initial health interview (which, together with one of the biomedical data collections, was carried out before respondents entered the ELSA study). The first ELSA data collection involved just over 12,000 individuals aged 50 or older, and the fourth sweep is expected to include just over 10,000 individuals.

The data can be used to inform studies of:

- The nature and timing of retirement and post retirement labour market activity;
- The determinants of economic wellbeing at older ages;
- Cognitive functioning and its impact on decision making among older people;
- Disability and the compression of morbidity;
- Economic, social and health inequalities in an ageing population;
- Social participation and social productivity at older ages.

By its nature and design, ELSA is set up to examine the interrelation of these six areas. As the study continues, the potential value of earlier investments in ELSA will begin to be fully realised.

Future capability
The next four years of funding will give ELSA 10 years of observation for the majority of the ELSA respondents, covering a significant period of life prior and post retirement, and will, for example, be able to study outcomes at age 70-75 for respondents whose decisions to work and when to retire were observed in earlier waves of the study. Such longitudinal data can address the causal factors underlying age-related transitions, particularly when considered alongside data from other countries. As the sample period lengthens, cohort comparisons could examine the impact of UK policy reform, or other changes to institutional, social or economic environments, such as the effect of changing pension arrangements on retirement plans or to understand the consequences of retirement on health, social participation or independence.

The data generated by the study will be a major resource for academic, policy and private sectors. They also have the potential to open important new avenues for multidisciplinary research – for example, through the joint analysis of genetic, biomedical, social and economic data. This kind of work will generate important new insights into the process of ageing. This scientific potential places ELSA, and UK research, at the leading edge of international studies of ageing.

Funding & partnerships
ELSA has been funded from September 2000 to April 2010, jointly by UK Government Departments coordinated by the Office for National Statistics (an investment of £8.3 million over the ten years), and the US National Institute of Aging ($15 million). The next four years of funding (2010 – 2014) is estimated to cost £13 million. Co-funding will be sought from UK Government Departments and from the US National Institute of Aging.

Information
http://www.ifs.org.uk/elsa

European Social Survey

Background
The European Social Survey (ESS) is an academically driven social survey designed to chart and explain the interaction between Europe's changing institutions and the attitudes, beliefs and behaviour patterns of its diverse populations. Now moving to its fourth round, the survey covers over 30 nations and employs the most rigorous methodologies

It was set up in 2001 as a time series survey, which means that long-term changes in social values throughout Europe can be monitored. It has a central co-ordination team, which receives EC funding, and fieldwork across Europe is funded by local agencies (ESRC in the UK). The fieldwork takes place every two years.

The UK fieldwork is led by a national co-ordinator and both they and the fieldwork team are based in the UK. The central co-ordination team are also led by a UK academic at City University, but are not fixed to a particular location, although much of the work relating to data preparation takes place at the Norwegian Social Science Data Service (NSD).

In 2005 the academic lead, Professor Roger Jowell, won the prestigious Descartes prize which goes to teams who have achieved outstanding scientific results through collaborative research. Strengthening the funding in the long term, as envisaged by the ESFRI proposal, would enable new and exciting methodological developments at the cross-national level, for example, investigating different translation techniques, experimenting with improving response rates and harmonising variables on a multinational basis.

Existing capability
Since 2001, the European Social Survey (ESS) has been mapping the long-term attitudinal and behavioural changes in Europe's social, political and moral climate. It is unique in that it has been specifically designed to facilitate comparative research between different countries over time. It is the dataset offering the widest possible coverage of EU member states and serves as a vehicle for methodological development in the area of data collection in cross-national surveys.

It allows governments, policy analysts, scholars and members of the public to interpret how people in different countries and at different times see themselves in the world around them. Covering attitudes to religion, politics, moral issues and pressing policy concerns, the data reveal intriguing contrasts between over 30 countries. Because an understanding of public attitudes is critical to formulating public policy, especially in an era of falling political participation and electoral turnout, the ESS is likely to have a major impact over time on European governance.

The ESS is of tremendous value to UK social scientists, not least as the official language of the ESS is English. It is an immeasurable advantage to comparative researchers in the UK to have access to a high quality dataset that enables their national trends in socio-political attitudes and values to be compared and contrasted with those in other European nations. As the data is freely available with high quality supporting documentation, the survey provides an important resource for the training of new researchers in comparative methods. Researchers in the UK constitute the second biggest user group of the ESS's 14,600 users. The survey now covers 30 nations and employs rigorous methodologies. It is therefore a leading example of successful international research collaboration – for both funders and academics.

Future capability
To date, the study has been funded at a relatively basic level and on a sweep by sweep basis. A proposal has been submitted to the EU via ESFRI for long-term infrastructure funding. If successful, the more stable support that this proposal would bring would enhance the capabilities and outreach of the survey, partly because costs could be dedicated to activities beyond basic fieldwork and preparation of data (e.g. through enhancing dissemination activities), and also because of the career progression that such stability would enable.

Funding & partnerships
The estimated cost of the entire ESS is €6 million (£4.04 million) per year. To date, the UK fieldwork has been ESRC-funded and the biannual sweeps currently cost approximately £500k at today's prices. ESRC is currently funding the UK component of the 2008 round of the survey and has made in principle commitment to support future waves of the survey. If the ESFRI proposal is successful, ESRC will consider enhancing its funding of future sweeps to support an upgrade of the survey as a whole.

Estimated cost	£700,000 (UK)
Operational date	2009-2010

Information
http://www.europeansocialsurvey.org/

European Synchrotron Radiation Facility

Background
The European Synchrotron Radiation Facility (ESRF) operates the most powerful high energy synchrotron light source in Europe and brings together a wide range of disciplines including physics, chemistry and materials science as well as biology, medicine, geophysics and archaeology. There are many industrial applications, for example in pharmaceuticals, cosmetics, petrochemicals and microelectronics.

New capability
The upgrade programme is designed to maintain the ESRF's role as Europe's leading provider of hard X-rays (up to 500 keV) from a very reliable source producing highly stable focused beams (down to 20 nanometres) with very high intensity. The central theme to the upgrade programme is the construction of long beamlines to address new scientific challenges with highly specialised nano-focus beamlines, delivering even brighter hard X-rays beams.

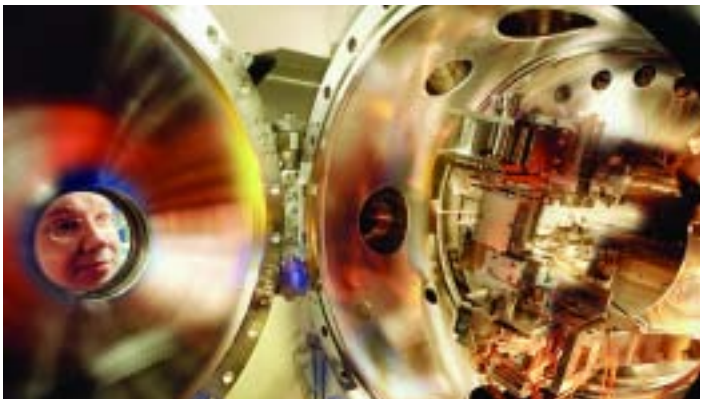
The key technological developments will be:

- the reconstruction of sixteen of the beamlines to have a much improved performance;
- a programme of improvements to the accelerator complex;
- instrument developments including optics, detectors and sample environments;
- development of computing hardware and software systems; and
- the construction of an extension to the experimental hall to allow beamlines between 105m and 140m in length for nano-focusing applications and new infrastructure to be housed.

The upgrade will be exploited in a scientific programme focussed on 5 broad scientific areas:

- nano-science and nano-technology
- pump-probe experiments and time-resolved diffraction
- science at extreme conditions
- structural and functional biology
- soft matter and X-ray imaging.

The renewed and enhanced ESRF will be able to face the scientific challenges of the 21st century and will have a direct impact upon the European Union priority themes



of health, energy, environment and climate change, new materials and nanotechnology.

The success of the scientific projects proposed is closely linked to an ambitious detector and optics development programmes and all aspects of the sample environment. The UK has specific expertise in these areas and this is an ideal opportunity for knowledge exchange between the ESRF, UK facilities and the UK scientific community. There will be the opportunity to increase the UK's industrial involvement as STFC has the ability to promote tendering opportunities arising from the upgrade programme. This will have the potential to increase the benefits to the UK.

Funding & partnerships
The expectation is that the extra €185 million will be paid for by the member countries in proportion to their shareholding, although this financial commitment is yet to be agreed. It is proposed that the €26 million from the UK will be funded by STFC through its CSR2007 allocation or from the LFCF.

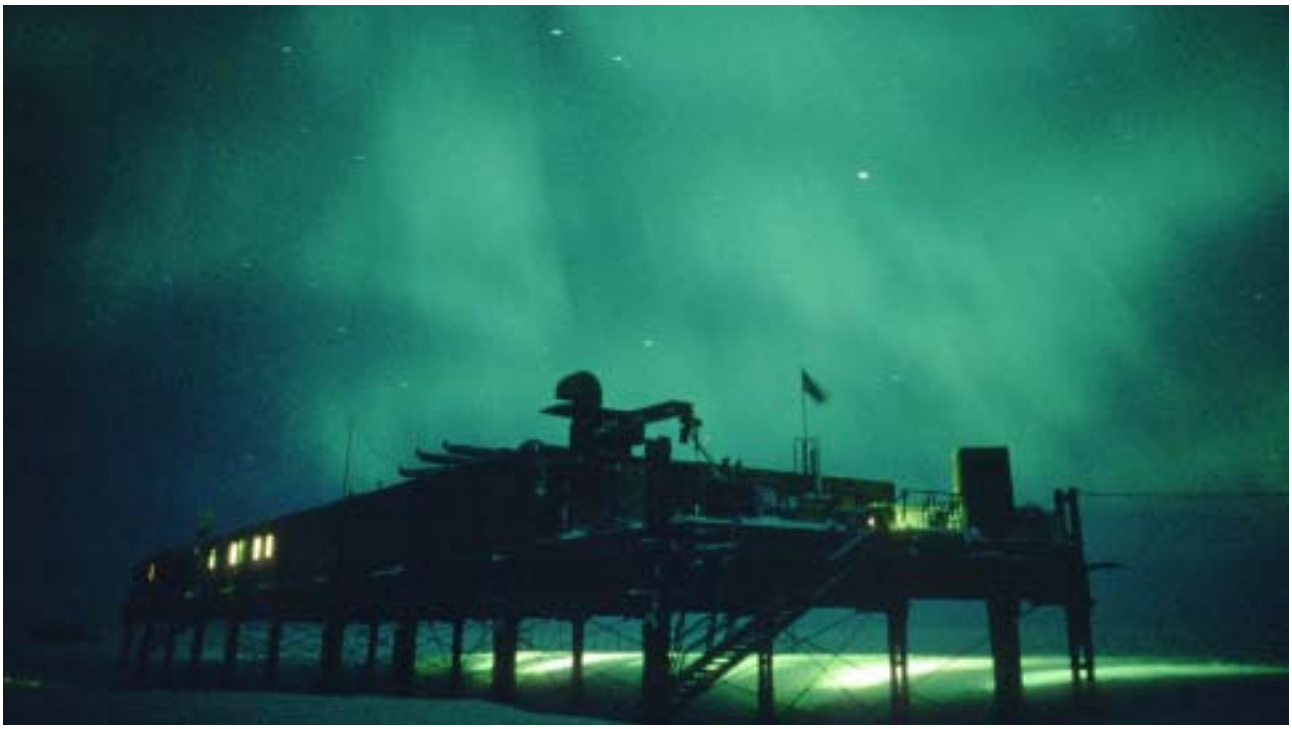
The other member's contributions are estimated as France €51 million, Germany €47 million, Italy €28 million, Belgium and Netherlands €11 million in total, Spain €7.5 million, Denmark, Finland, Norway and Sweden €7.5 million in total and Switzerland €7.5 million.

Due to the extent of the membership of ESRF and the possible contribution its scientific members, up to 18 countries could be financially involved in the upgrade programme. ESRF will also be working other synchrotron sources across Europe (e.g. Diamond Light Source in the UK and Soleil in France) in partnership to on beam line developments.

Estimated cost	€262 million
Estimated operational date	2017

Information
http://www.esrf.eu/

Halley Research Station, Antarctica



Background
The Halley Research Station in Antarctica is owned by NERC and operated by the British Antarctic Survey (BAS). It provides a vital platform to conduct globally significant research primarily in atmospheric sciences but also geology and glaciology.

It was here in 1985 that British scientists first measured the ozone depletion of the Antarctic stratosphere. Their discovery that this critical protection from ultraviolet radiation had been decreasing from 1975 to 1985 made headlines around the world and spurred the international agreement on banning chlorofluorocarbons (CFCs).

Measurements are taken of the ice of Antarctica beneath, of the air in the troposphere above, of the ozone in the stratosphere above that, and of the plasma in the geospace beyond them all.

Studies at Halley are crucial for a global perspective on ozone reduction, atmospheric pollution, sea level rise, and climate change. Halley, lying within the auroral zone, is ideally situated for geospace research.

Existing capability
Studies at Halley have been fundamental in alerting the world to human impacts on the Earth system, and it is expected that the value of the location will continue to be maintained into the foreseeable future as the UK community focuses on the general area of Earth system science. There is also a very strong international dimension to the research programmes and many of the studies have continued uninterrupted since the first base was established, providing vital long-term data series. Halley also provides a presence in the British Antarctic Territory, required by the UK Government.

The Halley station is located on the Brunt Ice Shelf in Antarctica. Due to the movement of the ice shelf and snow accumulation, the station has to be periodically dismantled and a replacement built elsewhere, to avoid the station drifting with the ice into the sea. The new station will be the sixth built since the first was established in 1956.

A design competition was launched by the Royal Institute of British Architects and BAS in June 2004. It was won by Faber Maunsell and Hugh Broughton Architects. It is a structure which is jacked up on legs to keep it above the accumulation of snow and with skis on the bottom of these legs, which allows the building to be relocated periodically. Under the Antarctic Treaty, NERC has an obligation to remove the old station.

Funding & partnerships
Funding for the Halley Research Station has been provided by the Large Facilities Capital Fund and NERC.

Estimated cost	£45-50 million
Estimated operational date	2010

Information
http://www.antarctica.ac.uk/

Institute for Animal Health, Compton

Background
The Compton site of the Institute for Animal Health (IAH-C) is internationally recognised as a Centre of Host-Pathogen Biology and has programmes focusing on the immunology of poultry and cattle (the key host species), vaccinology, and a number of infectious diseases including bovine tuberculosis, avian influenza, Salmonella, bovine respiratory disease and coccidiosis. IAH-C is a BBSRC-sponsored Institute, with a remit to carry out research on bacterial, parasitic and viral infections of farm animals.

New capability
The laboratories, animal accommodation and other facilities at IAH-C are old and need replacement if they are to continue to meet the standards required of a 21st century world-class research facility. Upgrade is essential to ensure that the UK maintains its ability for research activity in the above areas for the next 50 years.

Without urgent action the facility will eventually fail to meet the increasingly stringent Home Office, HSE and Environmental Agency statutory biosecurity requirements; nor will it meet the containment requirements for working with highly infectious agents.

The proposal is to re-provide animal and laboratory accommodation for the future needs of IAH-C, that meet modern standards for research on infectious diseases and for biocontainment. In addition, the new facilities will incorporate environmentally sustainable and efficient design solutions in the new buildings.

The main scientific benefit of the investment is the maintenance of vital UK research capability in the identification and control of animal diseases which threaten UK food security and also (in the case of those which can transfer to humans such as avian 'flu) human health. The combined effects of climate change and the continued increase in global trade and mobility are greatly increasing the threat and new challenges will continue to emerge. The economic and social consequences of failing to maintain capability to address known threats and a skill and facility base able to rapidly respond to unexpected challenges are incalculable.

Maintenance and operation of state-of-the-art facilities on this area are necessary to inform the regulatory and policy base, and to work effectively with the facilities maintained elsewhere in Europe and the rest of the world, which together present the global defensive barrier to emergent animal and zoonotic threats.

Funding & partnerships
The research programme at IAH-C is funded principally by BBSRC but there is also funding from others such as DEFRA and the EU.

Estimated cost	£150 million
Estimated operational date	2013

Information
http://www.iah.bbsrc.ac.uk

Institute for Animal Health, Pirbright

Background
The Pirbright site of the Institute for Animal Health (IAH-P) (a BBSRC-sponsored Institute, with a remit to carry out research on bacterial, parasitic and viral infections of farm animals) is internationally recognised as a centre of research on farm animal diseases exotic to the UK.

Maintenance and operation of state-of-the-art facilities are necessary to work effectively with the facilities maintained elsewhere in the world, to present the global defensive barrier to emergent animal disease threats.

Existing capability
IAH-P is the world reference laboratory for foot and mouth disease (FMD), peste des petits ruminants and rinderpest, and the regional reference laboratory for numerous other diseases of cattle, sheep, horses and pigs. This involves major responsibilities to the Office International des Épizooties (OIE) and the Food and Agriculture Organization of the United Nations (FAO) for the diagnosis of diseases in an emergency. The diagnostic services must available and fully operational 24 hours a day, 365 days a year.

New capability
The laboratories, animal accommodation and other facilities at IAH-P need replacing if they are to continue to meet the standards required of a 21st century world-class research facility. The proposal is to re-provide animal and laboratory accommodation that meet modern standards for research on infectious diseases and for biocontainment.

The new facilities are required to meet scientific challenges in the years to come, e.g. an expansion of work in response to new disease-causing agents threatening the UK as a result of climate change (e.g. bluetongue virus). In addition, the new facilities will incorporate environmentally sustainable and efficient design solutions in the new buildings.

Without urgent action the facility will eventually fail to meet the increasingly stringent Home Office, HSE and Environmental Agency statutory biosecurity requirements; nor will it meet the containment requirements for working with highly infectious agents.

Funding & partnerships
The research programme at IAH-P is funded principally by BBSRC but there is also funding from others such as DEFRA and the EU.

Estimated cost	£195 million
Estimated operational date	2012

Information
http://www.iah.bbsrc.ac.uk

ISIS Target Station 2 - Phases 1, 2, 3

Background
Neutron scattering has made unique and fundamental contributions to the understanding of the structure and dynamics of materials.

The 2005 UK Neutron Review concluded that 'The broad range of applications for neutrons makes them an essential tool in the discovery, understanding and applications of science in areas which are vital to the UK science and technology base. The UK has established a position of international leadership in the development of neutron-based techniques and, through facilities at ISIS and ILL, provides a unique platform to enable major contributions in areas crucial to society, such as in energy, health, transport and bioscience.' ISIS Target Station 2 (TS2) will address these areas by providing extremely efficient and cost-effective delivery of beams of cold neutrons for experiments in (among others) soft condensed matter, biomolecular sciences and advanced materials.

The 2005 UK Neutron Review also concluded that 'UK scientists will continue to require access to the best possible neutron facilities for the foreseeable future'. The first key action was to provide 'enhanced investment in ILL and ISIS, jointly with international partners, which will sustain the international competitiveness of these world-leading facilities for the next ten to fifteen years'.

