NERC
SCIENCE OF THE ENVIRONMENT

The business of the environment

our strategic direction

Who we are

NERC – the Natural Environment Research Council – is the UK's leading public funder of environmental science. We invest £330 million each year in cutting-edge research, postgraduate training and innovation in universities and research centres.

Our scientists study the physical, chemical and biological processes on which our planet and life itself depends – from pole to pole, from the deep Earth and oceans to the atmosphere and space.

We partner with business, government, the public and the wider research community to shape the environmental research and innovation agenda. Our science provides knowledge, skills and technology that deliver sustainable economic growth and public wellbeing.

NERC science leads the world in excellence and efficiency:

- UK environmental scientists produce more top-ranked publications per pound invested than any comparable nation.
- NERC scientists deliver 5000 refereed publications each year that are cited 40 per cent more often than the UK average.

We support:

- 3000 scientists and 1000 PhD students.
- 1000 research projects and 60 UK or international programmes.
- 55 universities and 20 research institutes.
- UK research capability including 4 ships, 7 aircraft, 6 polar stations, 6 data centres and 32 community facilities.
- Knowledge exchange and innovation activities with businesses, government departments and agencies, and local authorities.

Our vision

To place environmental science at the heart of responsible management of our planet

OUR GOALS

To fund excellent, peer-reviewed environmental science that helps us:

- Understand and predict how our planet works.
- Manage our environment responsibly as we pursue new ways of living, doing business, escaping poverty and growing economies.

MAKING IT HAPPEN

We will foster UK and international partnerships so that business, government, civil society and scientists can work together to:

- Address the challenges and opportunities of managing the environment.
- Co-design and co-deliver new environmental science.
- Find and apply existing scientific knowledge.
- Drive UK innovation, economic growth and societal wellbeing.

Environmental science for a changing

The environment is everyone's business. We depend on it for shelter, heat, light, food and water – all provided by globally interconnected trade, transport and communications. At present the world's population is growing by around 1 billion people every 12 years. More than half of us live in cities and more than half the countryside is used for agriculture. The way we live has changed our relationship with the environment. People are no longer bystanders examining a natural world; we are the dominant source of change.

People aspire to escape poverty and improve their living standards. Achieving this whilst living within the Earth's limits is the great challenge of the 21st century. NERC and the scientists we fund play a critical role in meeting this challenge.

NERC's strategy, science and funding decisions will be built on partnership. We will work with business to support UK ambitions for growth, resilience in a changing world,

world

and responsible management of the environment. With other research councils, government and civil society we will tackle, for example, sustainable urban living and how to manage ecosystems to continue providing the benefits we rely on. With other nations we will pool resources to address complex and shared environmental challenges – from sustaining healthy water supplies to understanding the implications of rapid warming in the Arctic. With universities and research centres we will sustain world-leading research that delivers value and impact for the UK economy and society.

Managing our environment demands ever-increasing sophistication. NERC has been a custodian of the 20th-century environmental record. Now we will harness the rapid development of information technology to open the record to the wider world. With partners we will use our data and knowledge to develop products and services that directly address the needs of business, government and society.

We will invest in technological innovation to meet the ever-growing demand for environmental science and information within finite budgets – to do more with less.

This document sets out our strategic direction. It demonstrates how NERC science will be critical in helping us balance our relationship with a changing planet. It explains how we will work in partnership, and invest our funds, to tackle the environmental opportunities and challenges that society faces.

We invite all our partners and scientists to work creatively with us to shape and deliver the UK's environmental research and innovation ambitions.

Carlos Munoz Yague/Look at Sciences/Science Photo Library

Bilewordtravel / Shutterstock.com

Meeting society's needs

Chris Gomersall/ 2020VISION

Benefiting from natural resources

Natural resources sustain life, wellbeing and economic activity. Yet growing UK and world populations make ever greater demands on food, water, energy, minerals and other essential services we get from nature.

All natural resources are derived from physical, chemical and biological processes that interact in land, water and air. NERC science tells us how these environmental processes control resource availability, and how we can use resources responsibly. This knowledge will help us use and recycle resources safely and efficiently, live within the Earth's limits, and steward natural resources for future generations.

FUELLING THE UK ECONOMY

Each year the oil and gas industry is worth £30 billion for the UK economy, supporting 440,000 jobs.

