

Response to the call for evidence on the ownership and governance of Natural Environment Research Council (NERC) Centres

Summary

As the UK's national academy of science the Royal Society welcomes the opportunity to respond to this call for evidence. Our response draws on the advice of over 20 Fellows expert in relevant scientific fields, science policy and research management. Preparation of this response was led by Professor Geoffrey Boulton FRS, Chair of our Science Policy Advisory Group (SPAG).

- Publicly funded research centres with a long-term, strategic role are important as independent sources of evidence for public policy and in supporting economic activity.
- Granting the NERC Centres independence might offer them advantages such as the ability to carry financial surpluses from year to year and allowing the Centres to set salaries that would attract the best talent.
- Of the claimed advantages to NERC: a) we do not understand how it would free NERC to act as “champion for the environmental sciences”; b) other research councils have not found the dual roles of centre ownership and research funder problematic; c) independence would not address the problem of pre-set budgets for maintaining world-class infrastructure; d) there is no evidence that research council ownership militates against high scientific standards.
- We summarise possible national and international models of ownership and governance, including full privatisation, creating independent charitable institutions, non-departmental public body status and consortia with universities.
- The evidence is a) that full privatisation is an inadequate vehicle for sustaining long-term strategic research and maintaining research excellence. b) Relatively high levels of assured core funding are necessary for centres to sustain a long-term strategic mission. c) Project based funding would be inadequate to support long-term strategic science.
- The call for evidence is not explicit about why change is being considered and why current arrangements are inadequate, thus making a focused and informative response difficult. Before making a decision, a full and analytic business case is needed that evaluates the strengths and weaknesses of different options and clearly articulates the rationale for change.

The function of publicly funded research centres

1. The starting point for an analysis of appropriate modes of ownership, funding and governance of a publicly-funded research centre must be an assessment of the public value that it creates either as a source of independent evidence for public policy or in stimulating or supporting economic activity in its sphere of operation.
2. Most such centres operate in a strategic fashion. They have sustained, long-term, thematic functions and goals, in contrast to universities, which, with few exceptions, are typically more diverse and able to re-configure their research efforts to create new knowledge wherever the opportunities lie. A national public research system benefits from the coexistence and interaction of these two modes: one a sustained thematically-defined function, the other concerned with the creation and application of new knowledge irrespective of theme. All major national research bases observe this distinction in one form or another.
3. The key prior question is whether the UK has been and will be dependent for the foreseeable future upon the information and analysis produced by the NERC Centres. If it has and it will be, two questions arise.

Whether and how the strategic roles of the Centres could be sustained if there were a change in the mode of ownership? How should this imperative be balanced against the benefits that the consultation paper claims will accrue to NERC ('as a funder and champion for the environmental sciences') if the Centres were to be moved outside the public sector (i.e. to a privatised or charitable status)?

How do the NERC Centres currently fulfil their strategic functions?

4. The four Centres under review have well-defined functions. It is important to consider them separately rather than necessarily assuming that a common solution will fit all. Their functions are set out below:

British Geological Survey (BGS)

BGS provides essential baseline evidence to support policies for energy supply, natural resources, infrastructure planning and environmental management. This infiltrates almost all major sectors of society, the national economy and the private sector. Topical examples include assessment of gas reserves from fracking; development of carbon capture and storage; radioactive waste management; site selection for major projects such as the Olympic Games or the third runway at Heathrow; natural hazards; mining subsidence; and maintaining the UK as a player in the global mining industry. BGS' external income in 2010/11 was 41.8% of its total income of £48.27 million.¹ This includes services, products and data licensing in addition to research commissioned by external partners. Its policy advice is directed primarily to the Department of Energy and Climate Change (DECC), the Department of Business, Innovation and Skills (BIS), the Department of the Environment Food and Rural Affairs (DEFRA) and the Department for International Development (DfID).

