

**ECONOMIC
IMPACT
BASELINE**



2010 Update

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1. Executive Summary

The Natural Environment Research Council (NERC) Economic Impact Baseline demonstrates the value of and impact of NERC science; the role NERC plays in developing the UK skills base; and the breadth of NERC science including, but not only, NERC's role in supporting climate science.

Excellence with Impact

NERC is the UK's main agency for funding and strategically directing research, training and knowledge exchange in the environmental sciences. NERC is committed to supporting excellent environmental research and training that is translated into economic impact.

In 2008 the UK overtook USA to become the G8 leader for environmental sciences as measured by citations impactⁱ. In 2009, UK researchers overtook Germany to secure the largest proportion of European Commission funding for environmental research, attracting 13% of the €220 million budget.ⁱⁱ

Research excellence is fundamental to making NERC and its research community attractive partners. It is this UK research excellence that persuades business and other investors to come to the UK.

Working through Research Councils UK (RCUK) in partnership with 20 other organisations, NERC conceived the Living with Environmental Change (LWEC) programme as a vehicle for accelerating the delivery of research to policy and business.

Delivering Economic Impact

This report illustrates five areas of impact that have been delivered during the last year through NERC investment.

Improving public policy and public services (section 2.1)

Assessing flood risk, protecting lives and property - the Flood Estimation Handbook saves £7-34 million costs; geological models save £46 million.

Responding to emergencies – NERC research aircraft, satellite instruments and ground-based radar provided vital information on the Eyjafjallajökull volcanic ash cloud for the aviation authority, COBRA and Met Office to get planes flying againⁱⁱⁱ.



Improving the performance of existing businesses (section 2.3)



Saving up to £130 million pa for the insurance industry^{iv} - environmental data and risk models inform a wide range of applications from space weather to flooding.

Increasing crop production – low cost seed mixes to boost bumblebee pollinators could be worth up to £440 million pa; equivalent to 13% of farming income^v.

Providing expert scientific consultancy – NERC research centres earned £156 million contract research and IP income over the last five years.

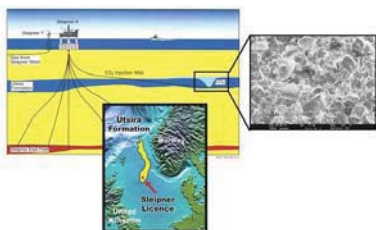
Delivering highly skilled people to the labour market (section 2.4)

Improving BP's performance – collaboration between universities and industry brings skills to identify new potential oil and gas sources.



Attracting R&D investment from global business (section 2.5)

Leading carbon capture and storage (CCS) - providing essential research and advice to government on the regulatory framework for CO₂ storage, site characterisation, storage capacity, and site monitoring^{vi} - North Sea CCS business could be £2-4 billion p.a. to the UK by 2030, sustaining between 30,000 and 60,000 jobs, with a cumulative value of £25-45 billion between 2010 and 2030.



Creating new business (section 2.6)

Creating new income - NERC research centre income from Intellectual Property (IP) was £4.3 million and total operating income was around £17 million in 2008/09^{vii}.



Creating new companies - NERC's Centre for Ecology and Hydrology (CEH) is establishing PHARMATIC, a new company that focuses on the development of biotherapeutics derived from parasites.

2. Delivering Economic Impact

2.1 Introduction: Excellence with impact

Public investment in science and innovation makes certain that the UK is able to compete in the global economy. Research Councils UK (RCUK) is ensuring that the UK is a world leader in a global market. RCUK confirms that our research excellence and relevance today, positions the nation strongly to seize tomorrow's opportunities. RCUK working in partnership cultivates the essential research and skills to provide the bedrock for the UK to have a productive economy, healthy society and contribute to a sustainable world.



In these three mutually supportive areas, RCUK tackles the greatest challenges facing society by drawing together world-leading interdisciplinary research programmes. Alongside the delivery of world-class research, RCUK invests in the next generation of researchers and scientific infrastructure to build the skills of the nation and ensure that the UK maintains a world leading position.

The Natural Environment Research Council is the UK's main agency for funding and strategically directing research, training and knowledge exchange in the environmental sciences. NERC's strategy [*Next Generation Science for Planet Earth 2007-2012*](#) recognises a responsibility not only to fund excellent research that addresses the critical environmental issues of the 21st century, but also to ensure that NERC makes a real contribution to building a sustainable economy and improving quality of life through increasing the economic impact of NERC's investment in research and training.

NERC-funded research is a foundation for what is becoming known as the Green Economy; that is an economy that makes optimal use of environmental resources, understands environmental constraints and environmental change processes and develops and implements technologies and solutions that ensure environmental sustainability.

The first Economic Impact baselines were published as part of the research council delivery plans in November 2007 to describe their economic impact and set a baseline against which they could assess and report progress on a regular basis. This document provides examples of economic impact achieved by through NERC investment in research and training.