The distribution of these natural resources depends on geological processes that create the ocean floor and the continents. NERC investment since the 1970s, now £12 million each year, supports the science that developed new geophysical imaging tools to understand how tectonic forces shape the Earth's crust, how sedimentary rocks form in basins, and how fluids flow through underground faults and sediments.

This science helps us find and extract energy and minerals ever more safely and efficiently. Over the last 50 years it has fuelled enormous growth in the energy industry – no other sector has created more prosperity for the UK.

NERC geological science is paving the way for geothermal energy and shale gas to reduce our dependence on coal and oil, and for storing our carbon emissions in empty oil and gas reservoirs.

Matthew Lloyd/Getty Images

FEEDING A GROWING POPULATION

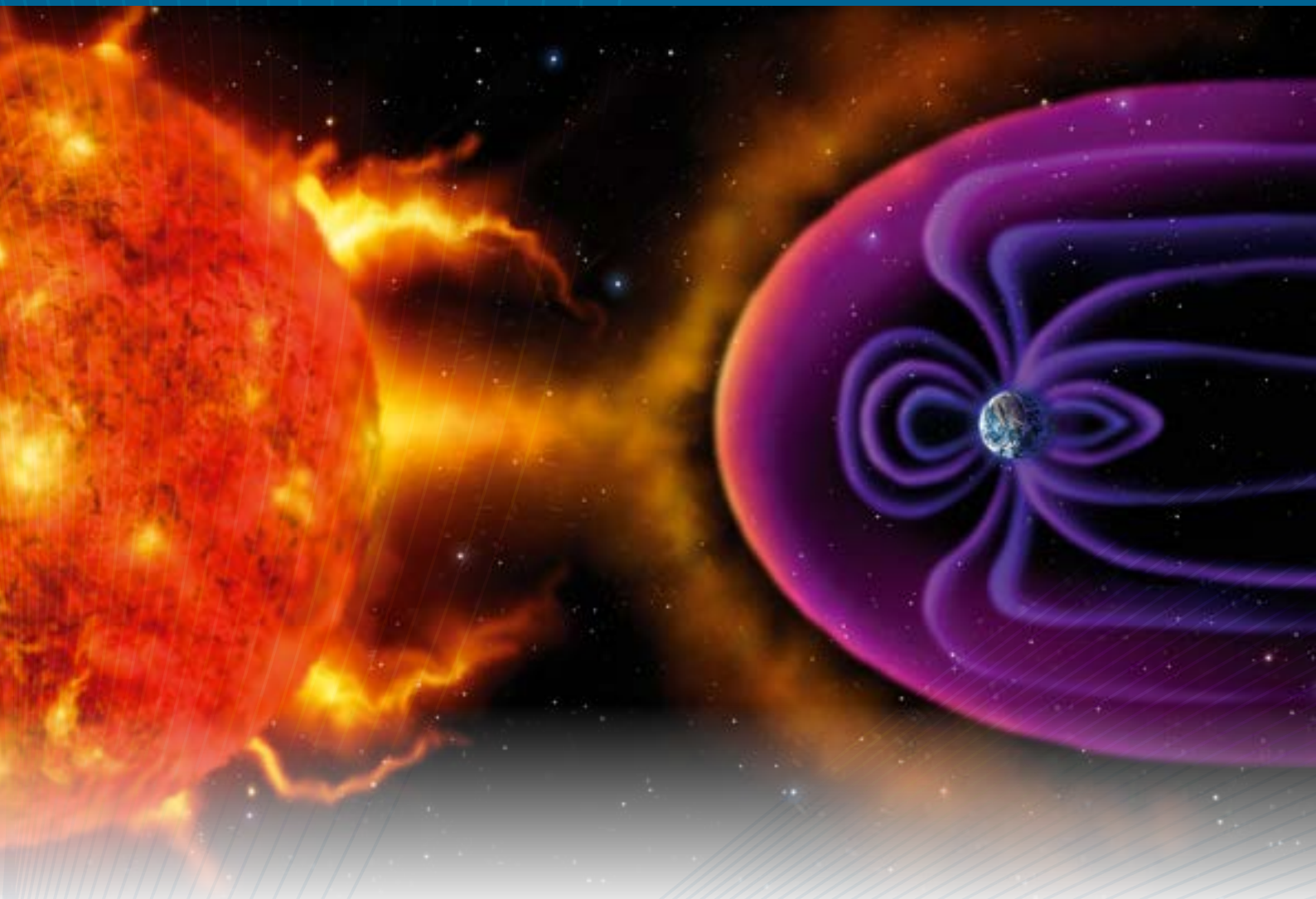
The UK agri-food industry is worth £96 billion a year and 3.8 million jobs. NERC annually invests £9 million in research that helps industry produce more food whilst reducing inputs (such as energy, water, nutrients and chemicals) and adverse environmental impacts – from farm to supermarket.