Centre for Ecology and Hydrology (CEH)

CEH monitors terrestrial, freshwater and atmospheric systems. The continuity of its long-term data sets such as biological records, countryside surveys etc are of critical importance in understanding the impacts of global change. Topical examples of its policy-related work include risks from metals in waters and soils; impacts of offshore wind farms on seabird populations; recommendations for offshore Special Protected Areas; flood risk mapping and forecasting; the basis for emission control measures and reduction of acid deposition; and risk assessment for lake restoration. Around 55% of its anticipated income of £34 million for 2013/14 comes from sources other than the NERC Science Budget.² Its policy advice is directed to DECC, DEFRA and DFID.

National Oceanography Centre (NOC)

International awareness of the importance of the oceans as an economic resource and their vulnerability to human impacts is growing. NOC acts as a UK "flagship" in this highly competitive field. It maintains and develops state-of-the-art capability in conducting long-term, ocean-scale research and observations; provides essential resources for the UK oceanographic community including administering and managing equipment and the two research vessels that have high and unpredictable operational costs determined by global fuel markets; manages data curation and core sample storage; and provides representation on major international committees. Topical policy advice includes advice on the United Nations Convention on the Law of Sea; sovereignty and control over mineral resources around the Falklands; planning of Marine Conservation Zones and protected areas; reform of the Common Fisheries Policy; and advice in response to the EU marine directive and the development of the EU's Integrated Maritime Policy. Its external income for the financial year 2010/11 was 22.3% of its total income of £47.22 million.³ Its policy advice is directed principally to DEFRA, but also to the Foreign and Commonwealth Office (FCO), BIS, and DECC.

¹ BGS (2011). *Annual report* <http://www.bgs.ac.uk/annualreport/>

² NERC (2013). *Annual report*. <http://www.nerc.ac.uk/publications/annualreport/2013/annualreport.pdf>

³ NOC (2011). *Annual review 2010-11* <http://noc.ac.uk/about-us/our-organisation/literature>

National Centre for Atmospheric Science (NCAS)

NCAS conducts research on the natural climate, how changes in the composition of the atmosphere drive climate change and on the impacts of climate change and weather events. Its work on processes that govern climate variability and change is complementary to that of the Met Office (a UK Government trading fund) which works on climate models and prediction systems. Topical policy-related work includes national responses to volcanic ash hazards; climate adaptation and mitigation policies; projecting temperature changes worldwide; impacts of emission control policy and air quality management; boundary layer pollution in London; and forecasting severe turbulence at airports. It has a mixed model of governance, part contracted to the University of Leeds and part retained by the NERC Office. Its external income is 15% of its total of £20 million.⁴ Its policy advice is directed mainly to DEFRA, DECC, DFID and the Ministry of Defence (MoD).

5. As a first-order summary, BGS majors in advice to national and local government, and to industry over a wide range of issues that are fundamental to our use of the sub-surface environment. CEH is primarily concerned with advice to government about the operation of the terrestrial biosphere and hydrosphere, making major contributions to policy for environmental health, biodiversity, farming and flood hazards. NOC is a major resource of skill and capability for the UK ocean science community in addition to its policy advice, where its work in supporting international treaties and partnerships almost certainly results in a return to the UK that is far greater than the cost of NOC. NCAS complements and contributes to the work of the Met Office in vital assessments of climate change. All need to maintain and develop a high level of scientific excellence over a wide range of issues in their respective fields in order to fulfil their strategic roles effectively. The Society's view is that these complementary functions are important in underpinning national environmental policies, practices and capabilities. The issue for NERC is one of optimisation: whether there are ways in which these functions can be safeguarded whilst reaping benefits that greater independence for the centres might bring.