This report illustrates five areas of impact:

- Improving public policy and public services
- Improving the performance of existing businesses
- Delivering highly skilled people to the labour market
- Attracting R&D investment from global business
- Creating new business

2.2 Improving public policy and public services

NERC scientists influence UK and global policy-making, for example through contributions to the assessment reports of UN Inter-governmental Panel on Climate Change (the IPCC) and the Stern Review on the economics of climate change.

Key metrics

NERC Research Centre programmes and NERC-funded research grants demonstrated that the scale and effectiveness of science to policy activities remained stable over four years at 62%. The proportion of these programmes or grants that then go on to give advice to Government is 31%, a rise of 5% in three years. Public sector co-authorship on NERC-funded ISI journal papers is 15% for 2008. In 2008/2009, NERC provided advice for 21 consultations and 10 parliamentary inquiries. NERC input has influenced recommendations to the UK government made in select committee reports on topics

including the regulation of geoengineering, the challenges faced by the UK in securing food supplies up to 2050, and air quality.

Miles Parker, Defra Director of Science and Deputy Chief Scientific Advisor

On climate science, the JCRP (joint climate research programme) with the Met Office is a positive step. Defra would encourage NERC to continue this trend of directly addressing critical UK policy needs. NERC's expert advice has been useful in developing the UKCP09 climate projections. The Proudman Oceanographic Laboratory data were heavily drawn upon in marine aspects of the UKCP09 climate projections. See MCCIP paragraph later in this sub-section.

Another good example is Countryside Survey which is jointly funded by NERC (45%), Defra (31%), conservation bodies and Devolved Administrations. Countryside Survey provides a periodic assessment of the status of the British countryside. This has been repeated at 8 or 9 year intervals since 1978, with the latest survey conducted in 2007. The results from Countryside Survey are relevant to a wide range of policies including hedgerow protection, soil carbon, Environmental Stewardship, air pollution, and biodiversity policy.

Living with Environmental Change (LWEC)

LWEC is a ten-year partnership programme launched in 2007 that aims to align £1 billion of partner research activities to its strategic objectives in the first five-years. The Research Councils have committed to invest £363 million over the current spending review period, with NERC committing £237 million of this. By the end of 2009, £470 million has been committed by partners to address LWEC strategic objectives.

NERC is leading on knowledge exchange (KE) in LWEC (with the Technology Strategy Board (TSB)) for all the LWEC partners. NERC and TSB have established the LWEC Business Advisory Board, so that CEOs and senior executives from leading businesses including FTSE100 companies strongly influence the co-design and co-delivery of LWEC strategy and programmes. In addition, the AVOID programme, funded through LWEC, provided policy-relevant evidence and research for the UN climate change conference needed to achieve international agreement on greenhouse gas emission reductions

Advising Climate Change Research and Policy

Influencing UN climate change conference in Copenhagen, November 2009

A number of NERC scientists gave talks at side events at the conference and were involved in behind the scenes analysis of mitigation options for DECC.

Informing potential impacts and adaptation of marine climate impacts

The UK Marine Climate Change Impacts Partnership (MCCIP - involving NERC research centres) launched a keynote document^{viii} for marine decision makers and stakeholders (including industry) outlining the vulnerability of UK, and adjacent seas, to the impacts of ongoing climate change. This, along with evidence from NERC's National Oceanography Centre (NOC), contributed to the UK Climate Projections (UKCP09)^{ix} regarding sea temperature, salinity, stratification, circulation and waves. UKCP09 is funded by the Department for Environment, Food and Rural Affairs (Defra) and is used to support decision making by a wide range of people who want to access potential impacts of the projected future climate and explore adaptation options to address these impacts.

Improving Air Quality

Reducing sulphur emissions

For the last four decades, NERC research and government policy have gone hand-in-hand to reduce sulphur emissions, a key air pollutant. This has led to significant reductions in respiratory and cardiovascular hospital admissions and avoidance of premature deaths^x. The economic impact to the UK

of these health improvements has yet to be quantified, but is very likely to exceed £1 billion pa (based on IGCB calculations). There is positive evidence that measures are working. For example, demonstration that industry/transport does not need to take further measures to curb sulphur emissions has a positive economic impact.

Influencing future air quality policies

According to evidence presented to the Environmental Audit Committee inquiry on air quality, air pollution could still be contributing to as many as 50,000 deaths per year^{xi} as it makes asthma worse and exacerbates heart disease and respiratory illness, despite the significant reductions outlined above following the introduction of previous policy changes informed by NERC research. NERC provided vital evidence for this inquiry and Defra has commissioned CEH to produce a Review of Transboundary Air Pollution (RoTAP)^{xii}.

The right trees reduce deaths

A NERC-funded study in the West Midlands found that doubling the number of the 'right' kind of trees (larch, pine and ash) could reduce excess deaths in the area by up to 140 per year by helping remove tiny polluting particles from the air. Scientists are now developing Urban Tree Air Quality Score (UTAQS) for urban planners and policy makers^{xiii}.

