

Scottish Government Rural Affairs and Environment

**Strategic Research Strategy
2011-2016**

1. Introduction

The Scottish Government funds, through Rural and Environment Science and Analytical Services (RESAS) division, a portfolio of strategic scientific research and related activities to support the development and delivery of rural and environmental policy and achievement of the Government's purpose and wider objectives as set out in the National Performance Framework (Annex 1).

The Strategic Research Portfolio (SRP) within the Rural Affairs and Environment (RAE) Portfolio supports a Greener, Smarter and Wealthier Scotland and contributes towards the achievement of a number of national outcomes including:

- We value and enjoy our built and natural environment and protect it and enhance it for future generations;
- We reduce the local and global environmental impact of our consumption and production;
- We are better educated, more skilled and more successful, renowned for our research and innovation.

The SG's RAE investment in scientific research provides a foundation for the sustainable use of our natural resources, the productivity and profitability of our agricultural sector and rural businesses, the prevention and effective management and control of animal and plant diseases and our ability to respond effectively to global challenges such as food security and climate change. The funding also helps maintain Scottish-based scientific capability of international standard and associated infrastructure at the Government's Main Research Providers (MRPs)¹.

This Strategy sets out:

- The wider strategic context for the Government's research investment in the Rural Affairs and Environment (RAE) portfolio;
- The strategic objectives for our research investment and research priorities for the 2011 – 2016 research programme;
- Our approach to knowledge exchange;
- How we monitor progress and assess the impact of our research investment;
- Future plans.

¹ The James Hutton Institute (JHI), Scotland's Rural College (SRUC), Moredun Research Institute (MRI) and the Rowett Institute of Nutrition and Health (RINH) within the University of Aberdeen (see Annex 2 for an overview and Annex 3 for a timeline of key institutional developments).

2. The Strategic Context

The SRP supports delivery of the objectives of the **Rural and Environment portfolio** and is situated within the broader policy and economic context for Scotland, including the **Government Economic Strategy** and **Science for Scotland**.

2.1 Rural Affairs and Environment Objectives

Our Rural Future published in 2011 sets out the Government's vision for Rural Scotland:

“We want to see a rural Scotland that is outward looking and dynamic – with a diverse economy and active communities. Rural prosperity will increase in ways which make best use of all of our resources – our people, as well as the land, seas, rivers and wildlife. Our rural communities will grow in confidence and diversity, taking control of local assets and providing local services to generate income and employment. Our young people will have the opportunity to build careers and prosperous futures in the area where they grew up. Services of the highest possible quality and with the greatest possible choice will be accessible to the whole community. Our world-rated natural, cultural and built environments will be managed sensitively to balance development requirements with the vital need to manage our precious natural assets sustainably. We want to see rural Scotland participating fully in the global exchange of ideas and culture, with the right connections to make this happen, including high speed broadband and appropriate transport infrastructure. Rural businesses will make best use of local assets to become more competitive and enterprising”.

The Spending Review 2011 highlights the underpinning, inter-related priorities that support achievement of the Vision including:

- Developing the rural economy;
- Supporting agriculture to deliver public benefits;
- Building up a world class food and drink industry;
- Empowering rural communities;
- Making best use of Scotland's natural assets;
- Tackling climate change.

The research portfolio supports effective delivery of these priorities.

2.2 Government's Economic Strategy

In September 2011, the Scottish Government refreshed its Government's Economic Strategy (GES). The fundamental principles of the approach remain, which are to ensure that the Government's resources and policies are focused on the achievement of a more successful Scotland, with opportunities for all to flourish, through increasing sustainable economic growth.

The Government Economic Strategy identifies six strategic priorities to accelerate recovery, drive sustainable economic growth and develop a more resilient and adaptable economy. It places a particular focus on a number of growth sectors identified as having high-growth potential, the capacity to be internationally successful due to existing comparative advantages or through the potential to capitalise on Scotland's unique natural assets. The GES seeks to build up these growth sectors to maximise value added and create high quality and sustainable jobs.

The Strategic Research Portfolio supports a number of the growth sectors including:

- Food and Drink (including agriculture) through funding a strategic partnership on food and drink;
- Life Sciences through funding a strategic partnership on animal science and wider support for plant and animal life science.

2.3 Science for Scotland

The wider importance of science to sustainable economic growth is highlighted in Science for Scotland which sets out Scottish Government's vision for 'a nation of world-class scientific achievement, a magnet for talent and for investment, a powerhouse of technology, innovation and enterprise, increasing sustainable economic growth.'

Commitments in Science for Scotland supported through the research portfolio include those to:

- Build on the success of research pooling to promote inter-disciplinary collaboration – through funding a multi-disciplinary and cross-MRP strategic research programme and through the MRP-University collaborations established to deliver three Centres of Expertise and two Strategic Partnerships;
- Ensure Scotland is well positioned to take advantage of emerging science-based market opportunities – through continued investment in the Scottish science base and establishing Strategic Partnerships in key growth sectors;
- Enhance links with the UK Government, Research Councils and with the EU – through alignment of the Strategic Research Programmes with two UK Government and Research Council partnerships (see below).

2.4 UK and Wider Science Alignment

The RESAS scientific research portfolio also operates within the broader UK strategic science funding environment. In addition to working with UK Research Councils, Defra and other UK and EU networks to co-ordinate and ensure best use of research funding and to maximise the value of SG's research investment, the portfolio is strategically aligned with the Living with Environmental Change partnership (LWEC), led by the Natural Environment Research Council (NERC) and the UK Global Food Security programme, led by the Biotechnology & Biological Sciences Research Council (BBSRC).

Living with Environmental Change (LWEC) lwec.org.uk is a partnership of twenty one public sector organisations that fund, carry out and use environmental research and observations. Partners include the UK research councils, UK government departments with environmental responsibilities, devolved administrations and government agencies. Its purpose is to ensure that decision makers in government, business and society have the knowledge, foresight and tools to mitigate, adapt to and benefit from environmental change.

The UK Global Food Security (GFS) programme foodsecurity.ac.uk involves the UK's main public funders of food-related research and training working together to meet the challenge of providing the world's growing population with a sustainable, secure supply of good quality food from less land and with lower inputs.

2.5 Public Funding for RAE Research

The Scottish Government has a long history of investment in agricultural, biological and environmental research to deliver public benefit. This includes funding policy-relevant and applied research that would not be funded through the market. The SRP funds short and long-term scientific research to inform the work of government and its advisory bodies in policy development and implementation. It also helps maintain Scottish-based scientific capability of international standard at the Government's Main (RAE) Research Providers (MRPs), adapting and evolving the infrastructure and skills base to meet current priorities and future challenges.

Government funded agricultural, biological and environmental strategic research in Scotland has been historically delivered by the Main Research Providers funded through grant-in-aid. In 2005 there was a move away from grant in aid funding with the introduction of commissioned programmes of research delivered by the MRPs working in collaboration with each other and, more recently, with other providers.

