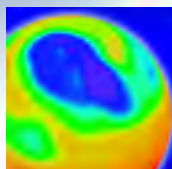


LARGE FACILITIES ROADMAP 2010



Research Councils UK

Research Councils UK (RCUK) is the strategic partnership of the UK's seven Research Councils. We invest annually around £3 billion in research. Our focus is on excellence with impact. We nurture the highest quality research, as judged by international peer review providing the UK with a competitive advantage. Global research requires we sustain a diversity of funding approaches, fostering international collaborations, and providing access to the best facilities and infrastructure, and locating skilled researchers in stimulating environments. Our research achieves impact – the demonstrable contribution to society and the economy made by knowledge and skilled people. To deliver impact, researchers and businesses need to engage and collaborate with the public, business, government and charitable organisations.
www.rcuk.ac.uk

The seven UK Research Councils are:

- ▶ Arts & Humanities Research Council (AHRC)
- ▶ Biotechnology & Biological Sciences Research Council (BBSRC)
- ▶ Economic & Social Research Council (ESRC)
- ▶ Engineering & Physical Sciences Research Council (EPSRC)
- ▶ Medical Research Council (MRC)
- ▶ Natural Environment Research Council (NERC)
- ▶ Science & Technology Facilities Council (STFC)

Foreword

It is my pleasure to present the 2010 Large Facilities Roadmap.

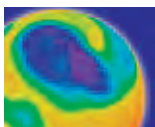
This Roadmap is an overview of research facilities that are under construction or planned by Research Councils UK (RCUK) and of other emerging facilities - in the UK or overseas - that are currently considered to be the highest priorities for UK research.

While many of the projects described in this Roadmap require substantial capital funding by RCUK, in many cases needing to bid to the Government's Large Facilities Capital Fund, not all of the projects are capital intensive. The Roadmap includes facilities for the physical and for the life sciences, for engineering, astronomy, environmental research, medicine, and the social sciences. 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 2008.

This Roadmap cannot include every project that has been proposed by the research community or every emerging international project. The projects included in this Roadmap have been selected by individual Research Councils, based on judgement of strategic importance for their communities, and through consultation with those same communities. A draft version of this Roadmap was made available for a public consultation in 2009.

I hope that this document serves as a useful depiction of the UK's emerging research facility landscape. It is important to recognise that funding for many of the facilities described here is not yet secured and that, in the present economic climate, investment in new facilities may be limited. However, the Roadmap should serve as a good indication of RCUK priorities in this area and we hope it proves useful to our international partners, to our research communities and to Government.

Professor Alan Thorpe
Chair, Research Councils UK



Contents

	Page
Chapter 1 - Context	
1.1 A Vision for World-Class Research	5
1.2 Challenges for the UK Science and Technology Base	6
Chapter 2 - Background	
2.1 The Purpose of the Roadmap	8
2.2 The Large Facilities Capital Fund	9
2.3 International Relationships	10
Chapter 3 - Facility Descriptions	11
Current Facilities	
British Election Study	12
Census of Population Programme	13
Centre for Longitudinal Studies	14
Economic and Social Data Service	15
English Longitudinal Study of Ageing	16
European Synchrotron Radiation Facility	17
Institut Laue-Langevin (ILL)	18
Large Hadron Collider	19
Mary Lyon Centre	20
National Centre for e-Social Science	21
National Centre for Research Methods	22
Oceanographic Research Ship RRS James Cook	23
Provision for High Performance Computing	24
Research Complex at Harwell	25
UK Biobank	26
Understanding Society - UK Household Longitudinal Study	27
Renewals and Upgrades	
Antarctic Marine Capabilities	28
Atmospheric Research Aircraft	29
Council for European Social Science Data Archives	30
Diamond Light Source - Phase III	31
European Social Survey	32
Halley Research Station, Antarctica	33
Institute for Animal Health, Pirbright	34
Institute for Animal Health, Compton	35
ISIS Target Station 2 - Phases II and III	36
Laboratory for Molecular Biology	37
Mega Amp Spherical Tokamak (MAST)	38
Mid-Range Facility Provision	39
Oceanographic Research Ship (replacement for RRS Discovery)	40
Rothera Research Station, Antarctica	41
UK Centre for Medical Research and Innovation (UKCMRI)	42



	Page
Emerging	
Administrative Data Liaison Service	43
Biomedical ESFRI Projects	44
Environmental ESFRI Projects	45
Environmental Omics Bioinformatics Facility	46
European 3rd Generation Gravitational Wave Observatory (Einstein Telescope)	47
European Centre for Systems Biology	48
European Extremely Large Telescope	49
European Life-Science Infrastructure for Biological Information (ELIXIR)	50
European X-ray Free-Electron Laser	51
Extreme Light Infrastructure	52
Facility for Antiproton and Ion Research (FAIR)	53
Future High Energy Colliders	54
Gateway Centres at the Daresbury and Harwell Science and Innovation Campuses	55
High Power Laser Energy Research Project	56
High Power Laser national facility (VULCAN-DIPOLE)	57
Integrated Rural and Urban Observatories	58
Neutrino Factory	59
Next Generation Neutron Sources	60
Platforms and Instrumentation	61
Secure Data Service	62
Square Kilometre Array	63
2012 Birth Cohort Study and Cohort Resources Facility	64
 Glossary of acronyms	 65
 Annexes	
Annex 1 Large Facilities Capital Fund Prioritisation Criteria	67
Annex 2 The OGC Gateway Process and how it applies to Large Science Facilities	68
Index of Facilities by discipline	70



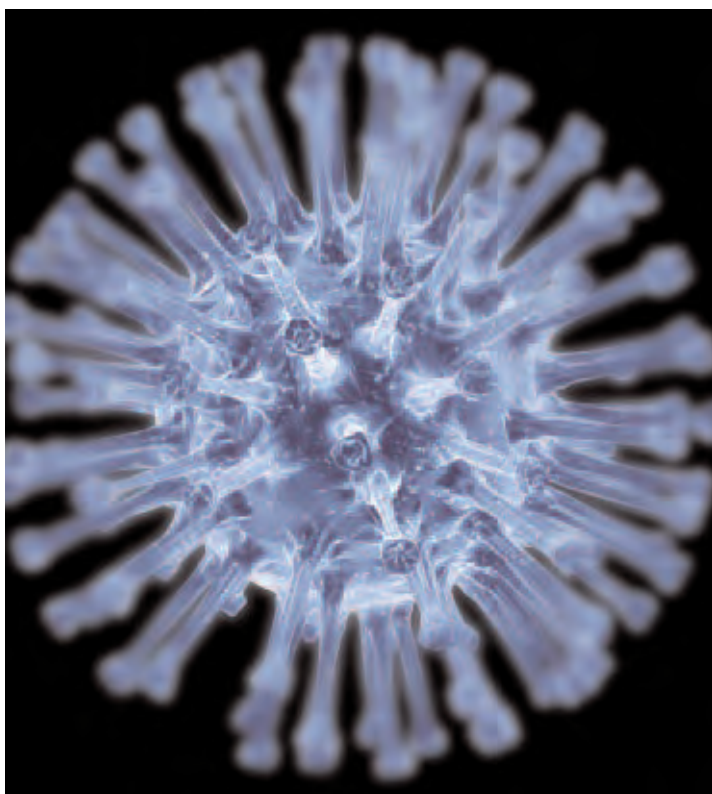
Chapter I - Introduction and Context

I.1 A Vision for World-Class Research

The UK is one of the best places in the world to undertake research. This reputation is based on the international standing of our universities, laboratories and facilities and on the world class reputation of our scientists, academics and support staff. The UK research community is highly successful and ranks second only to the USA on many key output criteria.

RCUK deliver world-class research and postgraduate training to sustain a strong research base and, working together with partners from across the business, public and charitable sectors, provide a framework for collaboration that can extend the boundaries of knowledge and increase the impact of the research and training supported. Research underpins cultural life in the UK and is required to predict and address many, if not all, of this decade's major challenges and new opportunities.

Access to a full range of world-class research facilities, either in the UK or abroad, is vital if the UK is to remain a leading research and innovation nation in all areas of research. These facilities include the traditional large physical installations but increasingly they also take the form of distributed, networked resources that exploit advances in information and communications technology to underpin new collaborative modes of research. Advancing information and communications technologies are leading to the development of means to generate,



store and exchange an increasing volume and diversity of data. These provide the wherewithal to address large and complex problems through the integration of many scientific approaches and individual inputs. This means that the nature of large facilities is changing. In particular, in many fields distributed communities will increasingly rely on more centralised facilities to provide data and



experimental platforms that provide the basis for integrated and large scale research efforts. These may be focused around particular technologies, or upon the consideration of particular problems or user needs. This evolution of large facility needs is likely to continue for the foreseeable future as technology develops, and therefore the Roadmap represents a snapshot of a rapidly changing landscape, which will need to be regularly reviewed and updated.

Large facilities and infrastructure also provide principal locations for scientific, academic and business collaboration. The development of scientific hubs in the locality of large facilities and infrastructure provides focus points to nucleate inward investment.

Many of the facilities listed in this Roadmap offer multidisciplinary research opportunities or exploit technological strengths that cut across RCUK. The Roadmap and the processes used to develop it are a positive indication of the commitment of RCUK 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 serve as excellent examples of the societal and economic challenges which guide the need for the facilities in this Roadmap.

Lifelong health and wellbeing – The demographic profile of the UK is shifting. We need to target the major determinants of health and wellbeing over the whole life course, aiming to prevent as well as cure disease, improve public health and quality of life, and reduce dependency in later life.

Digital economy – Highly networked and widespread 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.

Energy – We need sustainable and lower impact methods of energy provision, storage, distribution and usage to address the outstanding international issues of climate change, security of energy supply and growing energy demand. This will require new technologies and an understanding of the environmental, social and economic implications.

Global Food Security – The world is facing a potential crisis in terms of food security. The challenge is to

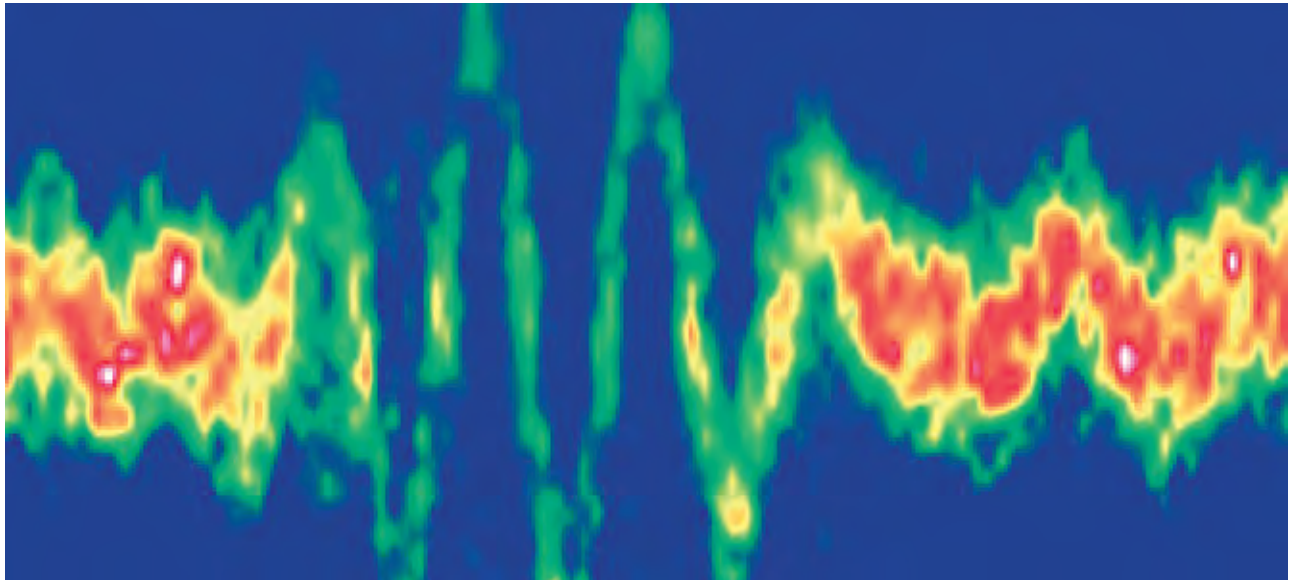
produce and supply enough safe and nutritious food in a sustainable way for a growing global population, which is projected to reach nine billion by 2050. Research can address fundamental issues of producing enough safe and nutritious food sustainably - environmentally, economically and socially.

Global Uncertainties: security for all in a changing world – The issues of security, conflict and uncertainty have gone beyond a national agenda to challenges that need to take into account the inter-related global context of crime, terrorism, environmental stress and global poverty. We need to understand the causes, improved methods of detection and possible interventions to prevent harm.