Assessing Flood Risks: Protecting Lives and Assets

NERC-funded storm surge modelling protects lives, assets and investments (DTZ)

- **NERC Modelling Safeguards Lives (£31 billion pa):**
In November 2007 the east coast of the UK experienced the worst storm surge for 20 years. Water levels due to tide and waves were accurately forecast two days ahead by NERC-funded predictive models. This prediction allowed agencies to operate the Thames Barrier and evacuate at-risk areas, so avoiding fatalities and significant financial losses. A similar storm surge in 1953 caused 307 deaths.
- **NERC Modelling Safeguards property (£2 billion pa):** Environment Agency analysis shows over 300km of roads and more than 500,000 homes are at risk of flooding in the Thames floodplain. NERC predictive modelling enables the relevant authority to raise the Thames Barrier, alleviating much of the risk. The estimated value of property within this area is £200 billion. 1% of this represents £2 billion in property assets.
- **Safeguarding London Economy (£2 billion pa in foreign investment, plus £94 million per flood day in avoided costs):**
Foreign Direct Investment (FDI) is worth £42 billion in Gross Value Added (GVA) to London each year. FDI could be severely curtailed should London be perceived at risk from flooding. Even a 5% fall in FDI due to perceived flood risk would cost the London economy £2.1 billion per annum. In addition, the economic cost of a flood event is estimated at c£94 million in GVA per flood day.

Avoiding up to £34 million in avoided costs

The Flood Estimation Handbook^{xiv} developed by NERC's CEH provides a better way of estimating flood frequency. Following an initial investment of £2.1 million the return is estimated at between £7 - 34 million^{xv} in avoided costs through improved risk management and policy implementation. The Flood Estimation Handbook is widely used by engineers, planners, policy-makers and insurers to predict flood frequency and contributes to preventative action.

Improving coverage and warning time of flood forecasting

NERC's CEH delivers its science through many routes, including collaborative partnerships. A recent example is the Flood Forecasting Centre (FFC) that went live April 2009^{xvi}. The FFC is a partnership between the Environment Agency and the Met Office to forecast for river, tidal and coastal flooding as well as extreme rainfall which may lead to surface water flooding. The information FCC provides to decision-makers and emergency responders is dependent on CEH's contribution of Grid-2-Grid (G2G) hydrological models. The new G2G model is being used to assess future flood risk at local levels and are improving the coverage and warning time of the flood forecasting systems that support our national flood management capabilities. The system will provide forecasts of flooding several days ahead on a 1 km

grid across England and Wales, encompassing catchments for which there are no measurements of river flow. It will also be capable of providing forecasts in probability form and maps of changing flood risk.

Safeguarding property in Oxford

NERC's British Geological Survey (BGS) models and associated software have been applied by the Environment Agency (EA) in England and Wales to help mitigate flood risks in parts of Oxford, safeguarding properties, worth an estimated **£46 million**^{xvii}. Cost savings from reduced insurance claims could equate to **£1.2 million** from a single flooding event.

Responding to emergencies

NERC's response to the Eyjafjallajokull volcanic ash cloud

Within 24 hours NERC's Dornier 228 aircraft was scrambled and continued to fly daily to sample the composition of the ash and to measure dispersion and pollutants. This enables the determination of levels of sulphur dioxide and glass shards as well as the density of the cloud and the direction of the spread. This information is then shared with the Civil Aviation Authority, COBRA and the Met Office to enable their decision-making.

NERC-funded scientists in Haiti response

Vital data provided by NERC's BGS helped the response to the Haiti earthquake in January. BGS scientists detected the 7.0 magnitude earthquake as it happened. Within minutes, they alerted agencies and rescue missions. Within 24 hours, the World Bank was using NERC seismic data and high-resolution satellite images to assess the damage around Port-au-Prince. Working with NGOs, the Red Cross and Unicef, the scientists assessed the status of Haiti's infrastructure, and identified areas safe from aftershocks, land slips and flooding. The UK scientists "played a critical role in providing a rapid assessment," said Dr Beverley Adams of disaster management company ImageCat. "These data are currently being used to help guide relief activities, develop reconstruction plans, and assess future post-disaster needs."

Influencing Marine Policy

The UK Marine Science Strategy^{xviii}

This is a 15 year strategy to deliver world class marine science to inform decisions on food and energy security, managing the seas sustainably and climate change. The new Marine Strategy drew upon NERC staff expertise^{xix}. In response to recent strategies and reviews, NERC is strengthening UK national capability to deliver the UK Marine Science Strategy and associated marine action plans. In 2010, NERC announced the creation of a new, national research organisation: the National Oceanography Centre (NOC) brings together the Proudman Oceanographic Laboratory (POL) in Liverpool and the National Oceanography Centre, Southampton (NOCS) into a single institution. NOC will work in partnership with the UK marine research community to deliver integrated marine science and technology from the coast to the deep ocean.

Marine and Coastal Access Act

For many in the marine and maritime communities the successful passage through Parliament of the Marine and Coastal Access Act, which received Royal Assent in November 2009 was a major milestone which offers new hope for protecting and managing our unique coastal environment. Its implementation will require continuing support by robust scientific evidence. This legislation is the result of many years of work by a broad cross-section of the marine community, including scientists at NOC. Its main features include the establishment of the Marine Management Organisation (MMO). The new MMO will help the UK to achieve the provisional targets of the European Marine Strategy Framework Directive.