The current strategy continues the broad direction of travel set out in earlier strategies and builds on the action points and principles in the 2005-10 strategy including:

- A focus on policy-relevant and applied research;
- An emphasis on knowledge exchange;
- Opening up a proportion of funds to competition;

- Supporting closer links between the Main Research Providers and the university sector.

A summary of progress against the action points set out in the previous strategy is attached at Annex 4. Other key changes incorporated into the 2011-16 Strategic Research Programme include:

- Development of 2 Programmes, each consisting of 4 Themes encapsulating the outcomes the research is intended to achieve and delivered by the MRPs working in partnership;
- The appointment of 2 Programme Advisors to co-ordinate activity across the two programmes, links with Scottish Government and engagement with the UK level research programmes;
- The introduction of Centres of Expertise (CoEs) and Strategic Partnerships (SPs) to enhance collaboration between the MRPs and the University sector, to broaden the supply base and to strengthen the flow of research from basic (university) research through applied research into policy and practice (via CoEs) and industry (via SPs).

3. Objectives of the Strategic Research Portfolio

There are three strategic priorities for the research portfolio:

- Supporting policy and practice;
- Supporting innovation and the economy;
- Scientific resilience;

Underpinned by two further supporting priorities:

- Scientific excellence;
- Collaboration and multidisciplinary working.

To that end the strategic research portfolio supports:

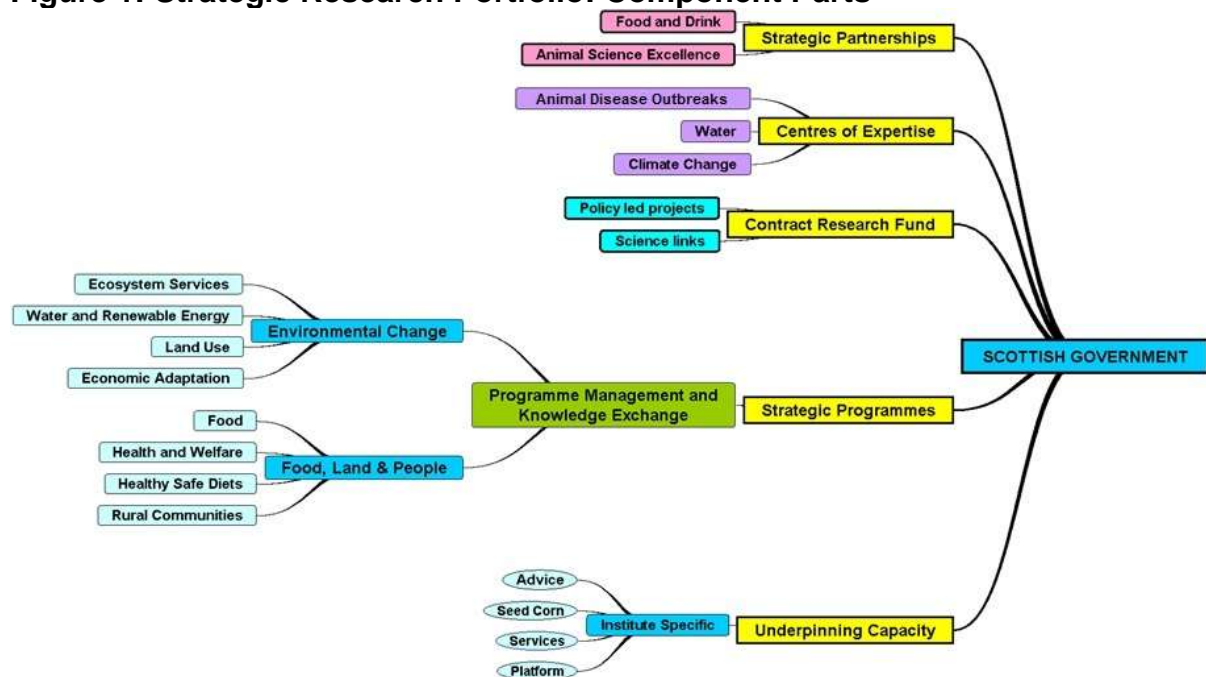
- Applied research to address current and emerging challenges (e.g. climate change, food security, natural resource scarcity), to meet short and medium term policy needs and to enhance productivity and economic growth (with a particular focus on agriculture, the food and drink industry and animal life sciences);
- Longer-term strategic research to understand change over time and enhance resilience to future threats (e.g. plant and animal disease);
- Maintenance of critical infrastructure and research assets including, facilities, collections and databases;
- Development of future research capacity and capability (e.g. funding PhDs and post-doctoral opportunities).

These strategic priorities are delivered through a wide portfolio of research activity (see Figure 1 below) comprising:

- two five year multi-disciplinary programmes of strategic research – one on environmental change and one on food land and people;
- three ‘policy-facing’ Centres of Expertise covering climate change, animal disease and water;
- two ‘industry-facing’ Strategic Partnerships focused on animal science and food and drink;
- investment in underpinning capacity to support Scotland’s strategic rural and environmental science base.

Annex 5 outlines research spend across the Portfolio while alignment of the different components of the Portfolio with the strategic priorities is set out in Annex 6.

Figure 1: Strategic Research Portfolio: Component Parts



The following sections outline in more detail the different components of the research portfolio.

3.1 Strategic Research Programmes and Themes

The Strategic Research Programme utilises Scotland’s renowned scientific capacity and capability in the Main Research Providers, bringing it to bear to provide new insights and to apply new knowledge and understanding to support the delivery of the Scottish Government’s purpose and priorities as set out in the National Outcomes.

The 2011-16 research programme addresses key current and emerging issues of critical importance to Scotland including: food security, climate change and

development of a low carbon economy, sustainable use of Scotland's land and other natural resources, thriving rural communities and rural development. Developed in collaboration with Scottish Government policy colleagues and CAMERAS partners², to ensure relevance to policy and practice the design of the programme was also informed by an independent advisory panel, a range of consultations with stakeholders, discussions and workshops with the Main Research Providers and engagement with other research funders.

The Strategic Research Programme comprises eight themes brigaded into two programmes:

Environmental Change Programme

The Environmental Change Programme includes research deliverables aimed at contributing to helping Scotland be more resilient to environmental change. Representing an investment of some £12.1 M per annum the programme is set within the framework of an Ecosystems Approach³ and aligned with the UK inter-governmental research partnership, Living with Environmental Change led by Natural Environment Research Council (NERC).

There are four Themes within the programme:

- Ecosystem Services
- Water and Renewable Energy
- Land Use
- Economic Adaptation

3.1.1 Ecosystem Services

The Ecosystems Theme aims to ensure that Scotland's environmental assets, biodiversity and ecosystem services are identified and valued to inform decision making.

