NATURAL ENVIRONMENT RESEARCH COUNCIL

Organisational Theme Reports
NERC Strategy 2007 – 2012
Next Generation Science for Planet Earth

Knowledge
November 2007

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Putting knowledge to work and encouraging knowledge exchange

1. Introduction

1.1 Theme reports are the core of NERC strategy for 2007 – 2012 *Next Generation Science for Planet Earth*. The reports are the culmination of consultation, advice and decision-making that took place over 2006 and 2007. They are working documents that provide the basis for implementation, informing Theme Action Plans. The corresponding sections of the published NERC strategy document are a summary of the information in the reports.

1.2 The reports were produced by Strategy Development Panels in 2006 and underwent further development in 2007 to incorporate changes to the strategy resulting from a public consultation. The overall process for development of the Knowledge report is summarised below

1.3 The NERC Chief Executive was delegated by NERC Council to establish the Knowledge Strategy Development Panel ('Knowledge panel') to identify the major 'knowledge' issues NERC needs to address, and develop options and recommendations for consideration at the November 2006 Council Meeting. Panel members were selected for their knowledge and experience, not as representatives from particular institutions or organisations.

1.4 The Knowledge panel met twice, on 24 April and 26 June 2006. The first meeting took the form of a workshop to set the scope of the panel, agree drivers and identify key issues. The second meeting was a targeted discussion of the issues and options developed by panel members following the first meeting. In addition there has been input from senior managers across NERC.

1.5 The panel was provided with a range of background material, and used a range of facilitated workshop techniques, complemented by in-depth panel discussion to identify and then further develop key strategy issues and options.

1.6 Following discussion, the panel agreed the panel scope should include:

- Science into policy
- Science in society
- Commercialisation of research
- Knowledge management and exchange
- Product and services
- Collaborative research with users
- Data management including products and services
- NERC's evidence base

1.7 The panel's report was presented to NERC Executive Board (NEB) on 21 September 2006. A revised version, incorporating the conclusions from NEB was presented to Council on 30 November 2006. Subsequently, the report was further updated to reflect the overall priorities agreed at Council for the theme.

1.8 A draft NERC Strategy Document was developed from the panel reports and was opened for public consultation in February – April 2007. A final version of the Strategy incorporating recommendations from the consultation, was approved by Council in June 2007 and published in November 2007. In October 2007 the theme reports were updated again to reflect this evolution of the strategy document.

2. Assessment of inputs to the panel

2.1 The panel undertook various exercises to identify the key strategic issues that need to be addressed by NERC in the strategy. This involved analysing the issues associated with the key drivers and other external influences. Various tools were employed to assist the analysis including a SWOT analysis, review of evidence and prioritisation exercises. This work provided the panel with a list of issues that were further refined and distilled into the challenges and options described in section 3.

2.2 The panel were provided with a range of written inputs, including:

- Baker report 1999
- RCUK Science in Society strategy
- NERC Delivery Plan and scorecard
- Office of Science and Innovation Economic Impact Group report
- External challenge report and NERC's input
- Science and Technology Committee inquiry into research council support for knowledge exchange
- Summaries of the targeted and general web-based consultation exercises
- Outputs from the science strategy development panels

2.3 The outputs and outcomes of the Knowledge panel also overlap with the science strategy development panels and the People, Delivery and Science Infrastructure panels. A two-way flow of information has taken place between the panels to ensure overlaps and gaps have been captured and taken forward. This has been achieved through discussions with:

- Director, Science and Innovation
- Head of Strategy Development, NERC
- Regular meetings between NERC directors and the NERC Chief Executive
- Regular meetings with panel secretaries (non-science panels)
- Regular meetings between science strategy panel lead and corporate panel lead.
- The NERC Executive Board
- NERC Science and Innovation Strategy Board
- NERC Council

3. Challenges

3.1 The scope of the Knowledge panel brigades key components of the NERC programme which help to deliver broader benefits from NERC research, be they evidence-based policy, commercialisation, provision of data and services or training, mediated through for example knowledge exchange, data and information management and communication with society. As such, they represent key channels through which the economy, environment and society can access the full value of NERC research.

