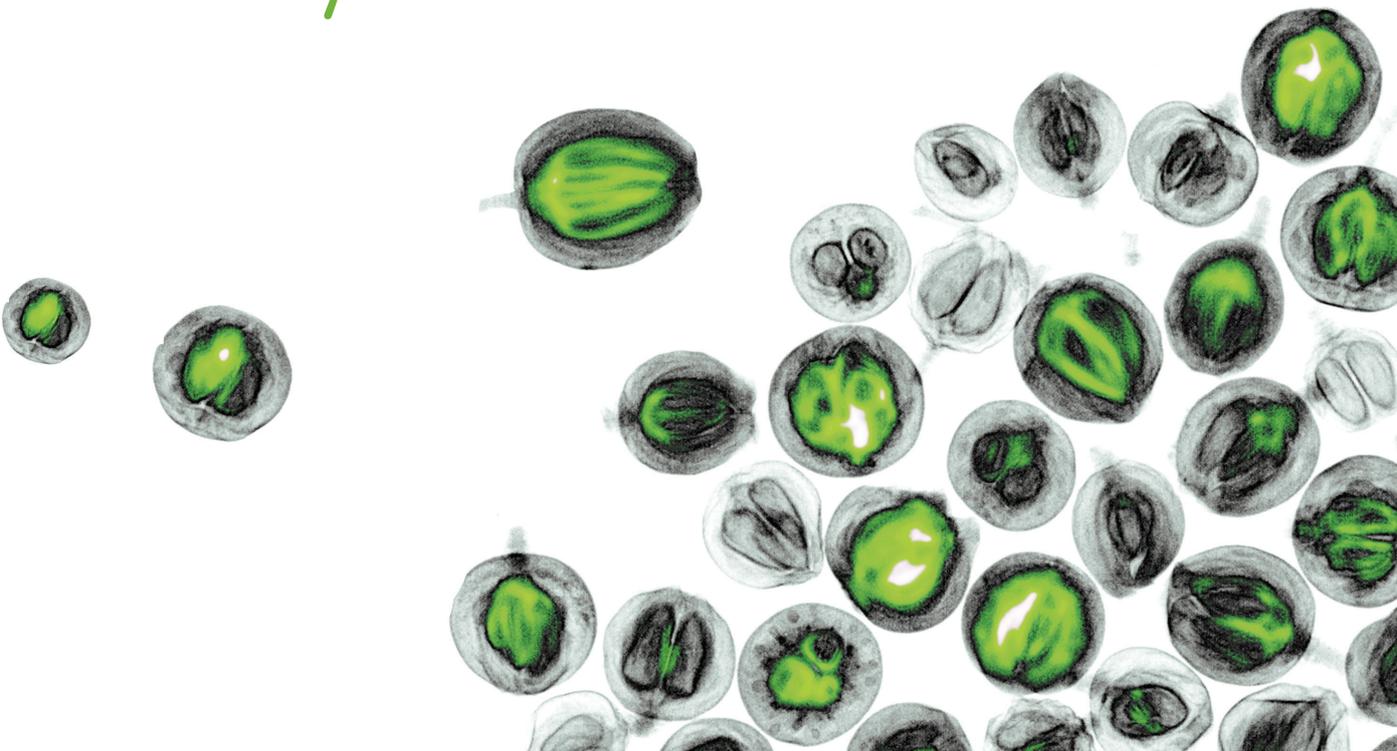


Science and innovation strategy for forestry in Great Britain





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Foreword

The fast-paced nature of modern life requires the knowledge provided by robust and high-quality science to support effective responses to the challenges which British society faces. Although forestry and managing trees requires a long-term perspective, threats from pests and diseases and changing patterns of weather call for new and innovative insights for policy makers and practitioners. These will ensure that tomorrow's forests remain resilient and continue to deliver economic, environmental and social benefits to British society. By supporting a globally competitive timber and wood-processing industry, maintaining high-level biodiverse ecosystems and providing places for people to play and work, forestry is part of the unique character of the British countryside.

The science that will be delivered under this strategy will support the management of our forests, woodlands and trees to ensure they make a significant and long-term contribution to government priorities in England, Scotland and Wales. It will generate solutions to how greater resilience to change can be achieved, how the benefits we all enjoy today will continue for future generations, and how wood and timber products can play their role in a sustainable, low carbon and resource-efficient British economy.