Government's 2011 UK National Ecosystem Assessment used NERC expertise to value nature's services. It estimated, for example, that the pollination of food crops by bees and other insects is worth £430 million to the UK each year.

Decades of NERC research helped reveal the decline of insect pollinators and its causes – changing agricultural practices, reduced wildflower diversity, pesticides and disease. NERC researchers worked with Defra, BBSRC, ESRC and agriculture companies to help farmers restore pollinators through smarter government regulation and stewardship schemes, low-cost wild seed mixes for crop margins, and replacing chemical pesticides with bio-pesticides.

NERC is stepping up its national partnership research – with government, business, BBSRC and charities – to support healthy pollinator populations and a sustainable agri-food sector.

Meeting society's needs



Resilience to environmental hazards

Extreme weather, volcanoes, earthquakes, space weather, pollution, novel diseases and invasive species all have serious impacts on people, supply chains and essential infrastructure in the UK and internationally. Many such hazards are becoming more frequent and severe as our environment changes and as populations and cities grow.

NERC scientists are rapidly advancing our understanding of the processes that create natural and man-made hazards, so that we are better equipped to manage vulnerability, risk, response and recovery. We will help partners use NERC science to make people, business and infrastructure more resilient to environmental hazards and emergencies.

KEEPING UK AIRSPACE OPEN FOR BUSINESS

Ash clouds from an Icelandic volcano closed UK and European airspace for six days in 2010. NERC and the Met Office rapidly mobilised their specialist research aircraft to help the UK Civil Aviation Authority establish safe flying limits and reopen airspace – avoiding £300 million of economic losses for each day commercial flights were grounded.

The joint NERC-Met Office aircraft, supported by a £40 million NERC investment since 2000, provides world-leading capability to study the physics and chemistry of air and clouds. NERC science also helps us understand how volcanoes erupt and the effects of ash deposits. Working closely with UK and Icelandic agencies, the research aircraft was used to assess the ash cloud, verify Met Office predictions for ash dispersion and lead a British Airways test flight.

Following the emergency, NERC technologists helped develop new ash sensors and safety protocols. When another volcano erupted in 2011, this capability kept Icelandic airports open and avoided more economic losses.

Now a web tool based on NERC science is being used worldwide to estimate more accurately the amount of ash released by erupting volcanoes.

REDUCING THE COSTS OF FLOODING

Phil Noble/Reuters

NERC data and risk models are used by UK and local governments to predict flood events and to plan major infrastructure investments – saving lives and minimising disruption for people, business and the economy.

Rising sea levels and more frequent storms increase the risk of destructive coastal floods. NERC scientists have analysed UK sea level, tide and storm surges for more than 50 years, and used the data to build a computer model that predicts coastal flooding. In 2007 their model accurately forecast the worst storm surge in 20 years, enabling authorities to protect people and infrastructure at proportionate cost.

The same model feeds directly into the Thames Barrier control centre. Closing the Barrier protects thousands of lives, safeguards £4 billion of property and business, and avoids £94 million costs per flood day in London.

Predicting sea-level rise, storm surges and river flows over the coming decades now enables us to delay replacing the Thames Barrier until 2070 – avoiding billions of pounds in premature infrastructure costs.

Meeting society's needs

Henrik Wess/Science Photo Library

Managing environmental change

Some environmental variability is natural, but human activities are directly causing additional physical, chemical and biological changes – often at scales and speeds never before encountered. These changes provide huge opportunities and challenges for our economy and way of life.

NERC science tells us how the processes of natural variability and man-made change work – as a whole Earth system, from global to local scale, from millions of years past to the present and into the future. We will help our partners use this whole-system knowledge to inform responsible management of the environment for multiple benefits – for example to produce renewable energy and food while conserving wildlife, or to understand the consequences of engineering our environment and climate.