Scotland's environment is a national asset and many sectors such as food and drink and tourism depend upon it. Securing the health of Scotland's environment is vital to sustainable economic growth and to a sustainable legacy. This theme provides techniques to measure that health, evidence for its resilience and mechanisms to better value it. Research and knowledge exchange activities within this Theme fall into four general areas:

² CAMERAS is a partnership initiative between Scottish Government – Marine Scotland Science, Rural and Environment Science and Analytical Services (RESAS) and Science Advice for Scottish Agriculture (SASA) – Scottish Environment Protection Agency, Scottish Natural Heritage, Forestry Commission Scotland, Food Standards Agency Scotland, Quality Meat Scotland and Scottish Water. It's purpose is to align and coordinate the scientific activity of the partner organisations to ensure best use of existing resource and enhanced support to Scottish Government policy development and delivery, primarily in the rural, environmental and marine areas.

³ The Ecosystem Approach (EA) is a strategy for integrated management of land, water and living resources that promotes conservation and sustainable use. An EA assesses how natural resources deliver four categories of ecosystem services: supporting (e.g. soil formation), regulating (e.g. water purification), provisioning (e.g. timber) and cultural (e.g. sense of place), which in turn deliver human well-being and economic prosperity.

- The production of methods for mapping Ecosystem Services (ES) in Scotland and of associated indicators to enable the spatial visions for trade-offs and/or multiple benefits in decision-making;
- The sustainability and resilience of ES to land use change, including the consequences of agricultural cropping systems on ES and the role of biodiversity in underpinning these services (in the uplands and lowlands);
- Development of an ES or green accounting methodology and concepts of value in relation to ES, incorporating issues of equity in ES benefits and utility of “Payments for Ecosystem services”;
- Development of an Ecosystems Approach decision making framework to understand the consequences of management decisions on ecosystem services. Exploring the utility of such a framework in relation to local applications, sustainable land use choices and the linkage to strategic planning approaches.

3.1.2 Water and Renewable Energy

The Water and Renewable Energy Theme aims to deliver strategic research to better understand the dynamics of water and renewable energy supply and how they may be affected by global change. There are four main objectives:

- to understand the current availability of water and renewable energy resources within Scotland and how these will be affected by changes in climate, land use and population. Outputs include maps of current and predicted future water availability and deficit, capacity for water storage, data on water quality, implications of renewable energy development for ecosystem services, inter-relationships between water and energy;
- to improve the environmental sustainability and resource efficiency of water and energy supply chains. Outputs include recommendations as to renewable energy options which are most suitable for Scotland, an assessment of Scotland’s contribution to global carbon emissions, the environmental impacts of wind and hydropower and tools to reduce water consumption;
- to improve the effectiveness of measures to manage water quality and control diffuse pollution. Outputs will include ways to promote uptake of policy measures and to achieve multiple benefits from water quality / flood risk policy measures, tools to identify pollution sources, prediction of future pollutant levels and their ecological impacts, and better understanding of how water quality will respond to land use and climate change;
- to mitigate, manage and adapt to increased flood risk. Outputs will include tools and guidance on effective Natural Flood Management measures, effects of land management and climate change on flood risk, ways to achieve multiple benefits with respect to ecosystem services.

3.1.3 Land Use

Research in the Land Use Theme aims to increase knowledge of how Scotland’s environment might be affected by predicted changes in climate and land use. It will provide evidence to inform the development of policy and practical measures to reduce Scotland’s greenhouse gas (GHG) emissions from land use, forestry and agriculture, and deliver multiple benefits from land use. In the longer term, outputs

from this Theme should help improve management of Scotland's rural environment, to help ensure that land use is sustainable and resilient to the impacts of climate change.

Research and knowledge exchange activities in this Theme falls into the following areas:

- Improved understanding of how changing land use (e.g. farming practices, peatland restoration and reforestation) affects GHG emissions, carbon sequestration, soil properties and biodiversity;
- Applying and testing the Ecosystem Approach for a range of land use systems and management practices (such as different tillage regimes and application of fertilisers and wastes to land). This builds on developmental work in the Ecosystem Services Theme, and should help identify opportunities to manage land to deliver multiple services and functions;
- Assessing socio-economic aspects of land use policy measures and practices. This includes assessing the cost effectiveness of different technical solutions for climate change adaptation and mitigation. Other research focuses on understanding what influences land manager attitudes and behaviours towards climate change adaptation and mitigation measures to inform strategies for dealing with barriers to uptake.

3.1.4 Economic Adaptation

The Economic Adaptation Theme considers the major changes facing Scotland's rural economy and aims to provide an evidence-base to help policies targeted at helping Scottish rural businesses adapt to these changes.

Work within the Theme falls into the following areas:

- Consideration of the impact of major drivers of change, such as CAP reform, global trade patterns and climate change, and the policy options available that will increase the underlying adaptive capacity of Scotland's rural economy to meet these changes. To date, the work on CAP reform has been vital in helping the Scottish Government understand the implications of different policy options on the agricultural sector in Scotland;
- Assessing the transition to a low carbon economy in Scotland by improving our understanding of the impact of climate change on the rural economy of Scotland. This will include enhancing our understanding of, and potential pathways towards achieving, a low carbon rural economy.

Food, Land and People Programme

Representing an investment of some £19.4 M per annum, the Food, Land and People Programme includes research deliverables aimed at optimising the use of Scotland's natural assets and is aligned with the UK Global Food Security programme led by the Biotechnology and Biological Sciences Research Council (BBSRC).

There are four Themes within the programme:

- Food

- Health and Welfare
- Diet and Health
- Rural Communities

3.1.5 Food

This Theme on “Efficient and resilient supply chains for food” aims to produce scientific evidence and techniques that will make Scotland’s food and drink supply chains more resource efficient and more resilient to change. Research and knowledge exchange activities within this Theme fall into three general areas:

- Socio-economic assessment of the resilience, efficiency and sustainability of food supply chains in Scotland, including a review of measurement approaches, projections of the impact of high level changes to demand and supply, and identification of opportunities for improvement;
- Improvements in resource use and resilience of crops grown in Scotland. This includes tools and technologies that will enable the breeding of varieties with improved nutrient uptake, better potential for by-products, improved nutritional qualities, and/or better resistance to abiotic stress. It also covers improvements in cropping systems and screening of wild species and landraces for desirable genetic traits;
- Improvements in performance of livestock production in Scotland, including tools and technologies to produce breeds with improved genetic traits for productivity, health, welfare and resilience, evidence to improve farming systems and the management of genetic resources, approaches to overcome barriers to the uptake of new technologies by industry, and decision support tools to optimise farm profitability and sustainability.