Predicting sea level rise

The Intergovernmental Panel for Climate Change (IPCC) identified that melting ice is the largest uncertainty in predicting future sea level rise. NERC's British Antarctic Survey (BAS) scientists have produced the most accurate, comprehensive picture of the rapidly thinning glaciers along the coastlines

both of the Antarctic and Greenland ice sheets. The findings are an important step forward in the quest to make more accurate predictions for future sea level rise.

Strengthening Arctic Research

Coordinating Arctic research

A UK Arctic Office, hosted at BAS offices in Cambridge, has been set up to coordinate UK research in the Arctic for NERC. In particular, it coordinates the logistical and polar infrastructure needed to make Arctic research possible. The Arctic Office services the agreement on polar research and logistical cooperation signed in December 2008 between the governments of Canada and UK. This includes sharing ships, aircraft and research stations in both the Arctic and Antarctic to increase science cooperation, which paves the way for a greater understanding of the rapidly changing Polar regions. The recent report from the International Polar Year illustrates how international cooperation is necessary to address the effect of climate change on vulnerable polar regions.

2.3 Improving the performance of existing businesses

The research we fund makes a substantial contribution to products and services in many business sectors, and provides the basis for expert consultancy services offered by our research centres.

Key metrics

In 2008/09, the contract research income earned by NERC research centres was £35.2 million. In the last 5 years NERC has attracted £156 million of commissioned research and IP income. Private sector co-authorship on NERC-funded ISI journal papers is being sustained at 4%.

Saving up to £130 million p.a. for the insurance industry

Environmental data and risk models have direct application to the insurance and re-insurance industry, with a wide range of applications from space weather to flooding. There is therefore great interest in supporting research as a means to business advantage. This sector's annual turnover is estimated at £240 billion. An example of NERC's impact on this sector is provided below.

High Resolution Climate Modelling and the Reinsurance Industry

Collaborations between NERC researchers and the reinsurance industry have developed the potential of high resolution climate models to advance catastrophe modelling in the reinsurance industry. Improved high resolution catastrophe modelling detailing the likely frequency and severity of hurricanes and severe weather will help to ensure that reinsurance companies are not unknowingly accumulating risk that could lead to large losses and destabilise the industry. It is estimated that if this led to only a 5% reduction in average insured losses due to storm damage, this would be worth between £62 and £130 million per annum to the UK insurance industry.

One such collaboration is the Willis Research Network. Willis Re is one of the 'big three' reinsurance brokers. It provides funding of around £2 million pa for postdoctoral research fellowships and PhD students at partner research institutes. One measure of the economic impact of this research is the willingness of Willis Re to use its resources to 'pull through' academic research into practical applications in the insurance industry. This is estimated to be £800,000 pa.

For Willis Re, the UK is the best place to fund research because of a unique combination of factors: global position, excellent science at reasonable costs, proximity of research institutes, global outlook of UK researchers and the ability to be flexible and assimilate knowledge. This will help the UK to maintain its competitive position as a centre for reinsurance and support its growth in the future. The UK reinsurance sector is worth about £7.2 billion.

Addressing priority issues for the water industry

The water industry is committing £27 billion to operations and infrastructure over the next five years. It faces significant challenges with implementing legislation (e.g. the Water Framework Directive) and

responding to climate change and energy pressures as it is the second largest user of electricity in the UK. The water sector needs have been mapped through LWEC, with catchment management being the top priority. This has been taken forward with UKWIR, Defra and the EA. A further example of how NERC funded research addresses major issues faced by the industry is provided below.

Hydroclam

NERC has supported the development of Hydroclam, a water monitoring device that helps water companies monitor tap water supply in real time. The value of maintaining water supplies in the event of a bust water main is estimated at £47k per day due to allowing businesses to continue trading (DTZ).

Hydroclam was licensed to Siemens and is estimated to have cumulative revenues of £60 million from 2008-2016. NERC enabled this development through research, commercialisation and studentship funding carried out at the University of Manchester.

Enhancing food security

Food and agriculture make up 2% of the economy but around three quarters of UK land area is under agricultural use, so that its importance to the environment and landscape is very high. With a predicted 30% shortfall in food supplies by 2030, there is a need for collaborative research on crops and on the environmental context. NERC's CEH, developed a simple, low-cost seed mix that can increase bumblebee numbers by 30-fold. This project underpins Operation Bumblebee, sponsored by Syngenta and Sainsbury's. Independent research of the Operation Bumblebee habitat has shown growers can increase bumblebee populations by up to 600% in just three years providing the essential food sources and undisturbed nesting sites. The economic value of pollination services to UK crops is up to £440 million pa; equivalent to 13% of farming income.