Existing capability
ISIS is currently the world's most productive pulsed spallation neutron source and has contributed significantly to many major breakthroughs in materials science, physics and chemistry during the last 15 years or so. The research carried out at ISIS (TS1 and TS2) has a strong synergy with the Diamond Light Source, Central Laser Facility, the Materials Innovation Institute and the Hartree Computational Science Centre, and will engage with the needs of industry

New capability
TS2 is the next step in the development of neutron scattering on pulsed sources, and will deliver world class performance for studies requiring cold neutrons, a broad spectral range and high resolution. In the technologically significant areas of advanced materials, soft condensed matter and biomolecular science TS2 will provide facilities which will have in many cases more than an order of magnitude improvement in performance over existing capabilities at ISIS. It will maintain ISIS's world lead in neutron scattering well into the next decade, and contribute significantly to the key areas of research and development identified in the last UK Foresight exercise.

ISIS TS2 will become operational in October 2008 with an initial suite of seven instruments. This will complete Phase 1 of the project. A second phase of five instruments

has earmarked funding from the Large Facilities Capital Fund and is at the advanced concept stage. This phase will be completed by 2012. TS2 Phase 3 would see the construction of a further six instruments over the period 2012-2016, bringing the total instrument complement to 18, and completing the instrument suite

Funding & partnerships
The TS2 Phase 1 project has UK funding for £105 million for the core project (building, extracted proton beam and target station) plus £27 million supplemented from the EU and international partners to give a total of £40 million for the first seven instruments.

Funding for Phase 2, the provision of a further five instruments, has already been earmarked in the Large Facilities Capital Fund. Italy, which is already contributing to the instrumentation of Phase 1, has signed a new agreement including contributions to a Phase 2 instrument. Negotiations are underway with the Netherlands, who are also contributing to TS2 Phase 1, for an involvement in a Phase 2 instrument. The same is true for Spain and Germany, with both countries contributing already to Phase 1 and wishing to continue their involvement in Phase 2. Sweden has contributed to the instrumentation on the first target station and is now considering contributions to TS2 Phase 2.

Estimated cost	£29 million (Phase 2) £35 million (Phase 3)
Estimated operational date	2012 (Phase 2) 2016 (Phase 3)

Information
http://www.isis.rl.ac.uk/

Laboratory for Molecular Biology

Background
The MRC-funded Laboratory for Molecular Biology (LMB) is widely recognised as one of the leading molecular biology laboratories in the world with 13 Nobel prizes awarded to staff past and present and with 18 of its current group leaders elected as Fellows of the Royal Society.

Current capability
LMB is at the forefront of understanding biological processes at the molecular level and improving our understanding of the molecular basis of such common diseases as Parkinson's and Alzheimer's. The discoveries and inventions made at LMB benefit the health and wealth of the nation; scientists trained at LMB feed into the UK and world scientific communities and many go on to provide the leadership for other institutes, university departments and companies. LMB research has also led to several successful spin-out companies such as Celltech and Cambridge Antibody Technology.

New capability
The current building is overcrowded by modern standards and there is constant difficulty in finding room to follow up exciting new scientific opportunities and to house the large number of visiting scientists that are attracted to the LMB. The case for a new building is based on the promise that LMB will continue to produce superb science and scientists for the UK and the world. New accommodation with state-of-the-art facilities is needed to help recruit and retain scientists of the necessary calibre to maintain LMB's premier position.

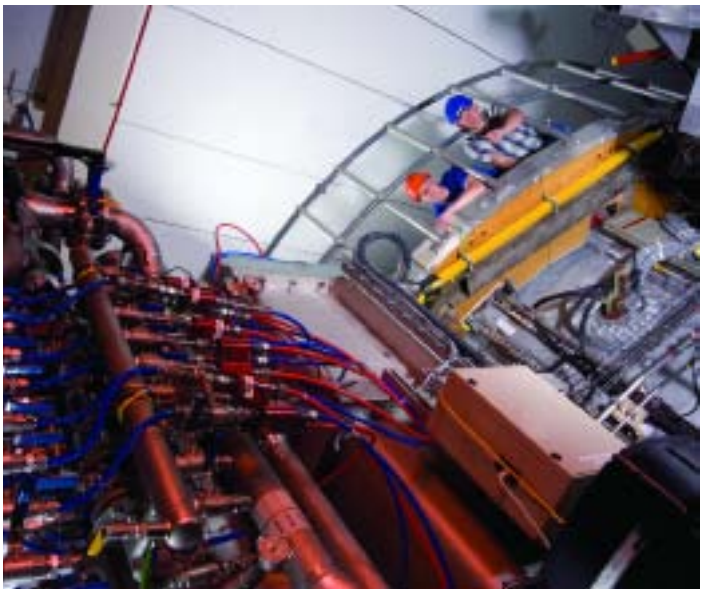
The continued location of LMB in the Cambridge area, with the University's basic science departments and biosciences start-up companies in and around the city, presents opportunities currently unparalleled in the UK for development of post-genomic biosciences. The Addenbrooke's site in particular is rapidly becoming one of the most vigorous research campuses in the UK, presenting numerous opportunities for interdisciplinary science and, of growing importance, for basic-to-clinical and basic-to-industry translational research.

Funding & partnerships
LFCF has earmarked funds of £67 million. MRC has allocated £118 million plus there will be an additional contribution from the University of Cambridge.

Estimated cost	£197.1 million
Estimated operational date	2012

Information
http://www2.mrc-lmb.cam.ac.uk/

MAST (Mega Amp Spherical Tokamak)



Background
Benefits of this project will be generated both for fusion science and technology and for the large number of disciplines that they bring together, including plasma physics – both low temperature and astrophysical, materials and surface science. For example, studies of high heat fluxes impinging on materials, engineering (e.g. in magnet technology, some MAST-U magnets could be the first to use a newly developed radiation resistant, high temperature tolerant resin that is being evaluated at UKAEA, Culham), atomic physics, and general studies of turbulence, instrumentation, data processing and image analysis.

Existing capability
MAST (Mega Amp Spherical Tokamak), pioneered at Culham, can produce the desired fusion conditions with much lower magnetic fields than existing JET-like tokamaks and is potentially the basis for fusion power stations that do not need superconducting magnets – an enormous advantage in terms of cost and simplicity. Built with minimal equipment, MAST has confirmed the exciting promise of its much smaller record breaking predecessor START.

New capability
Major improvements are now needed to realise MAST's full potential through an upgrade programme and determine:

- whether spherical tokamaks could be the optimum basis for a Component Test Facility, which would produce fusion power station conditions and strengthen and accelerate fusion development, and
- the spherical tokamak's eventual suitability for a power plant. An upgraded MAST will also deepen understanding of fusion physics generally, supporting the exploitation of the international experiment ITER.

At least one example from MAST technology (high current felt metal sliding joints) is currently being used by a private company in the isolation switch in a superconducting magnet. The upgrade of MAST will produce further technological innovations that may be taken up by industry, and/or be the basis of spin-outs (development of 16-20 GHz RF power sources for MAST has a potential overlap with work on tuneable sources being developed for military radar). Work at MAST in collaboration with university groups will lead to two way knowledge transfer to other fields of research in plasmas, instrumentation and data analysis, and will contribute to development of instruments for ITER (on which Culham is collaborating with groups from UK universities and from across Europe). These benefits (and contributions to other fields and to training) are additional to the main benefit of speeding up the development of a new clean source of power for all.

Funding & Partnerships
It is possible that, (following in-depth scrutiny by an ad-hoc group of experts assembled for this purpose), the upgrade of MAST will receive support from EURATOM. EURATOM will also contribute 20% (according to present rules) to the operating costs. Groups from other EURATOM members and beyond are likely to contribute to diagnostic systems at MAST-U and participate in MAST experiments.

Estimated cost	£35 million
Estimated operational date	2011-12

Information
http://www.fusion.org.uk/mast/

National Institute for Medical Research

Background
The MRC-funded National Institute for Medical Research (NIMR) is recognised as one of the UK's foremost basic research institutes with a strong track record and a reputation from its interdisciplinary collaborations and overall cohesiveness. In partnership with University College London (UCL), Cancer Research UK (CRUK) and the Wellcome Trust, the renewal of NIMR on a site next to the British Library in St Pancras, presents the opportunity to create the most powerful biomedical research environment in the UK, if not Europe. It will enable the Institute to deliver the vision that MRC has for it as a multidisciplinary biomedical research facility focused on basic and translational research.

The NIMR/UCL/CRUK/Wellcome Trust partnership provides the multidisciplinarity and critical mass required by MRC's vision to bring together NIMR's strengths in basic research with those of a world class university and first class charitable institutes, all co-located with excellent clinical facilities. The partnership will also provide access to the widest range of disciplines at UCL including physics, chemistry and mathematics.

Close collaboration between MRC, MRC Technology, Cancer Research Technology and UCL Biomedica, together with extra research space to be dedicated to translational collaborations with industry and investments in chemical biology and medicinal chemistry, will increase exploitation of the exceptional promise offered by the partnership into commercial developments for the public good and economic benefit.

New capability
The renewal of NIMR will be part of the development of a new biomedical research campus located in central London. It will significantly enhance NIMR's contribution to the UK's national research programme by expanding the Institute's programme for the translation of ideas, knowledge and techniques into clinical practice and into new products and devices. It will also facilitate scientific innovation through collaboration between research strengths at NIMR and those of UCL and CRUK in diverse fields.

The new state-of-the-art facilities will maximise value for money and be a fitting showcase for the high calibre research carried out by the Institute. They will also provide increased opportunities for training basic and clinical research workers and facilitate the retention and recruitment of world-class research staff

Funding & partnerships
The project will be funded in partnership between MRC, UCL, CRUK and the Wellcome Trust and is expected to be of the order of £500 million. A contribution will be sought from the LFCF. The estimated operational date is 2014 at the earliest.

Estimated cost	£500 million
Estimated operational date	After 2014

Oceanographic Research Ship (replacement for RRS Discovery)

Background
The oceans play a pivotal role in the functioning of the Earth system, for example the possible rapid collapse of the Atlantic Ocean's thermohaline circulation would lead to severe and rapid climate change in north west Europe. Seagoing science is an essential element of Earth system science. To maintain the UK's strong international leadership in producing high quality research in this area, NERC must retain the capability to field internationally competitive scientific programmes at sea using state-of-the-art research ships.

Existing capability
Although remote sensing continues to be very important for improving our understanding of the oceans, these techniques are generally only able to provide quantitative data from the first few centimetres of the ocean's surface – and thus cannot be used to study the majority of the ocean's volume, the sea floor and solid Earth beneath it. Other new and improved technologies, such as ROVs, autonomous underwater vehicles (e.g. AUTOSUB), deep ocean observatories and moorings offer new ways to observe ocean processes and/or parts of the ocean. These technologies require access to research ships for their deployment, retrieval and maintenance, and it is thought that their use will increase the requirement for ship-time.

NERC has two dedicated research ships for multidisciplinary ocean science cruises and continued investment in these facilities is required to ensure that the UK remains in the first division of seagoing science nations. Despite on-going improvements in the marine technologies that are used to sample the oceans, NERC will, for the foreseeable future, continue to require access to two dedicated research ships and the instrumentation that they contain.

New capability
The replacement for RRS Discovery (which is coming to the end of its scientifically useful life) will be a dedicated research ship for multidisciplinary ocean science cruises, complementing the RRS James Cook, which was commissioned early in 2007.

Funding & Partnerships
NERC is currently heavily involved with the bartering of marine facilities with its partners in the United States, Germany, France, the Netherlands and Norway. These barter arrangements promote a more efficient and cost effective use of each country's marine facilities by allowing the scientific communities access to a wider range of technical facilities and geographical areas in a given year than would have otherwise been possible. Continued access for the UK research community to barter facilities is contingent on there being on-going modernisation of NERC's research fleet and an enhancement of its facilities.

Funding for 70% of the capital cost is earmarked from the Large Facilities Capital Fund, and 30% will be provided by NERC.

Estimated cost	£55 million
Estimated operational date	2012

Information
http://www.noc.soton.ac.uk/

Polar Research Ship (replacement for RRS Ernest Shackleton)

Background
The NERC strategy for 2007-2012, Next Generation Science for Planet Earth, has identified the critical importance of increasing our knowledge of the role of polar regions in climate change. The Arctic and the Antarctic peninsula are two of the fastest warming regions of the planet, and we need to understand the impact of polar ice melt and its effect on ocean circulations. Maintenance of the British Antarctic Survey (BAS) infrastructure is essential for this.

Existing capability
Two ice-strengthened Royal Research Ships support the BAS operations in Antarctica. The RRS Ernest Shackleton provides logistic support to Antarctic operations, together with a secondary science capability. It is crucial to delivering world-class research in Antarctica and to meeting the Government's policy for a regional UK presence. Replacing the ship in 2014 will enable NERC to acquire a reliable vessel that is more cost effective, has a low environmental impact and meets the new international maritime requirements for safe operations in polar waters. It is crucial to meeting the Government's policy for a regional British presence.

New capability
The technical assessment is that in 2014, when the ship will be 19 years old and the current lease expires, the upkeep will be uneconomic; poor reliability and obsolescent systems will also put at risk the safety of operations in Antarctic waters. The plan is to replace it with a more cost-effective vessel that has a low environmental impact and meets the new international maritime requirements for safe operations in polar waters.

Funding & Partnerships
Antarctic infrastructure is funded by the Science Budget. NERC would expect to seek a contribution from the LFCF. There may be long-term cost-of-ownership savings because, under the current ES arrangement, NERC pays both the lease and depreciation on the balance sheet.

Antarctic infrastructure primarily meets national needs. NERC ships participate in international barter arrangements.

Estimated cost	£45 million
Estimated operational date	2014

Information
http://www.antarctica.ac.uk/

Polar Research Ship (replacement for RRS James Clark Ross)

Background
The NERC strategy for 2007-2012, Next Generation Science for Planet Earth, has identified the critical importance of increasing our knowledge of the role of polar regions in climate change. The Arctic and the Antarctic peninsula are two of the fastest warming regions of the planet, and we need to understand the impact of polar ice melt and its effect on ocean circulations. Maintenance of the British Antartic Survey's (BAS's) infrastructure is essential for this.

Existing capability
Two ice-strengthened Royal Research Ships support the BAS's operations in Antarctica. The RRS James Clark Ross has advanced facilities for the full range of oceanographic research; she also provides essential logistic support to Antarctic operations. The vessel is crucial to the delivery of NERC's world-class research in polar waters. Although she has a much longer life than the other BAS vessel (RRS Ernest Shackleton) because of her build specification, the technical assessment is that in 2020, when the RRS James Cook will be 30 years old, the upkeep will be uneconomic. Poor reliability and obsolescent systems will also put at risk the safety of operations in polar waters.

New capability
Replacing the RRS James Clark Ross will enable NERC to acquire a reliable vessel that is more cost effective, has a low environmental impact and meets the new international maritime requirements for safe operations in polar waters. It is crucial to meeting the Government's policy for a regional British presence in Antarctica.

Funding & partnerships
Antarctic infrastructure is funded by the Science Budget. NERC would expect to seek a contribution from the LFCF.

Antarctic infrastructure primarily meets national needs. NERC ships participate in international barter arrangements.

Estimated cost	£76 million
Estimated operational date	2020

Information
http://www.antarctica.ac.uk/

Rothera Research Station, Antarctica

Background
The NERC strategy for 2007-2012, Next generation science for planet Earth, has identified the critical importance of increasing our knowledge of the role of polar regions in climate change. The Arctic and the Antarctic peninsula are two of the fastest warming regions of the planet, and we need to understand the impact of polar ice melt and its effect on ocean circulations. Maintenance of British Antarctic Survey (BAS) infrastructure is essential for this.

Existing capability
The Rothera Research Station in Antarctica is owned by NERC and operated by the BAS, one of its institutes. Occupied since 1975, it accommodates up to 130 people and is situated on Adelaide Island to the west of the Antarctic Peninsula. It consists of extensive technical, scientific and domestic facilities, together with a crushed rock runway, aircraft hangar and wharf.

Rothera is pivotal to the delivery of NERC's world-class research in Antarctica and to meeting the Government's policy for a regional UK presence. It is also the gateway for the UK's Antarctic field and air operations.

New capability
Many of the facilities, such as the laboratory and the operations tower, have been upgraded or built since the mid 1990s. However, an independent condition survey has identified the need to renew the older structures that are beyond their economic life, such as the science and operations, waste management and technical workshops, to provide safe, efficient and low energy facilities to support science. Renewal work will include removal of the old structures as this required under the Antarctic Treaty.

Modern facilities will enable NERC's polar science to remain at the forefront of global research into the environment and climate change. The commitment to maintaining modern facilities will also reinforce the UK's policy objectives for the British regional presence and international leadership in Antarctic affairs.

Funding & partnerships
Antarctic infrastructure is funded by the Science Budget. NERC would expect to seek a contribution from the LFCF. The cost of removing the replaced facilities at Rothera (some £3 million overall) is funded from provisions in the NERC accounts.

Antarctic infrastructure primarily meets national needs. Rothera is used by other nations, such as Germany and the USA, as a transit gateway to Antarctica – these nations then provide reciprocal support at their facilities, which extends the reach and capability of UK science. Rothera is also used for national and international collaborative research.

Estimated cost	£30 million
Estimated operational date	2018

Information
http://www.antarctica.ac.uk/

Service Provision for High End Computing

Background
Computational science and engineering concerned with predictive scientific modelling and simulation activity is the third leg of modern scientific enquiry alongside experiment and theory. Computer-based simulation is the way forward when experiment and theory studies alone cannot provide the required level of detail, information or insight.

Research areas that use high end computing include engineering, understanding complex chemistry and materials, nanoscience, fusion plasma science, systems biology, climate science, oceanography and earth sciences - support for these is provided in current national services. Particle physics and astronomy researchers also use high end computing resources.

Existing capability
The Research Councils provide high end computing resources which complement the desktop and mid-range provision of universities. In order to stay competitive with international partners the strategy has been to carry out a competitive procurement exercise every 3 to 4 years for a 6-year service, with technology upgrades occurring during the lifetime of each service. There are three aspects to the procurement: hardware, service provision and computational science and engineering support.
EPSRC, as managing agent for high end computing on behalf of the Research Councils, has now procured three overlapping services for the Research Councils - CSAR, HPCx, HECToR.

New capability
The expected benefits from the establishment of the next generation high end computing national service are:

- World-class and world-leading scientific output. Researchers will be able to access intensive computing power for large calculations which are unable to be performed on local based cluster computers;
- Greater scientific productivity;
- Training support for graduates and post doctoral researchers;
- Increase in the UK's computational science and engineering skill base;
- Increase in collaborations with industry;
- A strengthening of the UK's international position for producing world-class science.

Participating in a leading role in the European HEC activity would address two of the goals in the RCUK international strategy:

- giving UK researchers access to facilities; and
- allowing the UK to influence international research.

Funding & Partnerships
The LFCF provides a contribution to the capital costs for HECToR. EPSRC, NERC and BBSRC are partners in HECToR and contribute the remaining proportion of the capital costs and all the running costs for the service.

LFCF contribution (HECToR)	£52 million
Operational date (HECToR)	2007 - 2013

Future HEC provision:
A proposal is under development for the establishment of a European infrastructure which could provide UK researchers with access to a wider range for leading edge computational resources that can be currently provided on a national level.

Fourteen European countries are starting to work together to plan a European entity for high end computing infrastructure – Partnership for Advanced Computing in Europe (PRACE). EPSRC is representing the UK in the partnership. The EC has agreed to fund a 2 year preparatory phase project.