3.1.6 Health and Welfare (Plants and Animals)

Scotland’s high health status for livestock, agricultural and horticultural crops gives competitive advantage and export opportunities to Scottish producers. The Health & Welfare Theme aims to improve farm productivity and sustainability through improvements to plant and animal disease control and enhancement of farm animal welfare. Research and knowledge exchange activities within this Theme fall into four general areas:

- Improvements in measuring and monitoring animal health and welfare and in evaluating the impacts of various health-promoting measures;
- Reduction of infectious disease in Scottish livestock and the maintenance of Scotland’s biodiversity, reduction of the risk to humans from zoonotic disease and securing the supply of safe foods. This will be achieved by the production of new diagnostic tests and vaccines, advice on cull strategies and bio-security measures, targeted treatment regimes and risk reduction through changing practices;
- Improvement of animal welfare through production of validated indicators of positive welfare in all farmed species, investigation of farmer motivations for and barriers to the uptake of welfare-related practices on farms, investigation of pain associated with management practices (such as castration in lambs)

and the economic viability of a food certification scheme based on positive welfare. The socioeconomic context of animal welfare in Scotland will be examined by addressing the links between animal welfare and sustainable land use;

- Reduction of losses in the potato, barley and berry fruit industries, through the development of new tools and methods for protecting food from pests and diseases while maintaining, and potentially increasing, sustainable crop production.

3.1.7 Healthy Safe Diets (Human)

The “Healthy, Safe Diets” Theme aims to improve the evidence base on what constitutes healthy food, on the contribution this makes to human health and wellbeing, and on how nutritional benefits can be improved through optimising food production and processing. The research and knowledge exchange within this Theme falls within two general areas:

- Consumer choice, diet and health, which seeks to understand the barriers to the uptake of a healthy diet by the people of Scotland and develop strategies to overcome these. This includes research to provide evidence on the mechanisms that induce satiety and on the effects of certain food groups (sugars, fats) on health to influence consumer behaviour;
- Enhancing health benefits of food including the collection of evidence to improve the Scottish diet through improvement of the nutritional value of food produce and products currently being consumed in Scotland. This work looks at different stages in the production process including methods to improve food through the introduction of changes in farming and processing techniques. It also covers the development of methods for food authentication.

3.1.8 Rural Communities

The Vibrant Rural Communities Theme aims to improve understanding of what makes a rural community economically and socially vibrant and what government and other stakeholders can do to assist communities to become more vibrant. Research and knowledge exchange within this Theme falls into three general areas:

- Rural economic performance and social outcomes. This work seeks to improve our understanding of why some rural communities perform economically better than others as well as examining whether economic performance is necessarily linked to better social resilience and well-being;
- Improved understanding of governance and decision making structures and processes for community empowerment. This work uses in-depth case studies, to improve our understanding of how empowerment currently works in rural communities, as well as how changes to governance frameworks or place based policy could make community empowerment more effective;
- Improved understanding of the existing linkages and the role of policy in shaping interdependencies, synergies and conflicts in land use. This policy related work looks at different aspects of rural and urban linkages including consideration of different models of service delivery, health and welfare

benefits of greenspaces, as well as conflicts and synergies in access to, or use of, greenspaces.

3.2 Centres of Expertise

Alongside investing in two 5 year strategic programmes of research SG is investing over £6 M per annum in three Centres of Expertise. Focused on areas of high policy priority these centres enable SG to address more immediate policy needs making best use of existing evidence and expertise. Introduced in 2011, and funded as collaborative ventures between the MRPs and university sector, these virtual Centres aim to enable the SG and its partners to draw on Scotland's scientific research and expertise in a more co-ordinated and integrated way. There are currently three Centres of Expertise focused on:

- Climate Change;
- Water; and
- Animal Disease.

3.2.1 Centre of Expertise in Animal Disease Outbreaks – EPIC

EPIC aims to provide the best available scientific advice to inform government policy on reducing the impact of animal disease outbreaks. It provides access to expertise from across Scotland to enhance the co-ordination and synergy of the science and to stimulate innovative thinking in support of policy. To that end the Centre provides:

- Rapid access to emergency advice in the event of a disease outbreak;
- Greater understanding of the risks and uncertainties associated with animals movements;
- Analysis of potential disease control options;
- Advice on the implications, risks and opportunities presented by international developments, commercial and institutional factors;
- A programme of knowledge exchange.

3.2.2 Centre of Expertise on Climate Change – ClimateXChange (CXC)

CXC aims to deliver objective, independent, integrated and authoritative evidence to support the Scottish Government in relation to its activities on climate change mitigation, adaptation and transition to a low carbon economy.

A collaborative initiative between sixteen of Scotland's leading research and higher education institutions, with a small Directorate team based at the University of Edinburgh, CXC provides an evidence base for Scottish Government policy and implementation partners through responsive call-down advice and analysis and a programme of short-term policy-focused research.

Key objectives of this research include:

- Analysing mitigation options to reduce greenhouse gas emissions and enhance carbon sequestration;

- Assessing distributional impacts and equity to understand the social and economic consequences of climate change policies;
- Developing adaptation strategies and appraising adaptation options drawing on an analysis of key climate change risks and opportunities;
- Promoting & demonstrating adaptation in practice through strategic advice and knowledge exchange;
- Developing indicators of climate change adaptation to assess the nature, extent and effectiveness of adaptation responses.

3.2.3 Centre of Expertise on Water – CREW

CREW aims to inform the Scottish Government’s policy on water management drawing on the best available scientific advice from across Scotland and beyond. It delivers both call-down expert advice and a programme of short-term research. CREW’s work programme is responsive to the needs of its users and is currently focused in the following areas: flood risk and hydrology, impacts of climate change, reducing diffuse pollution, sustainable water treatment, catchment-scale management, ecosystem services, water and health, and the Scottish Government’s Hydro Nation agenda. CREW’s work is aligned with and complementary to the water-related work under the RESAS Strategic Research Programme and links with ClimateXChange work where appropriate. CREW is a developing partnership between the James Hutton Institute and all Scottish Higher Education Institutes. CREW’s primary customers are Scottish Government policy teams, SEPA and Scottish Water.

3.4 Strategic Partnerships

In line with its support for innovation and the economy SG is investing over £3 M per annum in two Strategic Partnerships in key sectors with high growth potential: (animal) life sciences and food and drink science. The Strategic Partnerships provide a mechanism to enhance closer collaboration between the MRPs and Scottish universities in the context of the Government Economic Strategy and the overarching priority of increasing sustainable economic growth.

Introduced in 2011, along with the Centres of Expertise, these initiatives aim to strengthen the flow of knowledge from basic through applied research to meet longer-term industry needs and to enhance the commercial exploitation of the science base.

3.4.1 Strategic Partnership on Animal Science Excellence (SPASE)

SPASE was set up to improve the exploitation of research and contribute to innovation and economic growth in the livestock and animal health sectors. Specific objectives are to enhance Scotland’s world-leading position in animal science and to enable the animal science community to leverage additional funds from outside the Scottish public sector. SPASE aims to achieve these objectives through building

collaborations between the Main Research Providers and Universities and delivering international quality science that will benefit the livestock industry.