Potential benefits of greater independence for the Centres

6. Scientific institutions find independence of action of great value in responding rapidly to opportunities and exploiting them. In the case of the Centres in question, such independence is currently limited by the reporting line to NERC in conditioning their actions; by government rules about carrying over surpluses from one year to the next; by inflexible government purchasing systems that do not allow for rapid response; by the restrictions placed on the salaries that they are able to offer staff and, thereby, their ability to attract the best talent to ensure international excellence (in contrast to the freedom of universities to do so); and by the limitations of their pre-set budgets in maintaining world-class infrastructure. The latter will remain a major problem no matter what the source of funding but the others are key issues that could be resolved if a form of independence was identified that would permit the Centres to address them whilst maintaining their important national functions. A series of models of independence and the benefits and disadvantages they might offer are discussed in the following section.
7. The benefits to NERC of relinquishing ownership are set out in the consultation as "ensuring that it can focus on its externally facing roles as a funder and champion for the environmental sciences." The Society understands how NERC's responsibility as both a research council and an employer of researchers can sometimes be in conflict. However, it is not clear how the present arrangement militates against NERC's capacity to act as "a champion for the environmental sciences." It appears to be a weak argument for

⁴ NCAS (2010). *Annual report 2009-10* http://www.ncas.ac.uk/index.php/en/documents/cat_view/8-annual-reports

change of any great magnitude. Moreover, how would this capacity be improved if it were to lose centres that are major sources of environmental evidence?

What is the evidence that a move to independence can be successful without detriment to national strategic capacity?

We here discuss a range of models of ownership of research institutions by giving specific examples.

a) Full privatisation

8. There is little or no precedent for maintaining excellence in research for public good under fully privatised ownership, whether in the UK or abroad.
9. Twenty years ago science research in the UK gained its strength from three main sources: academia, large industrial research laboratories, and government-owned establishments. The large industrial laboratories including GEC Hirst Research Centre, ICI, and EMI died either because private finance did not appreciate the risks of long-term research or because the long-term is not a favoured element in the financial models of stock-driven corporations. Publicly-owned laboratories were not immune to this trend. Defence establishments have been the key to innovative research in aerospace and electronics, but the two largest laboratories, RAE Farnborough and RSRE Malvern, are now privately owned. Their current research trend is illustrated at Malvern by the owner, QinetiQ, which in 2010 abandoned the photonics research that had given the UK international leadership in LCDs and thermal imaging.⁵
10. Civil government research has suffered no less. Of a long list of establishments including the Laboratory of the Government Chemist, the National Environmental Technology Centre, the Road Research Laboratory, and establishments for Fire and Buildings Research, none now invest in long-term research. Two of the most prestigious laboratories, NEL and NPL, have both changed in structure. NEL is now owned by a German company and its research record is unimpressive. NPL spent years as a Government Owned, Contractor Operated (GOCO) organisation, and for much of that time its record suffered. A new form of ownership is now under consideration, with the hope that NPL's previous standard of research can be recovered.⁶ Central to this is the need to enhance collaboration with other parts of the UK research capability, notably in the universities. Any isolation of a research centre from the national research community is damaging, whether it occurs through funding constraints, limiting movement of staff, or lack of coherence of policy between institutions in making the case for high quality research.
11. The above trends illustrate the difficulty of maintaining strategic research for the public good in a privatised environment where short-term concerns to maintain income militate against the long-term maintenance of excellent research in pursuit of long-term strategic objectives.
12. Privatising the Centres may also raise questions over the impartiality of advice to government, depending on how they would be set up. Commercial providers tend to be poor substitutes for centres operating in the public interest (see paragraph 1): they are motivated to lock their clients into their services, which tends to influence the advice provided; government needs to be an intelligent customer, and hence needs its own specialists; and there is evidence in plenty that it is not a cost effective route in the long-term. Providing high quality, domain specific advice is a core role of all of NERC's Research Centres. To maintain this function within a privatised structure would require careful thought and management. Although it is

⁵ Hatcher M (2010). *QinetiQ under fire amid photonics cuts* <http://optics.org/indepth/1/3/4>