If the UK wishes to be a principal partner in the European activities, it needs to be able to contribute leading edge hardware alongside the other potential principal partners e.g. France, Germany, Spain, Netherlands. A contribution to the capital costs of the hardware will be requested from the LFCF.

Funding for further national facilities will need to be balanced with the developments that take place within the European context.

Estimated costs	To be confirmed
Estimated operational date	2010/11 - 2016/17

Information
http://www.epsrc.ac.uk/ResearchFunding/FacilitiesAndServices/HighPerformanceComputing/default.htm

UK Longitudinal Studies Centre

Background
The UK Longitudinal Studies Centre (ULSC) is the national resource centre for promoting longitudinal research and for the design, management and support of longitudinal studies.

The ULSC aims to:

- promote the use of the rich portfolio of longitudinal datasets in the UK;
- support users of those data through the provision of advice, information, training in longitudinal analysis and the provision of resources to make data easier to use;
- improve longitudinal survey methods, carry out methodological research and promote best practice in the production of high quality data for users.

Existing capability
The ULSC has built up a wide portfolio of activities and services covering all aspects of longitudinal survey research. These activities include:

- collecting the British Household Panel Survey (BHPS);
- providing a Methodological Research Programme to improve longitudinal survey and analysis methods, and disseminating results;
- promoting the application of research methods appropriate for the analysis of longitudinal survey and analysis methods, and disseminating results;
- developing data and research resources to enable easier access to longitudinal data, information and advice.

The British Household Panel Survey (BHPS) began in 1991 and is a multi-purpose study whose value resides in the fact that:

- it follows the same representative sample of individuals (the Panel) over a period of years;
- it is household-based, interviewing every adult member of sampled households;
- it contains sufficient cases for meaningful analysis of certain groups such as the elderly or lone parent families.

By the time current funding comes to an end in 2009 a total of 18 years of panel data will have been collected, making the BHPS one of the longest running panel surveys in the world. From 2010 the BHPS sample will be incorporated into the new UK Household Longitudinal Study.

The main objective of the BHPS is to further our understanding of social and economic change at the individual and household level in the UK. It provides nationally representative longitudinal data across a range of substantive domains. These include:

- labour markers
- income, savings and wealth
- household and family organisation
- housing and composition
- health
- social and political values
- education and training.

The BHPS is recognised as a world class research resource for the UK providing data that is used widely by UK researchers as well as growing numbers of overseas users. The BHPS also provides data suitable for comparative research with other panel surveys in Europe and the US.

Research using BHPS data has informed the thinking of policy-makers in a number of areas, for example:

- initiatives aimed at the eradication of child poverty;
- on the importance of education in determining later employment opportunities;
- flexible working conditions for families and the need for investment in high quality childcare;
- on the impact of introduction of the Working Family Tax Credit and the minimum wage.

Funding & partnerships
The ULSC was established by the ESRC as an independent centre in 1999. Current funding for the period 2004-2009 totals £13.5 million.

Funding for the ULSC currently ends in 2009. The Centre will therefore be making an application to the Council during 2008/09 for renewal.

Estimated cost	£1.4 million
Estimated operational date	2009

Information
http://www.iser.essex.ac.uk/ulsc/about/

ULSC
ESRC United Kingdom Longitudinal Studies Centre

Administrative Data Service

Background
Administrative data describe information that arises via the operation of a transaction, registration or as a record of service delivery. They relate specifically to the administration of a system or process and are not primarily generated as research resources.

While such data are not necessarily the preserve of government, all government departments and agencies keep records of the variety of services they deliver and the processes they register, often storing this information as electronic records that relate to individuals and/or organisations. These records have the potential to inform social scientific research, either directly through analysis of such data at the micro level or, via data linkage techniques, to enhance existing research resources.

Existing capability
Administrative records cover a wide variety of fields in both the public sector and private sectors, including demographics, consumer behaviour, education, social care and community support, crime, transport, health, taxation, social security, housing and migration. Via personal or organisational identifiers, data from different sources have the potential to generate rich resources for research purposes.

Future Capacity
The vision of the future therefore is to make better use of administrative data for two purposes. The first is so that data collected for administrative purposes is better utilised. Most administrative data have the potential to extend and add value to existing studies, to validate survey sources and to reduce the interview burden on census and survey respondents. This is particularly relevant given the technical developments over recent years which now make the handling of complex datasets much more viable than say five years ago. Second, the possibility regards the scope for linking large scale administrative datasets to address key policy issues of interest to central and local governments.

In additional there are potential cost savings arising from the better utilisation and integration of administrative data into national data collection and provision. Survey data often replicates (to some extent) what has already been collected from administrative sources. A pertinent point regarding administrative data is that they are already being collected. Therefore utilising administrative data to replace survey data or avoiding duplication with the system could result in potentially large cost savings, with little additional cost beyond the extraction, cleaning and standardisation of data. To support the development of the National Strategy for Data Resources for Research in the Social Sciences, ESRC plan to establish an Administrative Data Service (ADS). This service will have a number of functions. First and foremost, it will become a focal centre for knowledge about the availability of appropriate administrative data, their suitability for specific research purposes and the procedures required to gain access to and use such data. Second, it will work in tandem with government departments and agencies, seeking to develop and improve the use of administrative data resources for research purposes.

The ADS will not hold or store such data, but will act as an intermediary between researchers and the organisation(s) providing access to administrative data for research purposes.

To achieve these aims, the service will:

- help researchers to gain access to and link with administrative data resources;
- collect, develop and help disseminate information about the variety of administrative data resources potentially available for research in the social sciences and related disciplines;
- work closely with the departments/agencies responsible for the guardianship of administrative data resources, to explore the potential that such data have to inform research in the social sciences and related disciplines;
- explore the scope for linkage between various administrative data sources and to other personal records (e.g. survey data, census information), thereby enhancing and extending existing resources.

Funding & partnerships
The ADS is being established in consultation with members of the UK Data Forum. At present there is no expectation of supplementary funding from other organisations. The ADS will work across a variety of government departments and agencies to promote access to and appropriate use of administrative data sources.

Estimated cost	£500,000
Estimated operational date	2008

Biobanking and Biomolecular Resources Research Infrastructure

Background

The rapid progress of genomic research in humans has extended biomedical and health research from the study of rare monogenic diseases to common, multifactorial diseases. However, elucidation of complex disease aetiology is challenging because diseases are caused by a large number of small, often additive effects, representing the sum of the consequences of genetic predisposition, lifestyle and the environment. Identifying and validating the contribution these factors make to human disease will depend critically on the study of large collections of well-documented, up-to-date epidemiological, clinical and biological information and accompanying material from large numbers of patients and healthy persons, so-called biobanks. Biobanks are widely considered as a key resource in unravelling the association between disease subtypes and small, but systematic, variations in genotype, phenotype and lifestyle.

New capability

The Biobanking and Biomolecular Resources Research Infrastructure (BBMRI) project plans to build a coordinated, large-scale European infrastructure, with significant involvement from the UK, of biomedically relevant, quality-assessed sample collections, to facilitate the development of enhanced therapies to treat and prevent common and rare diseases, including cancer.

The network will cover:

- most human blood, sample and DNA banks;
- biomolecular resources, enabling technologies and high through put analysis platforms to decipher gene, protein and metabolite functions and their interactions;
- bioinformatics centres to ensure that databases of samples in the repositories are dynamically linked to existing databases and to scientific literature;
- harmonized standards for sample collection, storage, preanalytics and analysis.

The synergy, gain of statistical power and economy of scale achieved by interlinking, standardising and harmonising national resources will build on existing European and particularly UK strengths in this area; and further increase the quality and efficiency of future research studies.

The potential economic impact of a European resource is likely to be strengthened health care markets through increased efficacy of drug discovery and development and improved health care through the development of personalised medicine, both of which will secure European competitiveness in research and industry. Significant involvement from the UK research community will additionally increase national competitiveness in this area

Funding & Partnerships

The project is at an early stage and the full scientific case and costing model have yet to be developed.

There is significant UK interest in the project including UK Biobank (see page 19) and the proposal for preparatory phase FP7 funding is being led from the UK. MRC is a participant on the FP7 application. There is a potential for partnership with the planned ESFRI projects ELIXIR (see page 53) EATRIS (see page 50)

Estimated cost	€100 million
Estimated operational date	2009

Information

http://www.biobanks.eu/

COmmunity heavy-PAyload Long endurance instrumented aircraft for tropospheric research and geosciences (COPAL)

Background
National management of research aircraft in Europe has resulted in a diverse fleet of small to large size aircraft, all of which are limited to a practical endurance of five hours. For tropospheric research there is at present no heavy-payload and long-endurance aircraft in the European fleet. This situation precludes European scientists from performing research over oceanic, polar and remote continental areas, which are especially important for climate studies.

New capability
COPAL (Community heavy-payload long endurance instrumented aircraft for tropospheric research and geosciences) will be a heavy-payload aircraft for airborne research in environmental and geosciences. It will provide the European scientific community with a research aircraft platform, capable of reaching any remote area in the world. It will offer a unique opportunity to countries that are not yet operating research aircraft to develop expertise in airborne measurements and participate in international multidisciplinary experiments.

COPAL will overcome the space and payload constraints of existing research aircraft in Europe, making it feasible to distribute the development of instrumentation among external laboratories. It will allow European scientists to perform research over oceanic, polar and remote continental areas that are especially crucial for climate studies.

Two main aircraft alternatives are being considered and the timetable depends on the choice.

The use of a C130 or an A400M aircraft would overcome present space and payload constraints making it feasible to distribute the development of instrumentation among external laboratories. Such an option has many benefits in term of innovation. At the national level, operators of large aircraft, mainly in the UK, Germany and France, capitalise on their national academic community of experts in environmental research. With a heavy payload aircraft, such a mobilisation of experts can be extended to the European level, in particular from countries which are not operating research aircraft, hence increasing significantly the level of expertise.

Funding & Partnerships
This project has been developed by the European Fleet for Airborne Research (EUFAR).

Funding will be sought from participating European nations. Support is being sought under the EU's Framework Programme 7 preparatory phase funding.

COPAL stands only if it designed as a pan-European project. NERC is a participant in the COPAL project, which is on the ESFRI Roadmap.

Estimated cost	Between €50 million and €100 million.
Estimated operational date	2012

Information
http://www.eufar.net

Daresbury and Harwell Science and Innovation Campuses

Background
Development of the Harwell and Daresbury Science and Innovation Campuses as national hubs of interaction between the Research Councils, universities, the international R&D sector and high added value industries lies at the heart of STFC's strategy to create an environment and infrastructure which will deliver a step change in knowledge exchange, which is key to increasing the economic impact of research. The campuses are centred around world-leading research facilities such as ISIS and Diamond, which provide capabilities and expertise of benefit to both scientific and industrial sectors.

New capability
STFC has developed a technology strategy that identifies five areas of strong internal capability and relates each of them to areas of societal and economic relevance. In each of the capability areas we have identified a new campus-based technology centre initiative to improve access to our expertise, strengthen the technology impact of our activities, and facilitate a step-change in their effectiveness. These five new advanced technology institutes, which will be based at the Harwell and Daresbury campuses, will act as new focal points for collaboration with industry and academic users and as gateways to STFC's facilities and expertise.

A new Imaging Centre will transform "facilities access" into "solutions access". It will provide a gateway and consulting services to deliver "one-stop" problem-solving capabilities to industry and HEI researchers, by bringing together access to STFC facilities together with access expertise in computer simulation, detectors, data acquisition and analysis, and providing a focal point for collaboration and interaction.

The Hartree Institute at the Daresbury Science and Innovation Campus will be a new kind of computational sciences institute for the UK. It will bring together academic, government and industry communities and focus on multi-disciplinary, multi-scale, efficient and effective simulation. The goal is to provide a step-change in modelling capabilities for strategic themes in energy, life sciences, the environment, materials, and fundamental physics.

The Joint Institute for Materials Design will be co-located with the ISIS neutron source, the Central Laser Facility and the Diamond Light Source at the Harwell campus. It will exploit these facilities to offer world leadership in the area of materials discovery, characterisation and imaging, with key areas of focus being materials for energy applications (storage, fuel cells, batteries, catalysis, solar energy, and lightweight structures) and for electronics. It will serve as a focus of knowledge exchange between industry, academia and the scientific facilities of the campus.

The Detector Systems Centre will act as a conduit to bring together academic and industrial collaborators together with STFC's world-class detector capabilities and knowledge base. It will support fabrication, prototyping and characterisation of sensors both for research applications and industrially applicable markets (such as security and biomedical imaging), and will develop and commercialise both sensors and integrated detector solutions.

Negotiations are also well advanced to locate a space science and technology centre on the Harwell campus.

Funding & partnerships
Joint venture companies for the campuses will be established in 2008, coupled with a major marketing campaign to attract university groups and high added value companies regionally, nationally and internationally as well as investment from the international R&D sector. We will seek to form strategic partnerships with RDAs, building on our successful model of our partnership with the NWDA in the development of the Daresbury campus. In addition to RCUK funding, we anticipate significant support from the EU and from industry. Capital costs are estimated below:

Estimated cost £125-250 million
Estimated operational dates for the four centres will be phased over the period 2010 to 2012, with the Hartree and Detector Centres opening first.

Information
http://www.harwell.org.uk/
http://www.scitech.ac.uk/ResFac/Gateway/GatewayCentres.aspx

Diode Pumped Optical Laser for Experiments

Background
The interaction of a high power laser with matter creates truly extreme conditions, otherwise only found off planet. Unsurprisingly, this leads to exotic phenomena for fundamental studies, with potentially ground breaking applications in the wider world. These include electron acceleration to multi GeV energies that could lead to "synchrotrons on a table top", proton acceleration to >100MeV energies that could lead to low cost precision treatments for deep seated cancers, through to extreme pressures and temperatures that could form the basis of a fusion energy power source as advocated by the recent ESFRI endorsed initiative, HiPER.

The coupling of high power laser systems to other light sources, such as LINACs, has been limited by the low repetition rate of current sources. This project would remove that limitation, enabling a host of new pump-probe experiments for a wide variety of material science, physics and chemistry applications.

Existing capability
High energy, high power lasers are typically limited in shot repetition rate by the technology used as a power source – flash lamps. These are a very inefficient (~0.1 per cent) means of converting raw electricity into the pump light necessary to drive these lasers. This has limited the applications of high power lasers – in fusion energy, medical diagnostics and treatments, and in advanced particle accelerators.

New capability
Development of high average power, high efficiency laser systems is an emerging technology in many markets, currently hampered by the high cost of the components. Demonstration of progress in the scientific and envisaged commercial applications by a national facility such as DIPOLE would provide the impetus for high volume development, and thus significant cost reduction to the markets.

An opportunity now exists to use direct pumping by solid-state laser diodes that have efficiencies orders of magnitude greater (70-80 per cent). This makes it possible to build a high power laser facility with shot repetition rates measured in Hertz rather than minutes or hours. This opens up a wealth of application areas (for academia and industry) that have hitherto been excluded. DIPOLE is a project to construct the world's first user facility based on this technology and thereby open up a whole new approach to research using high power lasers. This would give UK academics access to an unrivalled capability internationally. The breadth of science would cover the entirety of the current high power laser programme. It would also extend to many options coupling with accelerator sources (for example SAPPHIRE), and could act as a prototype technology step for HiPER and ELI. This proposal is to construct for the first time a laser user facility based on high efficiency, high repetition rate solid state technology and thereby open up a radically new approach to research using high power lasers. This would give UK academics access to an unrivalled capability internationally.

The approach is modular, with two principal phases envisaged. The first phase would provide an internationally leading facility, while the second would open up wholly new areas and form the basis of a new generation of capabilities in many other projects and application areas.

The high repetition rate would move existing programmes from "individual shot experiments" into a new generation of statistical, advanced data gathering modes.

Funding & partnerships
This is the first submission for consideration under the LFCF. There are four (small scale) diode projects underway – France, Germany, USA and Japan. DIPOLE will build from the experience on these projects to provide the UK with a "next-generation" capability.

The project is highly flexible, offering opportunities to tie closely with accelerator developments such as Sapphire, or with HiPER and/or ELI, or it could be a stand-alone user facility.

The scale of the project is national, although close ties to a number of international developments are anticipated.

Estimated cost	£15 million (phase 1) £50-85 million (phase 2)
Estimated operational date	2012

Information
http://www.clf.rl.ac.uk/Projects/index.htm

Euro-Argo

Background
The Argo objective is to develop a global array of floats (spaced 300 km apart on average) throughout the ice-free areas of the deep ocean. It is an international programme for global in situ ocean observations, complementary to remote sensing observations from satellites. It has become the primary source of data on the ocean interior and is a cost-effective alternative to research cruises and voluntary ships observations. The array is a unique source of information on the role of the ocean in the climate system (global heat and moisture balance), it provides the data required by operational ocean monitoring systems and it is a unique source of data for scientific study of the Earth system.

It is estimated that 3,000 floats are required. They are battery powered, with a design life of up to 5 years, ie about 800 floats must be deployed each year to meet the target array. The data are transmitted in real time by satellite to data centres for processing, management and distribution.

New capability
Euro-Argo is the European component of Argo and its objective is to provide a sustained European contribution to the international Argo programme. Euro-Argo will improve significantly extended weather forecasts to seasonal range. Improved seasonal forecasting can have significant impact on society and the economy. Sustainable fisheries depend on better understanding and monitoring of the changing physical environment. The development of ocean services is bound to improve the safety and efficiency of marine operations and offshore activities.

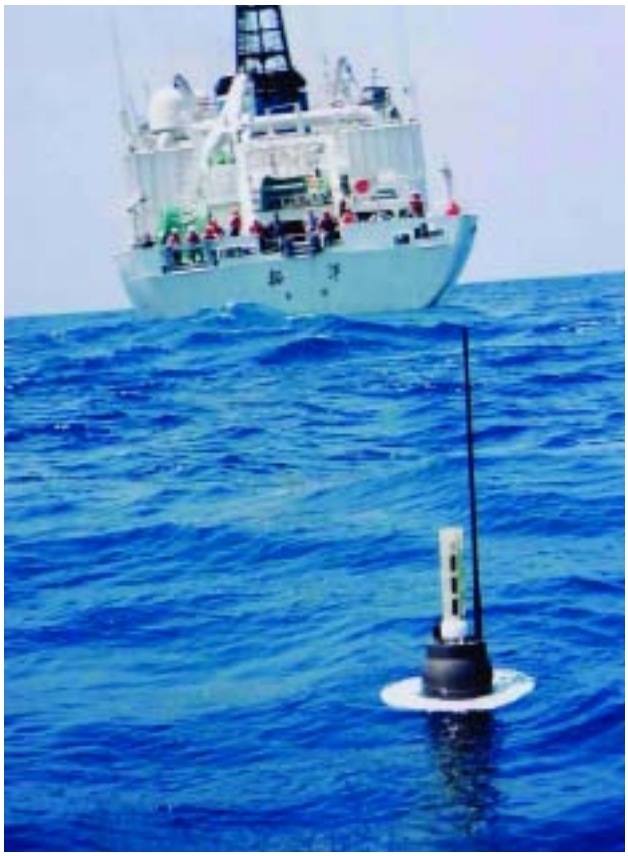
The European contribution will consist in the deployment of around 250 floats per year as well as the operation of the CORIOLIS Data Centre (one of the two Global Data Assembly Centres) to collect, validate and deliver the data to users.