Natural product protects crops

Work funded by NERC and HDB-Horticulture and undertaken by scientists at Lancaster University and Stockbridge Technology Centre has led to a breakthrough to improve sustainable food production. They discovered that treating tomato seeds with jasmonic acid (JA) resulted in protection against pests for up to eight weeks after germination. JA is involved in controlling a plant's natural defences against pests, but it had not been anticipated that it would provide protection for so long. The technology was assigned to Plant Bioscience Limited (PBL), which promoted the technology to the international agricultural products industry. In June 2009, following extensive field trials, Becker Underwood Inc. of Ames, Iowa entered into a worldwide exclusive license for the use of the seed treatment.

Advising on the environmental impact of wave and tidal power

Harnessing the full potential of UK marine energy could provide enough power for up to 15 million homes and save up to 70 million tonnes of CO₂ by 2050^{xx} and the potential for the marine energy sector to provide up to 16,000 jobs. The Joule Centre for Energy Research^{xxi}, in which NERC's CEH and NOC are involved in, ran a project for the North West Development Agency (involving the Mersey partnership of North West Universities, commercial organisations and other stakeholders associated with the energy industry) on Tidal Energy from eastern Irish Sea and Severn. The study demonstrated that tidal energy from the five main North-West estuaries (Solway to Dee) could supply 5-6% of UK present electricity demand, around half of North-West's current electricity needs. NOC and the University of Liverpool are now advising a consortium looking at the environmental impacts of tidal turbines/barrages.

Improving the performance of the UK oil industry

A project team, funded through NERC's Ocean Margins LINK, developed the Integrated Seismic Imaging & Modelling of Margins (iSIMM) system to detect and analyse organic (carbon-based) molecules to determine if an area is worth drilling. The team then created a commercial model that is such a large improvement on earlier techniques that it is already in use by the hydrocarbon industry. From this the team has developed a major new consultancy with oil companies. In addition to NERC/DTI funding, BP, Shell, Conoco, Phillips, Statoil, ENI, Anadarko and Amerada Hess, provided commercial sponsorship for the project, while WesternGeco supplied ship-time for seismic acquisition.

2.4 Delivering highly skilled people to the labour market

NERC is committed to enhancing the quality and output of the UK research base through the training of the next generation of environmental scientists, helping provide the UK economy with highly-skilled people. UK environmental science depends on a healthy and diverse research base. To deliver research that meets national and international priorities, NERC needs to ensure that there is a thriving environmental science community with the skills to address the both the scientific and organisational challenges identified in its Strategy. NERC places particular importance on creating an adaptable and integrated community, in which individuals work together across boundaries and undertake non-research roles to tackle the most crucial issues facing our planet. As this sub-section demonstrates, NERC encourages people to develop both research and other transferable skills and knowledge to ensure the continuation of supply necessary to sustain both a healthy science base and a healthy economy.

Testimonial: Professor L.A. Glover FRSE, FAAM, CBE Chief Scientific Adviser for Scotland

I am extremely pleased to have had the support of NERC during my research career. I have benefited from NERC grants and studentships which formed the core of my research during the early part of my career and created the basis of a University spin-out company in environmental biotechnology formed in 1999 and still trading. The opportunity to sit on one of the grant review panels allowed me both to input my experience to the panel as well as benefit from a much greater understanding of how the funding system worked. I feel very lucky indeed to have been a member of NERC Council where I was able to pursue my passion for knowledge exchange at a more strategic level. The confidence and knowledge gained from colleagues and officials on NERC Council and the insight into Government funding of science and its importance to the economy, were the key factors that made me decide to apply for the CSA Scotland post.

A time line setting out Professor Glover's career is provided at Annex B.

Key metrics

In 2008/09 NERC funded:

- a total stock of 988 PhD students and 362 Masters students. This translates as £4 million p.a. on Masters and £23 million on PhD students. Around 27% of NERC funded PhD finishers move into the private sector and 8% to the public sector. For Masters, 50% go into the private sector and 8% to the public sector.
- 86 Research Fellows. Fellows were the most-cited cohort of researchers in the NERC-funded research community in 2008. Around 95% of Fellows remain in academia.
- 30% of the NERC funded PhDs have industry or policy partners, known as CASE studentship awards. Currently, 120 studentships are supported by 53 organisations including AstraZeneca, BP, British Gas, Corus, Environment Agency, Met Office, RSPB, Schlumberger and Syngenta.

Collaborations with industry: Improving BP's performance

Dr Ken McCaffrey, a reader in Durham University's Department of Earth Sciences, is nearing the end of a four-year research project in collaboration with international energy company BP. This was funded by NERC through the Royal Society Industry Fellowships scheme, which encourages mid-career scientists to work in industry to develop long-term collaborations. In the long term, McCaffrey hopes the research will improve our understanding of where to look for oil and gas. BP recently negotiated agreements to drill in Azerbaijan, based partly on analysis and mapping involving McCaffrey. And it's now planning where to drill its first exploratory boreholes in Libya - a decision that McCaffrey's work will influence. This information could also help us forecast and manage the effects of geohazards like earthquakes, volcanic eruptions or landslides. 'Even in the UK, for example, there are places where old faults have been put under stress by present-day tectonic forces,' McCaffrey explains.