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, social and cultural progress.

In the future, the priority themes will provide a framework through which RCUK can mobilise research to address our ever-changing societal challenges.



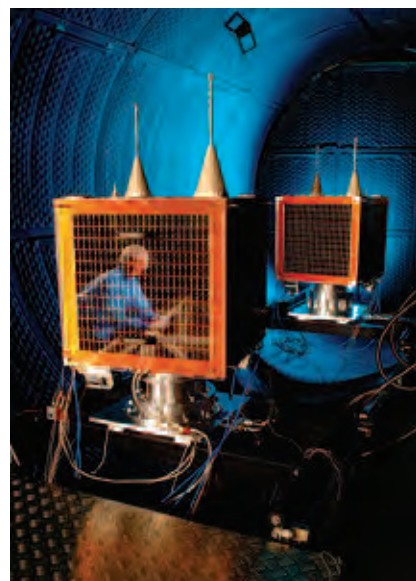


As well as providing solutions in areas of clear societal and economic impact, our facilities play a key role in developing our understanding of the universe, the earth, of materials and of life. While the immediate application of this kind of scientific knowledge may not always be clear, the joy of 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?

RCUK 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.



Chapter 2 - Background

2.1 The Purpose of the Roadmap

Background

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, in some cases distributed across a number of different countries.

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, RCUK published the first version of the Large Facilities Roadmap in June 2001, and updated this in 2005 and 2008.

This 2010 Roadmap includes national and international projects, within the UK and elsewhere.

What the Roadmap contains

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 RCUK as being of the highest strategic importance and that 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 research 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 research 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.

Research Councils are required to provide their parent Government Department with Asset Management Strategies (AMS) that include identification of new major investments necessary to deliver science strategies. There is a strong complementarity between the AMS and this Roadmap.

Consultation

In developing the final version of the Roadmap, RCUK have taken account of the views of interested stakeholders following a public consultation in summer 2009.

Since the 2008 RCUK Roadmap, Large Facilities Capital Funds have been allocated to the following projects:

- MRC Laboratory of Mol Biology (LMB II)
- Institute of Animal Health - Pirbright (Pirbright rebuild)
- Replacement for RRS Discovery
- Provision for High Performance Computing

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 central Government.

The Large Facilities Capital Fund, typically £100 million per annum, was established to support RCUK investments in large research facilities with capital funding that could not be sensibly accommodated from within individual 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.

Criteria for eligibility to bid for funds from the Large Facilities Capital Fund. RCUK provides advice to Government on the prioritisation of projects for funding from the Large Facilities Capital Fund. Normally, eligible projects should:

- be included on the current **RCUK Large Facilities Roadmap**,
- represent a large scale investment in research infrastructure. **'Large scale'** means having total capital costs greater than £25 million or representing more than 10% of the annual budget of the lead Council,
- serve a **significant community of researchers**, often spanning the research communities of more than one Research Council,
- be supported by a **significant capital contribution** from the lead Research Council, and, in some cases, contributions from other Councils or research funding bodies whose research communities are served by the facility,
- include in their business cases a proposal setting out how the **running and exploitation costs** of the facility will be covered.

Any departure from the criteria will only be applied with the approval of RCUK Executive Group. Where specific projects are allowed exemptions from one or more of these criteria the strategic case supporting the exemption will be clearly documented and recorded.

Inclusion of a facility in the Roadmap does not guarantee funding from either RCUK, central Government or 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 (See Annex 1). 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 RCUK.
- **Prioritisation of facilities for LFCF** – The Research Councils undertake a prioritisation exercise, using an agreed set of criteria (see Annex 1), to identify a package of facilities that should be recommended for funding from the LFCF. 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 'earmarked' funding.

RCUK thus provides advice to Government on prioritisation of the use of the finite LFCF budget. This process is managed by RCUK and taken together with consultation responses to this Roadmap, as well as any views expressed to Government from representative industry and scientific bodies and individuals, and forms the basis of advice to Ministers for their allocation of the LFCF budget.

Following the LFCF prioritisation exercise, there is a general process that is followed before funding is formally committed and released (see Annex 2). The funding approval process involves:

- **allocation of resource through the LFCF**
- **preparation of the project Science Case**
- **preparation of the project Business Case**
- **consideration by Government of the Business Case (in several cases) and submission to Ministers for approval of the commitment of funds.**

2.3 International Relationships

Excellent research can only be delivered when working with, and benchmarked against, the best researchers 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 addition, much research, for example in the environmental and social fields, concerns regional or global issues that need to be addressed by international collaboration. 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 four 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,
- jointly and distributed with other European or global partners.

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

The ESFRI Roadmap

The European Strategy Forum on Research Infrastructures (ESFRI) has played a major role in developing a roadmap of collaborative European research facilities. A number of these facilities 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 with possible RCUK contributions to the construction costs to enable access for UK researchers. Individual entries indicate where a facility is on the ESFRI Roadmap. It is possible that other ESFRI Roadmap facilities are included on future RCUK Roadmaps as they develop their preparatory phase studies and become more mature.

The ESFRI Roadmap can be found online at ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri_roadmap_update_2008.pdf

The ESFRI facilities contained within this Roadmap are identified within individual facilities descriptions in Chapter 3.

Chapter 3 – Facility Descriptions

How facilities are listed in this Roadmap

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 RCUK can be found on individual Council websites.

This 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.

How costs for facilities are listed

All costs listed in this Roadmap are costs (as £) to the UK, unless explicitly noted otherwise.

Emerging projects costs are listed as 'potential' because at time of writing it is not possible to provide more than an estimate of these.

In one or two instances, a UK cost estimate has not been given at all for a facility, as it is too early at time of writing to provide this.

British Election Study

Background

The British Election Study (the 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 most recently completed study took place in 2005 and retained all the key questions that have been 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 introduced innovative internet experiments aimed at developing better survey measures and ways of assessing media effects. The 2010 BES is currently underway and is mixing continuity and innovation.

Existing capability

The BES is a well established and important research tool used by both the academic and non-academic communities. The 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 amongst 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 2010 BES draws on a monthly internet survey to monitor 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 the ESRC commissioned an independent review of the 2001 and 2005 BES. 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 the 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 notes that interviewees view the BES as contributing to some of the best electoral analysis in the world.

The BES 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 the findings regularly during the 2005 election, and throughout 2010 the findings from BES will similarly be used by the media and researchers to reflect on the outcome of this 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 2007 the ESRC agreed funding for a 2009/10 wave of the British Election Study.

Cost	£1.5 million
Operational date	2008 – 2012

Information

www.essex.ac.uk/bes/
www.bes2009-10.org

Census of Population Programme

Background

Since 1801, every ten 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 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. In 2009 there were over 35,000 registered users.

The Programme services are currently 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), Scottish Longitudinal Study and new Northern Ireland 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*, funded in 2008-9, 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 UK Census longitudinal studies provide, in the case of the 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 longitudinal studies cross-link Census responses with vital events data (birth, deaths, and marriages) cancer registrations and other health records.

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 currently 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 and for the Northern Ireland Longitudinal Study the Northern Ireland Statistics and Research Agency.

The next Census will take place in 2011 and the ESRC will shortly carry out an independent review in order to inform the future strategic direction of the Programme.

Cost	£15 million
Operational date	2006

Information

www.Census.ac.uk

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 2000-1). 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, we can unravel the links between peoples health, employment and schooling, alongside many other aspects of their lives. By comparing the different generations in the three cohorts, we can chart social change and have a better understanding of 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 enquiries 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 aged 4 and 7 years) and one sweep of each of the NCDS and BCS70 (in 2008). Costs for the Millennium Cohort make up around 44% of the ESRC's contract and NCDS/BCS70 combined are around 19%.

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

A further £9 million of funding for CLS was agreed in 2010.

Cost	£35 million
Operational date	2000

Information

www.cls.ioe.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 time 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 focuses 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 by the surveys and made available by ESDS includes:

- 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. The UK Data Archive, who is the managing partner of the ESDS, 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 five years. ESRC have committed to funding the service for a further five years from 2007 to 2012 at a value of £12.3 million. In 2010, a Review of ESDS commenced with the main purpose to inform ESRC's decision on continued funding of the Service beyond 2012.

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

Cost	£28.6 million
Operational date	2003

Information

www.esds.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 comprised 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 ten 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 was funded from September 2000 to April 2010 jointly by a number of UK Government departments, the Office for National Statistics and the US Institute of Aging.

Estimated budget	£ 16 million
Operational date	2003

Information

www.ifs.org.uk/elsa

European Synchrotron Radiation Facility

Background

The 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, including 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 the 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 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 nano technology.

The success of the scientific projects proposed is closely linked to an ambitious detector and optics developments 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 improve the UK's "juste retour".

Funding & partnerships

The Upgrade Programme is divided into two Phases (Phase 1 and Phase 2) with additional Options within each Phase. The total cost of the complete upgrade programme is €287 million, with the expectation that €200 million will be provided by the member countries, in proportion to their shareholding, as an additional subscription cost. The member countries financial commitment agreed to date is €99 million for the minimum Phase 1 Upgrade, of which €14 million is the UK's contribution. This is currently being funded by STFC through its CSR2007 allocation. The UK contribution to the total Upgrade Programme is proposed to be €28 million, either through future STFC CSR allocations or from the LFCF.

The other member's contributions are estimated as France €55 million, Germany €51 million, Italy €30 million, Belgium and Netherlands €12 million in total, Spain €8 million, Denmark, Finland, Norway and Sweden €8 million in total and Switzerland €8 million.

Due to the extent of the membership of ESRF and the contribution of its scientific members, 19 countries are financially involved in the Upgrade Programme, which will be fully implemented by 2018. ESRF will also be working in partnership with other synchrotron sources across Europe (e.g. Diamond Light Source in the UK and Soleil in France) on beam line developments.

Cost	£28 million
Operational date	2018

Information

www.esrf.eu

Institut Laue-Langevin (ILL)

Background

The Institut Laue-Langevin is an international research centre at the leading edge of neutron science and technology. Funded by 12 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 coming 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 launched a major programme to renew its instruments and infrastructure in 2000, taking advantage of technological advances to enhance greatly the facilities it can offer the user community. The first 'M0' phase of the programme was completed in 2008 and delivered an average increase in the rate of detected flux across the instrument suite of a factor of 18. Plans for the next 'M1' and 'M2' phases of the programme were laid out in a long term strategy document in the autumn of 2006 entitled "Perspectives and Opportunities". This presented a ten year plan to keep the ILL at the forefront of science using neutrons until at least the end of the following decade. The strategy builds on areas where ILL is world-leading, and complements activity at 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:

- (i) The renewal of key reactor components;
- (ii) The provision of new moderators, instruments and techniques;
- (iii) The creation of Partnerships for Science and Technology
- (iv) 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 (24% of the total budget); currently €18 million per year and for that it receives typically 25% of the allocated beamtime.

Funding for Phases M0 (€39 million) and M1 (€56 million over the period 2007-2013) of the renewal programme comes from partner contributions through subscriptions plus an additional commitment of €18 million by the Associates between 2007 and 2015. The ILL Scientific Council believes that the scientific output of the Institute will benefit greatly from the timely completion of the M1 phase and they are working with us and the user community to refine the plans for the M2 phase laid out in the Perspectives and Opportunities document.

€20 million for part (iv) of the upgrade has been provided by the local French authorities.

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

Cost	£40 million
Operational date	2020

Information

www.ill.fr

Large Hadron Collider

Background

The Large Hadron Collider at CERN started operation for physics in 2009 and is the world's highest energy particle accelerator. It will operate at 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 four detectors, to data analysis and 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 2012 we anticipate a decision on a potential increase in the LHC collision rate by a factor of ten, 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 is already underway. Work is being carried out 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 the underlying expertise in solid-state pixel detectors – which have applications in many other areas such as the DiamondLight Source 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. A UK bid to the Large Facilities Capital Fund 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 ~20 non member states, have begun a focussed R&D programme on the technologies required for an upgrade in luminosity.

Cost of upgrade	£50 million
Operational date	2020



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.

Cost	£18 million
Operational date	2006

Information

www.mlc.har.mrc.ac.uk



National Centre for e-Social Science

Background

The National Centre for e-Social Science (NCeSS) is funded by ESRC to stimulate the development of new computer based infrastructure for exploitation by social scientists, enabling them to address the key research challenges in new and novel ways.

The overarching strategic aims of the Centre are to:

- harness, develop and sustain innovations in digital technologies to provide the tools and services that will drive forward the capacity of social scientists to address complex research questions in more sophisticated ways,
- stimulate the widespread uptake and use of such new tools and services across the social science community.