Funding & Partnerships
Funding will be sought from participating European nations. Support is sought under the EU's Framework Programme 7 preparatory phase funding.

NERC and the Met Office are participants in the Euro-Argo project. Defra, MOD and NERC have provided funding from research budgets for the UK Argo programme.

Estimated cost	€76 million
Estimated operational date	2010

Information
http://www.ifremer.fr/euro-argo/



European 3rd Generation Gravitational Wave Observatory (Einstein Telescope)

Background
Gravitation is the least understood of the fundamental interactions. Observation of gravitational waves over the full spectrum requires two approaches: a network of ground-based interferometric detectors for short period waves and a detector in space for the long period waves. Current gravitational wave detectors have limitations in sensitivity and bandwidth that limit the ability to fully characterise signals from all possible sources observable from the ground.

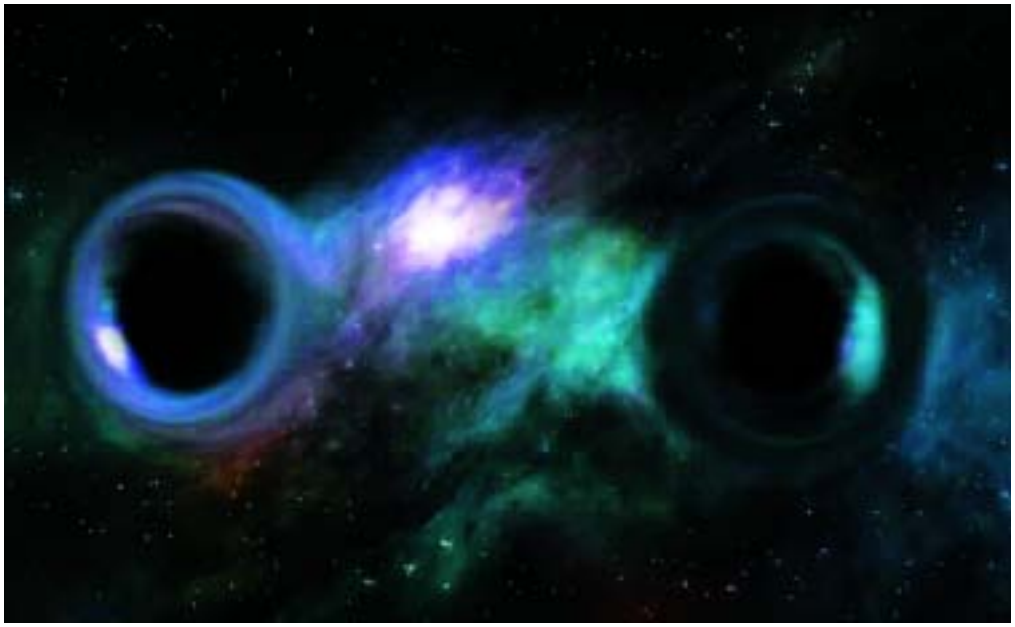
Future capability
While the first and second generation observatories open up the field of gravitational wave astronomy, the third generation detectors are required to complement optical and X-ray observatories in the study of fundamental systems and processes in the universe. A third generation detector with 10 times better sensitivity would facilitate high precision tests of General Relativity, resolve the origin of gamma ray bursts, observe binary mergers and measure to a few percent the masses, sky positions and distances of binary black holes. The additional science possible with third generation detectors will have a huge impact on key areas of astrophysics, cosmology and fundamental physics. To realise such an observatory, significant progress in non-classical light, advanced lasers emitting hundreds of Watts of continuous power, novel signal enhancing techniques is required, developments that will have applications in other scientific fields.

Funding & partnerships
The UK participates in GEO600 (a joint UK-Germany project) and in Advanced LIGO, contributing world-leading technology developed for GEO600 which, together with LIGO interferometers in the US, forms the first network of interferometers.

Under the FP6 ILIAS programme groups in Italy, France, Germany, and the UK built and operate the current European observatories. These groups, in collaboration with the Netherlands, Switzerland and Spain, have begun study of the technologies for a 3rd generation observatory. Current estimates for the cost of construction of this facility are approximately £200 million. A design study for a third generation facility was submitted to the FP7 framework call with the aim to complete a 3 year conceptual design in 2011, followed by a more detailed preparatory phase and construction beginning in 2014. Potential underground sites may be in Italy, Germany or the UK.

This facility has been identified as a priority in the Astroparticle Physics European Coordination (ApPEC) Roadmap. The potential UK contribution to the construction phase is estimated to be approximately £40 million. STFC provided the construction costs for the UK contribution to Advanced LIGO, provides infrastructure support and R&D resources for the UK groups exploiting the current European gravitational wave observatory, GEO600, and this is planned to continue at an approximate level of £2 million a year. Funding for the capital phase of the Einstein Telescope is a likely bid to the LFCF.

Estimated cost	£200 million
Estimated operational date	After 2014

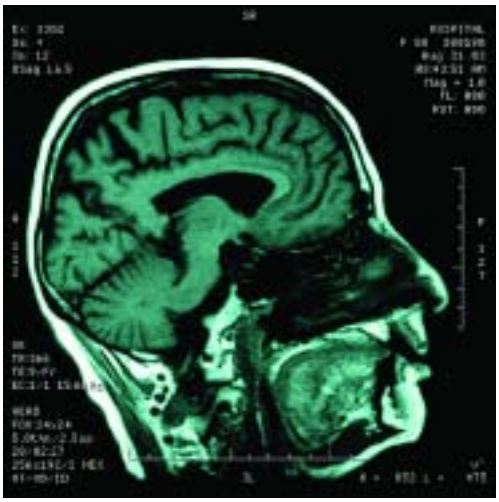


European Advanced Translational Research Infrastructure in Medicine

Background
Despite tremendous progress in the life sciences and increasing investment by the pharmaceutical industry into research and development, there is a widening gap between discovery and translation into medical products and applications. To capitalise on the increasingly vast quantities of information about the cellular and molecular mechanisms of health and disease, these discoveries need to be translated into new diagnostic, therapeutic and preventive clinical applications. The translational process, however, requires considerable know-how and infrastructure for preclinical and early clinical studies, which are not currently widely available in academia. Such a task can only be mastered in a dedicated translational R&D infrastructure that links and engages both clinical and basic scientists as well as strong industrial partners. The European Advanced Translational Research Infrastructure in Medicine (EATRIS) project will establish just such a European translational R&D infrastructure.

New capability
As a first step, a small number (5-10) of European centres dedicated to translational research will be networked. In later steps, additional dedicated centres are expected to join the EATRIS partnership.

The centres will offer pan-European access, will encompass interdisciplinary expertise and will focus on the following major areas (chosen because they cover some of the largest and most important disease areas in Europe): cancer, diseases of the cardiovascular system, brain disorders examined by advanced imaging, metabolic syndrome and infectious disorders studied using high security laboratories. They constitute model centres, which will develop joint programmes for translation, clinical validation, data management, quality assurance, monitoring/auditing and training, education and exchange.



Imperial College, London is the proposed location of the cardiovascular disease EATRIS centre.

As well as the potential for scientific advance, European infrastructure and expertise in translational medicine related to common human diseases has the potential to significantly strengthen the economic potential of health care markets in Europe.

UK-based centres within the EATRIS network and access by UK researchers to other EATRIS centres will enhance the UK's competitiveness and attractiveness to industry and provide skills, expertise and research capacity that could be applied to other disease areas not currently included in the network.

Funding & partnerships
The project is at an early stage and the full scientific case and costing model have yet to be developed.

MRC is a participant in the preparatory phase FP7 application for this project

There are planned partnerships with the ESFRI projects – ECRIN, BBMRI and ELIXIR.

Estimated cost	€255 million
Estimated operational date	2012

Information
http://www.eatris.eu/

European Centre for Systems Biology

Background
After two decades of genomic research, many of the molecular components of human cells, including those implicated in disease, have been deciphered or will be so in the foreseeable future. Despite this wealth of data, a systems-level understanding is still largely missing. The general focus of biomedical and much other biological research needs to change from primarily a 'reductionist' analysis at the molecular level to a systems-analysis level, capturing the characteristic network dynamics behavior, and thus providing a much more comprehensive understanding of biological processes.

Systems approaches will accelerate innovation from biological knowledge across the science base, and will be of particular significance in drug discovery and the development of industrial biotechnology.

A key development from the systems base will be synthetic biology – the ability to introduce novel/artificial components into living systems, e.g. to produce novel compounds in "biofactories". This will initially impact in bioprocessing applications but in the long term has considerable medical and other potential.

This has specific implications for complex diseases, for which the underlying genetic basis is related to combinatorial interactions of multiple genes and proteins, and for many other challenges in sustainable agriculture and industrial biotechnology.

New capability
This paradigm shift in research cannot be achieved by a few isolated research teams but requires the establishment of a European Center for Systems Biology (EUSYSBIO). This will provide critical mass and drive, in a similar way to that in which EMBL drove European molecular biology in the late 20th century and to integrate the emerging national systems biology centres.

EUSYSBIO will complement ELIXIR by providing a reservoir of skills at the interface between biological experimentation and modeling, access to state of the art instrumentation and computational tools, and an expanding portfolio of exemplar programmes.

Funding & partnerships
European activity will produce a critical mass capable of matching the USA in an area critical to the survival of the pharmaceutical and other major bioindustry sectors. The development of capability at the European level, networking the emerging activity in various member states, enables us to harness skills which are in short supply in the UK – particularly the good quantitative and modelling skills in Eastern Europe. EUSYSBIO will also underpin the development of standards and regulation at the European level, reducing the risk of transborder barriers to research and its exploitation.

There are systems biology centres in about nine EU member states at present including the UK, and these should form the networked basis of the new facility.

Estimated cost	€50-70million
Estimated operational date	2012

European Extremely Large Telescope

Backgroud
The present generation of 8 and 10 metre ground-based telescopes, complemented by the Hubble Space Telescope (HST) and other satellites, have generated a new view of the Universe and have produced a wealth of fascinating questions that only the vast collecting area and high spatial resolution of a more advanced telescope will be able to answer. These questions cover all the areas across planetary science, astronomy and cosmology that are the stated priorities in STFC's strategy for astronomy. They range from long-term modelling of weather patterns in Solar System planets, through direct imaging of Earth-like bodies around other stars, to understanding the complete formation histories of galaxies and probing all the way across the Universe and therefore back in time to image the first objects that ever formed.

Future capability
A new generation of optical/infrared ground-based telescopes of between 30 and 60 metres in diameter are being planned globally. These Extremely Large Telescopes (ELTs) will be the successors to the current telescopes, and present a mammoth increase in capability. The UK expects to participate in these developments via its membership of the European Southern Observatory (ESO), which is well advanced in the design for a 42 metre, segmented mirror telescope, the E-ELT. Global site testing is underway but it is likely that the telescope will be built on one of the world's few premier sites in Chile, Argentina or the Canaries.

The design will combine state of the art mirror technologies, using novel materials and coatings, with leading edge adaptive optics and software controls. It will require a massive engineering development, utilising a wide range of technologies currently being developed across Europe.

Although ESO does not operate juste retour, it is expected that the industrial return to the UK will at least match our percentage membership of the organisation over the period of design and construction. UK companies are already contracted to undertake design studies for the dome and are working with academic research centres to develop instrumentation concepts, software, management tools and advanced designs for adaptive optics.

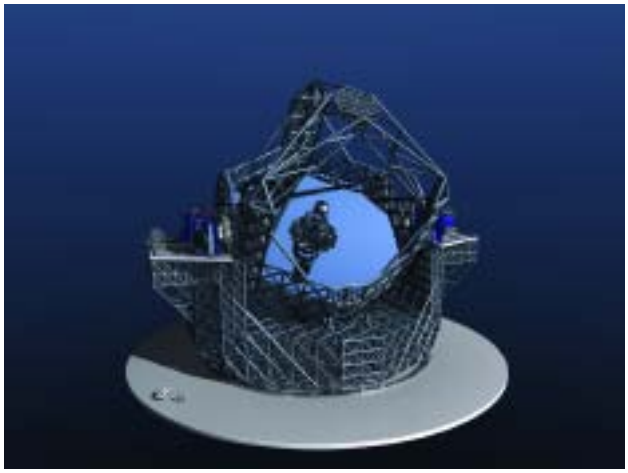
It is expected that there will be an on-going need to develop operating systems, instrumentation and telescope improvements through the operational phase of the facility, and for which the UK will expect to play a leading role. As the world's leading ground-based optical/infrared telescope facility, the E-ELT is expected to be a focus for many of the key research programmes across Europe and therefore provide an unparalleled opportunity for research training, science exploitation, international exchange and novel technology development

Funding & Partnerships
The project will be planned, constructed and funded via ESO which is an intergovernmental organisation of European astronomical countries, based in Germany but operating telescopes in Chile. The UK is a roughly 20% partner in ESO with annual contributions, made via STFC, of £15 million. ESO has approved €57 million for Design Studies, complementing around €28 million available through national funding associated with an EC FP6 Design Study Programme. It is expected that up to a further €8 million will be awarded to ESO from FP7 Preparatory Studies. The construction phase will require additional contributions from national partners in ESO. It is currently planned that the UK's share of this construction phase will be provided via the LFCF, commencing 2010.

ESO currently has 13 national partners (France, Germany, UK, Italy, Denmark, Netherlands, Portugal, Finland, Spain, Belgium, Switzerland, Sweden and the Czech Republic). The US research community is planning two, 30-metre telescopes (the Thirty Metre Telescope and the Giant Magellan Telescope). ESO and the STFC are in regular contact with the lead groups and with the US National Science Foundation with regard to a shared science vision, collaboration on site testing, key technologies and the opportunities for cooperative developments.

Estimated cost	€750 million
Estimated operational date	2017

Information
http://www.eso.org/projects/e-elt/



European Life-Science Infrastructure for Biological Information

Background
There is a massive increase in the biological information arising from deployment of high-throughput post-genomic technologies. Turning this into an increase in innovative output relies on putting infrastructure in place to enable integration and interoperability of datasets generated in different places, at different times and on different biological systems with different techniques.

Creating such an infrastructure will increase the speed and sophistication with which current problems in chemical, molecular and sub-cellular biology can be addressed. It will also vastly increase our capability to apply this knowledge in the systems and physiological context, largely through enabling modelling and predictive approaches, e.g. to understand more clearly and to manipulate the complex interactions which make up the function of a human, animal or plant cell or organ systems. This will have fundamental effects on how biology is done in future, but will also transform areas as diverse as the search for and testing of pharmaceutical agents, development of new medical and environmental technologies, better food crops and plant products for industry, accelerated development of biomanufacturing and novel bioenergy applications. These are key to the maintenance and development of the UK bioeconomy and the delivery of optimal healthcare in the UK.

New capability
The mission of the European Life-Science Infrastructure for Biological Information (ELIXIR) is to construct and operate a sustainable infrastructure for biological information in Europe to support life science research and its translation to medicine and the environment, the bio-industries and society. This will enhance all research and industry associated with living systems including health and medicine, the environment, the bio-industries and society.

The facility builds on the existing EBI (European Bioinformatics Institute - located at Hinxton, Cambridge), expanding the range of biological data being managed, and working through a network of nodes, one in each member state of the EU, coordinated through a central hub.

The hub will lead an extensive programme of development and implementation of software tools for data management and analysis, and the development and implementation of data standards. It will include a key activity in coordinating the development of European capability in systems biology.

A key aspect of ELIXIR is the upgrading of the computing facilities available at the EBI Hinxton. EBI currently uses the computing facilities provided by the Wellcome Trust for the Sanger Institute (with which EBI shares the site) and these need replacing by larger and more up-to-date capability in order to deliver ELIXIR.

The benefits to the UK of hosting ELIXIR at the EBI, based in the largest bioscience cluster in the UK, include the attraction of a large number of technically skilled staff from across Europe in key areas at the interface of biology, computing and data management. Many of these, together with skilled UK staff trained at EBI, will remain in the UK enhancing industry (particularly in the pharmaceutical industry) and the research base.

Funding & partnerships
Previous UK funding for capital developments at the EBI have come from the UK Research Councils and the Wellcome Trust (the Trust contributed most of the £10 million cost of the recent EBI building extension). The recurrent costs for EBI are currently provided through the EMBL subscription. The costing model for ELIXIR has yet to be developed and there are various options relating to the balance between the nodes and the hub, and the status of the nodes

The three relevant UK Research Councils (BBSRC, MRC and NERC) and the Wellcome Trust are all partners in the ELIXIR preparatory phase FP7 application, which has been submitted by EMBL/EBI. BBSRC is leading on behalf of these UK organisations within the proposal, and will be leading the section of the workplan developing the funding and governance model, as well as participating at some level in most other aspects of the project.

Estimated cost	€100 million
Estimated operational date	2012-13

Information
http://www.elixir-europe.org/

European Multidisciplinary Seafloor Observation

Background
The basic scientific objective of the EMSO (European Multidisciplinary Seafloor Observation) project is to undertake real-time long-term monitoring of environmental processes in the geosphere, biosphere and hydrosphere of European seas. Long-term monitoring will allow the capture of episodic events such as earthquakes, submarine slides, tsunamis, benthic storms, biodiversity changes, pollution and other events that cannot be detected and monitored by conventional oceanographic sea-going campaigns. Cabled sea-floor observatories are needed to collect long time series of simultaneous data relative to seismology, geodesy, sea level, fluid and gas vents, physical oceanography, biodiversity imaging at different scales. A network of observatories around Europe will lead to unprecedented scientific advances in knowledge of submarine geology, the ecosystem of the seas and the environment around Europe.

New capability
EMSO deep sea-floor observatories will be deployed to allow continuous monitoring security of the ocean margin environment around Europe for environment and security. They will be organised in a unique management structure at European level (and part of a global endeavour in sea-floor observatories), for long term monitoring of environmental processes related to ecosystem life an evolution, global changes and geohazards. EMSO will be a key component of GMES and GEOSS.

Implementation of EMSO will be based on connecting existing and previously autonomous systems, and providing power and long-term real-time data compatibility, integrating in the wider system of mobile and relocatable seafloor lander platforms.

The EMSO development is based on synergistic collaboration between the academic community and industry for the development of technology. This synergy allows each partner to increase its own know-how, to improve marine technology and set strategies to be competitive with countries such as USA and Japan.

Funding & partnerships
An ESONET Network of Excellence has been established by national groups.

Funding will be sought from participating European nations. Support has been sought under the EU's Framework Programme 7 preparatory phase funding.

NERC is a participant in the EMSO project.

Estimated cost	€150 million
Estimated operational date	2012

Information
http://www.ifremer.fr/esonet/emso/

European Polar Research Icebreaker (Aurora Borealis)

Background
Aurora Borealis will provide the world's first international drilling and all-season research icebreaker. It will further the international advantage that European research has in the polar areas. It will provide Europe with a capacity to launch autonomous scientific investigations into the central Arctic Ocean at any time of the year, and will be used around the Antarctic continental shelf in support of the Integrated Ocean Drilling Program (IODP).

New capability
Aurora Borealis will be the most advanced polar research vessel in the world with a multi-functional role of drilling in deep ocean basins and supporting climate/environmental research and decision support for stakeholder governments for the next 35-40 years. It will open new horizons for Europe in polar and marine research.