3.2 Successive Government reports (*references*) have highlighted the importance of realising these broader benefits. Most recently, the Science and Innovation Investment Framework (2004-2014, HMT, DTI, DfES) has set out the clear rationale for public investment in the science base in the context of the long-term wellbeing of the UK economy:

'The nations that can thrive in a highly competitive global economy will be those that can compete on high technology and intellectual strength - attracting the highest-skilled people and the companies which have the potential to innovate and to turn innovation into commercial opportunity. These are the sources of the new prosperity.

This is the opportunity. This framework sets out how Britain will grasp it. It sets out how we will continue to make good past under-investment in our science base - the bedrock of our economic future. More than that, it sets out not only how we intend to invest in this great British asset - the world-class quality of our scientists, engineers and technologists - but how we will turn this to greater economic advantage by building on the culture change under way in our universities, by promoting far deeper and more widespread engagement and collaboration between businesses and the science base, and by promoting innovation in companies directly…'

3.3 NERC already funds work of high economic significance, but aims to achieve a step change in delivering and demonstrating the economic impact of its research. Knowledge exchange (KE) is an important channel for this.

3.4 Based on a SWOT analysis the Knowledge panel has identified four challenges that respond to NERC's needs in the Knowledge area. These are:

1. Determine the balance between NERC's investment in science and its investment in exploitation of the resulting research

2. Improve NERC's approach to Knowledge

3. Ensure that society and the science community benefit from NERC's data and information holdings

4. Ensure that NERC funded science is used and its benefits demonstrated

3.5 The panel has discussed the issues associated with each challenge, and made recommendations. These are often fairly broad, high-level suggestions, and this reflects the breadth of the Knowledge panel scope.

3.6 Challenge 1: Determine the balance between NERC's investment in science and its investment in exploitation of the resulting research

3.6.1 The fundamental role of a Research Council is to fund excellent science, however it is accountable for use of public funds and has a responsibility to see that the outcomes of this investment are fully exploited to the benefit of the economy, environment and society. How should Council balance and structure its investments to see that both of these roles are addressed?

3.6.2 Whilst NERC's focus is on the delivery of excellent science, an important channel to the delivery of broader benefits is mediated through Knowledge Exchange (KE).

3.6.3 There are various definitions of KE in use, for example, the NERC KE programme defines it as: 'the processes by which knowledge, expertise and skilled people transfer between the NERC science base and its user communities to contribute to the economic competitiveness of the UK, effectiveness of public services and policy, and quality of life.' Recent discussions in Council on the Blue Skies Review, supported by the Knowledge Strategy panel suggest that this definition should be broadened, to include transfer of knowledge between different parts of the science base, and potentially also communication with society.

3.6.4 The realisation of exploitation benefits will normally involve NERC and our community working with partner organisations, be they commercial, public sector or in the not-for-profit sector. Improving our ability to do Knowledge Exchange is discussed under challenge 2. It is, however, important to note that in general, NERC neither has the skills, nor the funds to fully achieve these benefits alone, and focuses on research, and transferring the resulting knowledge to the partner organisations. A key factor in making this work is an active partnership at all stages in the process, and this has a resource implication on NERC supported science.

3.6.5 Considering this issue, NERC needs to take account of:

a. Different science investments having different potential for KE, over different timeframes, using different mechanisms. Each will have differing resource requirements for KE, indicating the importance of a flexible approach.
b. The national and international market for NERC knowledge, so that we can have a more informed understanding of the opportunities.
c. The existing patchy approach to KE in NERC – for example, some extremely strong performance in NERC Centres, particularly BGS, but a more process rather than impact orientated focus elsewhere.
d. The existing investments in KE and an evaluation of the benefits already delivered.
e. The reality of this challenge – an increased emphasis on KE requires additional investment, and given limited budgets, this means that at least initially, NERC's expenditure on basic research would decrease (this might happen anyway if NERC is not seen to be a strong KE performer).

3.6.6 Recognising these points, particularly point 3.5.5a, it is hard to establish a top-down balance for NERC's scientific and exploitation objectives now, especially as they are interlinked. NERC (through SISB, NEB and Council) should discuss the issue of a top-down balance further. As important, however, is the efficacy of our KE activities, and our ability to respond flexibly to new opportunities.