SUPPORTING BIODIVERSITY AND NATURE'S SERVICES

The diversity of living species is essential for many services we depend on – such as pollinating our food crops, cleaning our water and regulating disease.

NERC has long invested in research on animal and plant populations, the rapid loss of biodiversity around the world, and how biodiversity supports vital natural services. £1 million from NERC enabled UK researchers to assemble a database of 5000 long-term changes in the abundance of wild species. They discovered important relationships between population size and variability – and hence extinction risk.

This knowledge was used by conservation agencies to show, for example, that global vertebrate populations declined by 30 per cent between 1970 and 2008, and that amphibians are going extinct faster than birds or mammals. The Convention on Biological Diversity 2010 used the same NERC science to set and monitor biodiversity targets for 2020, agreed by 193 member nations.

Chris Gomersall / 2020VISION

NERC science is now being used by the Natural Capital Committee to advise government on the value of the UK's natural assets for economic, public and environmental benefit.

CLEANING UP OUR AIR

Air pollution costs the UK economy £15 billion every year in damage to human health, not including the cost of damage to our environment and crops. NERC investment of around £3 million a year has been critical to cleaning up our air.

In the 1970s and 1980s NERC evidence showed how airborne sulphur was deposited as 'acid rain' in UK lakes and soils. This scientific understanding was pivotal in establishing international protocols that successfully reduced sulphur pollution in the UK by 80 per cent.

Since 2000 groundbreaking NERC research has shown how airborne nitrogen oxides are reducing biodiversity and damaging our soils. The Europe-wide cost of nitrogen pollution is £280 billion a year.

Now NERC science is being used by UN, EU and UK legislators to establish safe limits for emissions and to set quality standards for our air, water and soil.

Mark Clarke/Science Photo Library

Meeting society's needs

Claus Lunau/Science Photo Library

Discovery science

Many of the greatest advances in environmental science have been driven by curiosity. The quest for new knowledge about the planet we live on has fascinated and inspired generations of scientists, and it continues to do so. We call this 'discovery science' – asking fundamental questions about how the Earth works: past, present and future.

Curiosity-driven environmental science has, throughout its history, delivered benefits to society that were unforeseen when the research began. We will help our partners turn the outcomes of discovery science into lasting benefits for our economy and society.

UNDERSTANDING POLAR ICE MELT

NERC has invested £90 million since 2000 to exploit the unique capability of low-orbiting satellites to study changes in the Earth's environment.

A new community of UK environmental scientists discovered widespread thinning of the West Antarctic Ice Sheet. They found that melting is due to warm ocean currents deep beneath the ice which cause the ice to flow into the sea faster than snow can accumulate. This discovery changed our understanding of how ocean circulation drives the future behaviour of great ice sheets.

More recent NERC investment enabled the UK to lead the European Space Agency's CryoSat-2 mission to understand rapid changes in the sea ice and circulation of the Arctic Ocean.

NERC is now investing £23 million in research programmes that bring together the best UK polar scientists and infrastructure to understand how such vast changes at the Earth's remote poles will impact our future sea level and climate.

REVEALING WILDLIFE SECRETS AND CRIMES

TEK IMAGE/Science Photo Library

Since DNA fingerprinting was invented in 1984, NERC has invested £40 million in using new genetic and genomic technologies to revolutionise environmental research and to develop innovative applications for our economy and society.

NERC scientists used these emerging methods to unlock the secrets of breeding behaviour and cooperation in wild animals. They also revealed the diversity of microscopic life in soil and the role of different soil organisms in providing essential services such as decomposition and nutrient cycling.

DNA fingerprinting funded by NERC has a range of forensic uses: to prosecute the persecution and illegal import of wildlife; to detect illegal fishing and incorrect food labelling; to identify trees responsible for subsidence in insurance claims.

New developments in these technologies may shed light on how TB infection is spread between badgers and cattle. They already offer faster and cheaper monitoring of biodiversity and endangered species.