⁶ Willets D (2012). *Written Ministerial Statement on the National Physical Laboratory* http://www.parliament.uk/documents/commons-vote-office/November_2012/27-11-12/2-BIS-NationalPhysicalLaboratory.pdf

difficult to be prescriptive, our review fails to find evidence of any such centre that has managed to retain this capability when its core funding is below about a third of its total income.

b) Creating independent charitable institutions

13. An independent research institute operating as a charity could be an appropriate model, with former Biotechnology and Biological Sciences Research Council (BBSRC) institutes as partial precedents. The 2006 Follett Review⁷ addressed the conflicts of governance that arose because of BBSRC management of institutes with an independent status both as companies limited by guarantee and registered charities. The ownership and governance structures of eight institutes were changed, of which five now operate under a simple charity model, two were embedded in universities, which also employ the staff, and one is both a charity and company limited by guarantee.⁸ Approximately 40% of the funding allocated to BBSRC is spent on grants to these institutes. It is important to recognise however that the reasons for change were not to save money or to privatise, but the unclear lines of responsibility. There is no such issue for the NERC Centres. If they were to become independent they would still require high levels of funding, presumably from the NERC budget, if they were to retain their strategic national function.
14. Rothamsted Research, a former BBSRC institute, offers a particularly distinctive example. It is an independent charitable institute that now receives strategic funding from BBSRC and considerable support from the Lawes Agricultural Trust. Its current activities benefit hugely from commercial successes over the years due to the nature of its work, that of global agriculture, which raises many commercial opportunities. However, it is not clear to us that such clear-cut major opportunities currently exist for any of the NERC research centres, except possibly in the case of BGS. Nevertheless the diversity of the external portfolio that BGS needs to exploit to bring in its external income makes the Society doubtful that it could make such a move without endangering the wide range of activities that it needs to sustain in order to fulfil its national functions.
15. Another example of an independent institute that still pursues long-term front-line science and a diverse portfolio is the Dunstaffnage laboratory of the Scottish Association for Marine Science (SAMS), which was transferred by NERC to SAMS in the late 90s. Although it is successful in winning NERC research grants, it receives no strategic funding from NERC and must match NERC funding with other sources to make these activities viable. Although it has been successful in scientific and educational terms, and benefits greatly from support from Highlands and Islands Enterprise, it is a relatively small operation and its long-term financial viability is perennially under threat because of the absence of strategic funding. It would be a bold experiment for NERC to assume that such a model could work for its large centres and their strategic roles.

c) A diverse pattern of governance and ownership: the MRC approach

16. The Medical Research Council (MRC) is distinctive amongst UK councils in the number and diversity of the thematic *Institutes*, *Units* and *Centres* that it funds.⁹ They are described in greater detail in Appendix 1. They represent a spectrum from the highly strategic Institutes to the more opportunistic Centres. All Institutes and their assets are owned by the MRC, which also employs most of their staff. There are two types of Unit: long-established and well-known intramural units (where the MRC is the main employer) and newer, university units (where the university is the main employer). Intramural units can evolve into university units where they can benefit from new scientific opportunities and funding streams, strengthened

⁷ Follett B (2006). *Independent review of governance of BBSRC sponsored institutes* http://www.bbsrc.ac.uk/web/FILES/Reviews/0606_institute_governance.pdf

⁸ BBSRC (2007). *Future governance of BBSRC-sponsored institutes* <http://www.bbsrc.ac.uk/news/archive/2007/070212-n-institute-governance.aspx>

⁹ Further information is available from: <http://www.mrc.ac.uk/Ourresearch/Unitscentresinstitutes/index.htm>

integration with university research activities and efficiency gains/cost savings which can then be re-invested into science. All institute/unit/centre investments are reviewed every five years. The scientific creativity of these bodies and the applications that have arisen from their work are envied both nationally and internationally. Notwithstanding the benefits of independence set out in paragraph 6, the achievements and high quality of the science of MRC owned and operated laboratories demonstrates that research council ownership is not incompatible with the highest scientific standards.