SPASE research focuses on three areas:

- The study of how genetic variation in animals and pathogens affects disease. The long-term benefits of this research will arise from the development of new vaccines and methods for disease control;
- The study of how early life environment affects productivity and welfare of Scottish livestock. The benefits of this research will arise from improved management techniques for farmers that will increase productivity and welfare;
- The use of systems approaches to understand, predict and control livestock health in different environments. This research aims to deliver improved methods for controlling livestock disease and preventing the transmission of disease to humans.

3.4.2 Strategic Partnership on Food & Drink Science

SPF&D aims to provide scientific evidence on food and drink to inform industry and government. Specific objectives are to: support growth of the Scottish food and drink industry and Scotland's reputation as a "land of food and drink"; to help the industry deliver healthy, sustainable, affordable and available products and to contribute to food security and resilience.

It conducts research into areas related to Scottish industry priorities including:

- The potential of cereal products to benefit human health;
- Short-chain fatty acids as satiety agents;
- Foodborne pathogen adaptation and survival through the food chain;
- Local and regional food systems;
- Effect of production techniques on nutritional quality;
- Sustainable protein selection for the food & drink industry.

4. Knowledge Exchange

Knowledge exchange (KE) is the principal activity through which outputs from research are shaped, shared and communicated with target audiences. A focus on an outward facing programme of KE is therefore of critical importance in reaping the benefits of SG's research investment and achieving improved outcomes for Scotland's environment, economy and her people. KE is essential for:

- **Engaging with users:** strengthening networks and increasing the penetration and impact of the science and research institutions we support;
- **Communicating achievements** to target audiences and raising the profile of SG's investment in science and recognition, across a broad range of audiences, of the value and relevance of science to their everyday lives;

- **Promoting openness and access** to the research and science we fund.

The 2011-2016 Research Programme heralds a number of changes from the previous programme in relation to knowledge exchange including:

- Greater engagement with policy to meet short, medium and longer-term policy needs;
- An increased focus on activities that help to stimulate all aspects of innovation (including improved business practices and the exploitation of new commercial opportunities);
- Active engagement with Small and Medium-sized Enterprises (SMEs) and the farming community where appropriate.

The key customers for SG's research investment in the rural affairs and environment portfolio are Ministers and policy divisions within the Scottish Government. Key users and audiences alongside SG include CAMERAS partners, sector-based stakeholders, commercial businesses, the general public and the scientific community.

RESAS's experience is that within programmes of commissioned research then KE activities directed towards scientific audiences flow naturally and resources to support this are thus embedded in the costs of the research. It cannot, however, be assumed that KE activities directed to other audiences will happen without some additional encouragement and support. Specific resources to be directed towards non-scientific audiences have therefore been identified within individual research Themes representing a minimum of 5% of the total value of each theme.

A collaborative KE Strategy involving all partners is essential for the effective co-ordination of activities across the portfolio and target audiences and end users. To that end, a Knowledge Transfer and Exchange (KTE) strategy has been prepared by the MRPs and agreed by RESAS. This KTE Strategy identifies a number of objectives including:

- To implement KTE strategies that represent the principal activity through which outputs from the research programme and funding for underpinning capacity are shaped, shared and communicated with key target audiences;
- To deliver valid KTE approaches that stimulate and deepen engagement with the key target audiences;
- To describe methods by which the impact of KTE outcomes can be assessed and measured;
- To devise outcome-based criteria against which success for each audience can be measured.

Its five target audiences are:

- Scottish Government including those involved in the design and delivery of policy;
- Stakeholders including farmers, land based industries and healthcare professionals;

- Commercial businesses including small and medium-sized enterprises (SMEs);
- The scientific community within and outwith Scotland;
- The general public including schools and other sectors across communities.

RESAS takes the broadest possible view of KE and proactively uses its position to capitalise on opportunities to enhance networking and communication. Examples include the provision of funding for the John Hope Gateway building at the Royal Botanic Garden Edinburgh as a centre for public engagement with science and support for the ‘knowledgescotland’ project that included the establishment of a website to support collaboration and communication across the MRPs and to begin to build links between the research and policy communities. RESAS has also used its Contract Research Fund to support projects that increase the utility of, and access to, key datasets, most recently the ‘Scottish Soils Database and Website’ project.

RESAS occupies a unique location between the scientific community supported through its research portfolio and the policy divisions of the Scottish Government which that portfolio supports. It has used this position to support closer working between the two communities for example through work-shadowing schemes; road shows; a ‘policy partners’ scheme; developing a CAMERAS rural affairs and environment evidence needs strategy; increasing the profile of commissioned work by prioritising KE work around ‘umbrella topics’ and the introduction of new initiatives such as Centres of Expertise.

These activities and those outlined above are collectively contributing to strengthening existing links and putting knowledge exchange at the heart of the strategic research portfolio.

5. Research Delivery

The 2011-2016 Strategic Research Portfolio is predominantly delivered through Scotland’s Main Research Providers who are the sole recipients of funding for the two strategic research programmes and underpinning capacity. The Centres of Expertise and Strategic Partnerships – representing some 15% of the RAE research investment – are delivered through collaborations between the MRPs and university sector.

5.1 The Main Research Providers

Government funded agricultural, biological and environmental strategic research in Scotland has been historically delivered by the Main Research Providers funded through grant-in-aid. The MRPs are a fundamental part of Scotland’s science base, enhancing Scotland’s reputation for both excellence and relevance in agricultural research in particular and, increasingly, helping to address wider environmental issues. Research institutes differ from universities in undertaking research that is both directed and applied and in enabling the maintenance and evolution of long-

term research programmes and capability. These attributes are increasingly important to governments as they respond to the complex challenges facing society.

In 2005 there was a move away from grant in aid funding with the introduction of commissioned programmes of research delivered by the MRPs working in collaboration with each other and, more recently, with other providers through opening up a proportion of the funding to competition and other suppliers.

All tender proposals for the 2011-16 strategic programmes of research delivered by the MRPs were subject to peer review to assess:

- Strategic relevance with respect to the policy context, research context and end user's needs;
- Scientific quality, feasibility and opportunity;
- Collaboration, co-ordination and networking within and across the Themes, and with scientists in CAMERAS and wider science communities;
- Knowledge exchange;
- Finance and value for money;
- Management procedures, systems and structures.

5.2 Underpinning Capacity

Alongside funding the Main Research Providers to undertake strategic programmes of research, the RAE Research budget also funds underpinning capacity at the research institutes. This investment of around £10 M per annum supports maintenance of long-term data collections of national importance, critical infrastructure and the long-term scientific and financial sustainability of the research institutes.