Aurora Borealis will be a powerful research icebreaker vessel (196m long and with 31,000 tonnes displacement) with 50 mWatt azimuth propulsion systems and deep drilling capability for use in extreme conditions in excess of 4,000m water depth. It will have high ice performance to penetrate autonomously into the central Arctic ocean, with 2.5m of ice cover, during all seasons.

Flexibility to equip the vessel with laboratory and supply containers, and the variable arrangement of other modular infrastructure, free deck-space and separate protected deck areas, will make it suitable for most marine research disciplines.

Construction will be technologically challenging and will result in increased knowledge and experience for marine technologies and the ship-building industry.

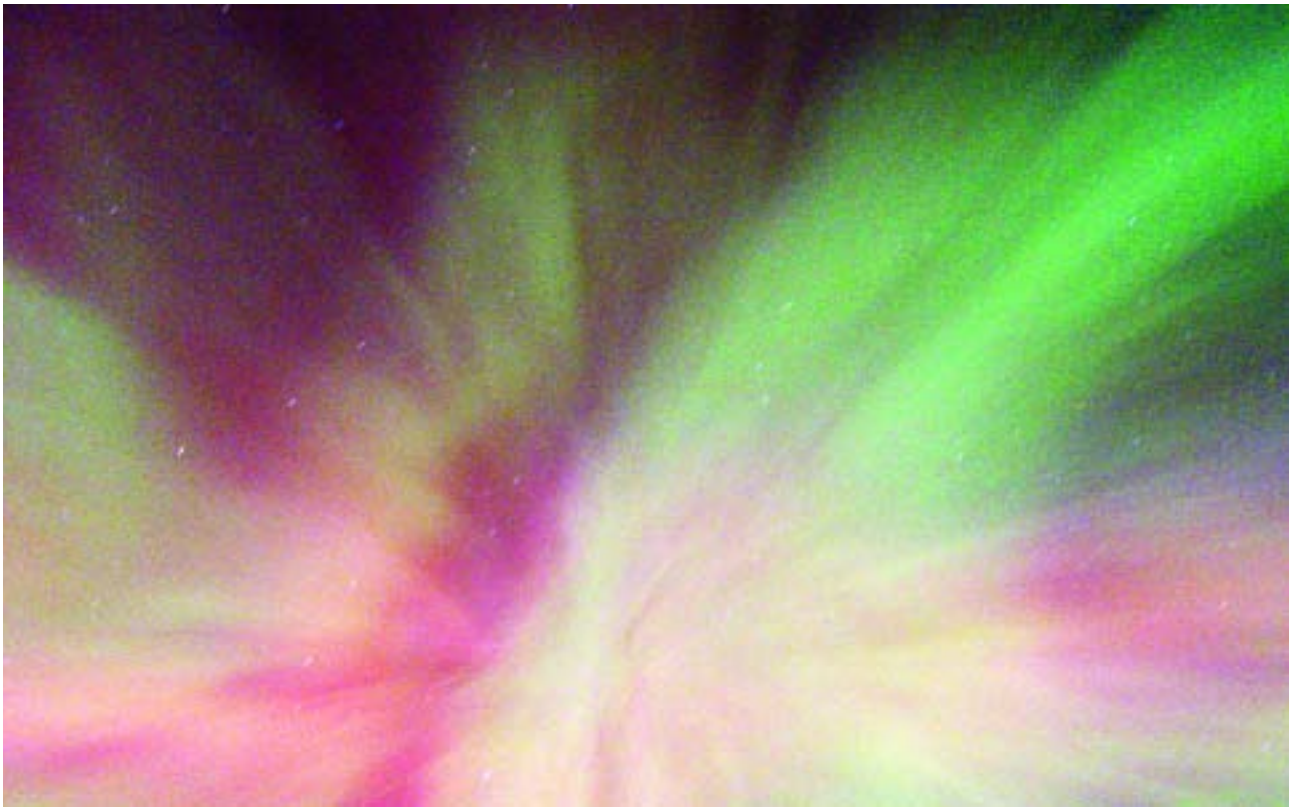
Funding & Partnerships
The European Research Icebreaker Consortium (ERICON) has been formed to manage the Aurora Borealis project. NERC is a member of the European Consortium for Ocean Research Drilling (ECORD), which is a participant in this project.

Funding has already been obtained from the Bundesministerium für Bildung und Forschung (BMBF), the Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI), and an application for EC Framework Programme 7 preparatory phase funding has been made.

Funding will be sought from participating European nations.

Estimated cost	€360 million.
Estimated operational date	2012

Information
http://www.eri-aurora-borealis.eu/



European X-ray Free-Electron Laser

Background
The European X-ray Free-Electron Laser (XFEL) project started in June 2007 and involves the construction of a new European / international user facility for the production and scientific use of ultra-bright and ultra-short pulses of spatially coherent hard X-rays.

There are competing projects in the USA (LCLS, Linac Coherent Light Source at Stanford) and in Japan (SCSS, Spring-8 Compact SASE Source at Spring-8). These are based on the normal-conducting Linac technology, with the consequence of a repetition rate not exceeding about 100 Hz. Although characteristics of the individual X-ray pulses are roughly comparable, the unique feature of XFEL is the superior repetition rate and operational flexibility related to the superconducting Linac choice. This translates, in terms of user advantages, in a much reduced acquisition time, in the possibility of parallel exploitation of five different experimental stations, in a very broad variety of possible time structures of bunch trains delivered to each beamline and the possibility of upgrading the machine at a later date. The basic components of the superconducting Linac FEL technology have been proven successful at the FLASH free-electron laser facility for VUV and soft X-ray radiation, built and operated for users by DESY in Hamburg.

Economic impact will result from the provision of new detectors, beamline optics and diagnostic equipment, by UK suppliers. UK participation will maintain UK scientists at the forefront of accelerator science.

Existing capability
The facility comprises a superconducting linear accelerator (Linac), based on the TESLA technology, 1.7 km long, accelerating electrons up to an energy of 17.5 GeV; the accelerator will distribute up to about 30 000 electron bunches per second (10 bunch trains with 600 μs duration, of up to about 3,000 bunches each) into a manifold of undulators (each feeding a separate photon beamline), comprising: three undulators (SASE1, SASE2 and SASE3) for the generation, via the SASE (Self-Amplification of Spontaneous Emission) process, of transversely coherent X-ray pulses shorter than 100 fs, and with peak power exceeding 10 GW, in a wavelength range from 0.1 nm to 1.6 nm; and a further set of 2 undulators (U1, U2) for the generation of hard X-rays, by the spontaneous emission process. The full facility, which will be 3 km long, will include 10 experimental stations with state of the art equipment for the scientific exploitation of the radiation by the users' community.

New capability
The availability of such X-ray pulses will allow presently impossible and potentially revolutionary experiments in a variety of disciplines such as condensed matter and materials physics, nanoscience, plasma physics, chemistry and structural biology. Examples include, the study of structural dynamics at the atomic level on the sub-ps timescale during chemical reactions, phase transitions, the solution of macromolecular structures without the need for crystallisation and access to presently inaccessible regions of the phase diagram of warm dense matter.

Funding & partnerships
£31.5 million is currently earmarked from the LFCF for the full project.

Thirteen countries are interested in becoming members.

Estimated cost	€1082 million
Estimated operational date	2013

Information
http://www.xfel.eu/

Extreme Light Infrastructure

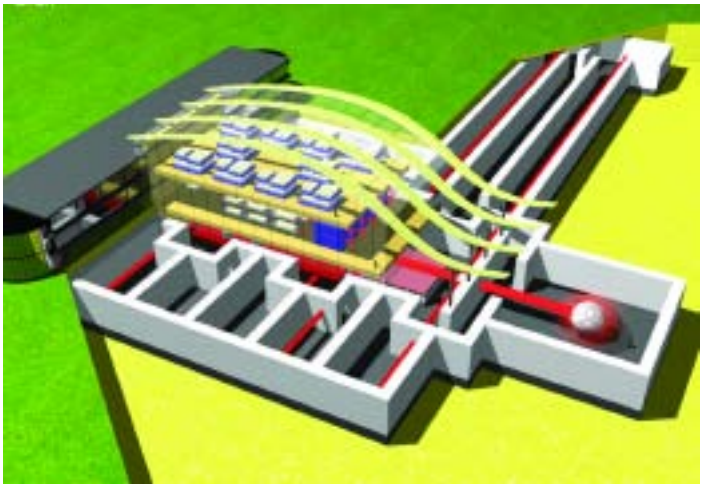
Background
Extreme Light Infrastructure (ELI) is a pan-European project to achieve the highest possible laser intensities and the shortest possible pulses. It has the potential to address a wide range of applications of great benefit to society, ranging from medical imaging, fast electronics, options for new oncology treatments, understanding the processes underlying the ageing of nuclear reactor materials, and the development of methods for nuclear waste processing

ELI will drive technology development in a number of industrial areas with key spin-out opportunities, including high repetition rate laser sources, advanced optics, detectors, sample handling techniques, etc. The commercial application of the beamlines is potentially very high, albeit at a very early stage of analysis.

ELI would secure European (and potentially UK) leadership in a field which is rapidly developing in Asia & USA

Existing capability
The UK is currently embarking on a 10 petawatt upgrade to Vulcan (currently the world's most powerful laser, based at the CLF, UK), which will offer a vibrant science programme and prepare the ground for this next step. Alongside this, the French have committed to build a prototype beamline (called ILE) to be built in Palaiseau, at a cost of about €25 million. ELI represents the next logical step after the development of these upcoming generation of national laser facilities.

New capability
ELI will provide wholly new types of sources for a wide range of science programmes and their application areas. Capable of producing extreme intensities of X-rays, electrons, protons, neutrons and optical beams, ELI will operate in a similar mode to a synchrotron with dedicated beamlines and high repetition rate delivery. It will go beyond current state-of-the-art by many orders of magnitude, delivering radiation on attosecond timescales, and accessing the ultra-relativistic regime for the first time with an exawatt class laser.



ELI will be the first infrastructure dedicated to the fundamental study of interactions in a new and unsurpassed regime of laser intensity: the ultra-relativistic field. At its centre will be an exawatt class laser up to 1000 times more powerful than Vulcan. This facility will operate in a "beamline" mode (cf. synchrotrons) offering ultrashort, ultra-intense pulses of gamma radiation, multi-GeV electrons, protons, ions, etc. These intrinsically synchronised particle and radiation ultra-short beams will offer unique tools for studying matter through pump-probe experiments. The focused intensity will open up fundamental science programmes to study the properties of the quantum vacuum (for example to mimic photon propagation in the very early Universe or test the quantum electrodynamical properties of a radiation gas), physics approaching the Schwinger limit and possibly even the physics that drives Hawking radiation.

Funding & partnerships
This proposal is coordinated by LOA (France), with 13 European partners in the 3-year preparatory phase (2008-2011).

This phase has funding (in-kind or direct) from 13 nations, amounting to €78 million in relevant funding, including existing staff and experiments on existing facilities. A bid for €7 million was submitted to the EC in May 2007 to provide the appropriate level of coordinating action, with anticipation of this being achieved through the EC and the partner countries.

The UK has had a long history of leadership in this area – from both a technology and science perspective. We have the opportunity to continue this by appropriate engagement with ELI coupled to our associated national level programmes.

The location of ELI is yet to be determined, with France just one of many possible locations, including the UK. Operation by 2014 is anticipated.

The costing is not well determined at this stage because major technology down-selection decisions have yet to be made. This will form part of the preparatory phase project output, with the probably range of costs reflected in our local estimates:

Estimated cost	£200-500 million
Estimated operational date	2014

Information
http://www.extreme-light-infrastructure.eu/

Facility for Antiproton and Ion Research (FAIR)

Background

The international FAIR project aims to provide scientists in Europe and the world with an outstanding accelerator and experimental facility for studying matter at the level of atoms, atomic nuclei, protons and neutrons as the building blocks of nuclei and the subnuclear constituents called quarks and gluons. Although the main focus will be on nuclear physics, it will also allow a range of studies in atomic physics, inertial confinement and astrophysics. In nuclear physics it will address the main frontiers of the subject, hadron physics, the phase diagram of nuclear matter and the structure of exotic nuclei, potentially answering such questions as:

- How were heavy elements formed in stars?
- What are the limits of nuclear existence?
- Can we manipulate nuclear decay rate by controlling the atomic environment?
- Are there new forms of strongly interacting matter?

New capability

This unique facility will be able to produce intense high energy, high brilliance beams of particles ranging from anti-protons to all chemical elements. FAIR will be the foremost facility in the world until at least 2020. The international recognition of the UK nuclear physics community is due to concentration of its resources in a few areas of research to achieve critical mass. UK participation in FAIR will give the UK community access to the foremost facility in the world in the majority of areas of scientific priority and allow the UK to continue to play a leading role in the development of the field.

Funding & partnerships

The total cost of FAIR is estimated at €1,187 million over 5 years with 75% of the funding being provided by the German government, assuming that 25% will be provided by other partners. It is the expectation that while some resources (of the order of £10 million, subject to peer review) would be provided from the baseline STFC budget, involvement on the scale that maintains UK leadership would require a bid to the LFCF for additional funds over the construction phase.

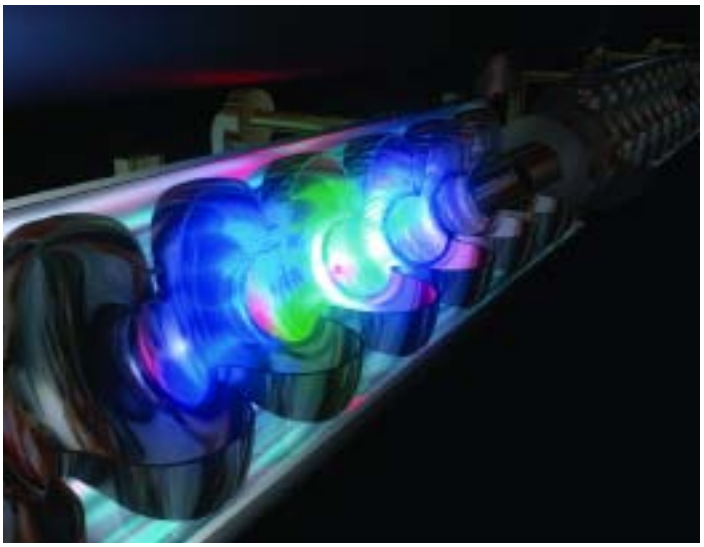
The UK is represented on all the initial bodies scoping the nature of the facility, both scientific and administrative. FAIR will be established as a limited liability company under German law, with a governing council on which the stakeholders are represented. An interim memorandum of understanding for the preconstruction phase was signed by the UK, Germany, Poland, France, Russia, Italy, Spain, Finland, Sweden, Greece, China and Austria. India and Romania have agreed contributions to the construction phase. It is the aim to start construction in early 2008. The science direction of the facility and the scope of the major experiments are being finalised and the UK has been fully engaged in these discussions, with representation of the major nuclear physics groups in the various collaborations, in order to influence decisions and set the science agenda in a way that reflects UK interests. STFC is considering the level and priorities for UK involvement as part of its strategic review.

Estimated cost	€850 million
Estimated operational date	2012/13

Information

http://www.gsi.de/fair/

Future High Energy Colliders



Background
A next generation particle physics accelerator to follow up discoveries at the LHC should be able to collide beams of electrons and positrons or perhaps muons at energies between 0.5 to 1 TeV. It should be tuneable to a precise energy and able to give very clean experimental conditions and high precision. Such a machine can complement the LHC, soon to start operations at CERN, by providing a way of studying precisely and in depth any new phenomena found at the LHC, which has great discovery reach but lacks precision. For example, the nature of particles that may be responsible for cosmic dark matter can be precisely determined by LHC and such a machine working together.

UK university groups and STFC laboratories have developed internationally recognised expertise in important areas for future colliders.

UK effort in particle accelerator technology has been enhanced through the creation of two new accelerator institutes, the Cockcroft Institute and the John Adams Institute. Work on future electron-positron colliders has been directed towards the simulation and design of the beam delivery system and in technologies such as alignment and feedback, which are broadly applicable. The new expertise we are building up in these areas will also benefit future projects such as free-electron and synchrotron light sources for the life sciences. The UK's work on high power proton accelerators and muon beam cooling with the MICE experiment positions us well to contribute to a future muon collider.

In the detector area, the UK has expertise in technology areas required for future precision colliders, such as very precise detectors to be placed very close to the collision point, and precise but large-scale energy measurement devices (calorimeters). Both themes make use of and enhance our underlying expertise in solid-state pixel detectors, which have applications in many other areas (such as Diamond and XFEL).

Funding & partnerships
A number of concepts for such a facility are being pursued. The International Linear Collider group is carrying out a Global Design Effort, drawing together researchers form Europe, the Americas and Asia. A Reference Design Report was published at the end of 2006 including detailed costing information for sites in Europe, Japan and in the US. The machine will be 30 - 40 km in total length.

Alternative concepts include the Compact Linear Collider involving groups from CERN and elsewhere, and the possibility of colliding beams of muons rather than electrons and positrons, which is technically challenging but offers potential synergies with a neutrino physics programme.

The earliest that any decision could be made to go ahead with construction on one of these options is around 2010-12, when physics results from the LHC become available.

The UK is engaged in global discussions on future colliders through the Funding Agencies for Large Colliders group (FALC). The international funding agencies from Germany, Spain, Canada, US, UK, Italy, Japan, Korea, India, China, France and CERN (representing the other European member states) have established this group to provide a forum where technical and financial issues are discussed.

Estimated cost	Likely to be more than £5 billion
Estimated operational date	Likely after 2020

Information
See for example
http://www.linearcollider.org/
http://clic-study.web.cern.ch/
http://www.cap.bnl.gov/mumu/

Ground-Based and Airborne Mobile Atmospheric Observatory

Background
Atmospheric science plays the central role in the science of climate change, from the understanding of changes to atmospheric composition to the local atmospheric hazards resulting from climate change. The key scientific and technical challenges currently faced by the UK atmospheric science research community include climate change science, weather processes, atmospheric composition (including air quality) and state-of-the-art technologies for observing and modelling the atmosphere.

Existing capability
The National Centre for Atmospheric Science (NCAS), a NERC institute, provides national ground-based and airborne atmospheric observing capability. A crucial aspect of atmospheric research involves making measurements to test predictions of model runs, and to investigate natural phenomena. These measurements are usually made during field campaigns that have been funded through NERC and held worldwide.

New capability
The sophistication of the science required for environmental prediction (both on "weather" and "climate" timescales) advances rapidly, as does the available technology.

NCAS therefore needs to invest in infrastructure to maintain its leading position and to adequately support the NERC community. The plan is for a new, state-of-the-art mobile observing facility, making use of the latest remote sensing and in situ measurement technology, to address the atmospheric processes and climate challenges of the 21st century.

This project will ensure that the UK remains at the forefront of international atmospheric science measurement.

Funding & partnerships
Funding will be sought from Research Councils and collaborative engagement with other national and European funding agencies.

Most atmospheric field campaigns are collaborative with international groups and in addition European scientists pay for direct use of NCAS instrumentation. NCAS is developing strategic alliances with other European countries and the USA to share major observing facilities.