Existing capability

The NCeSS node research programme consists of a series of projects located in HEIs across the UK, which are seeking to draw upon unfolding advances in e-technologies, tools and services and apply them to the particular needs of the social science community. The nodes cover quantitative and qualitative and mixed methodological approaches and a wide range of social science disciplines. The research programme also contains an equally important social shaping strand which aims to understand the social, economic and other influences on how e-Infrastructure is being developed and used, and its implications for scientific practice and research outcomes.

A National Director for e-Social Science leads on the development of a national e-social science strategy and co-ordination of the nodes.

Funding & partnerships

ESRC's £16.5 million investment in e-Social science has been primarily organised through the National Centre for e-Social Science (NCeSS), established in 2004, with funding of £10.5 million to date. Following a review of the Centre's activities in 2008 ESRC renewed its funding for the nodes for a further three 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 at Edinburgh.

Cost	£16.5 million
Operational date	2004

Information

<http://www.ncess.ac.uk/>

National Centre for Research Methods

Background

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

The NCRM research programme aims to stimulate imaginative new developments in methods and be responsive to new needs and opportunities that arise. The core of the research programme consists of node-based projects, which focus on innovative methodological development within the context of substantive research problems and applications, with an emphasis on transferability to other disciplines and research fields.

In addition, the hub conducts research on aspects of research methods and practice and commissions Networks for Methodological Innovation, which are designed to stimulate research and debate on new methodological challenges and synthesise projects, reviewing developments within specific methodological fields.

The NCRM 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 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 the ESRC,
- to co-ordinate and add value to the existing investments of the 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 renewed the hub contract for a further five year period and commissioned a further round of Centre nodes. £12 million was allocated by the Council to the renewal of the Centre.

Commissioning for a third round of nodes is now underway, to extend the research programme beyond 2011 for a further three years in line with the hub.

Cost	£21 million
Operational date	2004

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.

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

www.noc.soton.ac.uk/nmf/



Provision for High Performance 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 required.

Research areas that use High Performance 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 by the current national service. Targeted HPC systems are also provided to support research in the areas of particle physics and astronomy.

RCUK provide High Performance Computing resources that complement the desktop and mid-range provision based at universities. In order to stay competitive with international partners the UK strategy has conducted a competitive procurement exercise every three to four years for a six year service, with phased technology upgrades during the lifetime of each service. EPSRC, acting as the managing agent on behalf of RCUK, has successfully procured three overlapping services for the UK: CSAR, HPCx and HECToR. Each procurement has competitively sourced the hardware, facilities management, and user support functions needed to provide an integrated and internationally leading HPC service to UK users.

Future HPC provision:

Continued access to HPC hardware, associated support infrastructure and applications' development by the UK Research Base will support and enable:

- 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 research.

Future provision will be facilitated via a successor to the HECToR National service, ARCHER (Academic Research Computing High-End Resource) supported by EPSRC and partner councils, and Internationally through the UK's continued participation in PRACE (Partnership for Advanced Computing in Europe).

Estimated total costs: £57 million

Estimated LFCF request: £26 million

Estimated operational date: FY 2013/14-2016/17"

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

The LFCF also provides support to provide targeted systems for HPC enabled research in particle physics and astronomy. Procurement and running costs are facilitated by STFC

LFCF contribution: £12.3 million

Operational date: 2010/11

Information

EPSRC: www.epsrc.ac.uk/funding/facilities/hpc/Pages/default.aspx

PRACE: www.prace-project.eu



Research Complex at Harwell

Background

The Research Complex at Harwell 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 provide a unique staging ground for innovative multi-disciplinary research. Synergy between scientific disciplines and the Research Complex at Harwell will enable a vibrant scientific culture of multi-facility working and generate an excellent environment for training.



Existing capability

The Research Complex at Harwell will play a vital role in ensuring that the infrastructure investment made on the Rutherford Appleton Laboratory (RAL) site, and the 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 of Diamond, ISIS, the Central Laser Facility and other user facilities on the RAL site 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

The BBSRC, EPSRC, MRC, NERC, STFC and Diamond Light Source are partners in this project. MRC is leading the project on behalf of its partner Councils.

Funding from the LFCF has been approved.

Cost	£26.4 million
Operational date	2010

Information

www.rc-harwell.ac.uk
www.diamond.ac.uk
www.isis.rl.ac.uk
www.clf.rl.ac.uk

UK Biobank

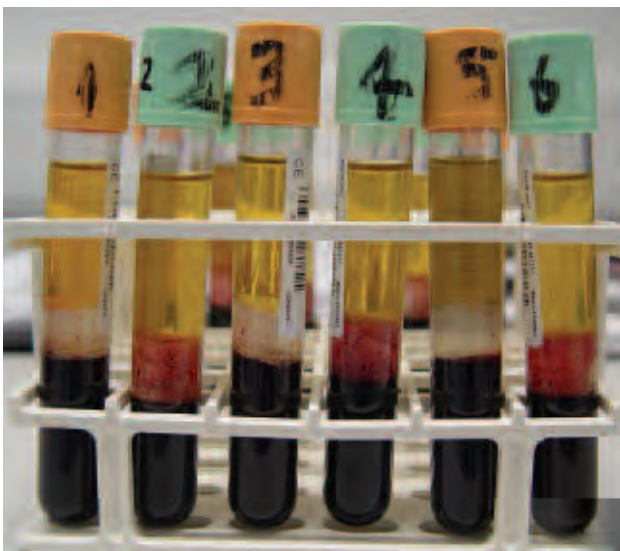
Background

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 which 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 ill-health, 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 six Regional Collaborating Centres, representing universities across the UK. Recruitment is underway and by March 2010 430,000 participants had taken part in the project with the recruitment of all 500,000 planned participants expected to be achieved in summer 2010.

Funding & partnerships

The development and recruitment phase of UK Biobank has been funded by the MRC, Wellcome Trust, Department of Health, Scottish Government, Welsh Executive, British Heart Foundation and the North West Development Agency. The total cost, to date, including a recent package of enhancements to the dataset through more detailed questionnaires and measures, is £68 million.

Costs for the post-recruitment, follow-up phase (2010-2015) have not yet been allocated, but are estimated at approximately £25 million for five 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.

Cost	£93 million
Operational date	2010

Information

www.ukbiobank.ac.uk

Understanding Society – the UK Household Longitudinal Study

Background

Understanding Society is a major new study of the UK population launched by ESRC in 2008/09. The study, consisting of some 40,000 households, is 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 include:

- an ethnic minority booster sample of over 3,000 households,
- incorporation of the British Household Panel Survey (BHPS),
- starting in 2009, annual interviews from all household members aged ten 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

Policymakers, scientists, researchers, research users and the general public will benefit from the insight *Understanding Society* will provide into the long term effects of social and economic change, the impact policy intervention has on us all, and the challenges facing our society and similar societies around the world. Its academic as well as economic and societal impact potential is therefore very significant.

The economic and societal impact of *Understanding Society* will be generated through two channels:

- the direct use of this unrivalled evidence base by the public, private and voluntary sector. There is specifically a huge potential for major impact 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 *Understanding Society* dataset will truly 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.

Understanding Society 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 *Understanding Society* 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 nearly £50 million (£19.4 million from the Large Facilities Capital Fund) over the period April 2007 - March 2015 to conduct the first five waves of data collections. Co-funding is being provided and sought from a range of other Government Departments and funding bodies.

Cost	£50 million
Operational date	2008/09

Information

www.understandingsociety.org.uk



Antarctic Marine Capabilities

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 Antarctic peninsula and the Arctic 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's (BAS) infrastructure is essential for this.



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. The RRS James Clark Ross has advanced facilities for the full range of oceanographic research; she also provides essential logistic support to Antarctic operations. These vessels are crucial to the delivery of NERC's world-class research in polar waters. The technical assessment is that in 2020, when the RRS James Clark Ross 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 these vessels will enable NERC to provide a marine capability 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 and Marine Capabilities is funded by the Science Budget. NERC would expect to seek a contribution from the Large Facilities Capital Fund.

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

Estimated cost	£200 million
Estimated operational date	2014 - 2020

Information

www.antarctica.ac.uk



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 all 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 ten 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. The aircraft will be complemented by a new state-of-the art mobile observing facility both ground-based and airborne.

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/>



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 spans 21 countries across Europe. Collectively, the organisations serve some 30,000+ social science researchers, providing access to some 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 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 these and scientific

publications. The major upgrade will make the existing RI more comprehensive, efficient and integrated. The aim is 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 facilitating the potential for increased cross disciplinary and cross national research.

Funding & partnerships

The upgrade costs are currently estimated at €30 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 supported for the UK Data Archive, the national member of CESSDA representing the United Kingdom, for almost 40 years, and has provided funding 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	£27 million
Operational date	2010

Information

extweb3.nsd.uib.no/cessda/home



Diamond Light Source – Phase III

Background

The emphasis of the choice of the beamlines in Phases I & II of Diamond was to produce 22 beamlines which 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 & 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 ps), 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 also

have excellent synergies with other major UK facilities (such as ISIS, CLF).

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

Funding & partnerships

Funding of £97.4 million has been earmarked from the LFCF, 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	£111 million
Estimated operational date	2015

Information

www.diamond.ac.uk

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 entering its fifth biennial 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 is carried out by UK fieldwork agencies, while the data archiving and dissemination for the whole study is based at the Norwegian Social Science Data Service (NSD).

In 2005 the ESS team won the prestigious Descartes prize. Strengthening the funding in the long term, as envisaged by the ESFRI proposal would not only extend the substantive value of the time series, but also enable new and exciting methodological developments at the cross national level – for example investigating different translation techniques; experimenting with improving response rates; harmonising variables on a multinational basis. It would also extend the project's time series, enabling it to continue monitoring changes in European value.

Existing capability

Since 2001, the European Social Survey has been mapping the long-term attitudinal and behavioural changes in Europe's social, political and moral climate. It's dataset offering the widest possible coverage of EU member states and serves as an exemplar of comparative quantitative methods.

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 especial value to UK social scientists, not least because it's official language is English. It is also of

immeasurable advantage to comparative researchers in the UK to have access to a high quality dataset which 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 social science. Researchers in the UK constitute the second biggest user group of the ESS's 35,000 users.

Future capability

To date, the study has been funded at a relatively basic level and on a sweep by sweep basis. The ESS has been successful in achieving funding through FP7 for an Infrastructure Preparatory Phase Project. The Preparatory Phase began in February 2008 and runs until May 2010. Its objective is to lay the groundwork for the ESS to become one of a small group of funded European Research Infrastructures with a sustainable future. If successful in obtaining long term infrastructure funding, the capabilities and outreach of the survey would be enhanced, 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 strategic opportunities for cross-national methodology that such stability would enable.

Funding & partnerships

The estimated cost of the entire ESS is €6 million per year. To date, the UK fieldwork has been ESRC-funded and the bi-annual sweeps cost approximately £500,000 at today's prices. ESRC has committed funding for fieldwork and UK co-ordinator costs associated with the survey for Rounds five and six, as well as a contribution towards the running costs of the central co-ordinating team between 2009 and 2014.

Estimated cost	£3.2 million
Operational date	2009

Information

www.europeansocialsurvey.org



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 beneath Antarctica 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	£50 million
Estimated operational date	2012

Information

www.antarctica.ac.uk

Renewals and Upgrades

Institute for Animal Health Development Programme Phase I, Pirbright Science

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 be 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 laboratory accommodation that meets 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	£135 million
Estimated operational date	2012

Information

www.iah.bbsrc.ac.uk



Renewals and Upgrades

Institute for Animal Health Development Programme Phase 2, Compton Science

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, 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.

In September 2009, IAH announced a new science strategy with a focus on viruses affecting large animals and poultry. To underpin this strategy, with the above stated aim of establishing a single site Centre of Excellence, a complementary Phase 2 development (IAH-DP2) is required to accommodate essential areas of scientific research from the IAH Compton site, at Pirbright.

The proposal is to re-provide laboratory accommodation and other facilities 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.

IAH-DP2 will facilitate the enhancement of the national capability to study economically important livestock diseases in their natural hosts, diseases which threaten UK food security and also (in the case of those which can transfer to humans such as avian flu) human health. This will serve as a 'hub and spokes' facility for UK livestock research with its CL2 and CL4 laboratories and animal accommodation being made available to a wider user community within the UK.

The IAH Centre of Excellence in virology of livestock will attract the very best scientists worldwide and provide training opportunities for the best young veterinarians and biologists seeking a career in research.