We very much welcome this new Science and Innovation Strategy, which reflects the priorities identified by government and by forestry stakeholders. It has flexibility to accommodate changing demands over time, it commits to interdisciplinary science through effective collaboration to achieve high impact, and it is innovative in its approach to using new channels of communication to allow the results of its science to be shared as widely as possible.



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1. Introduction

Science and innovation will enable the UK to maintain its position as a world leader in sustainable forest management and woodland creation, and ensure that the natural capital of its forests and woodlands continues to be valued both for business, as well as for the vital services and long-term benefits to society and the environment.

Sustainable forest management, effectively integrated with other rural and urban land uses through cross-cutting government policies, is a common requirement for all the countries of the UK. The UK Forestry Standard and its supporting guidance, which together provide the risk-based framework for policies and practices designed to deliver sustainable forestry, are underpinned by sound science and the robust evidence base provided by forestry research.

Forestry research requires a broad scope of activity. It must be forward-looking to anticipate long-term challenges, strategic to inform emerging policy issues, and technical to support new and more efficient forestry practices. It has to address the implications for forest and woodland ecosystems from a changing climate – whether from an increase in extreme weather events such as storms and flooding or long-term temperature changes – and the challenges of novel forestry pests and diseases brought about by global trade and the movement of natural products and other goods between countries.

The aim of this new Science and Innovation Strategy is to ensure that forests and woodlands in Britain are able to maximise their contribution to three key areas of sustainability through research into:

- the maintenance of a diverse, healthy and resilient environment;
- people's enjoyment of the countryside, both rural and around towns;
- the efficient use of timber and other ecosystem services to maintain and improve economic competitiveness.

Overview of the strategy

This strategy details how the Forestry Commission will commission science to support the development and delivery of forestry policy. Forestry policy is a fully devolved responsibility of the separate administrations in

Imagine 2020 ...

The world's population climbs towards 9 billion. Global pressure intensifies for low carbon societies to combat rising energy costs and greenhouse gas emissions. Land productivity is a political priority for food, energy and resources for industry. The need to ensure the resilience and adaptability of ecosystems to the changing climate is understood and considered essential for the continuance of the crucial services they provide to society.

Forests, woodlands and trees are now highly valued for the role they play in providing these benefits. They are more diverse, more productive and ecologically richer. They are better integrated with other land uses, providing a safe haven and network for biodiversity, supporting the carbon balance for other rural industries, as well as sustaining a nationally important forestry sector. In towns and cities, they play a key role in cooling, mitigating temperature rises, and encouraging the population to be healthy and active.

England, Scotland, Wales and Northern Ireland, and continues to develop in distinctive ways. The research commissioned under this strategy will address, as far as possible, a shared research agenda, which will be managed by the Forestry Commission on behalf of the Westminster Government, the devolved administrations and their stakeholders. This may be complemented by research commissioned directly by the devolved administrations in response to specific requirements.

The strategy has been developed in partnership with a wide range of people with a keen interest in the future of Britain's forests and woodlands. It is based on a series of stakeholder engagement meetings conducted in England, Scotland and Wales during 2012, and on a public consultation exercise in 2013. These endorsed the strategic outcomes and helped to identify the key research areas for the next generation of research programmes.

Structure of the strategy

This introductory section provides a vision for how the science commissioned under the strategy will deliver real benefits to British society, and details the four key outcomes it is focused on delivering.

Section 2 sets out the context within which the strategy will operate, and indicates how it can address the wide range of uncertainties that a long-term undertaking such as forestry must deal with.

Section 3 covers the Forestry Commission's mission and the rationale for government procurement of science.

Section 4 details the four outcomes that the strategy will deliver. Each outcome is set within a brief context and the broad research areas to consider are outlined.

Section 5 sets out the research commissioning process and governance structures for the development of future research programmes, together with improved procedures for quality assurance and peer review.

Section 6 addresses the ways in which research will be communicated, and how communication will be used to improve knowledge exchange and ensure the greatest impact from the science.

Section 7 sets out the baseline measures and the qualitative and quantitative assessment criteria that will be used to evaluate the outcomes-based approach and the success of the strategy in achieving its objectives.

Outcomes of the strategy

Goals for forest management are multifarious, and thus impact tends to be greatest when research is interdisciplinary. The focus of this strategy on outcomes rather than disciplines is intended to encourage this. Research programmes commissioned under the strategy will be integrated from the start to ensure that synergies are obtained between social, biological and physical sciences to deliver more effective impacts. The strategy also recognises the cross-cutting links between themes such as economics, social science and the National Forest Inventory, and these will be reflected in the future research programmes.