Estimated cost	£6.3 million
Estimated operational date	Within 5 years

Information
http://www.ncas.ac.uk/

High Power Laser Energy Research Project

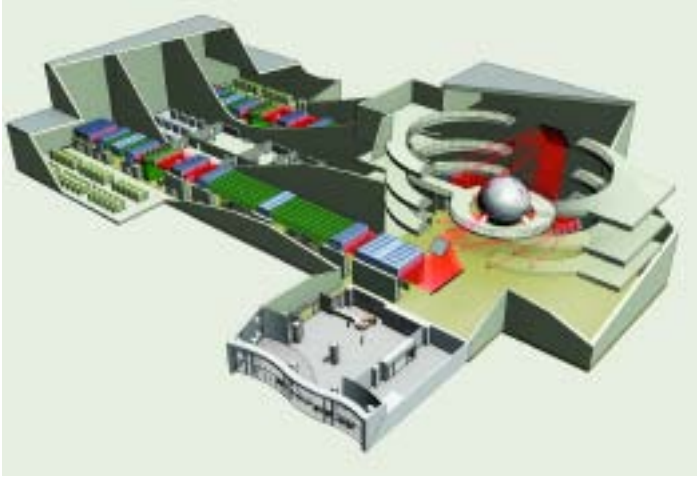
Background
High Power Laser Energy Research Project (HiPER) is a UK initiative for Europe to take a world leading position in the demonstration of inertial fusion energy and the science of extreme conditions. This approach to energy and science is made feasible by the advent of a revolutionary approach to laser-driven fusion known as fast ignition. HiPER will make use of laser technology in a unique configuration, allowing fusion fuel to be compressed and then ignited to induce a propagating burn wave yielding significant energy gain.

HiPER has been designed to marry together the establishment of European leadership in the science of extreme conditions with the key societal challenge facing mankind: a long-term supply of clean energy.

New capability
The science case offers a compelling argument for a step-change in laser capability for European academics. Its proposed science programme covers the entire spectrum of this rapidly developing field, with a facility capability that will offer unprecedented, internationally unique tools for the creation and quantitative diagnosis of high energy-density matter. The principal science areas range from laboratory astrophysics to fundamental atomic physics. The science includes the unexplained field of warm dense matter, transient non-equilibrium nuclear physics, planetary geophysics, relativistic particle beam creation and application, and turbulence. It also includes the physics of matter at extremes of temperature, density and pressure, or under extreme magnetic or electric fields, or in systems whose behaviour is dominated by radiation or burn physics.

The energy mission is aimed at establishing the case for the exploitation of laser driven fusion. It is timed to coincide with the upcoming demonstration of energy production from lasers (in around 2010-2012 in the USA). HiPER will illustrate the route to viable power generation by addressing the key R&D challenges, both scientifically and technologically. Multiple energy solutions are demanded by a risk-balanced strategy for energy supply, with fusion able to offer the "holy grail" of energy sources – limitless fuel with no carbon or unmanageable radioactive by-products, energy security, and a scale able to meet the long term demand. Laser fusion is highly complementary to ITER, and is based on a proven scientific technique.

European industry is very well placed to capitalise on HiPER (in the construction, operation and decommissioning phases). Indeed, this is a cornerstone of one key aspect of the consortium negotiations to date. With regard to the future energy applications of HiPER, the potential economic impact cannot be overstated. The



energy market is currently €3 trillion pa. HiPER would secure European (and UK) leadership in a field which is rapidly developing in Asia and the USA.

Funding & partnerships
The HiPER project is a consortium of seven European countries at the national level (Czech Republic, France, Greece, Italy, Portugal, Spain, with the UK taking the coordinating role), two regional governments (Madrid and Aquitaine), industry, plus scientists from four other countries (Poland, Germany, Russia, USA) and international links to Japan, South Korea, China and Canada. It has just completed a 2-year conceptual design. It will enter a 3-year preparatory phase project in 2008, with construction envisaged for the latter half of next decade. The facility will be the culmination of a strategic alliance of laser capabilities across Europe, for which the next (intermediate) step, PETAL, is currently under construction near Bordeaux at a cost of about €80 million. Technical work associated with the 3-year preparatory phase has funding (in-kind or direct) from UK, France, Czech Republic, Greece, Spain, Italy, Poland, Portugal, plus likely institutional funding in-kind from Germany, South Korea, Canada, USA, Japan, China. This amounts to €53 million in relevant funding, including existing staff and experiments on existing facilities. A further €15 million of direct funding is required from the EC and the national partners to fulfil the requirements of the preparatory phase from 2008.

HiPER has also signed agreements-in-principle with two other preparatory phase projects (E-ELT and ELI), and has arranged to make use of a series of bilateral agreements with non-European nations to share technology and non-technical information of mutual interest.

Estimated cost	€500 million
Estimated operational date	2017-2019

Information
http://www.hiper-laser.org/

Infrafrontier

Background
The mouse is the most commonly used model system to understand the molecular basis of health and disease in humans. Programmes are underway to generate mouse mutants for every gene in the mouse genome, creating a huge resource of potential models for the study of human disease. Current capacity to exploit this resource, however, is limited as existing facilities across Europe can only offer limited capacity for the characterisation, dissemination and archiving of mouse disease models. The current capacities, governance structures and funding strategies of existing infrastructures will not be able to meet the upcoming urgent needs. Current capacity is sufficient for the analysis and dissemination of only a few hundred disease models per year

New capability
A large scale, pan-European networked activity is required to organise phenotyping, archiving, and distribution of the tens of thousands mouse models likely to become available in the next decade. Infrafrontier has two components:

- Phenomefrontier - which plans to provide a European platform offering access to comprehensive phenotyping, facilities, including the latest in vivo imaging technologies using non-invasive methods as well as informatics tools to handle the phenotype data, and
- Archivefrontier - which will archive and distribute mouse models to the highest quality standards, with a major upgrade of the existing European Mouse Mutant Archive (EMMA).

Both components build on previous European/FP6 initiatives in mouse genomics; PRIME (to integrate and harmonise functional genomics research) and EMMA (distributed archive network). The MRC Mammalian Genetics Unit/Mary Lyon Centre (see page 13) is a key partner in the network proposal which includes plans to upgrade current facilities and construct new ones.
One of the major challenges for the 21st century is the functional annotation of the human genome and understanding the link between genes and disease. The

two parts of the project will enable European laboratories to make effective use of the mouse models in the global effort to meet this challenge. Infrafrontier will guarantee the accessibility of mouse models and will be essential to facilitate their exploitation. Such models are therefore of key importance to the pharmaceutical industry and in the development of novel biological and cell based therapies in the biotechnology sector. Both the access to facilities and the development of the skills base in mouse models will be important in maintaining the attractiveness of Europe as a base for research and development activities of international pharmaceutical and biotechnology companies

Funding & partnerships
The project is at an early stage and the full scientific case and costing model have yet to be developed.

The MRC Mammalian Genetics Unit, European Molecular Biology Laboratory and MRC are participants in the proposal for preparatory phase FP7 funding .

Partnership with the planned ESFRI project – ELIXIR
Estimated cost €320 million
Estimated operational date 2017

Information
http://www.infrafrontier.eu/

Left: Normally developing mouse embryo **Right:** Mouse embryo with open neural tube in the developing brain (exencephaly) and spinal cord (spinal bifida), extensive oedema caused by a severe congenital heart defect, and malformation of the limb

Infrastructures for Clinical Trials and Bio-therapy

Summary
The development of therapeutic innovations requires access to large populations of patients. Infrastructures supporting patient enrolment in clinical trials, data management, quality assurance, monitoring, ethics and regulatory affairs are required for quality and credibility of data and successful performance of clinical trials. Such networks covering clinical research centres and clinical trial units have been created at national level in some member states of the European Union, including the UK Clinical Research Network in the UK.

New capability
To ensure the competitiveness of European clinical research, and avoid fragmentation of health and legislative systems across countries, there needs to be an efficient, integrated, and professionalised infrastructure to support clinical trials including patient recruitment and investigation, data management, good manufacturing practice of biotherapy products, quality assurance, monitoring, ethics, regulatory affairs and adverse event reporting.

The network will improve the quality and efficiency of clinical research and take advantage of the European population and competencies, unlocking latent expertise and patients scattered across the EU member states.

An integrated European clinical research network should also enhance UK and European competitiveness for commercially driven health research and has the potential to strengthen healthcare markets

Funding & partnerships
The project is at an early stage and the full scientific case and costing model have yet to be developed.

MRC is a partner in the preparatory phase FP7 application, which the Department of Health is also supporting.

Partnership with other ESFRI projects - BBMRI and EATRIS (pages 44 and 50)

Estimated cost €36 million

Information
http://www.ecrin.org/

Instrumented Autonomous Global Observing System - European Research Infrastructure

Background
Global climate change represents arguably the most serious environmental issue facing mankind today, with implications for global political stability and the global economy. Reliable predictions of the future climate using climate models are a central and fundamental requirement for determining future mitigation strategies.

New capability
It is proposed to establish a sustainable distributed infrastructure for global observations of atmospheric composition from a large fleet of in-service aircraft. This will be achieved by installing autonomous instrument packages aboard, initially, 10-20 long-range aircraft of internationally operating airlines. Instrumented Autonomous Global Observing System - European Research Infrastructure (IAGOS-ERI) will provide high quality in situ observations of greenhouse gases and reactive gases, aerosol and cloud particles in the tropopause region, which is not adequately resolved by remote sensing from space but is one of the most sensitive regions for climate change. At the same time, IAGOS-ERI will provide detailed vertical profiles in the troposphere, which are of paramount importance for predicting changes in local and regional air quality and their causes.

The particular value of routine measurements from commercial aircraft is that they provide fundamentally calibrated long-term observations of critical chemical species, aerosols and clouds in the upper troposphere and lower stratosphere, a region which is critical for climate change and which is otherwise data-sparse. The use of commercial aircraft allows the collection of highly relevant observations on a scale and in numbers impossible to achieve using research aircraft, and where other measurement methods (e.g. satellites) have technical limitations.

Besides providing improved technology for sustainable operation and improved global coverage, IAGOS will develop new instruments for regular high quality measurements of CO_2, NOx, stratospheric H_2O, aerosol and cloud particles. Regular vertical profiles of CO_2 will provide a unique set of information for the validation of regional and global carbon cycle models used for the verification of CO_2 emissions and Kyoto monitoring. IAGOS-ERI will provide technological advances that are essential for atmospheric observations in currently observation-sparse regions of the atmosphere.

Near real-time products will be disseminated through the meteorological Global Transmission System, accessed by national weather services and ECMWF and transmitted to environmental agencies for their contribution to the GMES initiative. Near real-time IAGOS-ERI data will be used in automated validation procedures to assess weather forecasts in national meteorological centres and chemical weather forecasts in GMES centres. These data will also be assimilated to initialise air quality model forecasts managed by regional agencies. Downstream services of GMES, including environmental engineering societies may also use such data.

Funding & partnerships
Funding will be sought from participating European nations. Support is being sought under the EU Framework Programme 7 preparatory phase funding.

NERC is a participant in the IAGOS-ERI project.

Estimated cost	€20 million
Estimated operational date	2012

Information
http://www.fz-juelich.de/icg/icg-2/iagos

Integrated Carbon Observation System

Background
Unlike meteorological parameters that have been routinely collected by meteorological services for 50 years and for which global satellite observations have existed for 30 years, with secure commitments for the future, there is no co-ordinated system to measure atmospheric greenhouse gas concentrations in Europe. Only about half of the anthropogenic CO_2 emissions accumulates in the atmosphere, while the remainder is taken up by land and oceans on average in similar proportions. However, these sinks vary strongly in time and space. Quantifying present-day carbon sources and sinks and understanding the underlying carbon mechanisms are prerequisites to informed policy decisions.

Future capability
ICOS (Integrated Carbon Observation System) will provide the infrastructure for determining the greenhouse balance of Europe and of adjacent key regions of Siberia and Africa in support of climate change and biodiversity research. It consists of a harmonised network of ecosystem long-term observation sites and a network of atmospheric greenhouse gas concentration sites. The networks will be coordinated through a set of central facilities, including an atmospheric and an ecosystem thematic centre, a central data centre and an analytical laboratory.

Better understanding of vulnerability and regional feedbacks between climate and biosphere is the prerequisite for predicting the response of the earth system to global change. Research priorities for the coming years in the field of global and regional climate-biosphere feedbacks cannot be addressed without dense, consistent, long-term, integrated observations of trace gases and relevant environmental tracers and ecosystem parameters as those provided by ICOS. The ICOS observational data and secondary data products form the basis for improved understanding and adequate human action. ICOS will significantly enhance the observational basis and accessibility of observational data in benefit to the applied and basic scientific community ecosystems on land (forestry, agriculture, water resources) and in the seas (aquaculture, fisheries).

Funding & partnerships
Preparatory costs are €5 million, with total costs for implementation and operation over 20 years being about €270 million. The decommissioning cost is €7 million. The preparatory phase is funded by the EU under Framework Programme 7.

The UK provides one of the 16 research laboratories participating in the preparatory phase.

Estimated cost	€275 million
Estimated operational date	2012

Information
http://www.icos-infrastructure.eu/

Integrated Structural Biology Infrastructure

Summary
One of the grand challenges in biology is to combine the molecular structures of cell components into knowledge of the way in which cells function. The major challenge for structural biology in the next two decades will be the integration of structural knowledge at different resolution levels into specific cellular contexts, moving from structural biology to integrative structural cell biology. This will underpin biomedical sciences. The challenge requires a combination of structural biology techniques, providing information in different resolution ranges, and bridging the gaps between them. Furthermore, besides the static picture of a cell at different scales, there is a temporal component that is crucial and understanding cell biology requires consideration of the dynamics of these different processes.

New capability
The Integrated Structural Biology Infrastructure (INSTRUCT) project plans to link several European Centres with expertise in a particular structural biology approach (e.g. Italy - NMR; UK - crystallography) into a network to maximise interchange and application of parallel technologies to specific problems. Existing centres will be upgraded and new centres will be established. Each centre will maintain a set of core technologies including protein production, NMR, crystallography and various forms of microscopy. All centres will need instrumentation to be updated, the acquisition of new advanced equipment and the consolidation of mechanisms for allowing external access. There is a continuous need for technology upgrades and advancements to follow up and promote methodological developments in the field.

Europe has a large, innovative structural biology community that is internationally renowned and has successfully secured EU project funding in the past. The Centres will be open to the European academic and industrial community and will provide, on a project basis, access to production and experimental facilities.
The planned infrastructure will provide world-class facilities and make Europe competitive in structural biology. The requirements for highest precision instrumentation will challenge European industry to improve their capabilities and the use of the facilities for industrial research will strengthen Europe's industrial competitiveness, in particular in biotechnology and pharmaceutical companies.

Funding & partnerships
The project is at an early stage and the full scientific case and costing model have yet to be developed.

The proposal for preparatory phase FP7 funding is being led from the UK. MRC is a participant on the FP7 application and is leading the section of the work plan on the financial framework.

Partnerships with other European synchrotron facilities include ESRF, DESY, PETRA, BESY, SLS, LUCIA, Soleil, Diamond, the Trieste and SCANDINAVIA sources, and other neutron sources including ILL, Julich and ISIS.

With the planned ESFRI project - ELIXIR (see page 53)

Estimated cost	€300 million
Estimated operational date	2008

Information
http://www.instruct-fp7.eu/

Life Watch

Background
Planet Earth is a complex system driven by multiple interactions between human society and the natural environment. We have come to realise that biodiversity – the variety of biological species that inhabit the earth, the genes they contain and the ecosystems in which they live – is essential for maintaining the goods and services that our planet provides. The current rapid loss of biodiversity, added to climate change and population growth, is a new global phenomenon that requires entirely new approaches and mitigation strategies together with a societal response that must deal with the full spectrum of human socio-economic activities as well as with the ecological complexity of the world.

The decisions that society has to make and the actions that are necessary require high quality scientific information, knowledge and expertise of a kind that is presently at least scattered and inadequate, and mostly unavailable.

Building a system that allows us to understand Europe's biodiversity and ecosystems – from the pristine deep ocean to the human dominated agricultural land, roads and cities – and from that knowledge and information build the basis for adequate management, sustainable development and informed, rational decision-making, is the core of the Life Watch project. Life Watch will serve to support the scientific research and compile, use and transfer to policy-makers and the public the scientific information necessary and required for the understanding and rational management of our ecosystems on land (forestry, agriculture, water resources) and in the seas (aquaculture, fisheries).

New capability
Life Watch will construct and bring into operation the facilities, hardware, software and governance structures for research on the protection, management and sustainable use of biodiversity. It will comprise facilities for data generation and processing, a network of observatories, facilities for data integration and interoperability, virtual laboratories offering a range of analytical and modelling tools, and a service centre providing special services for scientific and policy users, including training and research opportunities for young scientists.

The pan-European approach of the facility will lead to substantial synergies in biodiversity research. The new infrastructure will integrate the full potential of taxonomic and ecosystem information with genomic data from other sources in an international (virtual) laboratory environment. The wealth of large data sets from different levels of biodiversity opens up new and exciting research opportunities. Comparative data mining in large-scale data sets allows for studying patterns and mechanisms across different levels of biodiversity. The large-scale approach supports understanding (and managing) the impacts of climate change on the distribution, adaptation and functions of biodiversity.

The facility will support the research necessary to meet the policy objectives in *EC Communication: Sustaining Ecosystem Services for Human Well-Being* (2006) and will be a major component of the European contribution to GEOSS.

Funding & Partnerships
Funding will be sought from participating European nations. Support is being sought under the EU's Framework Programme 7 preparatory phase funding.

NERC is a participant in the Life Watch project.

Estimated cost	€370 million
Estimated operational date	2014

Information
http://www.lifewatch.eu/

National Academic Drug Development Facility

Background
The proposal for a National Academic Drug Development Facility is intended to provide state-of-the-art, comprehensive facilities to support the conduct of early clinical studies, and specifically clinical pharmacological studies to accelerate the discovery and development of novel therapeutics. It would allow the academic community to undertake pharmacodynamic, pharmacokinetic, genomic and biomarker research studies associated with the development of novel therapeutic interventions. There may also be scope to include dedicated medicinal chemistry facilities.

New capability
The proposed facility would provide leading edge facilities, technologies and expertise not currently existing in academic departments to accelerate the discovery of novel pathways of disease, and therefore potential targets for therapeutic intervention ("druggable targets"); facilitate the development of novel therapeutic interventions, especially in disease areas that are not well served by industry ("orphan areas"); provide a focus for training in in vivo sciences (especially clinical pharmacology) and medicinal chemistry; the discovery of biomarkers of disease aetiology and progression, surrogates of outcome, and of toxicological markers.

The facility will also provide cost-efficient use of highly specialised technologies and increased UK competitiveness in translational medical research, making it a more attractive option for international pharmaceutical, biotechnology, and device/diagnostic industry investment.

The facility will enable faster discovery and development of therapeutic interventions and bring substantial added value to existing investments in centres of excellence in experimental medicine and translational research.

Funding & partnerships
The project is at an early stage of development and the options of how best to deliver such a national facility, either as a single physical entity or as a consortium of geographically distinct centres (each with differing but complementary expertises and technologies) still need to be considered.

The infrastructure for such a facility would require funding from LFCF and MRC with potential for other Research Council involvement. Furthermore, there is the possibility that other significant funders of medical research may wish to contribute if it helped to deliver their strategic goals. The pharmaceutical, biotechnology, and devices/diagnostics sectors would be key stakeholders.