Enhancing links with government

Paul Williams received NERC funding to undertake a Royal Society Pairing scheme for MPs, Civil Servants and scientists to help build bridges between parliamentarians and some of the best science research workers in the UK. Paul's testimonial demonstrates what has been achieved in the short term through one of these schemes.

Paul Williams, University of Reading

I was paired with Rob Wilson, the Conservative Member of Parliament for Reading East. I spent a week shadowing Mr Wilson at Westminster, to see behind the scenes at the House of Commons and learn about the working life of an MP. I was struck from the start by how demanding an MP's job is. It was a rare privilege to have access to a decision-maker for a few hours; to answer his questions about the evidence for climate change, and climate models.

I understand much more clearly now the intricacies of the political decision-making processes, and I am more aware of how to influence them. I am sure that Mr. Wilson valued the opportunity to develop improved links with his local university, and I believe he would feel comfortable about contacting me in future if he needs information about climate change. Overall, the MP-Scientist Pairing Scheme has been very beneficial to both the MP and the scientist, at least in my pairing, and I would not hesitate to recommend it to other eligible NERC scientists.

Enhancing government decision-making

NERC is working with policy makers to strengthen knowledge exchange by facilitating the translation of environmental science into public policy through policy placements and secondments. Four NERC policy placements were set up in 2009. These include placements within the Environment Agency and DECC. In 2008/09 nine policy secondments were funded.

SPICe: Gordon Lawrence, Cardiff School of Earth and Ocean Sciences

My time in the Scottish Parliament Information Centre (SPICe) exceeded all of my expectations. I was given a wide variety of tasks covering a large number of different areas that, prior to the placement, I was not expert in. Tasks performed included: writing two parliamentary briefings on topics (the management of Marine Assets by the Crown Estate Commissioners and on the impact of aviation on Climate Change); that were quite different from my research experience thus far; answering individual enquires from MSPs on policy subjects; and attending meetings with key stakeholders.

During the course of the placement I have been able to significantly develop my portfolio of professional skills including. I have also learnt an incredible amount about the legislative process of the Scottish Parliament, the Houses of Parliament in Westminster, and the European Union. These skills and knowledge will be invaluable in the future, whichever career path I pursue.

Training for capacity building in developing countries

BGS provides extensive training programmes to build geoscience capacity in several developing countries including Afghanistan, Montserrat, Ethiopia, Ghana, Nigeria, Papua New Guinea, Malawi and Mozambique. This initiative is contributing to economic growth in the developing world. For example, exploitation of the copper deposits identified by the British Geological Survey (BGS) in Afghanistan will help raise revenue for the Afghan government of around £30 billion.

2.5 Attracting R&D investment from global business

The impact of UK environmental science highlights how NERC investment is driving the UK's lead in environmental sciences and providing the right kind of platform to make NERC an attractive partner.

Key metrics

International co-authorship has risen substantially (13%) to 51%.

Over the current spending review period, NERC's partnerships with US funding agencies has leveraged £50 million co-funding through RAPID Watch, Environmental NanoScience programmes and a consortium on Ocean mixing. Further US resources were leveraged through participation in international

platforms addressing grand challenges, for example, since 2003 NERC, at a cost of \$5.6 million p.a., has participated in the US and Japanese led Integrated Ocean Drilling Programme, which has benefited from more than \$1.5 billion of international investment in state of the art ocean-drilling platforms.

Leading Carbon Capture and Storage (CCS)

CCS technology is widely regarded as critical for reducing carbon emissions, given the predicted continued reliance upon fossil fuels throughout this century. UK storage potential is more than 1,000 million tonnes of CO₂ enough for 180 years of emissions by UK's 20 largest power stations. UK government estimates the value of the North Sea CCS business could be £2-4 billion p.a. to the UK by 2030, sustaining between 30,000 and 60,000 jobs with a cumulative value of £25-45 billion between 2010 and 2030.

The UK is playing a global lead in CCS, which helps make the UK an attractive place to invest in for overseas business. NERC funded-research is specifically relevant in the areas of advice to government, on legislative framework for CO₂ storage and site characterisation, storage capacity, site monitoring. For example, NERC's BGS was involved in the world's first demonstration that carbon dioxide can be captured at source and stored underground and its 3D modelling is being used to investigate North Sea storage capacity. This work has the potential to reduce storage costs by approximately £94 million. The environmental impact of any CO₂ leakage would be low and this evidence has already resulted in a change of policy and legislation to allow storage (it was previously illegal under the OSPAR convention).

Improving European air quality

Cities all over Europe are queuing up for a service that quantifies greenhouse gas emissions across a region's industries and economic sectors. This includes ten capital cities: Madrid, Paris, Stockholm, Helsinki, Brussels, Athens, London, Oslo, Moscow, and Ljubljana. The system known as GRIP (the Greenhouse Gas Regional Inventory Protocol)^{xxii} makes it easy for policy-makers, regulators and industry to produce energy scenarios for emissions reductions based on their own expertise and understanding. GRIP was co-funded by the Tyndall Centre (of which NERC is a funder), the Environment Agency, and a researcher as part of his PhD. A new company, carbon capture ltd, was founded in 2008 to meet further demand.