Research commissioned under this strategy will deliver four key outcomes that will:

- Provide the evidence base for the delivery of healthy and resilient forest and wider ecosystems to enhance benefits for society.
- Provide the knowledge to deliver woodland management and expansion, as a component of sustainable land-use change.
- Provide the evidence base to allow the forestry sector to deliver a wide range of benefits from forests and woodlands to support sustainable economic growth in Britain.
- Result in changes to policy and practice through implementation by informed and engaged stakeholders, access to a high-quality skill base of forest researchers, and effective leverage to provide additional resources to increase the evidence base.

These outcomes are strongly influenced by the strategic priorities of the Westminster Government and the devolved administrations, and have been agreed by stakeholders (see Useful sources of information on page 22).

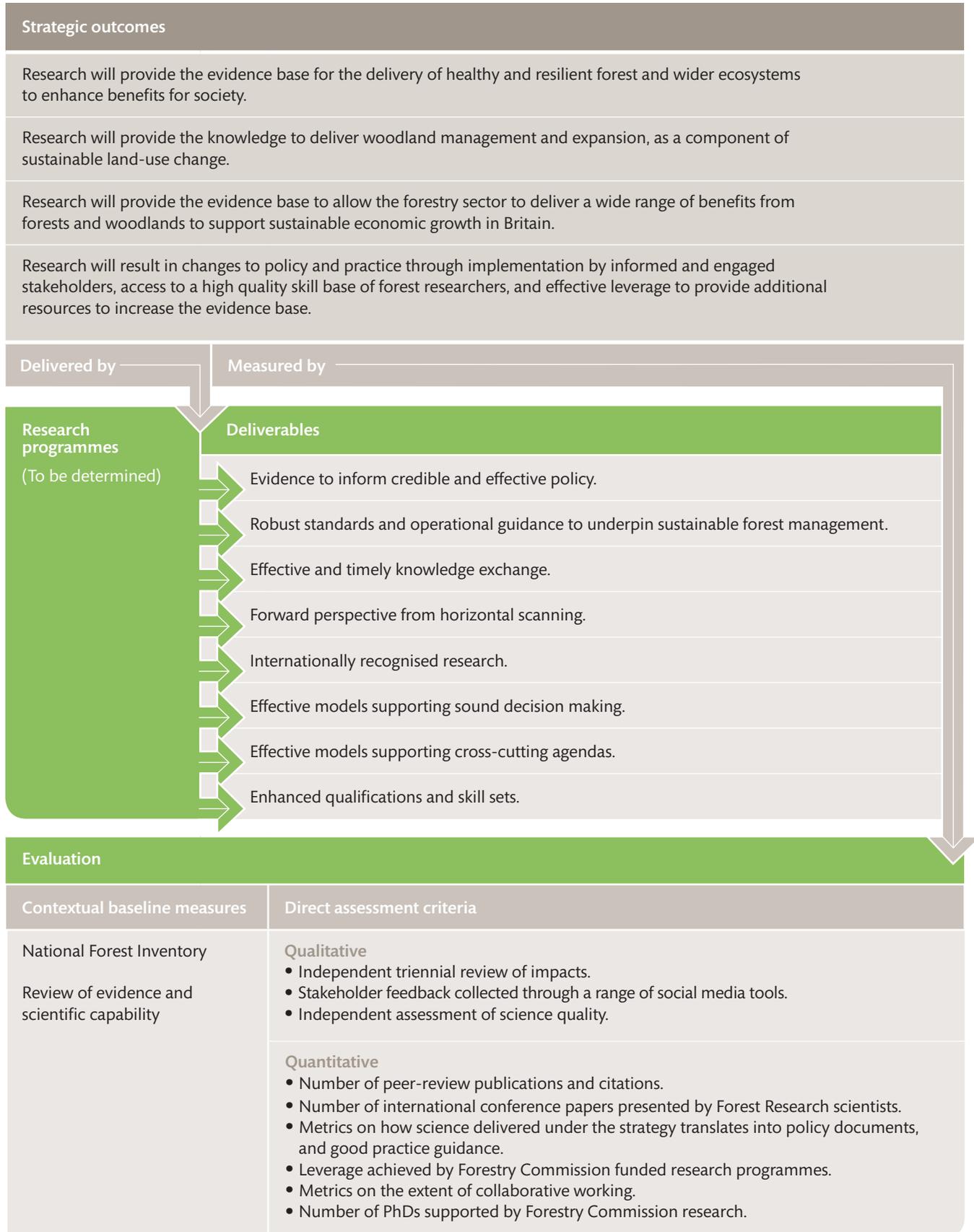
The diagram opposite illustrates how the strategy outcomes will relate to research programmes and their outputs, and how the success of the outcomes will be measured.