There is potential for partnership with other ESFRI projects - BBMRI (see page 44), EATRIS (see page 50) and ECRIN (see page 62).

Neutrino Factory

Background
In the last decade, it has become clear that neutrinos have non-zero masses, and mix strongly with each other; moreover neutrinos and their antiparticles may not be distinct entities. The masses are tiny, and probably do not arise, as other particle masses are postulated to do, from the Higgs boson. Indeed, neutrino masses may give us a window on physics at extremely high energy scales. It is also quite plausible that neutrino interactions of a type known as "CP violation" very early after the Big Bang may be responsible for the very existence of a universe filled with matter.

Future capability
The UK is pursuing a broad and incisive programme of neutrino physics, including the MINOS, T2K and SuperNEMO experiments, but to fully explore these phenomena will require a new type of accelerator – a Neutrino Factory based on a muon storage ring. The Beams for European Neutrino Experiments working group concluded that this would offer the best physics reach of any future neutrino facility.

To employ a muon storage ring as a Neutrino Factory it would be necessary to store muons within microseconds of production, followed by ionisation cooling of the muon beam. One of the favoured accelerator technologies for a neutrino factory is a circular ring called an FFAG. The FFAG also has a potential application as a medical accelerator where it could provide a robust and reliable source of hadrons and ions for cancer therapy. A prototype FFAG ring called EMMA is being constructed at Daresbury Laboratory and will explore both the neutrino factory requirements and the medical applicability of the technique.

The existing high-power proton accelerator infrastructure at RAL makes the UK a credible site for a Neutrino Factory, the only currently plausible scenario in which a frontier particle physics accelerator facility might be built in the UK, bringing significant direct and indirect economic benefits.

Funding & partnerships
The MICE experiment at RAL is the first attempt to demonstrate the feasibility of this technology. An international collaboration of roughly 150 physicists from eight countries is working on this experiment. Phase I of MICE (beamline and detectors) is nearing completion and a funding package for Phase II, which will add the cooling stages, is being supported by STFC. Our goal is to have completed the design study, and to have results from the MICE experiment at RAL by the end of the decade in order to inform a potential construction decision on that timescale.

In parallel, we are supporting an International Design Study of a Neutrino Factory as a global effort, with European collaboration likely supported through the seventh EU framework programme, with the aim of RAL being the host laboratory for the design study effort.

Estimated cost	£2 billion
Estimated operational date	After 2015

New Light Source

Background
A major challenge for science is to measure the structure and the dynamics of matter, the latter at the timescale upon which it unfolds. The full imaging of structural dynamics is not possible with conventional sources because the small scale dynamics of matter are usually too rapid to be captured. These ultra-fast structural dynamics will be accessible to the new facility. It is anticipated that the New Light Source (NLS) will open exciting new opportunities in material science, chemical science, nano-science, life sciences (including pharmaceutical and biomolecular applications) and in high energy density science.

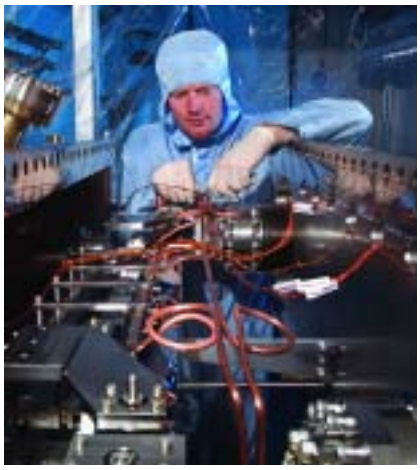
The NLS is likely to lead to new fundamental understandings and capabilities across a diverse range of science. Scientific disciplines over this diverse range (e.g. cell biology, material science, surface science, molecular sciences and quantum control) will be strongly impacted. Other aspects of the research that is enabled through NLS will impact directly into important technological areas, for example the development of nanotechnology, drug discovery and energy and medical research. In this way there will be a direct coupling to a number of important industrial sectors.

NLS will be a science driven project, the broad science objectives will be defined in the light of technical possibilities before the detailed facility specifications are developed. The project will be a joint effort over a wide range of scientific disciplines including, e.g. material scientists, life scientists, chemists, physicists, accelerator scientists and laser scientists.

Future capability
The NLS project is a proposed UK-based free-electron-laser (FEL) light source facility intended to have unique and world leading capabilities, especially in regard to short pulse duration and high intensity. It is anticipated that the facility would integrate advanced conventional lasers and a FEL with an optimised time structure and a broad photon energy range. By providing the means to directly measure ultra-fast structural dynamics it will enable new science and technology.

The project is now entering into a consultation phase in order to identify the key science drivers. Once these are established a detailed technical specification will be generated that defines the photon energy range, the additional conventional laser capability that the facility requires and the intensity and pulse duration specifications. Regardless of the final specifications, the science challenges that the NLS aspires to address include the following:

- Measuring structural dynamics in matter of all kinds;
- Structural imaging of biomolecules not accessible to conventional methods;
- Understanding warm dense matter;
- Using light to control, rather than simply observe, complex matter;
- Studying matter far from equilibrium and tracking phase changes in real time;
- Measuring electronic dynamics in real time: attosecond science;



Funding & partnerships
STFC has launched an initial phase of the NLS project, to deliver a vision for the key scientific goals, conceptual design, a costed proposal and an outline business case for this photon source.

The case for the NLS will be developed over the period April 2008 to October 2009. The first phase of the project, to be completed by October 2008, will be done through wide consultation with the scientific community to identify the key science drivers and define the broad facility specification. The science case based upon the consultation will be delivered for STFC consideration in October 2008. Following review by STFC, the project will proceed to a conceptual design study in which the detailed science aims and the technical details of the facility to achieve these will be fully defined. It is anticipated to be submitted for further consideration in October 2009. In the second phase significant input of staff time from STFC, Diamond and a number of HEIs is required.

The present proposal is jointly supported by STFC and Diamond Light Source coupled to strong HEI involvement.

Due to the early stage of consultation we do not yet have a definitive technical design and so the cost remains uncertain but will likely exceed £100 million. A more definite cost will be determined at the end of the first consultation phase (later in 2008).

Delivery is planned for 2015.

Information
http://www.newlightsource.org

Next Generation Neutron Sources

Background
The 2005 UK Neutron Review concluded that the broad range of applications for neutrons makes them an essential tool in the discovery, understanding and applications of science in areas which are vital to the UK science and technology base.

The Neutron Review also concluded that:

- UK scientists will continue to require access to the best possible neutron facilities for the foreseeable future and, in particular, to a next generation facility that is competitive with other similar projects underway in the USA and Japan, within fifteen years;
- There should be enhanced investment in ILL and ISIS, jointly with international partners, that will sustain the international competitiveness of these world-leading facilities for the 10-15 years;
- the UK is a highly credible country that could host a European next generation neutron source;
- the UK has the potential to build a megawatt-class spallation neutron source through the upgrade of ISIS, but should defer further planning for this option until the outcome of the wider discussions on European plans is known;
- the UK should, with immediate effect, join international projects addressing key technology developments associated with the next generation of neutron sources.

New capability
The UK has made major scientific and technical contributions to the planning and development of next generation neutron sources, including SNS, J-PARC and to various design studies for a next generation European spallation neutron source, and will continue to do so since we have the highest concentration of relevant expertise in Europe. The UK is cautious with respect to the start of construction of a next generation European source, preferring to build on lessons learned from the operation of the new US and Japanese sources.

The UK has established a position of international leadership in the development of neutron-based techniques and, through facilities at ISIS and ILL, provides a unique platform to enable major contributions in areas crucial to society, such as in energy, health, transport and bioscience.

The research carried out at a next generation neutron source has a strong synergy with the Diamond Light Source, Central Laser Facility, the Materials Innovation Institute and the Hartree Computational Science Centre, and will engage with the needs of industry.

Funding & partnerships
There are three inter-linked projects in terms of both costs and schedule - ILL upgrade, ISIS MW upgrade and the European Spallation Source (ESS) as defined in the ESFRI Roadmap. An effective capital budget profile that would cover most potential options would ramp from an initial £3 million in FY08/09 (allowing a rapid additional investment in ILL and subsequent exploitation for a decade or more) to a plateau of £25-35 million per year needed to allow the realisation of the next generation neutron source. Depending on negotiations with other European countries, subsequent investment would be either directed towards ESS, if the future of ILL were in doubt beyond 2020, or towards an ISIS MW upgrade plus a major investment into ILL infrastructure. In either case there is a need for a design/development/prototyping phase before full construction commences. The plan aims to maintain the capacity of UK accessible neutron facilities while steadily increasing the capability. The initial financing phase is crucial since lack of investment in ILL could lead to a weakening of the user community during the construction phase of any new source and so reduce our ability to benefit from eventual exploitation.

The UK is one of three main partners in the ILL. France and Germany would be expected to match UK funding for ILL. Potential sources of funding for the ISIS MW upgrade (£500 million) are the UK (50 per cent) and European partners. Funding for the ESS (£1 billion) might be expected to follow a pro-rata GDP contribution except for the host country.

Estimated cost	£25-35 million pa over 8 years
Estimated operational date	2015 MW ISIS 2020 ESS

Information
http://www.neutrons.cclrc.ac.uk/

Research Facility for the Birth Cohort Studies

Background
The British Birth Cohort Studies are recognised worldwide as unique and remarkable longitudinal research resources.

Existing capability
Since 1946, and at approximate 10-12 year intervals, each new cohort study has provided invaluable research evidence on a wide range of topics including the antecedents and consequences of child poverty, smoking in pregnancy, crime and antisocial behaviour, the long term impacts of education and training and lifestyle links to the early onset of cardio-vascular and other diseases.

While each cohort has revealed much new evidence to inform health, educational, social and economic policy, the full potential of these studies can now be realised by intercohort comparison. Collectively they have grown and developed in importance as a set of studies which provide unprecedented opportunities for comparative investigation of the links between upbringing, family structure, education, employment, retirement and health. They provide analysts with the opportunity to investigate phenomena using individual-level longitudinal analyses within a comparative framework – one of the most powerful analytical methods available in the absence of randomised controlled studies. In combination, the studies present an unprecedented opportunity to investigate the forces and patterns that have shaped and continue to shape the lives of three overlapping generations, the majority of whom are still living in the UK today.

Future capability
However, for the last 60 years the birth cohort studies have evolved separately. The proposal is to for a new facility which will integrate, harmonise and extend them. To achieve this goal, the key features of the research laboratory are:

- To house and maintain five existing major birth cohort studies, providing continued information from approximately 60,000 individuals covering a wide range of topics (health, educational development, family circumstances, social behaviour, employment, lifestyle activities, etc);
- To promote the integration of a wide range of social and economic variables with biomedical samples (e.g blood, saliva) and health information. These data will be linked to newly available administrative data sources (e.g. school, social security, tax and hospital records);
- To launch a new birth cohort study;
- To undertake or coordinate new data collection for the five studies from 2010 and 2012 (based on current data collection cycles);

- To promote intercohort comparison via the adoption of common data collection methods and instruments, and by reprocessing of existing data;
- To set up and operate a Remote Secure Access Facility for the analysis of sensitive data which cannot be freely distributed to researchers. This includes linkage to administrative records and biomedical detail.

The research facility will be path breaking. It will enable unprecedented understandings of how economic, social and biological factors combine to explain human behaviour in important areas such as health, poverty, child development and healthy ageing. New interdisciplinary work will be possible between economists, epidemiologists, geneticists, psychologists and sociologists. Research interest in the facility will be worldwide, especially in North America and other EU countries.

There is no other country in the world which has the opportunity that the UK now has to develop its birth cohort studies within an integrated framework.

Funding & partnerships
The estimated cost of the British Birth Cohort Facility, including full economic costs over the next five years is £105 million.

However, there will be major opportunities to secure additional co-funding from foundations, international sources and government departments, which currently co-sponsor some of the existing cohort studies.

Estimated cost	£105 million
Estimated operational date	2010

Secure Data Service

Background
Sensitive data are defined as those which are potentially 'disclosive' (i.e. they could, in conjunction with other data, reveal the identity of an individual or an organisation) or are protected under legislation which limits their distribution to researchers.

Access arrangements to sensitive data are varied. Some data collections are only available 'on site' - that is, in the premises of the data collection agency - and in a strictly controlled environment. Others are available only special conditions regarding they way they are stored, analysed and destroyed after use. Various procedures are currently being trailed to facilitate better access for research purposes while safeguarding the confidential nature of certain datasets. These range from new data licensing arrangements to the development of secure virtual data laboratories. As part of these developments ESRC plans to establish the Secure Data Service.

Existing capability
ESRC currently funds (or cofunds with others) the collection of information from individuals and/or organisations and makes such data available to the research community via the Economic and Social Data Service (ESDS). Basic identifying information (names of people/organisations, addresses, detailed spatial identifiers) is always removed from such data before to their deposit with the ESDS, in accordance with guarantees of confidentiality given to respondents.

Future capability
To support the development of the National Strategy for Data Resources for Research in the Social Sciences, ESRC plans to establish Secure Data Service (SDS). This service will provide controlled access to sensitive and/or disclosive personal or organisational information which cannot be released for research purposes under End User Licence or Special Licence conditions.

Access to data placed within the Secure Data Service (SDS) will be managed and operated by the service provider, according to rules and conditions established by the individuals with responsibility for the guardianship of the data. These may vary from source to source, but will provide for the following:

- a secure environment, within which sensitive microdata will be held;
- an information function, via which the research community will be made aware of the resources held within the SDS and the procedures required to gain access;
- an application, authorisation and authentication process through which researchers will make application to access data held within the Secure Data Service;
- a remote access facility, via which authorised and authenticated researchers will gain access to specific data and software held in the secure environment;
- screening procedures to ensure that research outputs requested by researchers are checked to ensure that the conditions specified by the data guardian(s) regarding release of research outputs are satisfied.

The establishment the Secure Data Service will help to ensure that the full research potential of these resources is exploited. It will permit researchers to carry out detailed work to link data and/or to create new analytical variables or to undertake analytical procedures which require access to detailed identifying information. Other examples include the development of linked data where the linked variables are disclosive, and the provision of administrative data from government departments/agencies where the provider stipulates that such data cannot be held outside a secure environment

Several countries have or are planning the development of similar services. Through ESRC membership of the International Data Forum, the service will take account and learn from developments occurring internationally.

Funding & partnerships
ESRC will seek outline proposals to establish the service. From these the ESRC will judge the most appropriate level of resources to allocate to the Service.

The Service is being established in consultation with members of the UK Data Forum. At present there is no expectation of supplementary funding from other organisations.

Estimated cost	£300,000
Estimated operational date	2008

Square Kilometre Array

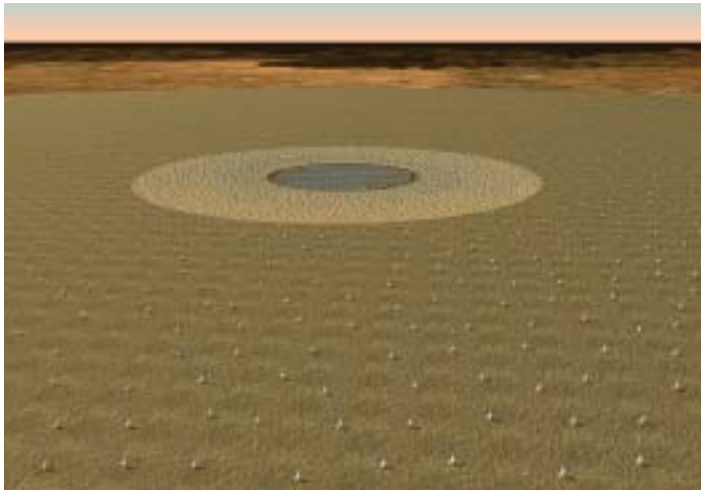
Background
The proposed Square Kilometre Array (SKA) will attack many of the most important problems in cosmology and fundamental physics. Observations of pulsars will detect cosmic gravitational waves and test General Relativity in the vicinity of black holes. It will study the distribution of neutral hydrogen in a billion galaxies across cosmic history, thus making it possible to map the formation and evolution of galaxies, study the nature of dark energy and probe the epoch when the first stars were born. In addition, it will also study the formation of planetary systems and address the search for extraterrestrial life. The major increase in performance compared to existing telescopes, and the flexibility inherent in the likely telescope design suggests that the SKA will be a transformational science tool.

New capability
SKA represents the future of world radio astronomy, complimentary to developments such as the ELT for optical/infrared observations. It will scan and map the radio sky with >100-times better sensitivity than is currently possible and will attack many of the most important problems in general relativity, cosmology and astrophysics. The SKA will be a distributed array of collecting "stations" - each of area about 10,000 m^2 - spread out over 100s of km. The frequency coverage will extend from about 0.1 to about 20 GHz.

From the outset, the development of the SKA, within the timescale and a reasonable budget, is predicated upon partnering technology development with industry. A large part of the facility will require mass replication of components and subsystems. R&D work in the UK is focusing on detailing the required technologies and then working with UK industry to identify the optimal manufacturing route. It is expected that this work should ensure that the UK's return is at least as strong as its potential investment

In addition to the step-wise scientific impact, with resulting opportunities for UK scientists to build on our strong heritage of radio astronomy and astrophysics and cosmology research, the broader opportunities for public interest, building on the wide-ranging science aims, are considerable. The SKA will also provide a major opportunity for the training of researchers.

Funding & partnerships
Due to the size and complexity of the project, the SKA is being planned from the outset as a global endeavour with technical, management and organisational input currently coming from scientists and administrators in over 15 different countries. A choice of site, likely to be in the Southern Hemisphere, is expected in 2008 or 2009.



Support for the current research and development phase of the SKA in the UK has been provided under the EU FP6 'SKA Design Study' (SKADS) programme and through matched STFC funding. Following the inclusion of the SKA in the ESFRI Roadmap, STFC is now acting as coordinator for a bid (about €7.5 million) for continuing funding from EU FP7 for the period 2008-2011. Funding to move into the construction of SKA Phase 1 will require substantial investment from all participants, including consortia and agencies in Europe, North America, Australia and potential partners in Japan, China and India. Europe is expected to take a 40% share in the global project, and 25% of the European share would be appropriate for the UK equivalent to about £70 million in the period 2010 to 2020. STFC is currently funding the R&D activity at around £1.5 million per year, and this is expected to rise to around £2 million within the next few years. Assuming construction of the Phase B array by 2015, an additional UK fund of £20 million might be required from the LFCF over 5 years.

Already global in conception, funding agencies and scientists are now working together to explore the appropriate legal, policy and technical framework required for the SKA. Recently the SKA partners in South Africa and Australia have announced their intention to proceed with SKA 'Pathfinder' telescopes, which along with European endeavours such as LOFAR and similar development programmes in the USA, together provide part of the technical basis on which the SKA design will develop.

Estimated cost	€1.1 billion
Estimated operational date	2014-2020

Information
http://www.skatelescope.org/

Underground Science Initiatives

Background
Many nuclear reactions important in astrophysical environments are extremely rare processes. Experimental investigation is severely hampered by the background induced by cosmic rays. Measurements require extremely low background environments, such as those underground where the hard rock shields cosmic radiation. Such environments also open up interesting possibilities for interdisciplinary science, involving such areas as geology, microbiology and security. The UK is positioned to play a leading role in several underground science projects.