The availability of these facilities at IAH Pirbright is critical to meet the challenge of sustainable and secure food supplies in the UK. The economic and social consequences of failing to maintain capability, to rapidly respond to unexpected threats and emerging challenges from animal diseases resulting from the combined effects of climate change and the continued increase in global trade and mobility 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 operational date 2017

Information

www.iah.bbsrc.ac.uk



ISIS Target Station 2 - Phases II and III



Background

Neutron scattering has made unique and fundamental contributions to our 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) is central to the development of the Harwell Science and Innovation

Campus and has a strong synergy with the Diamond Light Source, the Central Laser Facility, the Research Complex at Harwell, and the proposed Imaging Centre, Detector Systems Centre and Hartree Centre.

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 became operational in 2009 with an initial suite of seven instruments. This completes Phase I of the project. Phase II, for the next four instruments, has earmarked funding from the Large Facilities Capital Fund (LFCF) and is at the detailed design stage with a goal of completion by 2014. Phase III, which also has earmarked funding, would see further enhancement to ISIS instrumentation over the period 2012-2017.

Funding & partnerships

The TS2 Phase I project had LFCF 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. £21.8 million funding for Phase II, the provision of a further four instruments, has already been earmarked in the LFCF. Italy, which has contributed to the instrumentation of Phase I, has signed a six year agreement including contributions to two Phase II instruments. Negotiations are underway with Germany and the Netherlands, who have also contributed to TS2 Phase I, for an involvement in a Phase II instrument. Spain has a four year agreement which has so far contributed to Phase I and to TS1 instrumentation. Sweden has a three year agreement which has contributed to TS1 instrumentation and has recently received funding approval for agreement renewal.

Estimated cost	£30 million (Phase II) £35 million (Phase III)
Estimated operational date	2012-14 (Phase II) 2015-17 (Phase III)

Laboratory for Molecular Biology

Background

The MRC 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 16 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 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 allocated funds of £67 million. MRC has allocated up to £138 million plus there will be an additional contribution from the University of Cambridge.

Estimated cost	£212 million
Estimated operational date	2012

Information

www2.mrc-lmb.cam.ac.uk



Mega Amp Spherical Tokamak (MAST)



Background

EPSRC and STFC support fusion research as part of the RCUK priority theme on energy. Realising fusion energy will be a long term international endeavour and this is an area in which the UK is demonstrating international leadership in road mapping and research.

In magnetic confinement fusion, the main “fast track” route is from JET (the world-leading tokamak operating at Culham in the UK) through ITER (funded by a global collaboration and being built in France) and DEMO (a demonstration fusion power plant, there is no agreement to build this yet) to commercialisation. In addition to these main steps, there is increasing international support for a Component Test Facility (CTF) to test fusion power station components before building DEMO.

Existing capability

MAST (the Mega Amp Spherical Tokamak) is the domestic experiment of the Culham Centre for Fusion Energy. Spherical tokamaks, pioneered at Culham, are more compact than other tokamaks, using the magnetic field more efficiently. MAST and its sister experiment, the National Spherical Torus Experiment (NSTX), at Princeton in the USA, are the only major tokamaks of this type.

New capability

The proposed MAST upgrade would provide much hotter, better controlled, longer pulse fusion plasmas allowing scientists to address the following internationally important fusion research objectives:

- to contribute to the development of the ‘physics of ITER’, through experimental campaigns aimed at refining and extending the knowledge of several areas of physics and to help frame the ITER experimental campaigns,

- to validate the physics of the Spherical Tokamak as a candidate for a Component Test Facility (CTF), a key element to support the development of a DEMO (Demonstration Fusion Power Plant), and
- to contribute to the development of divertor concepts for DEMO (the divertor, the tokamak’s heat exhaust system, is a particularly challenging component). The unique design of MAST allows incorporation of novel concepts not possible on other tokamaks.

The leading role of the MAST upgrade in the development of a Component Test Facility and the contributions to ITER and DEMO were highlighted as key aspects in the UK’s development of fusion research in the report “A 20-year Vision for the UK Contribution to Fusion as an Energy Source”, which was commissioned as part of EPSRC and STFC’s fusion strategy development in 2009.

Added value of MAST developments

The specialist fusion developments for the MAST upgrade may lead to more widely applicable technology developments for the businesses engaged in supplying equipment for the upgrade, and to their securing much bigger contracts from the multibillion ITER machine being built in France. The technical expertise maintained and developed through this upgrade will help position the UK to maximise its contribution to ITER and to developing the wider fusion technology pathway including a Component Test Facility and demonstration fusion reactor.

Funding & Partnerships

Besides the fusion research team at Culham, experiments on MAST are run by UK university research teams. University engagement is increasing with many PhD students and, for example, the University of York having specialist remote access facilities to run experiments. Overseas laboratories participate in MAST experiments. The upgrade is expected to leverage contributions from some of these, such as heating equipment, to add to the UK’s own investment.

Estimated cost	£31 million
Estimated operational date	2015

Information

www.cfe.ac.uk

Mid-Range Facility Provision

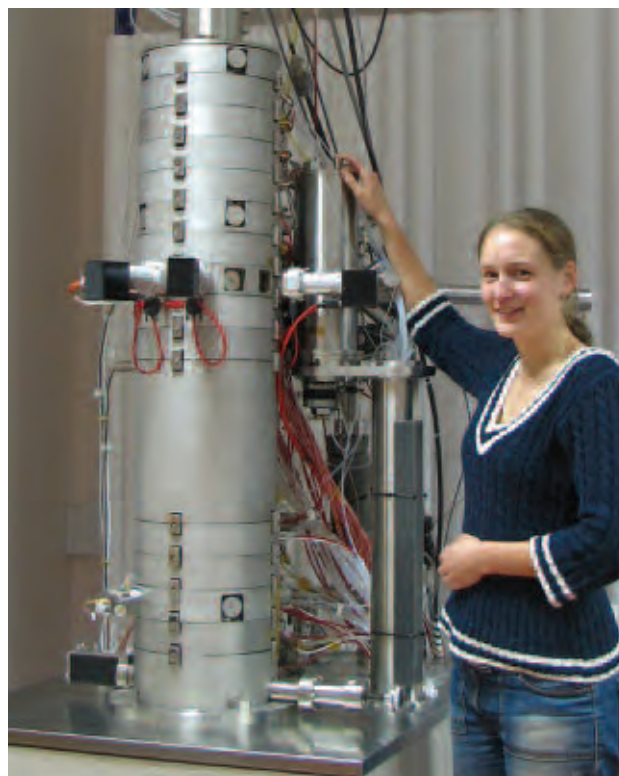
Background

Mid-range facilities are of a scale where there is limited provision in the UK. This may be due to a number of factors, for example:

- the relative cost of the equipment,
- the equipment is not required at every research organisation,
- the level of expertise needed to operate and analyse data is greater than that normally available at individual research organisations,;
- where the facility is a community resource.

In 2009 EPSRC reviewed its support for mid-range facilities to determine the areas of need in the Engineering and Physical Sciences remit. The review identified a need for new or continuing provision in the following areas:

- Dark Fibre Infrastructure
- Epitaxy
- EPR Spectroscopy
- Free Electron Laser Facility
- National Service for Computational Chemistry Software
- X-ray Crystallography Service
- Chemical Database Facility
- Engineering Instrument Pool
- Mass Spectrometry
- Materials Characterisation Facility
- Solid-State NMR
- X-ray Photoelectron Spectroscopy



The approach will be to provide most services 'free at the point of access' however some services will be provided on a 'core plus' model via tickets. This mechanism will give service operators a degree of stability to enable long term planning and retention of key staff (the core), whilst also providing a tensioning mechanism, as users will request tickets through research grant funded projects. Services will 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.

Estimated cost	£50 million
Introduction to service	2010

Information

Progress on the provision of the above facilities and further information can be obtained from the following link:

www.epsrc.ac.uk/funding/facilities/epsrc/Pages/midrange_prog.aspx

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 being provided from the LFCF, and 30% will be provided by NERC.

Estimated cost	£75 million
Estimated operational date	2014

Information

www.noc.soton.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 research. Rothera is also used for national and international collaborative research.

Estimated cost	£35 - 40 million
Estimated operational date	2018

Information

www.antarctica.ac.uk



UK Centre for Medical Research and Innovation (UKCMRI)

Background

The UK Centre for Medical Research and Innovation (UKCMRI) will be a world-class centre for interdisciplinary medical research, as part of a growing cluster of scientific excellence, of international renown, at the heart of a great world city. The centre will bring together MRC, Cancer Research-UK (CR-UK), Wellcome Trust (WT) and University College London (UCL) on a 3.5 acre site next to St Pancras International station. It presents the opportunity to create the most powerful biomedical research environment in the UK, if not Europe.

MRC's NIMR will be part of this new development. It 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. UKCMRI will deliver the MRC vision for a multidisciplinary biomedical research facility focussed on basic and translational research.

The NIMR/UCL/CR-UK/Wellcome partnership provides the multidisciplinary 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 first-class clinical facilities. The partnership will also provide access to the widest range of disciplines including physics, chemistry and mathematics at UCL.

Innovation is at the heart of the project. UKCMRI will offer a unique opportunity for exploitation of discovery. Its proximity to practising clinicians/clinician scientists and leading centres of experimental medicine provides the required immediacy of contact to accelerate clinical translation of discovery.

New capability

UKCMRI will use inter-disciplinary and innovative approaches to elucidate the basic biology underlying the understanding of human health that is necessary to attack the roots of human mortality and morbidity, including cancer, circulatory disease, infectious disease of the



immune and nervous systems, and the multiple degenerative conditions associated with ageing.

The UKCMRI focus on the foundations of human health and will allow its work to make a significant contribution to our understanding and treatment of disease in the developing world. UKCMRI will build its portfolio on the world-class foundations provided by the founding research institutes and UCL. It will recruit world research leaders, and will recruit and develop outstanding researchers in the early stages of their careers, who will generally move on to leadership positions throughout the UK and international biomedical research community.

The UKCMRI will be supported by a state-of-the-art research facility, and serviced by a flexible and science-led administrative structure. UKCMRI research will lead to a better understanding of life for the material and cultural benefit of humanity.

The new strategy is under development and will include four main goals:

- research excellence,
- training and developing future scientists,
- a catalyst for networking and collaboration supporting the nations biomedical endeavour,
- fostering innovation and translation.

The size and potential new building and central London location will facilitate:

- critical mass to enable effective multidisciplinary working and a unique environment for new approaches to biomedical scientific training,
- close interactions with the London medical cluster where the addition of UKCMRI will significantly increase the influence of London in the world arena,
- unrivalled transport links to build excellent relationships within the UK and abroad with other centers of research excellence and with pharmaceutical and biotechnological companies.

Funding & partnerships

The project will be funded in partnership between MRC, UCL, CR-UK and the Wellcome Trust and is expected to be of the order of £626 million including land (costing £85 million) which has already been purchased by the partners. The MRC will contribute £300m (land £47 million and buildings £253 million) to the construction project including a contribution from the LFCF. The estimated operational date is 2015 at the earliest.

Estimated cost	£626 million
Estimated operational date	Late 2015

Information

www.ukcmri.ac.uk

Administrative Data Liaison Service

Background

Administrative data describe information which 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.

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.

To help better exploit administrative data and in support of the National Strategy for Data Resources for Research in the Social Sciences the ESRC commissioned an Administrative Data Liaison Service (ADLS) for a three-year pilot period from October 2008. For the first year the Service developed links with potential data providers, developed its communication tools and refined its expertise. The Service formally came into operation in October 2009 and aims to become a focal point 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. The Service works in tandem with government departments and agencies, seeking to develop and improve the use of administrative data resources for research purposes.

Existing capability

The Service does not hold or store data, but acts as an intermediary between researchers and the organisation(s) providing access to administrative data for research purposes.

To achieve these aims, the Service:

- helps researchers to gain access to and link with administrative data resources,

- collects, develops and helps disseminate information about the variety of administrative data resources potentially available for research in the social sciences and related disciplines,
- works 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,
- explores 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.

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, is to develop and make use of large scale linked administrative data to develop entirely new research datasets. These will allow key policy questions for local and national government to be addressed.

In addition there are potential cost savings arising from the better utilization 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.

Funding & partnerships

The Service works across a variety of government departments and agencies to promote access to and appropriate use of administrative data sources.

Potential cost	£500,000
----------------	----------

Biomedical ESFRI projects

1. Biobanking and Biomolecular Resources Research Infrastructure (BBMRI)

The 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:

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

2. European Advanced Translational Research Infrastructure in Medicine (EATRIS)

EATRIS will establish a European translational R&D infrastructure that links and engages both clinical and basic scientists as well as strong industrial partners. 5-10 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.

3. Infrafrontier

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 2 components:

- i) 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
- ii) 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). INFRAFRONTIER will guarantee the accessibility of mouse models and will be essential to facilitate their exploitation.