Examples of some attributes of the science base maintained through 'Underpinning Capacity' include:

- Building capacity for scientific advice and supporting short-term analytical work in support of advice;
- Maintenance and enhancement of Scottish based data sets and collections recognised as of national or international importance to the scientific community and to other end users;
 - Unique germplasm collections essential to the research community and to plant breeders;
 - Commonwealth Potato Collection;
 - Raspberry and Blackcurrant high health stock collections;
 - Barley collection;
 - Collections developed over many years that represent a rich resource because of their breadth and diversity and/or the ability to look back over time;

- Plant and animal pathogen and pest collections requiring long-term maintenance and active regeneration, the continued access to which is essential for the research community;
 - The National Soils Archive - support for both maintaining its physical integrity and also increasing its value to end users;
- Maintenance of a responsive and reactive capacity;
 - To develop diagnostic tests for new and emerging diseases;
 - To provide Bio-mathematical & Statistical services;
- Promoting the scientific and financial sustainability of the Scottish science base and of individual institutes;
 - Seedcorn funding to support;
 - Training for PhD students and funding for PhD studentships;
 - More speculative research to develop new techniques and build new capacity in anticipation of future research requirements;
 - 'Platform' funding - supporting institutes to maintain, enhance or develop SG relevant capacity by funding the shortfall between the full economic cost of third party contracts and the actual grant received.

6. Assessing / Measuring the Impact of our Research Investment

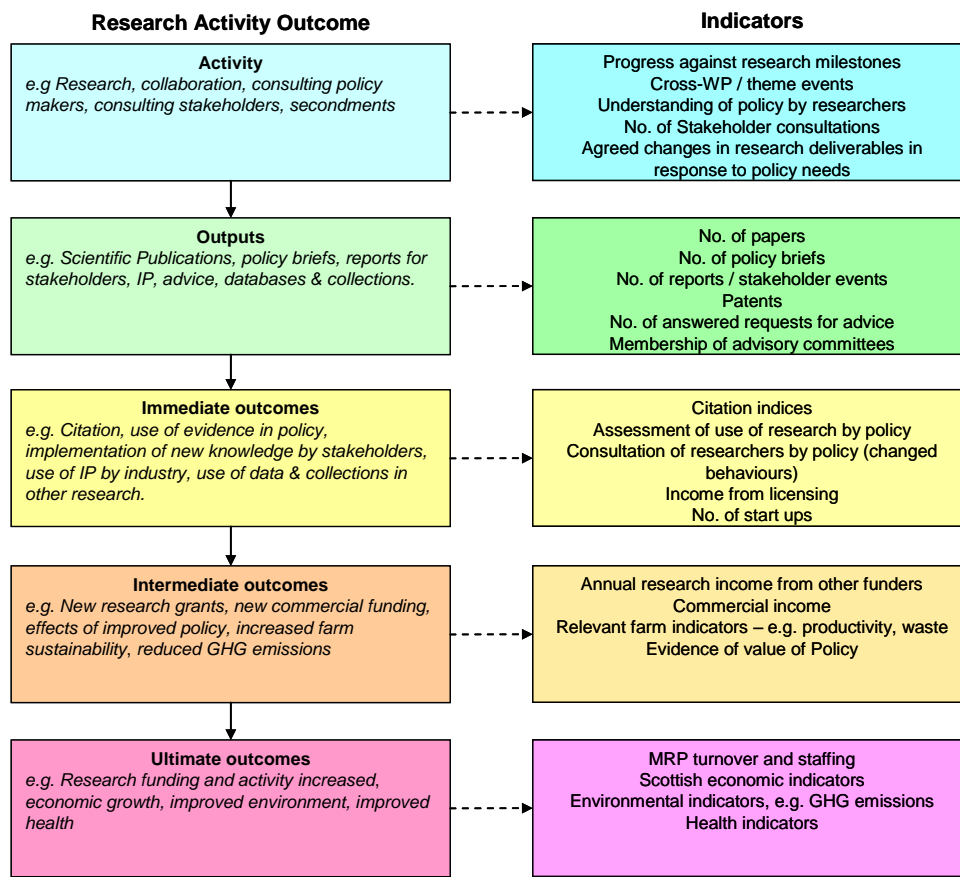
A Performance Management Framework (PMF) has been developed to better and more systematically measure and assess the impacts of the SG's RAE research investment. Data and evidence collected under the Framework will enable Government and the Main Research Providers to:

- Ensure accountability for the research spend;
- Demonstrate the benefits being derived from that spend;
- Use performance data to enhance impact and value for money.

Based around the strategic objectives which the spend is aimed to achieve (see Section 3), the framework uses a logic model to link inputs to activities, outputs and short and longer-term outcomes (see Figure 2 below).

Measurement of the impact of investment in science is widely acknowledged as a challenge for a number of reasons, including the time lag between research and impact, the non-linearity and complexity of the links between activity and impact and associated challenges in establishing causal connections and the effects of external factors and events. The framework therefore uses multiple lines of evidence to monitor performance and impact. These include key indicators reported annually, monitoring trends over time, comparison between different elements of the research portfolio and, where appropriate, benchmarking with external organisations and funders.

Figure 2: Generic Logic Model for Research Activity with Example Indicators



Annual reporting is a major component of the framework. Reporting requirements were developed in consultation with scientists at the Main Research Providers. Key indicators were selected to reflect progress towards delivering the five strategic priorities for research portfolio:

- Supporting Policy and Practice;
- Supporting Innovation and the Economy;
- Collaboration and Multidisciplinary Working;
- Scientific Excellence;
- Scientific Resilience.

Comprehensive information on outputs and outcomes across these five strategic priorities is gathered using narrative examples under twelve categories and seventeen key performance indicators (see Table 1 below). Information is collated in an interactive “dashboard” that links the aims of the research with its outputs and outcomes.

Table One: Summary of Quantitative Performance Indicators⁴

Performance Indicator	Portfolio	Prog.	Theme	COE	SP
1 Financial Inputs					
2 Personnel					
3 Number of policy briefings, reports, submissions to policy consultations					
4 Number of scientists on advisory groups and giving evidence to Parliamentary Committees and Public Inquiries					
5 Income from industry relevant activities					
6 Publications for trade audiences					
7 Number of new patents granted and licensed					
8 Number of new licensing agreements					
9 Number of spin out companies					
10 Number of research scientists who undertook consultancies for industry					
11 Number of external collaborations					
11a Number of collaborating institutions					
12 % of peer reviewed publications co-authored by more than one MRP					
13 % of peer-reviewed publications co-authored by MRPs and other institutions					
14 % of peer-reviewed publications co-authored by natural and social scientists					
15 Number of peer-reviewed publications					
15b % of peer-reviewed publications in high impact factor journals					
16 External funding for research					
17 Number of PhD students & completion rates					

⁴ The columns highlight which indicators are collected for the different elements of the strategic research portfolio including the whole portfolio, Programme, Themes, Centres of Expertise (COE) and Strategic Partnerships (SP).