3.6.7 The Knowledge panel have made some recommendations, which will help Council establish the evidence base for any change to the current funding balance. An important starting point will be to establish the level of current spend associated with exploitation and the impact of this investment. This will help NERC to identify whether either a change in the funding balance is needed and/or a change to the type and profile of exploitation activities (if the funding is already a significant part of the NERC budget).

3.6.8 NERC should:

Ref	Recommendation
1.1	Identify its current baseline KE funding, taking account of both core KE funds, and KE activities supported more broadly (e.g. through Centres, as spin-offs to grants etc).
1.2	Establish and maintain a benefits database, so that NERC is better able to demonstrate what it is actually achieving with its investments, rather than a record of processes.
1.3	Set an expectation that all NERC science investments should identify the opportunities to deliver broader benefits, with all fund-holders required to prepare KE plans measured against clear criteria.[1]
1.4	Take a more flexible approach to funding KE activities. Accept that the balance of budget between research and KE may be different for each project or programme (within defined bounds), with simple mechanisms for changing the balance during the lifetime of the project/programme, for example promoting entrepreneurial activity by access to 'follow-on' funds.
1.5	Review the outputs of recommendations 1.1 to 1.4 as evidence in any changes to the funding balance.

3.7 Challenge 2: Improve NERC's approach to Knowledge Exchange

3.7.1 NERC can do Knowledge Exchange better by:

- Creating a Knowledge Exchange culture.
- Listening better to business and policy users to seize opportunities for partnerships.
- Improving access to NERC's knowledge base.
- Ensuring access to knowledge brokers and communicators of our science.

3.7.2 These activities are crucial for strengthening engagement between world class research groups and external stakeholders.

3.7.3 Demonstrating and delivering a step-change in the economic impact of research are key priorities for all the Research Councils. KE is an important channel for delivering economic impact, and whilst NERC has made this a priority over recent years, and there have been some

[1] As an example of this, Council has recently decided that all responsive mode grant proposals must have an acceptable KE plan (taking into account the nature of the science proposed). Strong KE plans will have access to additional funding to support implementation.

major successes (e.g. Evolutec, Thames Barrier, Ozone Hole, URGENT programme), Council and others (reference External Challenge) have expressed the view that NERC corporately needs to be clearer about its KE Strategy.

3.7.4 The recent RCUK report on 'Increasing the economic impact of Research Councils' (see: http://www.dti.gov.uk/files/file32802.pdf) has considered the issue of economic impact generically for the Councils, and the Knowledge panel has built on the findings of this report and focussed on NERC specific issues to examine how NERC can improve its KE.

Knowledge Exchange Culture

3.7.5 The NERC community is made up of diverse groupings with varying commitment to KE, a variety of KE practices, and various sources of funding (not just from NERC). There is some extremely strong performance, for example in the NERC Centres and some Directed Programmes, but this is often insufficiently captured and celebrated corporately. Centrally, NERC has a limited number of KE professionals with experience in the many facets of KE (marketing, technology translation, advocacy, commercialisation etc.).

3.7.6 Whilst NERC's KE Delivery Plan clearly demonstrated some past successes and the way that we segment our activity, the current emphasis remains on KE activity rather than impact. This is reflected in the targets and leads to a culture of activity-based KE rather than goal-based KE. Furthermore, NERC has too many KE mechanisms, which some feel creates a confused picture and make it difficult to achieve a willingness to embrace KE.

3.7.7 In order to shift NERC's KE culture towards embracing the diversity and need for impact-based approach, strong leadership is essential and a clear set of KE priorities and the commitment of top management to KE need to be communicated effectively. Support for innovation, entrepreneurship and appropriate risk-taking needs to be encouraged to support NERC's KE agenda. In setting NERC priorities, it will also be very important to learn from best practice, both within NERC (for example at BGS), in our sister Councils and externally.

3.7.8 NERC should:

Ref	Recommendation
2.1	Develop a coherent, prioritised KE strategy, built around a simple set of KE mechanisms, and learning from best practice.
2.2	Deliver a formal implementation programme led by top management to get buy-in to the new strategy, and to make clear NERC's expectations of the community and how they can benefit.
2.3	In parallel, put in place sufficient resources to provide the necessary communication, guidance and ongoing support, including "KE ambassadors" distributed though the community, support for Environmental Policy Fellows in key areas, training materials and workshops.
2.4	Stimulate entrepreneurial activity by raising awareness and understanding of commercialisation opportunities in environmental sciences
2.5	Reward and celebrate success and provide recognition through incentivisation, a formal programme of media communications and annual innovation events.