4. Infrastructures for Clinical Trials and Biotherapy (ECRIN)

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, GMP manufacturing 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.

5. Integrated Structural Biology Infrastructure (INSTRUCT)

The INSTRUCT project plans to link several European Centres with expertise in a particular structural biology approach 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.

There is a continuous need for technology upgrades and advancements to follow up and promote methodological developments in the field. 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.

Funding & Partnerships

Projects are at an early stage and the full scientific case and costing models have yet to be developed. MRC is a participant on the FP7 applications.

Potential (total) cost of all 5 bids	Over €1000 million
Estimated operational date	From 2010-2017

Information

1. www.biobanks.eu
2. www.eatris.eu
3. www.ecrin.org
4. www.infrafrontier.eu
5. www.instruct-fp7.eu

Environmental ESFRI projects

1 Euro-Argo

The Euro-Argo array is the European component of a world wide in situ global ocean observing system based on autonomous profiling floats. 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. Euro-Argo aims to deploy 250 floats per year, with a lifetime of 3 - 4 years. The data are transmitted in real time by satellite to data centres for processing, management and distribution. The benefits of Euro-Argo will include data for: ocean monitoring systems and scientific study; improved seasonal forecasting; sustainable fisheries; improved safety and efficiency of marine and offshore activities.

2 European Multidisciplinary Seafloor Observatory (EMSO)

EMSO will provide real-time, monitoring of environmental processes in the geosphere, biosphere and hydrosphere of European seas. It will allow the capture of episodic events - physical and biological - that cannot be detected and monitored from research ships. A European network of cabled seafloor observatories will collect long-time series of simultaneous data on: seismology, geodesy; sea-level; fluid and gas vents; physical oceanography; and biodiversity. Implementation will be based on connecting and integrating existing and previously autonomous systems.

3 Integrated Carbon Observation System (ICOS)

ICAS will provide the infrastructure for determining the greenhouse gas balance of Europe and adjacent areas. The concept is a high-precision long-term network of stations measuring greenhouse gas fluxes from terrestrial and ocean ecosystems and their atmospheric concentrations. The ICOS measurements will be combined, using advanced carbon cycle models, into an operational information system that will benefit ecosystem and earth systems research and provide the understanding of the underlying carbon mechanisms needed for informed policy decisions.

4 Svalbard Integrated Arctic Observing System (SIOS)

Svalbard is an excellent location for studies of: Arctic ecosystem changes; ocean and atmospheric transport patterns; Arctic ice cover; energy balance between layers of the atmosphere, and for dense satellite monitoring. It has a wide variety of facilities operated by 20 countries and an international university. The UK (NERC) maintains laboratory and field facilities at Ny Alesund. SIOS will upgrade the existing infrastructure and activities on Svalbard to establish an Arctic Earth Observing System, integrating research studies and monitoring platforms.

5 Other environmental ESFRI projects.

There are other ESFRI projects that are not yet at a stage of maturity where strategic support decisions can be made: COPAL (tropospheric research aircraft); ECCSEL (carbon capture); EISCAT_3D (Sun/Earth interactions); EPOS (geophysical monitoring); IAGOS (instrumented aircraft); and LifeWatch (biodiversity).

Funding & Partnerships

Projects are supported under FP7 for the preparatory phase. Full scientific cases and costing models are being developed.

Potential cost of 1 - 4	£53 million
Estimated operational date	2011 - 2015

Information

1. www.euro-argo.eu
2. www.emso-eu.org
3. www.icos-infrastructure.eu
4. www.forskningsradet.noservlet/Satellite.c=Page&cid=1234130481137&pagename=sios/Hovedsidemal
5. www.eufar.net/copal
www.ntnu.no/eccsel
www.eiscat3d.se
www.epos-eu.org
www.iagos.org
www.lifewatch.eu

Environmental Omics Bioinformatics Facility

Background

Omics covers the complete make-up of the building blocks of life, at the genetic, protein and mRNA levels, and products of metabolism. It includes the assimilation, evaluation and interpretation of the data using bioinformatics. In recent years omics technologies have advanced markedly; many more samples are processed to high resolutions and produce vast amounts of data. By 2016 omics will include vast surveys of entire communities and up to the ecosystem scale. The emerging data challenge requires access to HPC and skilled technical support, for analyses, training, and the curation and management of omics data for the UK environmental sciences community.

Access to the latest omics technologies, including measurement and informatics, will enable the UK to retain its position at the cutting edge of environmental genomics, developed through earlier RCUK investments. These earlier investments have transformed the way in which many aspects of the ecology and evolution of life are understood, as well as providing regulatory tools. To tackle priorities in the areas of biodiversity and environment/health, major investment will be required in high-throughput analysis of key organisms and community genetic codes, high end computing services, data analysis, storage and management.

Existing capability

There is a national and global capacity for running samples and generating raw data. High-throughput molecular data generation is provided through the NERC Biomolecular Analysis Facility (NBAF), giving access to a range of omics analytical hardware including 'second generation' DNA sequencing technologies. However, without the ability to integrate individually generated data sets across habitats and time, these can provide only snapshots rather than integrated science of broader relevance.

New capability

The facility will provide the environmental science community with expertise and support via an internationally recognised centre of excellence for environmental omics. It will support the analysis and interpretation of bio-molecular data, linking with other data generation and analysis activities. It will be a focal point for innovations at the interface of environmental and molecular sciences, and will contribute extensively to the UK's ability to determine functional biological responses and their relevance in different environments. It will ensure that omics data are fully exploited via a dedicated 'hub' for data aggregation, inter-operation and analysis.

The facility will have a major impact on the UK's capability in Metagenomics - a means of defining the genetic make-up of communities in a given environment, applied to soil, deep earth, marine, freshwater or atmospheric environments. It will also help to identify characteristic and novel patterns of flora and fauna, which could evolve into 'indicators' of functional status and resilience. Such studies will help to explain how life evolved and detail at the biotic and abiotic levels the various nutrient cycles operate under different conditions. Subsequently advances process-understanding will help to parameterise climate models, hence reduce uncertainty and improve predictions of climate change. These will in turn contribute to improved insights into how changes in the water cycle will impact on societies, including the security of food supply, food production and the environmental dynamics of some pathogens.

The new facility will act as a UK node in an international network and will drive pioneering work in the field of data-sharing, data-standards and ontology development, and foster community working.

Funding & partnerships

The facility will work closely with the European Bioinformatics Institute and the proposed European Life-Science Infrastructure for Biological Information (ELIXIR), with the need for environmental scientists to work with heterogenous, natural systems often giving rise to quite different requirements. It will assist the research community to identify optimal service providers for data generation by building strong ties with the growing capability of Asia and the USA in sequencing and omics technologies.

Funding will be sought from the Large Facilities Capital Fund.

Potential cost	£30 million
Estimated operational date	2016

Information

www.nerc.ac.uk

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

Whilst 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 ten 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 three year conceptual design in 2011, followed by a more detailed preparatory phase and construction beginning in 2016/17. Potential underground sites may be in Italy, Germany or the UK.

This facility has been identified as a priority in the APPEC Roadmap. The potential UK contribution to the construction phase is estimated to be approximately £40million. STFC provided the construction costs for the UK contribution to Advanced LIGO, and continues to provide infrastructure support and R&D resources for the UK groups exploiting the current European gravitational wave observatory, GEO600. Funding for the capital phase of the Einstein Telescope is a likely bid to the LFCF.

Potential cost	£40 million
Estimated operational date	After 2016

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 behaviour, and thus providing a much more comprehensive understanding of biological processes.

Systems approaches will accelerate innovation from biological knowledge across the science base, exploiting the unique way in which diverse disciplines work together, simultaneously, in distant locations. This 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 bioprocessing applications, but in the long term have considerable implications in our understanding of complex diseases, for which the underlying genetic basis is related to combinatorial interactions of multiple genes and proteins, and 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 Centre 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, by integrating the emerging national systems biology centres.

EUSYSBIO will complement ELIXIR by providing a reservoir of skills at the interface between biological experimentation and modelling, access to state of the art instrumentation and computational tools, registries and standardised analysis platforms, including data quality control and the associated research to accelerate, automate and facilitate its operation. This will lead to 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 basis of the new distributed infrastructure.

Potential cost	£50 million
Estimated operational date	2014

European Extremely Large Telescope

Background

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 those areas across planetary science, astronomy and cosmology that are the stated priorities in STFC's strategy for astronomy. They range from direct imaging of Earth-like planets around other stars, to understanding the formation histories of galaxies by probing all the way across the Universe and therefore back in time to image the first objects that formed soon after the Big Bang.

Future capability

Between two and three optical/infrared ground-based telescopes of 30 to 40 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. They will uniquely complement the next generation of space-based facilities being developed by ESA and NASA. 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 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 and are working with academic research centres to develop precision polishing technique for the telescope mirrors, instrumentation, 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

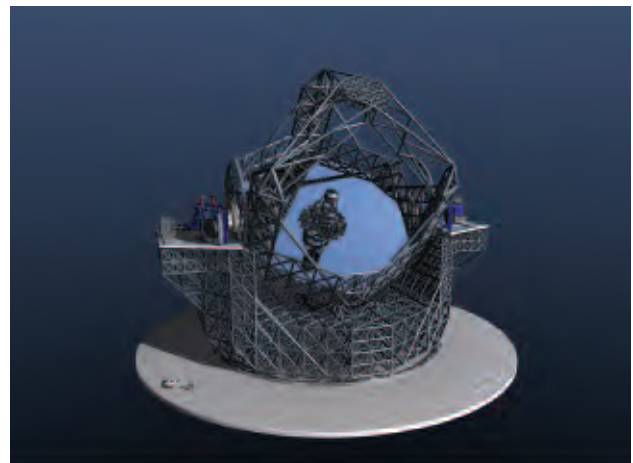
The project is being planned, and will be constructed and funded via ESO which is an intergovernmental organisation of European astronomical countries, based in Germany but operating telescopes in Chile. The UK is a roughly 16% partner in ESO with annual contributions made via STFC of £15 million. ESO has approved €57 million for Design Studies, complementing around €32 million available through funding associated with an EC FP6 Design Study & FP7 Preparatory Study Programmes. 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 required from 2011.

ESO currently has 14 national partners (France, Germany, UK, Italy, Denmark, Austria, Netherlands, Portugal, Finland, Spain, Belgium, Switzerland, Sweden and the Czech Republic). The US research community is planning two, 30-metre class telescopes (the Thirty Metre Telescope in Hawaii and the Giant Magellan Telescope for Chile). 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.

Potential cost	£45 million plus contributions to ESO subscription
Estimated operational date	2018

Information

www.eso.org/projects/e-elt/



European Life-Science Infrastructure for Biological Information (ELIXIR)

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 being generated in many places, 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 and supporting food security needs, 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 bioindustries and society. This will enhance all research and industry associated with living systems including health and medicine, the environment, food security, the bioindustries 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 distributed nodes located in 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 international coordination of the development of European capability in systems biology. A key aspect of ELIXIR is the upgrading of the computing and associated service 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

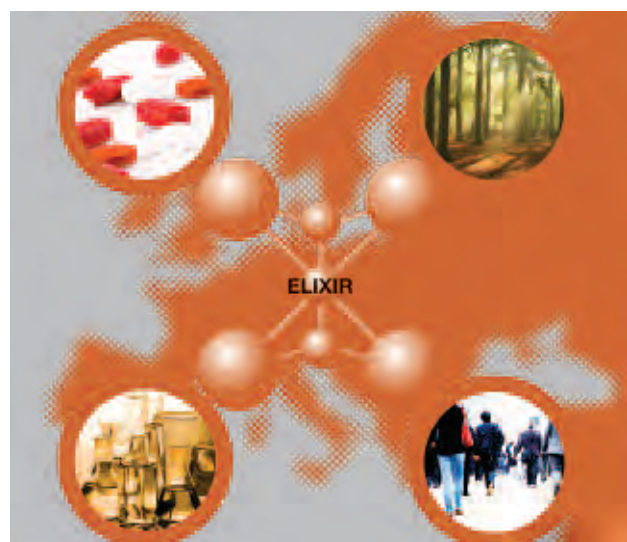
Previous UK funding for capital developments at the EBI have come from the RCUK and the Wellcome Trust. The recurrent costs for EBI are currently provided through the EMBL subscription. BBSRC and MRC have already directed over £20 million to strengthen UKwide capability in High Throughput Genome sequencing and analysis during 2009. The costing model for ELIXIR is undergoing development to establish a model of funding for international technical expert and provision of central data facilities being based at EBI and complimentary direct funding for distributed technical nodes.

The three Research Councils (BBSRC, MRC and NERC) and the Wellcome Trust are all partners in the ELIXIR preparatory phase FP7 capacities project, which is coordinated by EMBL-EBI. BBSRC is leading on behalf of these UK organisations, and managing the section of the workplan developing the funding model, as well as participating at some level in most other aspects of the project.