Making it happen

Siemens press picture

INVESTING IN INNOVATION AND IMPACT

NERC helps UK business and government find and use environmental science to accelerate economic growth and responsible environmental management. To achieve this we will:

- Broker strategic partnerships with leading businesses, bringing them together with researchers, government and NGOs to identify their innovation needs and harness NERC science to meet them.
- Develop innovation programmes in industry sectors with high growth potential and where environmental science can make a major contribution. Innovation programmes will be led by business, working with the Technology Strategy Board, research councils and others to co-design new research and to translate existing knowledge.
- Open up valuable environmental data, working with other public data holders and business to develop innovative environmental information products and services.
- Establish research and innovation hubs at campuses where NERC research centres are co-located with universities and other local partners.
- Reshape NERC's organisational capability to provide the enterprise culture and skills needed to deliver our innovation objectives.

A NATURAL BUSINESS PARTNER

Businesses depend on the environment for essential raw materials, secure supply chains, safe operations and waste disposal.

Smart businesses use environmental science in many ways. To develop innovative products and services, reduce costs, manage environmental impact, improve customer service and grow shareholder value. To anticipate future environmental and regulatory conditions, develop investment plans and build resilience to environmental hazards and change.

NERC listens to business needs so we can broker access to the best scientists, data and skills – to translate existing knowledge and to co-design new research and innovation.

For example, with Marks & Spencer we funded a senior university researcher to help develop sustainable food supply chains.

With oil and gas companies we designed a new university centre for doctoral training (CDT) to provide the environmental science skills they need.

With agriculture, water and food retail companies, NERC and BBSRC are funding researchers to join a new 'business club' to help reduce the carbon, water and financial costs of food supply.

Together we deliver innovation and growth with responsible environmental management.

Hydradam

Jackie Johnston/AP/Press Association Images

Louise Heathwaite

Making it happen

Olafur Sigurjonsson/Reuters

INVESTING IN WORLD-CLASS RESEARCH AND SKILLS

Discovery science drives fundamental advances in knowledge, across the breadth of the NERC science remit, with profound future implications. We will:

- Fund excellent discovery science to sustain the health and international competitiveness of UK environmental science.
- Improve our peer-review processes to focus on groundbreaking discoveries.
- Use our independent research fellowships to develop outstanding scientists who become internationally recognised leaders in research and innovation.

Postgraduate training sustains the flow of top talent and skills for UK science, business and government. We will:

- Concentrate NERC support in new doctoral training partnerships (DTPs) with university and research centre partners who offer both excellent and broad training environments.
- Direct a proportion of this investment to deliver skills priorities identified by business and government, for example by establishing new centres for doctoral training (CDTs) with business partners.

Strategic research provides the understanding to meet the challenges and needs faced by society. We will:

- Fund strategic research programmes that help business, government and society to benefit from natural resources and ecosystem services, build resilience to environmental hazards and manage environmental change.
- Direct a proportion of this investment to co-design and co-fund partnership research programmes with research councils and others.
- Develop more agile processes that speed up decision-making for partnership research and draw upon the world-leading excellence and creativity of UK researchers.

TRAINING HIGHLY SKILLED PEOPLE

NERC's £26 million annual investment in PhD training nurtures the highly skilled people who generate innovation and growth. We work with universities and employers to equip graduates with the skills to evaluate and use environmental science evidence across business and government sectors.

Nicola Ranger's career was launched by NERC funding for a PhD in atmospheric physics and a fellowship in the Parliamentary Office of Science and Technology, giving her the skills to apply climate science expertise to policy and business.

This training led to roles in HM Treasury as a policy analyst for the highly influential 2006 Stern Review on the economics of climate change, and at Defra as a scientific advisor on the IPCC Climate Change 2007 report.

Moving to a leading risk modelling company, Risk Management Solutions, Nicola's team was the first to link a climate model to an insurance catastrophe model, generating new climate change business for the UK. Now at the Grantham Institute on Climate Change and the Environment, Nicola continues to collaborate with insurance firms and government on climate policy.

Making it happen

National capability comprises the large research infrastructure, services and facilities, data, national-good services and long-term science provided by research centres and universities. These essential national assets are supported by NERC alongside other public and private funding. Working with partners, we will:

- Sustain our funding for UK national capability that delivers scientific understanding of environmental processes over large time and space scales, supports world-leading environmental science, and meets national needs such as rapid response to environmental emergencies.
- Enable the most ambitious Earth-system science by funding long-term, global-scale programmes that integrate research across disciplines.
- Reduce the long-term cost of our large research facilities and invest in new sensors and robotic technology that make far-reaching environmental research and observation more cost-effective.
- Ensure the ownership arrangements for NERC research centres enable them to thrive as vibrant, innovative, sustainable organisations that attract and retain the best scientists.