Listening and Partnerships

3.7.9 Working through partnerships is an essential component of delivering NERC's scientific and exploitation agendas. NERC has many such partnerships at the moment, but these are often at project level and rarely have an overarching structure or strategy.

3.7.10 Whilst NERC has started to engage users at programme definition level, this approach needs to 'bed in', and be broadened to stronger engagement in strategy definition, where priorities are particularly targeted at supporting users needs.

3.7.11 NERC should:

Ref	Recommendation
2.6	Listen to users at the very beginning of the strategy development process to inform a programme of key strategic partnerships that reflects user pull. Users at all levels, from international to national, regional and local, need to be involved through the entire process including disseminating outcomes and benefits.
2.7	Create new strategic partnerships with the public and private sector in areas of common interest
2.8	Work with partners in the Environmental Research Funders' Forum to identify and address areas of research need, and barriers to the efficient exchange of information, particularly in the context of public policy formation
2.9	Target at Board level major business users like BP, Shell, Rolls Royce (even Tesco) that have explicit environmental agendas. Similar senior level engagement is needed with policy users.
2.10	Appoint Key Account Managers responsible for developing the top 10 (say) strategic partnerships using a formal customer relationship management process.
2.11	Initiate a user 'club' and run this as a mechanism for engaging a broader range of potential users.
2.12	Establish a London Environment Network covering the LDA, EEDA and SEEDA regions building a cadre of KE fellows in academic departments
2.13	Build collaborations with the Technology Strategy Board, RDAs and others to drive rapid-take up and commercialisation by the private sector of research undertaken by NERC centres.

Access to Knowledge

3.7.12 NERC's knowledge base is highly distributed and much of its knowledge is inaccessible (both internally and externally). Whilst better access to knowledge is necessary it is not sufficient – it will not in itself lead to better KE. Access is about people as well as systems. Access mechanisms need to reflect the disparate requirements of stakeholders, including the general public, and the opportunity for better public engagement.

3.7.13 NERC should:

Ref	Recommendation
2.14	'Know what it knows'. Implement a Knowledge Management programme that pulls together the knowledge already generated and establishes a process for capturing new knowledge as it is generated. The scope should cover at NERC-funded publications, research outputs, datasets, skills, capabilities, relationships, assets.
2.15	Implement access mechanisms that reflect user needs.
2.16	Get independent people to 'write' the interface to the general public to improve engagement.
2.17	Not rely on web-portals alone - use intermediaries who act as ambassadors and translators of need into NERC related priorities and tasks (and vice-versa).

Knowledge brokers and communicators

3.7.14 Both of these roles are key to NERC, to ensure that we can build enduring partnerships with users, and communicate NERC science to the widest possible audience. Whilst particular individuals may have an inherent aptitude for theses roles, NERC also has the opportunity to encourage the development of the necessary skills, through training, opportunities to gain direct experience of these activities, and offering incentives for good performance.

3.7.15 NERC should:

Ref	Recommendation
2.18	For knowledge brokers, encourage secondments and placements, in both directions between academic research and user organisations, and encourage networks, so that experience can be gained of working in the different sectors. When NERC recruits for knowledge brokers, it should ensure that candidates have direct experience of working at the interface between these sectors.
2.19	Increase support for 'science to policy' and 'science to industry' facilitators
2.20	For science communicators, expand the opportunities for communication training as part of post-graduate and post-doctoral support, as well as support for its own staff.
2.21	Implement appropriate recognition and reward schemes, to reinforce the importance and value of these skills.

3.8 Challenge 3: Ensure that society and the science community benefit from NERC's data and information holdings

3.8.1 NERC's core assets include its data and information holdings. What steps should NERC take to ensure that the scientific community, and society-at-large are benefiting fully from these assets?

3.8.2 NERC's data (both owned and developed by others through NERC funding) is a long-term national asset, which needs to be managed effectively if it is to be maintained and exploited. To take full value, data needs to be available, discoverable, accessible, secure, usable and understandable by those who wish to use it. Interoperability, and resilience to changes in personnel are also becoming a key requirement.