7. Governance arrangements

Research Portfolio

A **Strategic Research Programme Board** has been established to help oversee effective deployment of the RAE Research spend. Chaired by the Director of Environment and Forestry (the Directorate within which the research portfolio sits) and comprising a mix of Scottish Government officials and external experts the Board:

- provides oversight, advice and direction, as required, to different elements of the research portfolio;
- ensures coordination of the different elements of the research portfolio and alignment with wider policy and research agendas;
- receives reports on performance and delivery from each of the different elements of the strategic research portfolio;
- makes decisions to resolve any issues of performance and to ensure effective management of risk.

Research Programmes

The Directors Executive Committee oversees delivery of the research outputs from the Environmental Change and Food, Land and People programmes. Comprising the Directors of the four MRPs and with a rotating Chair the Committee:

- provides the focus for effective coordination of activity between the Main Research Providers;
- directs and manages resources to ensure delivery of the 2011-16 Strategic Research Programmes;
- ensures that knowledge exchange is an integral part of delivering the Programmes;
- identifies and prioritises new opportunities and suggests ways in which the MRPs could respond to these through changes to the research programme.

Centres of Expertise and Strategic Partnerships

The Strategic Partnership for Food and Drink Science and the three Centres of Expertise have individual Steering Groups while the Strategic Partnership for Animal Science Excellence has a Scientific Advisory Panel. These Groups provide advice and recommendations to the initiative Directors and any associated management group. Any issues arising from the recommendations of the Steering Groups that cannot be addressed within the Centre or Strategic Partnership, by consulting the RESAS Project Officer, or by referral to the Directors Executive Committee, are brought to the attention of the Strategic Research Programme Board as the ultimate governance authority.

8. Future Plans: 2016 Onwards

We continue to seek to maximise the value and impact of our science investment and plan to undertake a Portfolio Review in 2014. This review will assess the relevance and impact of our investment, the scientific quality and impact of the research we fund and future scientific direction, current models for procuring research and alternative funding models.

Designed to inform RAE science investment post 2016, including the foci and the structure of the research portfolio, the Review will be led by RESAS reporting to the Strategic Research Programme Board.

Annex 1: National Performance Framework

The [National Performance Framework](#) underpins delivery of the Scottish Government's agenda which supports an outcomes-based approach to performance.

The Government's Purpose is: 'To focus government and public services on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.'

The Government has [five objectives](#) that underpin this core purpose and sixteen [National Outcomes](#) describe what the Government wants to achieve over the next ten years. Fifty [National Indicators](#) track progress towards the achievement of National Outcomes and ultimately the delivery of the Purpose. [Scotland Performs](#) reports on progress against the National Performance Framework.

Annex 2: Main Research Providers

Moredun Research Institute moredun.org.uk

Moredun Research Institute (MRI) is committed to promoting animal health and welfare through research and education and is recognized worldwide for its contribution to research into infectious diseases of farmed livestock which has led to improved treatment and preventive strategies for farm animals across the globe. In this way, Moredun has, and continues to, contribute significantly to global food security.

MRI carries out research that aims for greater understanding of disease pathogenesis, the development of diagnostic tests and the creation of novel vaccines. Scientists work with farmers and vets to improve animal health and wellbeing and to support sustainable agriculture. It is a company limited by guarantee (CLG) with charitable status. SG is MRI's largest customer and in 2012-13, SG funding accounted for 46.7% of MRI's total income of £13.5 M. MRI is listed as a public body in Schedule 8 of the Public Services Reform (Scotland) Act 2010, and is classified by ONS as a public sector/general government/central government body.

The James Hutton Institute hutton.ac.uk

The James Hutton Institute is an international research centre which makes major contributions through knowledge, innovation and services to address key global issues, such as food and water security, climate change and sustainable development. The principal activity of the Institute is to conduct research in soil, plant, environmental, social and economic sciences. In partnership with people, organisations and governments it delivers evidence based solutions to the global challenges facing land and natural resource use both now and in the future.

The James Hutton Institute was established on 1 April 2011 through the merger of the Macaulay Land Use Research Institute, based in Aberdeen, and the Scottish Crop Research Institute, based in Invergowrie, Dundee. The Institute has 600 staff as well as a Postgraduate School of over 120 PhD and MSc students. Like MRI, it is a CLG with charitable status and a public body. In 2012-13, SG funding accounted for 71% of James Hutton Group's (including its commercial subsidiaries) total income of £38 M.

Rowett Institute of Nutrition and Health abdn.ac.uk/rowett

The University of Aberdeen Rowett Institute of Nutrition and Health (RINH) is a key centre for the study of food and its relationship to long-term health and an internationally recognised Centre of Excellence for nutrition research.

RINH carries out research on how nutrition can prevent disease, improve human and animal health and enhance the quality of food production in agriculture. It became an integral part of the University of Aberdeen in 2008 and has charitable status but

as a Higher Education Institute is not a public body. The University does not produce annual accounts for RINH but in 2012-13 SG research funding was estimated to account for about 75% of RINH's annual income.

Scotland's Rural College (formerly Scottish Agricultural College) sruc.ac.uk

Formed following the merger of SAC with Barony, Elmwood and Oatridge Colleges, SRUC is an integrated research, education and consultancy organisation focusing on outcomes which can impact on sustainable land use, the environment and the rural economies in Scotland and internationally.

SRUC research focuses on sustainable, efficient, low-carbon crop and livestock farming systems – including key components of genetics, nutrition, health and animal welfare; economic, environmental and social sustainability of rural areas, food supply chains and businesses; innovation, behaviour; and rural policy. SRUC is a Company Limited by Guarantee (CLG) with charitable status, a public body and in 2008 was designated a higher education institution (HEI) for the purpose of Part II of the Further and Higher Education (Scotland) Act 1992. SG is SRUC's largest research customer with SG grant funding of about £7.7 million per annum accounting for 41% of SRUC's research income (but only 10% of SRUC's total income).

SG also funds SRUC to provide a range of veterinary and advisory services (VAS) and, via the Scottish Funding Council (SFC) the institute's education function at annual revenue cost of approximately £7 million. Overall, SG revenue funding in 2011-12, including that provided by SFC, accounted for approximately 42% (£28 million) of SRUC's total income for 2010-11 of £67 million.

Biomathematics and Statistics Scotland bioass.ac.uk

Biomathematics and Statistics Scotland (BioSS) undertakes research, consultancy and training in mathematics and statistics in the agricultural, environmental, food and health sectors.

BioSS, which is part of the James Hutton Institute, contributes to delivery of the strategic research programmes, centres of expertise and strategic partnerships through collaboration with the other Main Research Providers. The quantitative expertise of BioSS staff helps to address a wide range of design, modelling and analysis issues.