d) Bodies closer to government

17. If the fully privatised represents one extreme of a spectrum of ownership, governance and function, the other extreme is that of a non-departmental public body (NDPB) responsible to a government minister. The Environment Agency (EA) is one such example, being responsible as an executive NDPB to the Secretary of State for Environment, Food and Rural Affairs. It plays a central role in delivering the environmental priorities of central government.¹⁰ It is an interesting example because of its dependence (or interdependence) on NERC centres. Its planned income for 2013/14 is £1084 million, 60% of which comes from Grant-In-Aid and the other £413 million from licensing and a variety of statutory levies.¹¹ In other words, the operational aspects of environmental management cost about ten times what is expended on long-term research and monitoring (an under-estimate as the EA relates only to England). Most of its R&D is applied¹² but it seems very likely that it is dependent on the research and monitoring produced by the NERC centres. Have these inter-dependencies been examined? The media for example attributes much of its underpinning research to the EA, although the true credit for much may lie elsewhere.¹³

e) International examples

18. We suggest that NERC should also explore the way that the duality noted in paragraph 1 is dealt with in other countries. As an example, we set out in Appendix 2 how this issue is dealt with in the USA in the field of environmental science. We offer examples of three major national institutions that have a long-term strategic role, and three independent ones, one a private, not-for-profit foundation, one a part of a public university and one part of a private university. All are renowned internationally for the excellence of their research, although a cost-benefit analysis of their operation and effectiveness would be required before contemplating using them as models. All depend heavily on substantial federal funding. We particularly draw NERC's attention to the way that the National Center for Atmospheric Research (NCAR) is managed on behalf of the National Science Foundation (NSF) by a consortium of universities.

Observations on ownership and governance models

19. We draw two major general conclusions from the foregoing analysis:
- Fully privatised institutes are poor vehicles for sustaining long-term strategic research. Few such institutes have succeeded in maintaining high levels of research excellence and their record of sustaining a long-term mission is poor.
 - Relatively high levels of assured core funding are necessary if institutes or centres are to sustain a long-term strategic mission. In US examples, as is also the case elsewhere, core funding from government is essential for strategic bodies that are called upon to provide systematic advice to government, although their ownership models may vary.

¹⁰ Further information is available from: <http://www.environment-agency.gov.uk/aboutus/default.aspx>

¹¹ Environment Agency (2012) *Coprorate plan update* <http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0412bwhz-e-e.pdf>

¹² Further information is available from: <http://www.environment-agency.gov.uk/research/policy/default.aspx>

¹³ Beattie J (2013). *Fracking runs risk "high risk" of polluting countryside, government report warns* <http://www.mirror.co.uk/news/uk-news/fracking-runs-high-risk-polluting-2172909>