NERC TECHNOLOGY GOES DEEPER AND FURTHER

NERC is a world leader in developing autonomous technology and sensors to study remote environments. Over the last twelve years we have invested £22 million to develop a fleet of autonomous underwater vehicles.

Such capability enables UK scientists to reach inaccessible regions to discover new forms of life, to detect ocean heating beneath polar ice and measure carbon dioxide deep in the Atlantic Ocean.

Over the next ten years, this kind of technology will reduce the cost of environmental research and observation. The latest NERC Autosub delivers a step-change in capability. It will go deeper and further than commercial or military vehicles, remaining at sea for up to six months and travelling 6000km.

NERC is working with Defra, the Technology Strategy Board and small businesses in the maritime and defence industries to develop this UK technology and grow new markets.

AN INTERNATIONAL PARTNER OF CHOICE

Our world-leading environmental science and international networks make us a partner of choice for research funding agencies and scientists in 80 nations. Together we agree international research priorities and share resources to tackle them.

NERC co-founded the Belmont Forum of 13 nations from five continents, and contributed £2 million to the Forum's £26 million collaborative research actions to address coastal vulnerability, freshwater security and food security.

We funded £10 million of a £40 million programme with ESRC and DFID – Ecosystem Services for Poverty Alleviation. This programme works with researchers in Asia, Africa and South America to understand how to manage ecosystems so they continue to provide the natural services that people rely on.

NERC invested £40 million over 20 years – alongside £25 million from international partners – to assess the risk of rapid climate change due to fluctuation in the Atlantic 'conveyor belt' circulation that carries heat northwards. Researchers observed an unexpectedly large decrease in the circulation during winter 2009-10 that influenced NW Europe's weather. Better understanding of such processes helps to improve the UK's world-leading climate and weather forecasting models.

INTERNATIONAL PARTNERSHIP

Environmental, social, political and economic challenges are globally interconnected. International partnership fosters economic growth and social wellbeing among nations. It also creates opportunities for UK leadership and competitive advantage – for environmental science and technology, and for wider government goals such as new export markets, inward investment, national security and international development.

We will work with our partners and scientists to:

- Agree large-scale international research priorities and jointly tackle them.
- Access all parts of the Earth to understand how it works and to monitor how it changes.
- Make the best use of resources by aligning national programmes and sharing capability.
- Use the global scale and relevance of environmental science to address international development goals.
- Help UK business use environmental science and technology to develop international markets and resilient supply chains.

Making it happen

LISTENING TO OUR PARTNERS

To realise the UK's ambitions, we must build effective partnerships. NERC will actively engage with partners in business, government, society and the research community to:

- Understand shared opportunities and needs.
- Shape and deliver NERC investment in science and innovation.
- Build public confidence in research and inspire the next generation.

MANAGING OUR ASSETS AND ADMINISTRATION

The quality and effectiveness of NERC administrators are essential to deliver our ambitions. At the same time, we recognise our responsibility to achieve value for money with scarce public funds. To balance these demands we will:

- Drive efficiency in the way we manage assets, administration and resources – within NERC and across partnerships.
- Work across Research Councils UK to seek common and simplified funding processes, and to share internal services such as HR, finance, estates and information technology.

RECOGNISING OUR SUCCESS

We will measure our progress, improvement and achievement by the following key indicators:

- **World-class excellence** of UK and NERC-funded environmental science – benchmarked against other nations and measured through analysis of scientific publications, citations and wider measures of scientific quality.
- **Impact** – economic and societal benefit – of NERC science, demonstrated through case studies, user testimony, economic valuations and annual metrics agreed with BIS.
- **Partnership** effectiveness, demonstrated by satisfaction, outcomes and co-funding (leverage).

We will develop more detailed indicators of progress for each of the actions in this strategy. These will include specific indicators for business partnership, delivery of environmental information products and services, technology development, research centres and value for money.

David Noton/Nature Picture Library

This strategy is an invitation to all those who share our ambitions to work with us to achieve them.

To discuss opportunities for working together, please contact:

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Published in 2013