Potential cost	£75 million
Estimated operational date	2010-20

Information

www.elixir-europe.org



European X-ray Free-Electron Laser

Background

The European X-ray Free-Electron Laser (XFEL) project started in June 2007 (with FP7 Research Infrastructures funding) 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 ~ 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 researchers 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 $\sim 30\,000$ electron bunches per second (10 bunch trains with 600 μ s duration, of up to $\sim 3\,000$ bunches each) into a manifold of undulators (each feeding a separate photon beamline),

comprising: 3 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 3.4 km long, will include ten experimental stations with state of the art equipment for the scientific exploitation of the radiation by the user communities.

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 crystallization and access to presently inaccessible regions of the phase diagram of warm dense matter.

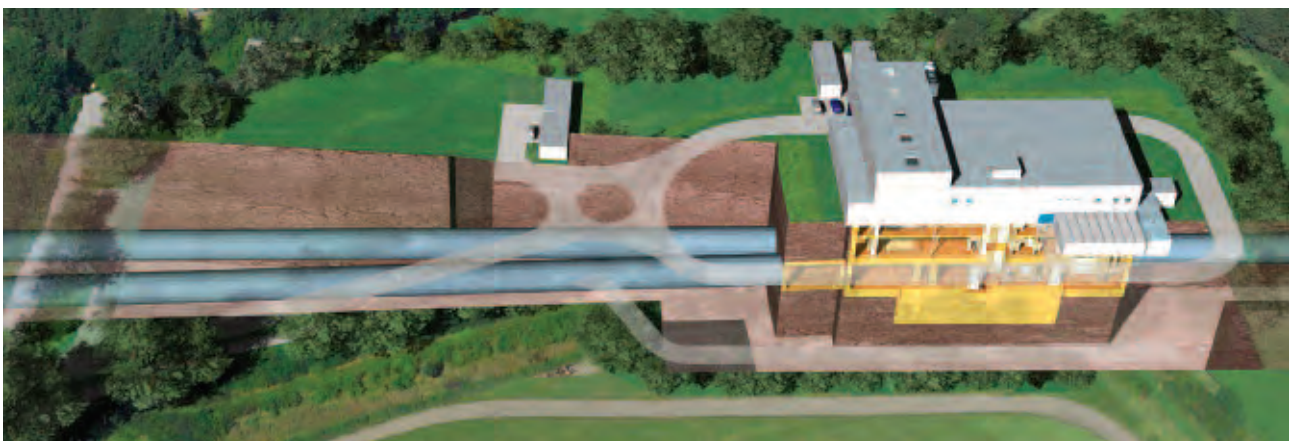
Funding & partnerships

An international Convention was signed in November 2009 by six countries

Estimated operational date 2014

Information

www.xfel.eu



Extreme Light Infrastructure

Background

ELI is a pan-European project to achieve the highest possible laser intensities and the shortest possible pulses. As such, its principal mission is to explore new scientific frontiers, with three linked areas of investigation: entering the ultra-relativistic regime for the first time; enabling science in the attosecond time domain; and developing applications of laser driven 'beamlines'.

These potential applications cut across a broad range of areas – 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.

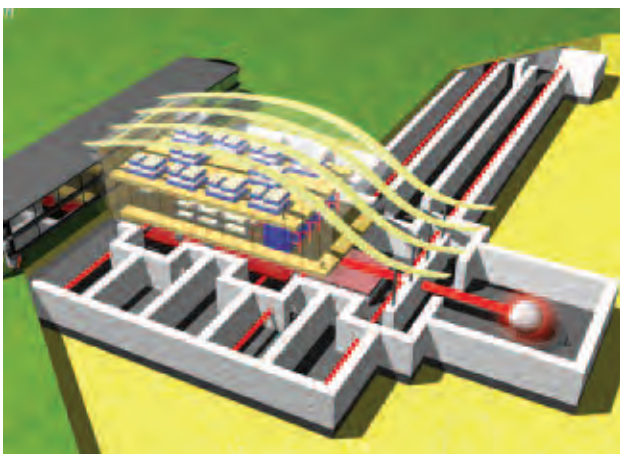
ELI will secure European leadership in a field which is rapidly developing in Asia and USA.

Existing capability

The UK is planning to upgrade Vulcan (currently the world's most powerful laser, based at the Central Laser Facility, RAL), to 10 Petawatt 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) in Palaiseau, at a cost of ~€25 M. ELI represents the next logical step after the development of this 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 present-day Vulcan. This facility will operate in a "beamline" mode 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

The Preparatory Phase project (2008-11) is coordinated by LOA (France), with 13 European partners. The current phase has funding from the EC, with in-kind support from a number of nations and institutions, including the UK.

The UK has a long history of leadership in this area, from both a technology and science perspective and coordinates the technical work of the current "preparatory phase". We have the opportunity to maintain our leading approach by appropriate engagement with ELI coupled to our associated national level programmes – Vulcan and DIPOLE (q.v.).

The location of ELI will be on three sites (Czech Republic, Hungary, Romania) managed as a single facility as part of an ERIC consortium. Construction will be paid for by these three nations using domestic and European Structural funds. Technical input is envisaged from the UK, FR and DE amongst others. Operations will commence in 2016.

Potential cost	No direct UK contribution to construction currently envisaged
Estimated operational date	2016

Information

www.extreme-light-infrastructure.eu

Facility for Antiproton and Ion Research (FAIR)

Background

The international FAIR project aims to provide researchers 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 the FAIR experiments 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 eight years with 75% of the funding being provided by the German government assuming that 25% will be provided by other partners. 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,



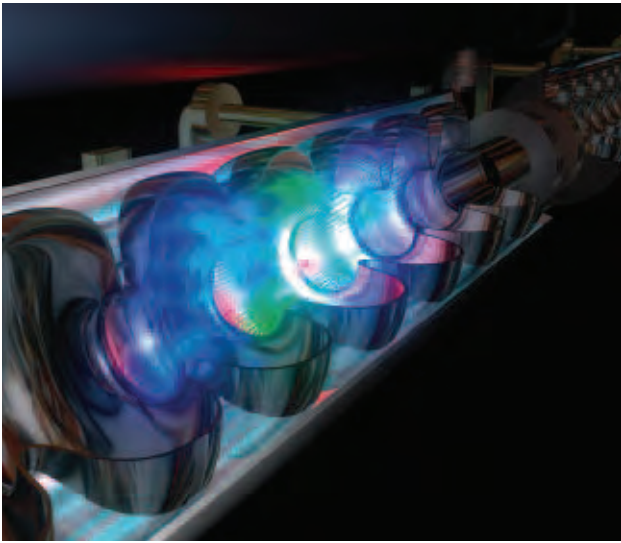
Poland, France, Russia, Italy, Spain, Finland, Sweden, Greece, China and Austria. India and Romania have agreed contributions to the construction phase. It is expected that the first experiments will run in 2015, with the full facility completed, at the earliest, in 2017/18. The science direction of 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. In 2009 STFC reviewed the level and priorities for UK involvement, and re-affirmed its contribution to the construction of one of the FAIR experiments, NuSTAR.

Potential cost	£10 million
Estimated operational date	2017/18

Information

www.gsi.de/fair/index_e.html

Future High Energy Colliders



Background

A next-generation particle physics accelerator designed to collide beams of electrons and positrons, or perhaps muons, at energies between 0.5 to 1 TeV, is likely to be required as a way to follow up discoveries made at Large Hadron Collider, currently starting operations at CERN. It would provide 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 together with an electron-positron collider.

Future capability

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, starting 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 Light Source and XFEL).

Funding & partnerships

A number of concepts for such a facility are being pursued. The International Linear Collider group is participating in a Global Design Effort, drawing together researchers from Europe, the Americas and Asia. This project is working towards a Technical Design, which should be complete by the end of 2012. The machine will be 30 - 40 km in total length. In collaboration with groups from CERN and elsewhere, R&D for a Compact Linear Collider (CLIC) is also being investigated. These two concepts have many technological synergies. Other concepts include 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 2012/13, 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.

Potential cost	£350 million
Estimated operational date	After 2020

Information

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

Gateway Centres at the 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 RCUK, 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 strategy which identifies areas of strong internal capability and relates each of them to areas of societal and economic relevance. Within these capability areas we have identified a new campus-based science and 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 new advanced 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 Solutions Centre will provide accessible, time-critical imaging information to users of the research facilities on the Harwell campus. This will be enabled by the provision of unrivalled imaging technology, expertise in computer simulation, detectors, data acquisition and analysis, and the provision of consulting services to deliver "one-stop" problem-solving capabilities.

The Hartree Institute on the Daresbury campus will be a new kind of computational science and engineering institute for the UK. It will 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, materials and the environment.

The Detector Systems Centre will bring together academic and industrial researchers and STFC's world-class detector capabilities and knowledge base on both the Harwell and Daresbury campuses. 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.



The International Space Innovation Centre (ISIC), co-located at Harwell with the European Space Agency centre and a business incubator, will be the UK's strategic hub for the space industry and academic community, with a unique concentration of capabilities to support research, collaboration, operations and business growth. The ISIC will form a core element of the Harwell Science and Innovation Campus.

Additional Gateway Centre initiatives that align with STFC's strengths will be explored. These include centres aligning with core capabilities of STFC, and also satellite activities growing from the initial Gateway Centres.

A Joint Institute for Materials Design co-located with the ISIS neutron source, the Central Laser Facility and the Diamond Light Source has been identified as one such future opportunity. It would assist in the provision of top-quality materials designed for study in these facilities, develop new methodologies for studying materials in operating conditions, and contribute to the discovery and optimisation of new functional materials.

Funding & partnerships

A Joint Venture partnership was established in 2008 to take forward the development at the Harwell Science and Innovation Campus, and a similar partnership is being developed for the Daresbury Science and Innovation Campus with expected completion in 2010. The Joint Ventures will professionally market the campuses to attract university groups and high added value companies regionally, nationally and internationally as well as investment from the international R&D sector.

To support the Gateway Centres within this framework we will seek to form strategic partnerships between the research councils, with other PSREs, RDAs and HEIs. In addition to RCUK funding, we anticipate significant support from the EU and from industry.

Potential cost £125 million

Information

www.scitech.ac.uk/ResFac/Gateway/GatewayCentres.aspx

High Power Laser Energy Research Project (HiPER)

Background

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 novel 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 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 demonstrating the case for the exploitation of laser driven fusion. The current phase is timed to coincide with the upcoming demonstration of energy production from lasers (in ~2010-2012 on the US National Ignition Facility, NIF). HiPER will then illustrate the route to viable power generation by addressing the key R&D challenges, both scientifically and technologically.

It is clear that 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 long-lived 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 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 researchers from 12 nations (UK, Czech Republic, France, Greece, Italy, Spain, Portugal, Poland, Germany, Russia, USA and Republic of Korea), two regional governments (Madrid and Aquitaine) and industry. The first six countries are participating at a national level, with the UK taking the coordinating role.

It completed a two year conceptual design in 2006 and is now mid-way through a three year "preparatory phase" project (2008-11). A prototyping and detailed design phase is planned to follow (2011-16), 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) steps are PETAL (currently under construction near Bordeaux at a cost of ~€80 million) and DIPOLE (q.v., to provide the underpinning technology).

The current preparatory phase has funding (in-kind or direct) from: the European Commission, UK, Czech Republic, France, Greece, Spain, Italy, Poland, Portugal, and the Republic of Korea.

HiPER has 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 total project costs are £1 – 5 billion, subject to assessment in the Preparatory Phase. Progression to a fully international facility is being explored as part of the Preparatory Phase.

Potential cost	unavailable at time of writing
Estimated operational date	2020

Information

www.hiper.org/

High Power Laser national facility (VULCAN-DIPOLE)

Background

The interaction of a high power laser with matter creates truly extreme conditions, otherwise only found off planet. Unsurprisingly, this leads to the ability to study directly a wide range of 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 (via HiPER, q.v.).

Existing capability

For many years, the UK has led the world in this field of science with the Vulcan Petawatt and Astra-Gemini laser facilities at the Rutherford Appleton Laboratory. This has delivered a hugely successful research program, and has allowed the UK to provide leadership in the development of next-generation international scale facilities such as HiPER and ELI.

Looking to the future, the major challenges require development of new techniques to push the boundaries of peak power, and new technologies to enable operation at high repetition rate. Current approaches are limited to the Petawatt power levels (whereas tens to hundreds are required), and repetition rates measured in minutes or hours (whereas multiple pulses per second are required). High repetition rate technology can also deliver high electrical-to-optical efficiency (typically 100 times more efficient than conventional “flashlamp” technology), which is a pre-requisite for viable operation of many of the applications.