20. As the US examples illustrate, independent bodies are important contributors to the sciences that government bodies need to draw on to fulfil their strategic functions, much as happens in the UK. The fundamental difference is that the former win competitive government funds for specific projects and capabilities, whilst the latter receive core funding for the institution in furtherance of its strategic objectives but targeted and managed in ways that it chooses. The central questions for NERC in exploring how greater centre independence could be achieved are:
- Would independent bodies need core institutional funding to be sustainable, or could a strategically focussed centre could be sustained in the long-term by project funding alone (without a core funding guarantee)? If there were to be a privatised future for the centres, how would NERC propose to prevent the privatised labs being taken over, asset-stripped and closed with the consequent loss of vital national capability? Could this be prevented if government had a “golden share” or limited a GoCo contract period?
 - How would long term strategic funding be guaranteed if the centre were no longer owned by NERC? What would be NERC's longer-term financial support for a privatised lab or independent charity? Would NERC simply be a “customer” or would it provide underpinning funds, or some combination of funding mixes? What level of support could be guaranteed over 5-10 years?
21. The Society believes that a credible, long-term funding commitment would be required and that project based funding alone would be inadequate to support a commitment for long term, strategic science. The Dunstaffnage laboratory of SAMS (paragraph 15) is one that is successful in these terms, but has a level of vulnerability and exposure to risk that is too high for bodies that are key parts of national research infrastructure.
22. The NERC consultation identifies a reason to consider relinquishing ownership of the centres as a desire to focus on its role as a funder of environmental science. The arrangement between NSF and the consortium of universities that manage NCAR on its behalf, or the arrangements for MRC extramural Units are models that NERC could consider for some, although not all, of its Centres’ functions. If a satisfactory and sustainable agreement could be reached that would protect long-term strategic capabilities, these routes might offer both the benefits of independence referred to in paragraph 6 together with entry into the competitive environments of the Research Excellence Framework and research council grant competitions that recognise and incentivise research excellence¹⁶. It would however not release NERC from the responsibility (that NSF has) of due diligence in ensuring that its agent acts in the best interest of the function it is contracted to deliver. It is also important to note the central role of NCAR is to provide a community resource that works to the great advantage of the academic community (analogous to part of the function of NOC). We are sceptical that long-term strategic research would be regarded by universities as of similar value.
23. If NERC should conclude, as the Society does, that it is important to retain the strategic national roles of the Centres, the evidence presented above suggests that it would be optimistic to believe that public funding for these roles could be substituted by private funding or overheads on contracts. If public funding were to be reduced, long-term strategic work would be displaced by the shorter-term contracts that would be required to sustain the organisation. The loss of capacity building that comes from the non-viability in these circumstances of leading edge research will inevitably result in a loss of the leading-edge skills needed for excellent advice to government (note that this is not to argue against periodic assessments of whether some activities in Centres should be moved into other bodies such as universities, which can be dealt with

¹⁶ Note however that there is an issue of equity. Universities compete both for their core funding for research through the REF process and for individual project funding from research councils and charities. Centres that have core funding and some project funding assured would be on the up-side of a tilted playing field if they were also able to bid for research council project funds.

through adequate strategic oversight and independent review of the Centres' work). Whether NERC retains the current governance of Centres in its present form or transforms them into independent entities, the requirement would remain for government to be their principal funder through a block grant to maintain national capability. Presumably this would simply involve a transfer of funds that currently flow through NERC.

24. There is also a question of confidence in the sustainability of Centres if NERC ceased to be owner. The history of core strategic funding for independent bodies is unlikely to give the confidence to those managing long-term programmes that the present model of ownership does. Although it appears that independence brings benefits provided that core funding can be assured, the inherent uncertainties of the latter need to be balanced against those benefits.

Managing change

25. If NERC were to divest itself of ownership of the four Centres, it would be a much more onerous legal, managerial and political process than that accompanying the withdrawal of BBSRC from a role in managing its institutes (which were already companies limited by guarantee and registered charities). The process of transition of MRC Units from intramural to Extramural should also be explored. The potential disruption to the work of the Centres that the process of divestment would bring is one of the considerations that need to be balanced against any perceived benefits to NERC.

Final comments

26. The consultation document is skeletal. It is difficult to do more than raise a series of issues and hypothetical options in response. The document says nothing of substance about the different possible forms that ownership and governance arrangements might take, what will or might happen to government funding and how the public good and positive externalities arising from the present arrangements will be maintained. What is required is a properly written business case which seeks to evaluate the various options – including the status quo - and assigns some likely benefits or disadvantages for the options.
27. The starting point must be an analysis of why the status quo is unsatisfactory. The rationales given in the consultation are unpersuasive as reasons for major change. The recently-completed evaluation of NERC centres concluded that "the research being carried out in the centres is mainly excellent", that they "scored very highly for economic and society impact", and that they "provide an environment that is generally conducive to producing research and impact of internationally excellent or world-leading quality."¹⁴ It implies that mechanisms to enhance scientific excellence are not urgently needed, and it would seem unwise to risk this environment unless there is a strong driver for change. (Moreover, wholly-owned MRC Institutes and Units operate at high levels of international excellence). Perhaps there are unstated reasons: for instance, the cost of major facilities such as research vessels; a concern about costs; or a view that independent bodies subject to market disciplines could yield the same results more cheaply. Before embarking on a change of the magnitude implied by the consultation, NERC must consider what capacities are needed, what is the most effective way to organise them, and whether a process or status can be devised that would produce some of the benefits of independence summarised in 6 without jeopardising national capabilities in view of the precedents summarised in 8-18.
28. There are a number of further issues that should be addressed:

¹⁴ NERC (2013). *Evaluation of NERC Centres 2013* <http://www.nerc.ac.uk/about/news/centre-eval.asp>

- Would Research Councils UK (RCUK) seek to negotiate to retain its current funding streams and would NERC expect to allocate its share purely on research merit and record of impact? Would government pay the up-front costs of change? Would any eventual savings be ring-fenced within NERC? Would NERC in reality have any greater discretion than in present circumstances? Could NERC obtain the maximum financial benefits if it still owns some centres such as BAS i.e. by operating a mixed mode model?
- If NERC divests all but one of its research centres, and if the other centres took their funding with them, NERC would become a very small disburser of grants. Would this then threaten its survival as an independent research council, with the loss of a voice to “champion the environmental sciences”, and might this also require a reorganisation of the research councils?
- The risks of major change in the direction indicated are significant both to the national capability and the independence and rigour of advice to government. Have the views of government, both national and devolved, been sought?

Appendix 1 Medical Research Council, Institutes, Units and Centres

Institutes

Institutes are very long-term flexible bodies charged to address major challenges in health-related research using multi-disciplinary methods often requiring ground breaking methodology and technology development. They are provided with sustained support and state-of-the-art facilities over a long period of time. They offer scientists maximum flexibility to engage in innovative “risky” research, avoiding traditional university-style departmental boundaries. They attract and develop outstanding students and early career scientists from the UK and internationally. There are three institutes.

Units

Units are set up to meet specific needs or to tackle important research questions where the need cannot easily be addressed through grant funding. They are led by well-established principal investigators, overseen by a director. Units are fully-funded by the MRC and there is no set limit on their lifespan. They attract and develop outstanding students and early career programme leaders from the UK and internationally and often have a major impact through developing future research leaders in their specialist areas. There are two types of unit: the long-established and well-known intramural units (where the MRC is the main employer) and the newer, university units (where the university is the main employer). Intramural units can evolve into university units where they can benefit from new scientific opportunities and funding streams, strengthened integration with university research activities and efficiency gains/cost savings which can then be re-invested into science. By the end of 2013, 10 units will remain as intramural units and there will be 17 university units.

Centres

Centres allow the MRC to help universities develop and consolidate internationally competitive, high-profile centres of excellence with a clear strategic direction in areas of importance for UK medical research. They provide intellectually stimulating and well-resourced programmes and environments which are attractive not only to established researchers but also to new investigators. MRC core funding is provided for a set period to develop the centre’s capabilities and research strategy, and is expected to help universities attract further support from other funders as well as the MRC. As of June 2013 there are 26 centres and related charity partnerships.

Appendix 2 Examples of approaches to the organisation of national environmental science capability in the USA

National Center for Atmospheric Research (NCAR)

NCAR conducts collaborative research in atmospheric and Earth system science and provides tools and technologies to the scientific community including research, supercomputers, instrumented aircraft and observing systems. It is managed by the University Corporation for Atmospheric Research (UCAR), a non-profit consortium of universities, on behalf of the NSF. It is formally an NSF Federally Funded Research and Development Centre that works in the public interest as a long-term strategic partner with NSF. It is set up as an independent body but with restrictions on their activities, such as being prohibited from manufacturing products, competing with industry or working for commercial companies. NCAR's total expenditure in fiscal year 2011 was \$268 million, of which 95% was provided from federal funds.¹⁵

The Office of Oceanic and Atmospheric Research (OAR)