Ensuring safety of marine shipping

NERC's BAS was recently awarded a major contract to lead, develop and manage sea ice monitoring services for research ships, cruise liners and fishing boats in the Southern Ocean. The project delivers a range of polar environmental information services as part of the European Commission and European Space Agency's Global Monitoring for Environment and Security programme.

NERC space science attracts foreign investment

The UK space industry contributes around £5.8 billion annually to the UK economy. The UK government invests around £270 million a year including investment by NERC in Earth Observation (EO) and the associated underpinning technologies required to address key science issues including in climate and environmental change. NERC's investments in EO research, in addition to producing world-leading environmental science, also support young EO scientists and technologists at both PhD and postdoctoral level. This provides the UK with next generation of highly skilled EO scientists and technologists, skills that in many cases are transferable and therefore benefit industry helping make the UK an attractive area for international investors. NERC directly supports subscriptions (currently around £47 million pa) to ESA missions¹, a significant part of this investment being placed with UK industry in the development and implementation of new science missions.

Protecting space assets

Insurance loss claims peaked at \$1.2 billion p.a. during the last solar maximum. NERC's BAS is leading a European funded consortium to better protect space assets from high energy particles in the Van Allen radiation belts during periods of high risk. The consortium will develop the capability to dynamically model and forecast the energetic particle environment in near-Earth space. This builds on BAS's world ranking science expertise and a track record of successful involvement with the London insurance market through the TSUNAMI initiative.

¹ This NERC investment will now be delivered through the new UK Space Agency, in which NERC will play an active role

2.6 Creating new business

NERC aims to make advances in science and technology available to potential users, and to increase the economic impact of its research. For business and industry, the results of NERC research can lead directly to new products and services or we can support existing activities by, for example, providing environmental data or collaborating with the private sector in research (see section 2.3).

Key metrics

Income from Intellectual Property (IP) was £4.3 million and total operating income was around £17 million in 2008/09^{xxiii}.

Generating income

New Technology

NERC's BAS has produced a range of bird activity loggers to enable the migratory paths of birds to be established. In 2009, activity loggers with a value over £0.5 million were sold to researchers across the world. The success of the devices has also assisted with international collaboration and many peer-reviewed and cited papers.

Commercialisation schemes

Follow-on Fund

A specific example of how the Follow-on Fund has been used can be demonstrated by NCAS. A compact instrument technique originally developed by NCAS for the measurement of volatile organic compounds in air (for air quality applications) is now undergoing commercial adaptation to allow stand-off detection of suspect complex mixtures. Supported by the NERC follow-on fund, Yorkshire Forward and the Ministry of Defence the device is the first to use lab on a chip technology to resolve highly complex unknown mixtures in the field.

Environment Young Entrepreneurs Scheme (Environment YES)

This scheme helps train future entrepreneurs within the environmental sciences to provide them with an insight into commercialisation. For example, a team of graduate students from the University of Oxford was rewarded for their exceptional entrepreneurial skills by scooping first prize of £1000 in the Environment Young Entrepreneurs Scheme (YES) competition.

New companies

Cascade Technologies

This spin-out company formed from a NERC-funded research group at the University of Strathclyde has developed and patented the world's first real-time technology for the detection, measurement and monitoring of gas emissions and explosives through its use of quantum cascade lasers. The measurement of exhaust gas emissions in the shipping industry is essential for informing more effective emissions legislation^{xxiv}. In 2008/09, Cascade Technologies secured an additional £1 million of funding to develop further Market opportunities.

PHARMATIC

NERC's CEH is in the process of establishing PHARMATIC, a new company that focuses on the development of biotherapeutics derived from parasites. The recruitment of a Chief Executive Officer will help with the formation of this spin-out company.

Annex A: Summary Statistics

Grant-in-aid £402m

External funding* £53m

Total NERC staff 2,459

Staff in higher education institutions employed on research grants 1,240

* This includes external research funding, plus other operating income, including data sales

<p><u>Science to Policy</u></p> <p>Inputs to Government consultations: 21</p> <p>Inputs to Parliamentary inquiries: 10</p> <p>Government funded research programmes: 77</p> <p>Number of PhD policy secondments and placements: 13</p>	<p><u>Training & Skills</u></p> <p><i>PhD students</i></p> <p>Total number of PhD students: 988</p> <p>Percentage of PhDs with industry/policy partners (CASE): 30%</p> <p>Expenditure per annum on PhD training £23.0m</p> <p>First destination of PhD students: private sector 27%, public sector 8%</p> <p><i>Masters students</i></p> <p>Total number of Masters students funded: 362</p> <p>Expenditure per annum on Masters students: £4.0m</p> <p>First destination of Masters students: private sector 48%, public sector 8%</p> <p><i>Post Doctorates</i></p> <p>Number of post-docs employed on NERC grants: 1,240</p>
<p><u>User engagement/ Products & Research Services</u></p> <p>Contract research income earned by NERC research centres: £35.2m</p> <p>Growth in level of co-funding of research: £2.98m</p> <p>Co-authored ISI publications: public sector 15%, private sector 4%</p> <p>Knowledge Transfer Partnerships: 15</p>	<p><u>Licensing & Commercialisation</u></p> <p>Patents filed by NERC grant-holders: 7</p> <p>Royalties & license income earned by NERC research centres: £4.3m</p> <p>Follow-on funding and Innovation awards: £1.5m</p> <p>Invention disclosures by research centres: 33</p> <p>License agreements signed (excl. data): 6</p>

All data relates to FY 2008/09 unless otherwise stated.