New capability

The UK has the opportunity to push both of the principal technical boundaries as part of a coherent approach to this field of science.

Upgrading of VULCAN to the 10+ Petawatt power level is being planned by STFC to ensure continued UK leadership until the latter part of next decade, providing continuity for the development approach that has been highly successful over the past ten years.

The proposed DIPOLE project will complement this by developing a scheme for direct pumping by solid-state laser diodes, at high efficiency (>10%) and high repetition rate (>1 Hz). This will open up a wealth of application areas (for academia and industry) that have hitherto been excluded.

Initially DIPOLE could be stand-alone, but is designed to allow retro-fitting onto Astra-Gemini and/or VULCAN in subsequent years to “future-proof” our domestic laser facility capability and provide maximum return on investment.

These developments would give the academic and industrial community access to unrivalled capability internationally. The breadth of research would cover the entirety of the current high power laser programme. It would also enable the development of many options to couple with accelerator driven light sources (such as XFEL and LCLS), and would act as an important prototype technology step for both HiPER and ELI.

The whole approach is modular, and the diode-pumped system development is fully amenable to multi-national development.

Funding & partnerships

Vulcan has been the principal UK national facility in this area, funded by STFC. Upgrade to the 10+ Petawatt level comes in two phases. The first (2007-9) allowed the project to proceed at low technical risk. The second (construction) phase (~£20 million) allows the project to be delivered mid next decade.

For the diode pumped laser technology development, there are four existing (small scale) diode projects currently underway in France, Germany, USA and Japan. DIPOLE would build from the experience on these projects to provide the UK with a “next-generation” capability. It is planned that this is performed in partnership (technical and financial) with the principal European teams – from Czech Republic, France and Germany. Coordination with ongoing work in the USA and Japan is anticipated.

Potential cost	£25 million (Vulcan 10PW) £50 million (DIPOLE technology)
----------------	--------------------------------------------------------------

Estimated operational date	2014-15
----------------------------	---------

Information

www.clf.stfc.ac.uk/Projects/index

Integrated Rural and Urban Observatories

Background

The natural and anthropogenically influenced environments in catchments, cities and coasts have become battlegrounds for environmental change in recent years. Currently our understanding of the interactions between the active processes in the Zone of Human Interaction (i.e. earth and land surface processes, hydrological processes, ecological processes, the built environment, human activity and vulnerability) is very poor. There is inadequate evidence for the detection or attribution of environmental changes or their consequences, and so the calibration and validation of environmental process and impact models is poor.

An integrated approach to the survey and monitoring of baselines and changing parameters is required to allow whole systems or risk-based approaches to decision making. The research base that currently underpins our response to environmental change and enables us to live with and adapt to rapid environmental change is totally inadequate to allow reliable and appropriate decisions and policy development.

Some of the major science challenges facing the world driven by environmental change are those in understanding scale and heterogeneity, both spatially and temporally. The current revolution in computing capacity, sensor technology and remote sensing will allow the environmental science community to develop the knowledge base required quicker and more fully at a range of scales from millimetre to kilometre.

Existing Capability

There are uncoordinated programmes of survey and monitoring of natural processes in soils and water, and the biodiversity and ecosystem services provided, in a variety of rural catchments and coastal environments. The EA and Defra are developing demonstration catchments. There is very little monitoring in urban and peri-urban areas even though changes in energy resource use, water supply, drainage and waste policy and planning are changing or set to change in the near future.

Future Capability

This will comprise an integrated set of sensor networks and high-frequency observations, covering the major upland, lowland, coastal and urban environments. The monitored and regularly survey sites an areas will be linked explicitly into web portals, to allow researchers and practitioners ready and efficient access to data. There will be links with observatories and facilities in Europe through the European Plate Observing System (EPOS, an ESFRI project), and possibly the USA. Eight to ten major sites will be telemetered for long-term observations of a range of geological, soil, chemical, physical and biological

parameters in the earth and hydrological systems. The observatories will build on the UK's current and planned observational systems, such as those developed for previously RCUK funded research programmes and will build on other initiatives of EA, SEPA and Defra. The data from the UK Rural-Urban Observatory System will provide a major contribution to the monitoring and forecasting of environmental change impacts for UK and will be a part of a European environmental change monitoring system through the EPOS initiative.

The realisation of appropriate survey and monitoring of environmental variables in catchments, cities and coasts will enable the parameterisation and design of environmental (including climate) change impact models and provide the data required for their calibration and validation, so allowing evaluation of the scale and speed of impacts of environmental change and the degree of societal and economic risk.

Funding & Partnerships

Collaboration with environmental regulators, central, devolved and local government will be vital to ensure that maximum use of the facilities for research, evidence gathering, and compliance is achieved. Industry involvement will be actively sought, in particular, agriculture, water and waste. Collaborations with other industries, such as energy suppliers, the mineral industry, heritage and tourism will also be important. Linkage to Europe will enhance the science developed from the data and knowledge base.

Potential cost	£15 - 20 million
Estimated operational date	2014-2017

Information

www.nerc.ac.uk

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. Construction of MICE is underway with beamline and detectors installation nearing completion. Work is now beginning on the cooling stages. Our goal is to have results from the MICE experiment at RAL in order to inform a potential construction decision in the middle of the next decade.

In parallel, RCUK are supporting an International Design Study of a Neutrino Factory as a global effort, with European collaboration, which is supported through the seventh EU framework programme, with the aim of RAL being the host laboratory for the design study effort. Estimated total project cost is £2 billion.



Potential cost	unavailable at time of writing
Estimated operational date	After 2018

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 research 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.

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 neutron community has expressed considerable interest and support for the proposed European Spallation Source as defined in the ESFRI



Roadmap and intends to collaborate in the design phase. It is also clear that the community wishes to see the continued operation and upgrades of the two major existing facilities ISIS and ILL.

We believe that a coherent approach to the provision of neutron sources in Europe is needed. This strategy needs to address continued operation and upgrades to ILL and ISIS, as well as the role of a

new European Spallation Source. We believe that any major new investments in neutron facilities in Europe should be considered



within the overall European landscape in neutron scattering; we should make sure we have a balanced programme that meets the science needs of the European research area.

The research carried out at a next generation neutron source will have a strong synergy with the Diamond Light Source, the Central Laser Facility, the Research Complex at Harwell, and the proposed Imaging Centre, Detector Systems Centre and Hartree Centre.

Funding & partnerships

There are three inter-linked projects in terms of both costs and schedule - ILL upgrade, ISIS MW upgrade and the proposed European Spallation Source. The STFC strategy is to ensure that any major new investments in neutron facilities in Europe form part of a coherent programme that meets the science needs of UK researchers. An effective capital budget profile that would cover most potential options would ramp from an initial £3 million in FY10/11 to a plateau of £25-35 million per year. This would allow a rapid additional investment in ILL over three to four years, with subsequent exploitation for at least the decade 2013-2023 following ILL convention renewal and while the next generation neutron source is constructed. Depending on negotiations with other European countries, further investment would then be directed towards ESS or towards an ISIS MW upgrade. In both cases there is a need for a significant design/development/prototyping phase, much of which can be of common benefit for either project as well as current operating facilities. Such a plan would maintain the capacity of UK accessible neutron facilities while steadily increasing the capability. 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 %) and European partners. The level of any UK investment in ESS would need to take account of the UK's existing high share of investment in European neutron sources, and the commitments of other countries to invest in continued operation and upgrades to ILL and ISIS.

Potential cost	£240 million
Estimated operational date	2021 MW ISIS 2023 ESS

Platforms and Instrumentation

Background

Much of environmental research has been pursued with manned observatories, field workers with portable instruments or remote sensing from satellites. Using these techniques, our knowledge is limited by both the frequency with which such data can be produced and its coverage. Some regions of our planet are still inaccessible. Technology now exists to enable development of autonomous instrumented vehicles, or dense networks of instrument platforms, to provide data with sufficient spatial and temporal resolution to address many key problems. Blending these technology elements, together with the development of new sensors, is given greater urgency by the need to monitor environmental change. Operational forecasting systems will also benefit, with improved accuracy from denser data networks, which can be provided at a fraction of the cost of manned observatories.

Development of the next generation of autonomous instruments will revolutionise our ability to provide more frequent and higher resolution regional-scale observations, whether in densely populated or remote, inaccessible regions. Unmanned aerial vehicles (UAVs) and autonomous underwater vehicles (AUV) are examples of such instrument platforms and the UK has a strong technology lead in this area. For example, the 'Autosub' submersible developed by the National Oceanography Centre can conduct missions under floating iceshelves, collecting physical, chemical, biological and geophysical data from a previously inaccessible region. Such technologies have migrated to commercial applications (e.g. in oil and gas field work). Low green powered remote instrumentation has been developed to make measurements in the polar regions where temperatures can fall to -70°C and there is many months continuous darkness.

Future capability

The UK has a range of technology demonstrators in both autonomous vehicles and instrument platforms on land, in the air and under the sea. Key requirements now are:

- development of lower cost vehicles with higher payload and increased endurance. An exciting prospect is for such vehicles to operate in 'swarms', to provide greater spatial resolution,
- scaling up of instrument platforms to provide dense networks of sensors, with higher power capabilities and the ability to reconfigure instruments and networks in response to environmental events,
- for maximum utility, parallel developments in communication, both to base stations and between sensors. End-to-end data management techniques, with the ability to enable rapid data assimilation in to models, are also required,
- development of renewable power systems and low power electronics both to maximise the data rates achieved and to provide access to the most inaccessible environments,
- exploration of key new environments: the deep sea and the lake and river systems under several km of ice in Antarctica.

Funding & partnerships

NERC would expect to seek a contribution from the Large Facilities Capital Fund.

Potential cost	£30 million
Estimated operational date	2013-2018

Information

www.nerc.ac.uk

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, but only via special conditions regarding the way they are stored, analysed and if they are destroyed after use. Various procedures are currently being trialled to facilitate better access for research purposes whilst 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 and in support of the National Strategy for Data Resources for Research in the Social Sciences the ESRC commissioned a Secure Data Service for a two year pilot period. For the first year the Service has developed its technical capability and rigorously tested the access and security procedures required to deliver the data safely, along with developing partnerships with potential data providers. The Service formally came into operation in October 2009.

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 prior 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 has established a pilot 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 of 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 and the SDS will take account and learn from these developments.

Funding & partnerships

The Service is being funded by ESRC with additional support from the current provider of the Service, the UK Data Archive and the LFCF.

The Service will build and maintain effective stakeholder partnerships.

Potential cost £2.2 million



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

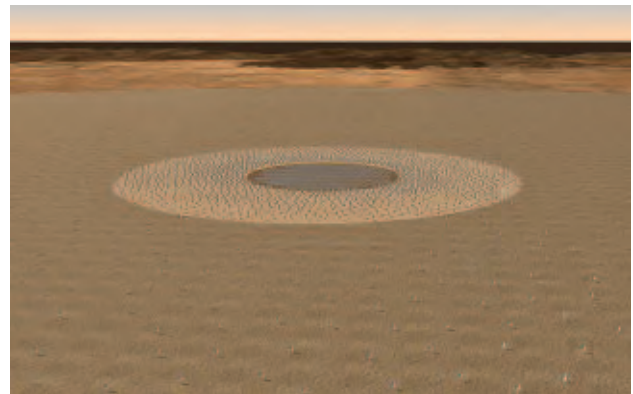
SKA represents the future of world radio astronomy, complimentary to developments such as the ELT for optical/infrared observations. It will scan and map the radio sky with >100-times better sensitivity than is currently possible and will address many of the most important problems in general relativity, cosmology and astrophysics. The SKA will be a distributed array of collecting "stations" - each of area ~10,000 m² - spread out over 100s of km. The frequency coverage will extend from ~0.1 to ~20 GHz.

From the outset, the development of the SKA, within a reasonable timescale and 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 focussing 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 it's potential investment.

In addition to the step-wise scientific impact, with resulting opportunities for UK researchers 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 more than 15 different countries. A choice of site, likely to be in the Southern Hemisphere, is expected in 2010.



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), and now via a FP7 Preparatory Studies programme (PrepSKA) worth €22 million, €5.5 million of which is from the EC. STFC is acting as coordinator for the PreSKA European consortium and leading the global funding agencies initiative. Funding for the construction of SKA will require substantial investment from all participants, including consortia and agencies in Europe, North America, Australia and potential partners in Japan, China and India. The SKA is expected to be developed in phases, with each phase capable of delivering part of the science goals. The business case for Phase 1 is expected to be made to funding agencies and the LFCF in 2010. Europe may take a 60% share in the global project, and 20% of the European share would be appropriate for the UK. In Phase 1 this is equivalent to €36 million in the period 2011 to 2015. €17 million has been earmarked by Government via the LFCF towards this first Phase. Assuming construction of the full array from 2018, an additional UK fund of €80 million might be required.