Annex 3: Strategic Research Institutional Timeline

1913	Rowett Research Institute is founded
1913	Edinburgh and East of Scotland College of Agriculture form a joint committee on research in animal breeding with the University of Edinburgh
1920	Moredun Foundation established as a charity by farmers (originally called the Animal Diseases Research Association)
1921	Scottish Plant Breeding Station (SPBS) is founded in Edinburgh
1928	Hannah Research Institute (dairy) created in Ayr
1930	Macaulay Institute for Soil Research (MISR) created with philanthropic gift by TB Macaulay
1951	Scottish Horticultural Research Institute (SHRI) is established at Invergowrie
1981	Scottish Plant Breeding Station based in Edinburgh is amalgamated with SHRI at Invergowrie and renamed the Scottish Crop Research Institute
1987	Macaulay Institute founded through merger of MISR and the Hill Farm Research Organisation
1987	Scottish Agricultural Statistics Service (SASS) created from statistics groups in the Scottish Agricultural Research Institutes (SARIs)
1987	Scottish Agricultural College created by bringing together West of Scotland, North of Scotland and East of Scotland Colleges
1989	SCRI creates its commercial arm – Mylnefield Research Services (MRS) Ltd.
1995	Biomathematics and Statistics Scotland (BioSS) created by merging SASS and the former Agriculture and Farming Research Council's Unit of Statistics based at Edinburgh University
2001	Hannah Research Institute, Macaulay Land Use Research Institute, Moredun Research Institute, Rowett Research Institute and Scottish Crop Research Institute declassified as an NDPBs as part of the 'bonfire of the quangos'
2005	Strategic Research for SEERAD: Environment, Biology and Agriculture Strategy 2005-10 document published and with it a move from grant to programme funding takes place
2006	Hannah Research institute closes
2008	Rowett Research Institute amalgamated into the University of Aberdeen as the Rowett Institute of Nutrition and Health
2011	Creation of the James Hutton Research Institute amalgamating SCRI and MLURI

- 2011 Competitive element and closer working with HEI sector introduced to the strategic research portfolio commissioning process with the establishment of the Centre of Expertise and Strategic Partnerships
- 2012 Scottish Agricultural College merges with Barony, Elmwood and Oatridge, Land Based Colleges to form the Scottish Rural College (SRUC)

ANNEX 4: Action Points from 2005-10 Research Strategy

AP	Action	Status and Relevance for 2011-16 Programme
Relevant Research		
1	Research Programmes funded by SEERAD Science and Research Group will demonstrate increasing and clear relevance to Scottish Executive policy priorities.	Achieved and continuing priority for 2011-16
2	The proportion of research funded by SEERAD Science and Research Group classified as policy relevant will increase	Subsumed within action above
3	The proportion of applied research (according to Frascati manual definitions) will increase.	Achieved and continuing priority for 2011-16
4	SEERAD Science and Research Group will be unlikely to support basic research but will continue to fund strategic underpinning research of policy relevance.	Continuing priority for 2011-16
5	Work currently undertaken by the MRPs which is no longer required will be identified.	To be addressed in Portfolio Review and bespoke reviews as required
6	Research will be commissioned as Programmes which will have high level policy objectives as the drivers.	Drivers encapsulated in themes of 2011-16 Programme. Future funding models to be covered in Portfolio Review
7	An increasing proportion of SEERAD Science and Research Group funds will be subject to competition.	15% funds open to limited competition in 2011-16. Continuing priority with the proportion of funds subject to competition to be explored in the Portfolio Review
8	SEERAD Science and Research Group will develop a system for assessment of Research Programmes and providers which takes full account of relevance, quality and value.	Performance Management Framework developed for 2011-16 Programme. Portfolio Review to consider relevance, quality and impact
9	SEERAD Science and Research Group will use peer review systems for advice on the quality and value of research it funds.	Proposals for 2011-16 Programme were subject to peer review
10	SEERAD Science and Research Group will set up a Strategic Advisory Panel to advise on matters of research strategy and policy.	Strategic Research Programme Board established in 2012 to provide strategic direction and oversight of research portfolio

Knowledge Transfer and Exploitation		
11	Appropriate mechanisms for commercialisation of the research outputs from the SEERAD Science and Research Group research portfolio will be encouraged.	Support for Innovation and Economy one of five strategic priorities for 2011-16 Programme. Portfolio Review to explore scope to enhance support for commercialisation opportunities
12	A separate stream of funding for knowledge transfer activities will be identified within each Programme.	Overarching Knowledge Exchange Strategy developed for the 2011-16 Research Programmes and a minimum of 5% of the value of each research theme to be directed toward KE
13	MRPs will be asked to develop strategies for end-user engagement.	Set out in Knowledge Transfer Strategy for 2011-16 Programme. Requires continuing focus and attention
14	The Strategic Advisory Panel will be asked for guidance on strategic level end-user engagement.	Discussion of KE Strategy with Strategic Research Programme Board
15	SEERAD Science and Research Group will continue to look for opportunities to publicise and disseminate the work of the Research Programme to as wide a public audience as possible.	Captured within KE Strategy. RESAS focus on raising awareness within SG and CAMERAS partnership
Sustainability Of The SEERAD Research Base		
16	SEERAD Science and Research Group will, on a continuing basis, identify those parts of its Research Programme which require to be conducted in an Institute setting.	Underpinning Capacity established in 2011-16 Research Portfolio to fund Institution-specific activities, assets and infrastructure necessary to maintain the strategic science base
17	Further consultancy studies will examine the issues involved in forming long term relationships between Universities and SEERAD Science and Research Group's MRPs and the scope and potential for reorganisation and integration of the MRPs to support common activities.	Merger of RINH within University of Aberdeen in 2008; Merger of Macaulay Land Use Research Institute and Scottish Crop Research Institutes to form James Hutton Institute in April 2011 (wider merger of MRPs ruled out at that time)
18	SEERAD Science and Research Group will support the deepening of relations between its MRPs and Universities.	Centres of Expertise and Strategic Partnerships funded as collaborative Initiatives between the MRPs and wider University sector. Continuing priority
19	SEERAD Science and Research Group will look for opportunities to fund jointly with other relevant research funders at the Project, Programme and Initiative level.	Joint funding arrangements in place with BBSRC and TSB. Continuing priority to ensure maximising value research spend
20	Research will be funded through grants for rolling Programmes.	Future funding models to be examined in Portfolio Review
21	A development funding stream will be introduced.	Funding for seedcorn activity provided as part of Underpinning Capacity

Annex 5: Strategic Research Portfolio Spend 2013-14

	£m
Strategic Programme	
Programme Management and KE	0.5
Environmental Change	12.1
Food, Land and People	19.4
Underpinning Capacity	9.7
Centres Of Expertise	
Water	1.0
Animal Disease	1.9
Climate Change	3.9
Strategic Partnerships	
Food and Drink	1.9
SPASE	1.4
Contract Research Fund	5.0
TOTAL	56.8

ANNEX 6: Research Portfolio alignment with Strategic Priorities

	Policy and Practice	Innovation and Economy	Scientific Resilience	Scientific Quality	Collaboration
Research Programme & Themes					
Centres of Expertise					
Strategic Partnerships					
Underpinning Capacity					



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