3.8.3 At present, NERC's approach to data management is variable. Some of the Research Centres, most notably BGS, have recognised the value of data to their science and business model and have implemented rigorous data management and delivery policies. Many NERC designated data centres are exemplars, and provide a hugely valuable community service. Whereas, there is a less coherent approach in other areas, particularly for NERC grant schemes. Sometimes there is insufficient appreciation of the strategic (post-project) value of data and to accept the real cost of data management when new activities are funded.

3.8.4 Data and information management has been identified as a key issue in all the science panel strategy reports. Points raised often echo debate at the Knowledge strategy panel, and include:

- Knowing what data exist and being able to access it.
- The importance of long term monitoring and survey.
- The need for data centres and NERC's data management community to engage with their science communities in order to understand what the big science challenges are going to be and what role data and information management is going to play in helping meet these challenges.
- Not all the data needed to deliver NERC science will exist within NERC and there is a need to further develop links with data outside of NERC.

3.8.5 The Knowledge panel also recognised the need for specialist information management and technology support staff, and the importance of recognising career paths in this area.

3.8.6 NERC's Information Strategy Group (ISG) does oversee these issues, and its thinking has strongly contributed to this report, however ISG has very little visibility at SISB or Council, and its focus has been on the 'wholly-owned' component of NERC, rather than considering the totality. This has limited its opportunity to act, and effectiveness.

3.8.7 The Knowledge panel also discussed the issue of whether all publicly funded data should be made available free of charge (this is known as the 'fee or free' debate). The UK Government policy is that users should pay for data, however the situation is often rather more complicated than this, due to the following issues:

a. Some sectors discriminate between basic and value-added data. For example, within the Meteorological and Oceanographic community, the provision of all basic data free, or at cost-of-reproduction is the norm.
b. Some UK Government agencies make data available free for public information (e.g. Environment Agency flood maps).
c. The approach to data policy varies nationally, regionally and internationally.

3.8.8 Furthermore, from the perspective of deriving maximum economic benefit (to the UK) from data, it is critical to get the balance right between the point in any value chain when value is ascribed to data, and maintaining the connection between the supplier and the user through charges, which incentivises the supplier to understand user-requirements and to develop and refresh data products that users need. It should also be noted that NERC's research centres

have a responsibility to exploit their intellectual property and income from data licensing can help offset the substantial costs of maintaining data sets, the NERC data centres and data supply services.

3.8.9 The current charging position across NERC is not uniform which can cause confusion within the NERC community, and beyond. There is therefore real benefit to NERC in having a more consistent approach to charging for data, with a clearly explained charging policy, with charging based on usage and not on the user.

3.8.10 Council has not debated the 'fee or free' issue (certainly not recently), and whilst individual components of NERC have contributed to national and international debates and negotiations, we have not done so corporately.

3.8.11 Taking into account the discussion above, NERC should:

Ref	Recommendation
3.1	Nominate a NERC 'data champion' with visibility at SISB, NEB and Council. The data champion would provide advice to these bodies to ensure that data and information management, including career paths in this area, received a proper level of recognition, consideration and resourcing.
3.2	Require a data element to all KE plans, so that all those who request NERC funds have considered data issues as part of their proposals.
3.3	Provide guidance to peer reviewers and moderating panels on NERC's data policies.
3.4	Organise a Council debate on the 'fee or free' question of data provision, so that Council can be exposed to the diversity of views and regimes, and to help NERC contribute to national, regional and international debate corporately.
3.5	Develop a consistent approach to charging for data, with a clearly defined charging policy. As part of this NERC should move to supplying data for bona fide academic use at no more than the marginal costs of supply.
3.6	Demonstrate the potential of modern digital technologies to create innovative data and information portals
3.7	Identify, and where possible, support the creation of new data and information products, moving to Fair Trader accreditation across NERC

3.9 Challenge 4: Ensure that NERC funded science is used and its benefits demonstrated

3.9.1 Demonstrating and disseminating the benefits of publicly funded research, to encourage its full use, is a priority for the research councils. Communicating benefits to the widest possible audience in a timely and relevant manner is key to helping NERC to raise its profile, develop and build partnerships, and is essential for accountability to public and government.