OAR is a division of the National Oceanic and Atmospheric Administration (NOAA), a federal scientific agency that has operational responsibility to provide critical and accurate weather, climate and ecosystem forecasts. OAR is responsible for research to underpin better forecasts, earlier warnings of natural disasters, and a greater understanding of the Earth, operating under the principal themes of climate, weather, air quality, and ocean and coastal resources. NOAA's R&D funding is 13.5% of its total funding of \$5.5 billion (as requested in 2014). It anticipates 69% of its R&D funding in 2014 to be from federal agencies and 31% from non-federal entities including private companies, academia and non-profit making bodies.¹⁶

US Geological Survey (USGS)

The USGS has a remit analogous to that of the BGS and CEH combined. It provides scientific information to describe and understand the Earth, to minimise loss of life and property from natural disasters and manage water, biological, energy and mineral resources. It collects, monitors, analyses and provides scientific understanding about natural resource conditions, issues and problems, including water and biological resources. The US Fish and Wildlife Service's research function was incorporated in the USGS in 1996. It is a Federal scientific agency and part of a bureau of the US Department of the Interior, making budgetary requests directly to the US President's office. Its budget for fiscal year 2012 was \$1.1 billion, the major (unspecified) part of this being from federal sources.¹⁷

Woods Hole Oceanographic Institution (WHOI)

WHOI is a research and educational institution to advance understanding of the ocean and its interaction with the Earth system. It is a private, independent, not-for-profit institution run by the WHOI Corporation and a Board of Trustees created by the recommendation of a National Academy of Sciences committee in 1927. The bulk of its funding comes from grants and contracts from the NSF and other government agencies alongside foundations and private donations. It also offers facilities and services for use by external groups and organisations. Its operating expenditure in 2011 was approximately \$227 million, with 74%

¹⁵ NCAR/UCAR (2013). *Quick facts about NCAR & UCAR* <https://www2.ucar.edu/about-us/quick-facts>

¹⁶ NOAA (2013). *Financial Year 2014 Budget Summary* http://www.corporateservices.noaa.gov/nbo/fy14_bluebook/FINALnoaaBlueBook_2014_Web_Full.pdf

¹⁷ US GS (2013). *The United States Department of the Interior budget justifications and performance fiscal year 2014* http://www.usgs.gov/budget/2014/greenbook/2014_greenbook.pdf

from government sources (NSF, US Navy, NOAA & others others).¹⁸

Scripps Institution of Oceanography

‘Scripps’ is part of the publicly funded University of California, San Diego. Its mission is to ‘seek, teach, and communicate scientific understanding of the oceans, atmosphere, Earth and other planets for the benefit of society and the environment.’ Its research expenditure in financial year 2011-2012 was \$153 million, of which about 95% was from government (largely NSF, Department of Defence, NASA, NOAA, and state sources).¹⁹ *‘Private gifts and endowments furnish funds critical to launching new areas of research, supporting students, purchasing equipment, and constructing new facilities’.*

Lamont-Doherty Earth Observatory

‘Lamont-Doherty’ is part of Columbia University, a private institution. It ‘seeks fundamental knowledge about the origin, evolution and future of the natural world’ and conducts research on many aspects of the planet from its interior to the outer reaches of the atmosphere, covering climate change, earthquakes, volcanoes, non-renewable resources, environmental hazards. Its expenditure for financial year 2011-2012 was approximately around \$92 million, of which 82% was derived from governmental sources.²⁰

¹⁸ WHOI (2011). *2011 Annual report* <http://www.whoi.edu/2011annualreport/financials>

¹⁹ Scripps Institution of Oceanography (2012). *Annual report 2011-2012*.
https://scripps.ucsd.edu/sites/scripps.ucsd.edu/files/files/Scripps_Institution_Oceanography_AR_2011-2012.pdf

²⁰ Lamont Doherty Earth Observatory Columbia University Earth Institute (2012). *Annual report*
https://www.ldeo.columbia.edu/files/uploaded/image/LDEO_Annual2012.pdf