SuperNEMO is a next generation double beta decay project being developed by French, UK, Russian and US groups. Based on existing technology from the NEMO projects developed over the last 18 years, this will become the most important double beta decay experiment in the next 10 years. The EURECA (European Underground Rare Event Calorimeter Array) project is a UK-led initiative to construct a tonne-scale detector for cosmic dark matter.

In addition to these projects, STFC has received statements of interest for underground experiments in nuclear astrophysics, in climate studies and for the development characterisation of low-background detectors, which emphasises the versatility and usefulness of underground experimental facilities.

The UK currently hosts a relatively modest underground facility at Boulby which offers a unique low-background environment because of the particular rock composition in which it is placed. We are working with the mine owners to conduct a feasibility study of new excavation at the mine as part of a deeper-level mining project, which might open up the possibility of larger caverns for future experimentation.

Future capability
The UK is positioned to play a leading role in several projects studying the nature and properties of neutrinos. Experiments studying neutrinos from the sun and cosmic rays have shown that neutrinos have a small, but non-negligible mass. The properties of the neutrino have been shown to deviate from the theoretical prediction. These results can be explained by neutrino oscillations where the neutrinos change type. Although there are experiments both running and in construction that study neutrino oscillation, these experiments are not able to identify the fundamental type of neutrinos; to do this, and to measure the neutrino's absolute mass, we must look for neutrinoless double beta decay. SuperNEMO will uniquely address key outstanding questions in particle physics on the nature and properties of neutrinos.

Only 4% of the universe is made of ordinary matter; dark matter comprises roughly a quarter of the rest. A particularly well-motivated solution to the dark matter problem are weakly interacting massive particles (WIMPs) produced in the early universe. To explore this theory, direct detection of WIMPs is necessary. EURECA is a UK, French, German, Russian and Spanish collaboration aiming to construct a tonne-scale direct dark matter detector, using a combination of targets and detector technologies. It builds on forerunner experiments, CRESST, EDELWEISS and Rosebud, effectively combining all European expertise on cryogenic low-temperature calorimeter technology into a single collaboration. A positive detection by EURECA will have implications for our understanding of the Universe and supersymmetry.

Funding & partnerships
SuperNEMO and EURECA are European collaborations. Construction of SuperNEMO is anticipated at an approximate cost of £30 million over 2 years beginning in 2008 following a 2 year engineering design phase. UK participation in EURECA is estimated to be of the order of £14 million over a two phase construction period of 7 years. STFC is providing the UK funding for the design phase of the former at a level of about £2 million. Funding for the R&D phase for EURECA will be considered shortly.

Estimated cost	£45 million (UK costs)
Estimated operational date	After 2010

Information
http://www.aspera-eu.org/

Glossary of acronyms

AWI	Alfred Wegener Institut für Polar- und Meeresforschung
BAS	British Antarctic Survey
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BBSRC	Biotechnology & Biological Sciences Research Council
BHPS	British Household Panel Survey
BMBF	Bundesministerium für Bildung und Forschung
CEA	Commissariat à l'énergie atomique (the French Atomic Energy Commission)
CERN	Conseil Européen pour la Recherche Nucléaire (original – French). Now called Organisation Européenne pour la Recherche Nucléaire (European Organization for Nuclear Research)
CESSDA	Council of European Social Science Data Archives
CLS	Centre for Longitudinal Studies
CNRS	Centre National de la Recherche Scientifique (French National Center for Scientific Research)
COPAL	Community heavy-payload long endurance instrumented aircraft for tropospheric research and geosciences
CRESST	Cryogenic Rare Event Search with Superconducting Thermometers
CRUK	Cancer Research UK
CSAR	Computer Services for Academic Research
DEFRA	Department for Environment, Food and Rural Affairs
DESY	Deutsches Elektron-Synchrotron
DIPOLE	Diode Pumped Optical Laser for Experiments
DIUS	Department for Innovation, Universities and Skills
EATRIS	European Advanced Translational research Infrastructure in Medicine
EBI	European Bioinformatics Institute
ECORD	European Consortium for Ocean Research Drilling
ECMWF	European Centre for Medium-Range Weather Forecasts
ECRIN	European Clinical Research Infrastructure Network
EDELWEISS	Experience pour DEtecter Les Wimps
E-ELT	European Extremely Large Telescope
ELI	Extreme Light Infrastructure
ELIXIR	European Life-sciences Infrastructure for Biological Information
ELSA	English Longitudinal Study of Ageing
ELT	Extremely Large Telescope
EMBL	European Molecular Biology Laboratory
EMMA	Electron Machine for Many Application
EMPReSS	European Mouse Phenotyping Resource of Standardised Screens
EMSO	European Multidisciplinary Seafloor Observation
EPSRC	Engineering and Physical Sciences Research Council
ERICON	European Research Icebreaker Consortium
ERL	Energy Recovery Linac
ERLP	Energy Recovery Linac Prototype
ESDS	Economic and Social Data Service
ESFRI	European Strategic Forum for Research Infrastructures
ESO	European Southern Observatory
ESRC	Economic and Social Research Council
ESRFI	European Strategy Forum on Research Infrastructures
ESS	European Social Survey
EUFAR	European Fleet for Atmospheric Research
EUMODIC	European Mouse Disease Clinic
EUMORPHIA	European Union Mouse Research for Public Health and Industrial Applications
EURECA	European Underground Rare Event Calorimeter Array
EURATOM	European Atomic Energy Community
EUROFEL	European Free Electron Laser
EUSYSBIO	European Center for Systems Biology
FAIR	Facility for Antiproton and Ion Research
FAO	Food and Agriculture Organization of the United Nations
FEL	Free Electron Laser

FFAG	Fixed Field Alternating Gradient
FFAM	Facility for Airborne Atmospheric Measurements
FMD	Foot and Mouth Disease
GEOSS	Global Earth Observation System of Systems
GMES	Global Monitoring for Environment and Security
HECToR	High End Computing Teraflop of Resource service
HiPER	High Power Laser Energy Research Project
HST	Hubble Space Telescope
IAGOS-ERI	Instrumented Autonomous Global Observing System - European Research Infrastructure
IAH	Institute of Animal Health
ILC	International Linear Collider
INI	Isaac Newton Institute
INSTRUCT	Integrated Structural Biology Infrastructure
IODP	Integrated Ocean Drilling Program
ITER	International Tokamak for Internal Confinement Fusion (former acronym dropped)
LBNL	Lawrence Berkeley National Laboratory
LFCF	Large Facilities Capital Fund
LHC	Large Hadron Collider
LIGO	Laser Interferometer Gravitational-Wave Observatory
Linac	linear accelerator
LMB	Laboratory for Molecular Biology (MRC)
LUCIA	Line for Ultimate Characterisation by Imaging and Absorption
MAST	Mega Amp Spherical Tokamak
MEIS	Medium Energy Ion Scattering
MGU	Mammalian Genetics Unit
MICE	Muon Ionisation Cooling Experiment
MINOS	Main Injector Neutrino Oscillation Search
MLC	Mary Lyon Centre
MRC	Medical Research Council
NCAS	National Centre for Atmospheric Science
NCDS	National Child Development Study
NCeSS	National Centre for e-Social Science
NCESS	National Centre for Electron Spectroscopy and Surface Analysis
NCRM	National Centre for Research Methods
NEMO	Neutrino Ettore Majorana Observatory
NERC	Natural Environment Research Council
NIMR	National Institute of Medical Research Renewal
NSD	Norwegian Social Science Data Service
OIE	Office International des Épizooties
ONS LS	Office for National Statistics Longitudinal Study
PAMELA	Particle Accelerator for Medical Application
PRACE	Partnership for Advanced Computing in Europe
RCUK	Research Councils UK
RRS	Royal Research Ship
SARS	Sample of Anonymised Records
SDS	Secure Data Service
SKA	Square Kilometre Array
SLS	Swiss Light Source
STFC	Science & Technology Facilities Council
SuperNEMO	Next generation NEMO project
T2K	(from) Tokai To Kamioka
UKCRN	UK Clinical Research Network
UKHLS	UK Household Longtitudinal Study
ULSC	UK Longitudinal Studies Centre
WIMP	Weakly Interacting Massive Particles
XFEL	X-ray Free-Electron Laser

Annex 1 – Large Facilities Capital Fund Prioritisation Criteria

Output 1 - A Healthy Research Base (Scientific Impact) **This criterion includes:**
The importance (or depth) of the scientific knowledge that would result from the project including what the potential for real breakthroughs in its area are.
The timeliness (or urgency) of the scientific goals.
The negative impact of not funding the facility.
The breadth of the scientific base that would benefit from the facility.
The current position of the UK in this area.
How the facility will enhance, sustain or exploit the UK's existing position.

Output 2 – Better Exploitation (Economic and Societal Impact) **This criterion includes:**
The opportunities that are opened up for knowledge or technology transfer and innovation.
The scope for education, training and investment in the skill base.
The impact on public understanding and outreach.
The match with Government public policy priorities.
How the facility will exploit the UK's unique capabilities and/or skills base.

Delivery and Cost Effectiveness **This criterion includes:**
The funding arrangements that are proposed and how the opportunities for international partnership been exploited.
The value for money and how the benefits are commensurate with the cost.
The level of technical risk in the project and is this risk is being managed.

Annex 2 – OGC Gateway Process and how it is used in Large Science Facilities

Following the Ministerial approval of earmarked funds, the sponsoring Research Council is required to follow the Office of Government Commerce's (OGC's) Gateway process.

OGC's Gateway Process
DIUS and the UK Research Councils use this process to help procure large scale scientific facilities. All new procurement projects in civil Central Government – including Non Departmental Public Bodies (NDPBs) - are subject to the Gateway process, which examines a project at critical stages in its lifecycle to provide assurance than it can progress successfully to the next stage. The process has a series of Gateway Reviews, as follows:

1. To confirm the business justification;
2. To confirm the procurement method and sources of supply;
3. To confirm the investment decision - before letting any contracts;
4. To confirm "readiness for service";
5. To confirm "in service benefits".

Each project has a Senior Responsible Owner (SRO), a Project Manager (PM), and possibly a Project Owner (PO). One of these assesses the overall level of risk of the project (high, medium or low) using a standard Project Profile Model. For the highest risk projects the Gateway reviews are led by a leader appointed by the OGC, and all members of the team are independent of the procuring Department. For medium risk projects, OGC appoint an independent team leader and the remainder of the team are independent departmental staff. For low risk projects, departments can appoint their own team leader and team members, who are independent of the project. The reviews give each a project a red, amber or green status, depending upon the readiness of the project at that point. Each project will have a lead Research Council. The Chief Executive, as Accounting Officer, will either take on the role of SRO for that project themselves, or will delegate it to one of their senior staff. The SRO will appoint a PM – who might be a staff member of the Research Council or one of its institutes, or located in a university or elsewhere.

Details of the Gateway process can be found on OGC's website: http://www.ogc.gov.uk

Preparation of the Science Case
Before funding is formally committed and possibly released, DIUS requires the proposed facility to produce a Science Case. The PM must ensure that an independent assessment of the scientific value of the project has been made. In practice this will be some form of peer review, which needs to cover the following criteria:

- Importance (depth) of science knowledge to be delivered by project;
- Breadth of science knowledge that will benefit from investment;
- Match with international positioning of UK science;
- Strength of opportunity for training (links to number of users);
- Contribution to/from UK technology/industry base;
- Opportunity for spin/off and exploitation.

In addition, the science case should cover the timing (for the facility to be in service, and therefore for key decisions to be made), other possible options, total budgetary estimate and any costs of feasibility studies required before proceeding to the next stage which is the production of the Business Case. The Science Case should also indicate whether sources of funding are in place, or whether the project would require funding from other sources. Other funding sources include other Government Departments, other countries, UK universities and industry. It also includes the LFCF, a capital fund held and managed by DIUS to help fund large facilities.

For the largest projects, and any which may want to draw some funding from the LFCF, the SRO will present the Science Case to the RCUK Executive Group for endorsement. The Executive Group acts as the top level review and advisory board for all projects, for the Large Facilities Roadmap and for the LFCF. Assuming that they are satisfied the science case is robust the RCUK Executive Group will authorise the project to move on to Gateway Review 1, the Business Case. If funding is sought for a project from the LFCF, the Executive Group will also provide early advice on the relative priority of the project in comparison to other possible calls on the Fund.

Preparation of the Business Case – Gateway Review 1
Gateway Review 1 will confirm the justification and robustness of the business case. In particular it needs to include:

- A more detailed requirement that reflects user requirements – possibly an outline specification;
- Confirmation of technical feasibility of the project;
- Identification of success criteria against which options for delivery of capability from the investment can be judged;
- Analysis of main options (e.g. UK only, collaboration etc) and cost effectiveness & risk;

- Analysis of "opportunity cost" of undertaking this project versus other
- competing for funds in same time-scale;
- Assessment of affordability;

The SRO will present the results of Gateway 1 to the RCUK Executive Group. The business case should confirm that funding for the project is in place. However, for projects which are seeking some funding from the LFCF, the RCUK Executive Group will only recommend to DIUS that such funding is made available once they have seen the results of the Gateway 1 Review. If the project is recommended for approval by the RCUK Executive Group, that approval will need to be confirmed by DIUS following a satisfactory Gateway 2 review. Approval by DIUS Ministers is required in all cases, and if the project is above the DIUS' delegated powers, or requires funding from beyond the current three-year Spending Review period, approval is also required from HM Treasury.

Procurement Strategy – Gateway Review 2

The Gateway Review 2 will assess the procurement strategy. By the time of this review the strategic outline Business Case should be sufficiently well developed to assure the review team that subject to the subsequent approval and commitment of the earmarked funding by DIUS ministers, the project is viable and has high potential for success and is ready to invite proposals or tenders from the market. This review is undertaken before sending out Invitations to Tender (ITTs) and before any major capital expenditure has been undertaken. The procurement strategy will need to:

- Confirm that project is under control (on plan, to budget so far)
- Confirm that project as planned will deliver expected benefits, or success criteria
- Review value for money of procurement strategy proposed
- Confirm that costs are within current budget line
- Confirm that issues of whole lifecycle funding have been addressed (e.g. where do future running costs come from and commitment in principle)
- Identify risks and confirm that appropriate risk management plans in place.
- Ensure that specifications (ITTs if appropriate) reflect project output requirements
- Ensure that adequate and realistic project plan and management structure in place for the remainder of the project

In general the Gateway 2 Review, and further Gateway Reviews, would go to the SRO and/or a Project Board rather than to the RCUK Executive Group, except for those projects where the procurement strategy has major implications across the Research Councils (e.g. where the location of an international facility might have an impact on other possible facilities). From this point on, the RCUK Executive Group will want to assess progress on all current projects every six-months, on a "by exception" basis.

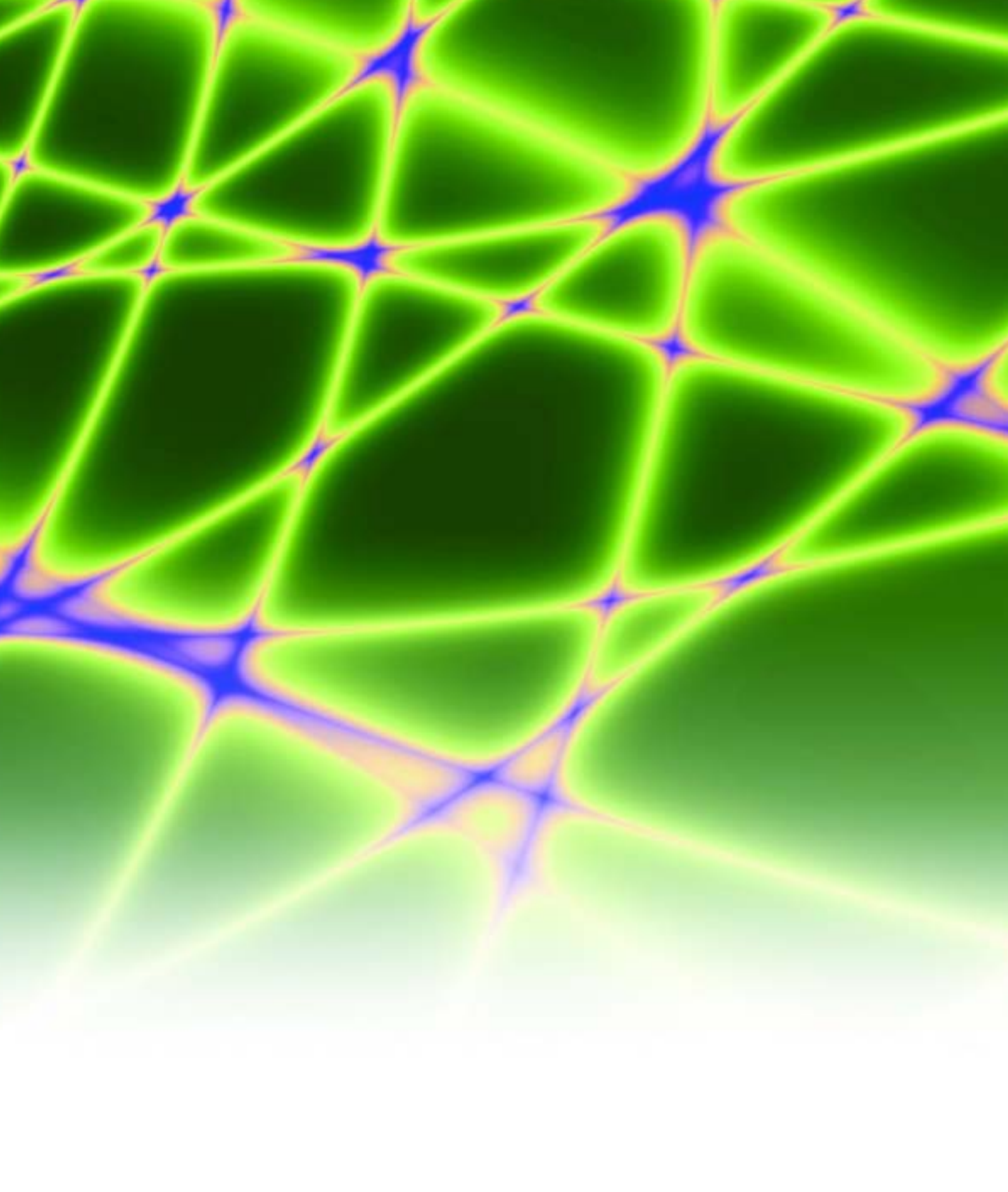
Progress through the remaining Gateway Reviews will be related to the procurement strategy. For projects being completed under the direct control of one of the Research Councils, the Gateway process should be followed fairly closely. Where, for example, the project is multinational and has developed its own project review procedures, the SRO may use these to assure themselves that an equivalent level of project control information is being provided. Research Councils will in all cases incorporate the Gateway process into their own normal strategic, financial, and administrative procedures.

Annex 3 – Committed funds for the Large Facilities Capital Fund

The level of commitment and facilities currently drawing from the Large Facilities Capital Fund is given are outlined below:

Committed Projects £'000		
Name	**Lead Council**	**Total LFCF Contribution**
IAH Pirbright	BBSRC	31,000
UK Household Longitudinal Survey	ESRC	12,500
HECTOR	EPSRC	52,000
Research Complex	MRC	26,400
Halley VI	NERC	20,100
Diamond Phase 2	STFC	82,400
Diamond VAT	STFC	25,000
MICE	STFC	7,500

Index of Facilities by discipline



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