Sources: NERC Economic Impact Reporting Framework 2008/09; NERC Research Outputs Database; NERC Annual Report 2008/09

Annex B: Professor Anne Glover Career Timeline

Professor L.A. Glover CBE, FRSE, FRSA, FAAM, FIBioL	
1995	Fellow of the American Academy of Microbiology
1996 – 2000	NERC Grant - Co-Investigator – Environmental Diagnostics Programme
1998 - 2001	NERC's Freshwater Sciences Peer Review Committee
1998 – 2001	Reader, Molecular and Cell Biology, University of Aberdeen, Scotland
1999 – 2000	NERC Grant - Principal Investigator: Soil Biodiversity Programme
1999 – 2003	Technical Director, Remedios, Aberdeen, Scotland (University spin-out)
2001 – present	Personal Chair, Molecular and Cell Biology, University of Aberdeen, Scotland
2001 - 2010	Member of the Natural Environment Research Council
2005	Fellow of the Royal Society of Edinburgh
2006 - present	Chief Scientific Adviser (CSA) for Scotland
2007	Honorary DSc Napier University
2008	Woman of Outstanding Achievement by the UK Resource Centre for Women in Science, Engineering and Technology.
2008	Fellow of the Royal Society of Arts
2008	Fellow of the Institute of Biology
2008	CBE (for services to environmental sciences)
2009	Honorary Research Fellow, University of New South Wales, Sydney
2009 - present	Chair of UK Collaborative for Development Sciences (UKCDS)

Annex C: References

- ⁱ Department for Business, Innovation and Skills: International Comparative performance of the UK Research Base September 2009: Evidence Ltd:
http://www.dius.gov.uk/science/science_funding/science_budget/~media/publications/I/ICPRUK09v1_4
- ⁱⁱ Informal, preliminary data provided by UKRO
- ⁱⁱⁱ <http://www.nerc.ac.uk/press/releases/2010/18-volcanicplume.asp>
- ^{iv} DTZ (2010): High resolution climate modelling and the reinsurance industry
- ^v http://www.operationbumblebee.co.uk/pdfs/Sainsburys_growers_bring_back_bumblebee.pdf
- ^{vi} <http://www.bgs.ac.uk/research/energy.html>
- ^{vii} <http://www.nerc.ac.uk/publications/annualreport/2009/annualreport.pdf>
- ^{viii} Hardman-Mountford, N., Litt, E., Mangi, S., Dye, S., Schuster, U., Bakker, D., Watson, A. (2009) Ocean uptake of carbon dioxide (CO₂), MCCIP Briefing Notes, 9pp. www.mccip.org.uk
- ^{ix} <http://ukclimateprojections.defra.gov.uk/>
- ^x <http://sid.nerc.ac.uk/details.aspx?id=186>
- ^{xi} Environmental Audit Committee - Fifth Report: Air Quality (2010)
<http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenvaud/229/22902.htm>
- ^{xii} <http://www.rotap.ceh.ac.uk/about>
- ^{xiii} <http://sid.nerc.ac.uk/details.aspx?id=81>
- ^{xiv} <http://www.ceh.ac.uk/feh2/fehintro.html>
- ^{xv} Pricewaterhouse Coopers LLP (2006) 'Economic benefits of environmental science - A study of the economic impacts of research funded by the Natural Environment Research Council' 8, 9, 27, 34, 102-116
- ^{xvi} <http://www.ffc-environment.agency.metoffice.gov.uk/>
- ^{xvii} DTZ (2010): Modelling the UK in 3D
- ^{xviii} UK Marine Science Strategy (2010)
<http://www.defra.gov.uk/environment/marine/documents/science/mscc/mscc-strategy.pdf>
- ^{xix} Sutherland et al 'The identification of 100 ecological questions of high policy relevance in the UK' *Journal of Applied Ecology*, 43: 617 – 627
- ^{xx} Marine Energy Action Plan (2010)
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/wave_tidal/funding/marine_action/marine_action.aspx
- ^{xxi} <http://www.joulecentre.org/>
- ^{xxii} <http://www.grip.org.uk/Home.html>
- ^{xxiii} <http://www.nerc.ac.uk/publications/annualreport/2009/annualreport.pdf>
- ^{xxiv} <http://www.cascade-technologies.com/pdfs/Cascade%20investment%20round%20April%202008.pdf>