3.9.2 NERC shares scientific knowledge with policy makers and regulators, industry and business, non-governmental organisations (NGOs) charities and the public. NERC has several mechanisms to communicate the benefits of our science such as the quarterly magazine, Planet Earth, the Annual Report, various e-mail bullets and roadshows. NERC should be in

an excellent position to demonstrate the benefits of NERC science, because of the high-level of business, policy and societal interest in the environment.

3.9.3 A more fundamental issue NERC needs to address is the ability to recognise the potential and actual benefits of NERC funded research . We need to know what it is NERC produces, define and clarify NERC's primary outputs, and put in place strategies to maximise their use.

3.9.4 There is an increasing political push to demonstrate better the use and benefits of our research, as demonstrated in the 10-year investment framework and the House of Commons Science and Technology Committee report of the research councils support of knowledge exchange. These are key drivers, and NERC must be seen to be responding.

3.9.5 Thus, NERC needs to develop a more systematic and coordinated approach to communicating what we do to ensure we are reaching our target audiences. NERC will also need to gain a better understanding of the many different audiences we need to communciate with and identify the best ways in which to engage them. It is also imperative that we evaluate the success of current and future mechanisms and learn from our and other's experiences.

3.9.6 Various barriers to undertaking these activities have been identified that NERC will need to address if we want to achieve our objectives in this area. For example, even though many of our researchers have excellent communication skills and undertake communication activities, others need support and training to develop these skills more fully. Also, communicating benefits takes time and money and, as this activity is not fully recognised or rewarded, there is perhaps too little incentive to encourage people to undertake these activities.

3.9.7 NERC will strengthen its science in society programme in order to raise awareness of the outcomes of NERC investments in science and engage in dialogue on issues of environmental concern or interest The majority of NERC's public engagement work is undertaken with our sister research councils through the RCUK science in society strategy. NERC will complement this by developing its own public engagement work on environmental issues on which NERC leads, seeking partners as appropriate.

3.9.8 NERC is currently developing a communications strategy to address the questions raised here. This will recognise the complicated structure of NERC and clearly spell out the objectives of communication initiatives in all areas of our work. It will cover the needs of science in society as well as corporate communication drivers such as knowledge exchange and profile raising.

3.9.9 The following recommendations need to be considered as part of the development of the communications strategy:

Ref	Recommendation
4.1	Undertake an exercise to establish the different types of benefits there are from NERC research , (e.g. economic benefits, impact on policy, public interest, commercialisation opportunities, scientific breakthrough etc) which audiences need to know/would be interested in them and the best forms of engagement.
4.2	Refine NERC performance evaluation methods, seeking to assess the economic impacts of all our major investments on a rolling basis, and developing further our systems for capturing and recording economic impact case studies
4.3	Produce an annual Economic Impact Report summarising the achievements of both NERC and of the community that it supports

4.4	Promote a change in culture: reward and recognition for these communication activities (metrics, prizes, funding).
4.5	Train scientists and employ more skilled media and communication professionals.

4 Meeting the Challenges

4.1 The published NERC Strategy highlights some of the ways in which the NERC will be "Meeting the Challenges" for the Knowledge Theme. These are essentially some of the potential key deliverables. They often cut across several of the Theme's challenges. For consistency, we have included them below against the challenges that they most strongly relate to. They are not exclusive and may evolve during the Strategy's lifetime.

"Meeting the Challenges" (from the NERC Strategy)	Knowledge Challenges			
	1	2	3	4
Improve our understanding of the knowledge needs of our key stakeholders and create strategic partnerships where advantageous	X	X		X
Deliver objective scientific evidence in readily useable forms to help policy-makers, businesses and citizens understand and respond to environmental change		X	X	X
Develop simpler, more flexible funding schemes to support knowledge exchange	X			
Require all fund-holders to prepare plans for effective exchange and dissemination of knowledge	X			
Promote dialogue through a variety of mechanisms including secondments and greater use of both existing and new networks		X		
Encourage and support activities that promote public engagement and awareness of environmental science and work with Research Councils UK to help deliver science in society objectives		X		X
Strengthen data management including supporting new data products and helping develop a clearer approach to data charging			X	
Help bring new products and services to market by protecting and exploiting NERC's own intellectual property and by providing encouragement, support and follow-on funding to researchers in universities	X	X	X	