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, and have committed over \$100 million to these projects. Along with European endeavours, such as LOFAR, and similar development programmes in the USA, these provide the technical basis on which the SKA design will develop.

Potential cost	£120 million
Estimated operational date	2014-2020

Information

www.skatelescope.org

2012 Birth Cohort Study and Cohort Resources Facility

Background

Birth Cohort studies, which track a large sample of babies from birth into adulthood, gather information on their lives as they grow up. The UK has a unique and internationally renowned collection of birth cohort studies spanning over 60 years. The British Birth Cohort Studies are recognised worldwide as remarkable longitudinal research resources.

Existing capability

Since 1946, and at approximate ten to twelve 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 where we look across different generations. Comparing the 1958 and 1970s generations told us that social mobility in Britain may have stalled. 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

In summary, the project will:

1. launch a new interdisciplinary birth cohort study in 2012,
2. launch a new Cohort Resources Facility, to support and enhance utilisation of the existing cohort studies.

This pioneering initiative will enable a new birth cohort study to be established in 2012 and provide for the first time, a Cohort Resources Facility dedicated to providing enhanced access to and supporting the work of the existing cohorts. This will ensure UK's birth cohorts time series is not broken and ensure maximum value is secured from the existing cohorts by supporting cross cohort research. It will allow analysis across the generations by comparing patterns of activity, at similar ages, amongst the



different cohorts' members. For example, it will enable the analysis of the latter 20th Century/early 21st Century phenomenon of women delaying starting a family - what are the social, economic and educational impacts of having older parents compared with earlier generations? As such, it will provide the bedrock for cutting edge research to be undertaken, across the lifecourse, into such important areas as health and poverty. The Study will also help us to understand more about how a child's very early growth and development - particularly of the body and brain - influences their future health and wellbeing as well as their risk of future illnesses. New interdisciplinary work will be possible between economists, epidemiologists, geneticists, psychologists and sociologists.

Research interest in both the 2012 Birth Cohort Study and the Cohort Resources Facility will be world wide, 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 and enhance its birth cohort studies.

Funding & partnerships

The estimated cost of both the 2012 Birth Cohort Study and the Cohort Resources Facility, including Full Economic Costs over the next five years is £33.5 million. This includes £28.5 million of earmarked funding from the Large Facilities Capital Fund and an additional £5 million of funding from the ESRC and the MRC who are developing the Project.

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.

Potential cost	£33.5 million
Estimated operational date	2010

Information

Further information on the 2012 Birth Cohort Study and Cohort Resources Facility Project can be found at: www.esrcsocietytoday.ac.uk/ESRCInfoCentre/opportunities/archive/birthcohort.aspx

Glossary of acronyms

AHRC	Arts and Humanities Research Council
BAS	British Antarctic Survey (NERC)
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BBSRC	Biotechnology & Biological Sciences Research Council
BHPS	British Household Panel Survey
BIS	Department for Business, Innovation and Skills
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
CLF	Central Laser Facility
CLS	Centre for Longitudinal Studies
CNRS	Centre National de la Recherche Scientifique (French National Center for Scientific Research)
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
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
ERL	Energy Recovery Linac
ESDS	Economic and Social Data Service
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
ESRC	Economic and Social Research Council
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
FAAM	Facility for Airborne Atmospheric Measurements
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
FMD	Foot and Mouth Disease
GEOSS	Global Earth Observation System of Systems

GMES	Global Monitoring for Environment and Security
HECToR	High End Computing Terascale Resource
HiPER	High Power Laser Energy Research Project
HST	Hubble Space Telescope
IAH	Institute of Animal Health
ILC	International Linear Collider
ILIAS	Integrated Large Infrastructures for Astroparticle Science
INI	Isaac Newton Institute
INSTRUCT	Integrated Structural Biology Infrastructure
ITER	International Tokamak for Internal Confinement Fusion (former acronym dropped)
J-PARC	Japan Proton Accelerator Research Complex
LBNL	Lawrence Berkeley National Laboratory
LCS	Linac Coherent Light Source
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 (NERC)
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
NuSTAR	Nuclear Structure, Astrophysics and Reactions
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
SNS	Spallation Neutron Source
STFC	Science & Technology Facilities Council
SuperNEMO	Next generation NEMO project
T2K	(from) Tokai To Kamioka
UKCRN	UK Clinical Research Network
WIMP	Weakly Interacting Massive Particles
XFEL	X-ray Free-Electron Laser

Annex I – Large Facilities Capital Fund Prioritisation Criteria adopted by RCUK

Output 1 - Impact Factors

This criterion includes:

Innovation The importance of the knowledge that would result from the project - and whether it offers the potential for real breakthroughs in its area.

Scale and area of benefit The breadth of the quality research base that would benefit

Research strategy factors

- The current UK competitive position in this area
- Whether the area is demonstrably a priority for funders (at project funding level)
- Whether funding (or not) will affect the UK's position in this area

Social / economic impact strategy Whether there is evidence that the advances in research offered will be turned into social or economic benefit for UK.

Output 2 – Risk and Cost factors

This criterion includes:

The value for money and how the benefits are commensurate with the cost.

The level of technical risk in the project and how this risk is being managed.

Annex 2 – The OGC Gateway Process and how it applies to 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) Gateway Review process.

OGC's Gateway Process

All Government acquisition programmes and projects that score as 'medium' or 'high' risk on OGC's RPA (Risk Potential Assessment) tool, including Non-Departmental Public Bodies (NDPBs), are subject to the OGC Gateway process. This examines programmes and projects at critical stages in their lifecycle to provide assurance that they can progress to the next stage. The process follows a series of Gateways - Gate 0 is for programmes and Gates 1-5 are for projects:

- Gate 0 - the strategic assessment review – repeated throughout the life of the programme
- Gate 1 - to confirm the business justification
- Gate 2 - to confirm the procurement/delivery strategy – takes place before procurement activity commences
- Gate 3 - to confirm the investment decision – takes place before the letting of major contracts
- Gate 4 - to confirm readiness for service of the project's output e.g. new building or IT system
- Gate 5 - review of operations and benefits realisation

OGC Gateway Reviews are conducted by independent accredited Review Teams selected for their knowledge and experience and take place over three to four days. The output, delivered to the SRO on the last day of the Review, is a report and recommendations on how the programme/project can maximise its chances of successful delivery. Gateway Reviews also assign a 'delivery confidence' rating for the programme and project.

BIS Projectcentre leads on OGC Gateway activity for BIS and its delivery partners, including the RCUK BIS Projectcentre works closely with OGC and can be contacted at projectcentre@bis.gsi.gov.uk

Given the capital sums involved and the nature of the assets delivered by LFCF programmes and projects, the starting assumption is that all LFCF funded initiatives will be rated as at least 'medium' risk for OGC Gateway purposes. This means that the Reviews are delivered via BIS Projectcentre. OGC's RPA (Risk Potential Assessment) tool provides further clarification of the risk status for the purposes of Gateway.

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

Preparation of the Science Case

Before a detailed Business Plan is developed to make the case for funding, BIS requires the proposed facility to produce a Science Case. The Programme/Project Manager 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 research,
- 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 estimates and any costs of feasibility studies required before proceeding to the next stage, the production of the Strategic Outline 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 BIS 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 Justification. 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 Strategic Outline Business Case - Gateway Review 1

Gate 1 looks at the justification and robustness of the Strategic Outline Business Case. It provides assurance that the proposed approach to meeting the business

requirement has been adequately researched and can be delivered. It also confirms that the benefits to be delivered from the project have been identified at a high level, and that their achievement will be tracked using a defined measurement approach.

The SRO will present the results of Gate 1 to the RCUK Executive Group. The Business Case should confirm that funding for the project is in place. However, for projects that are seeking some funding from the LFCF, the RCUK Executive Group will only recommend to BIS 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 BIS following a satisfactory Gate 2 (delivery strategy) Review. Approval by BIS Ministers is required in all cases, and if the project is above the BIS delegated powers, or requires funding from beyond the current three-year Spending Review period, approval is also required from HM Treasury.

Delivery Strategy - Gateway Review 2

Gate 2 assesses the project's delivery/procurement strategy. By the time of this Gateway 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 BIS Ministers, the project is viable, has high potential for success and is ready to invite proposals or tenders from the market. This Gateway is undertaken before any significant procurement activities commence.

In general the Gate 2 Review, and further Gateway Reviews, 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 RCUK (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.

Gateways 3-5

Progress through the remaining Gateway Reviews is related to the nature of the project, its delivery strategy, milestones and outputs.

Gate 3 is the Investment Decision Review, and takes place before the project signs a contract with the supplier. It checks that the project is still required, that it is achievable and affordable, and that implementation plans are robust.

Gate 4 is the **Readiness for Service Review**. It focuses on the readiness of the organisation to 'go live' with the project's deliverables and the necessary business changes, and checks the arrangements for management of the operational service(s).

Gate 5 is the **Operations Review and Benefits Realisation Review**. It confirms that the desired benefits of the project are being achieved, and that the business changes are operating smoothly. The Review is repeated at regular intervals during the lifetime of the new service/facility.

NOTE:

- In exceptional circumstances, Gates 1 and 2 may be combined.
- In some circumstances, where a programme is undergoing OGC Gate 0 Reviews, it may not be necessary for projects within the programme to undertake Gateways 1-5.
- For complex delivery projects with a long and/or phased implementation stage, multiple Gate 4 Reviews may take place.

Index of Facilities by discipline

	Page		Page
Astronomy, Astrophysics, Nuclear and Particle Physics		Materials Science	
European 3rd Generation Gravitational Wave Observatory (Einstein Telescope)	47	Gateway Centres at the Daresbury and Harwell Science and Innovation Campuses	55
European Extremely large Telescope	49	Diamond Light Source – phase III	31
Facility for Antiproton and Ion Research (FAIR)	53	European Synchrotron Radiation Facility	17
Future High Energy Colliders	54	European X-Ray Free Electron Laser	51
High Power Laser Energy Research Project (HiPER)	56	Extreme Light Infrastructure	52
Large Hadron Collider	19	Gateway Centres at the Daresbury and Harwell Science and Innovation Campuses	55
Next Generation Neutron Sources	60	High Power Laser national facility (VULCAN-DIPOLE)	57
Neutrino Factory	59	Institut Laue-Langevin (ILL)	18
Square Kilometre Array	63	ISIS Target Station 2 - Phases II and III	36
		Laboratory for Molecular Biology	37
		Mid-Range Facility Provision	39
Biomedical and Life Sciences		Social Science and the Humanities	
Biomedical ESFRI Projects	44	Administrative Data Liaison Service	43
European Centre for Systems Biology	48	British Election Study (BES)	12
European Life-Science Infrastructure for Biological Information (ELIXIR)	50	Census of Population Programme	13
Institute for Animal Health - Pirbright	34	Centre for Longitudinal Studies (CLS)	14
Institute for Animal Health - Compton	35	Council for European Social Science Data Archives (CESSDA)	30
Laboratory for Molecular Biology	37	Economic and Social Data Service (ESDS)	15
Mary Lyon Centre	20	English Longitudinal Study of Ageing (ELSA)	16
Research Complex at Harwell	25	European Social Survey (ESS)	32
UK Biobank	26	National Centre for E-Social Science (NCeSS)	21
UK Centre for Medical Research and Innovation (UK CMRI)	42	National Centre for Research Methods (NCRIM)	22
		Secure Data Service (SDS)	62
		Understanding Society - UK Household Longitudinal Study	27
		2012 Birth Cohort Study and Cohort Resources Facility	64
Computer and Data Treatment			
Provision for High Performance Computing	24		
Energy			
High Power Laser Energy Research Project (HiPER)	56		
Mega Amp Spherical Tokamak (MAST)	38		
Environmental Sciences			
Atmospheric Research Aircraft	29		
Antartic Marine Capabilities	28		
Environmental ESFRI Projects	45		
Environmental Omics Bioinformatics Facility	46		
Halley Research Station Antarctica	33		
Integrated Rural and Urban Observatories	58		
Oceanographic Research Ship (replacement for RRS Discovery)	40		
Oceanographic Research Ship RRS James Cook	23		
Platforms and Instrumentation	61		
Rothera Research Station, Antarctica	41		



Research Councils UK
Polaris House, North Star Avenue
Swindon, Wiltshire SN2 1ET
United Kingdom

Tel: +44 (0) 1793 444420
Fax: +44 (0) 1793 444409

www.rcuk.ac.uk info@rcuk.ac.uk