Key values assumed in the strategy

A key driver for the strategy will be collaboration between fields of science and partnership working between organisations to generate and share knowledge, as well as delivering best value for money. The strategy will encourage:

- Collaborative working with colleagues and others, across government and the wider sector, to ensure that forests, woodlands and trees meet the needs of people in Britain.
- A bold, ambitious and professional approach to achieve high standards of quality, efficiency, sustainability, and continual learning.
- Relationships and collaboration with colleagues and other stakeholders will be built on trust and openness to facilitate effective knowledge exchange.

How the Science and Innovation Strategy outcomes will be delivered and evaluated.



2. The context for the strategy

Sustainable development underpins the aspirations of the forestry policies and strategies of the UK Government and the devolved administrations in Scotland, Wales and Northern Ireland, and this strategy has been designed to provide the evidence base to support the delivery of those aspirations.

In providing the evidence base, the strategy complies with the Government's approach to the management and use of science, research and engineering in government¹ and works within established codes and guidelines. It is flexible to ensure that it is responsive to current political priorities, while also taking a longer-term perspective to maintain sufficient continuity. Research will be guided by the common purpose and principles outlined in forestry policies and strategies (see Useful sources of information), namely stimulating economic growth, maximising well-being and protecting our environment – without negatively affecting the ability of future generations to do the same.

A joined-up approach

Sustainable forestry practice is increasingly being required to integrate effectively with other rural and urban land uses and it must operate at a range of different scales; the British forest estate is diverse – ranging from large, productive, managed woodlands to small, semi-natural woodlands with high biodiversity interest.

This strategy will contribute to a distinct range of priority areas defined in forestry and wider environment strategies, and more widely in those of other government departments. It will help to address current and emerging challenges on cross-border issues such as biodiversity, plant health and climate change. The long-standing research relationship with Wales and the Northern Ireland Forest Service will be formalised through memoranda of understanding.

Forestry research will also reflect wider issues, for example European nature and environmental directives, Horizon 2020 and the EU Plant Health Regime. It will complement the UK forestry sector's research interests and priorities, which are set out in the UK National Research Agenda for the European Forest Technology Platform. Where possible, it will support independent, innovative and entrepreneurial research alongside more formal longer-term programmes.

Dealing with uncertainty

The outcome-based approach adopted by this strategy will allow uncertainty in a complex environment to be addressed through interdisciplinary thinking and solutions. This will help science to make sense of global events such as financial crises, and climatic changes resulting in increasingly extreme biotic and abiotic events, to provide some certainty for the long-term decisions which forestry requires.

Healthy forests, woodlands and trees can help to provide clean water from well-managed supplies, resilient ecosystems and good air quality. Increasing energy costs and the move to a low-carbon society are affecting forest cover, land use and landscapes. These changes to more traditional approaches to land management will require a greater understanding of the value, scale and nature of the trade-offs to ensure that policies are complementary and are not delivering unintended consequences.

These threats and challenges demand new information about species choice, woodland management and restoration, land use, pest epidemiology and control. However, they are also developments which suggest an 'exciting new world' in which forestry has much to offer.

Forestry is a long-term commitment and research requires an intelligent vision about the forces that will influence UK woodlands over the next 50 years, to enable them to best serve the changing demands society will place upon them. Governments are increasingly using 'horizon scanning' to help them develop policies informed by evidence and futures analysis. For forestry and woodlands, this should be a cross-cutting activity with other government agencies, which may already have developed alternative land-use and society scenarios. To encourage this, the Forestry Commission, Defra and its agencies are supporting an environment horizon-scanning capability at the Centre for Environmental Risks and Futures at Cranfield University².

3. Forestry Commission mission

The Forestry Commission mission is to protect and expand forests and woodlands and increase their value to society and the environment. It aims to achieve this by developing a supportive framework for a sustainable forestry sector to enable it to deliver tangible benefits to society, whether economically, socially or environmentally.

The Forestry Commission is a non-ministerial department of government. With the formation of Natural Resources Wales in 2013, the Forestry Commission remit now only covers England and Scotland. However, it continues to deliver research and other services to Wales under a cross-border agreement. The research delivered under this strategy is purchased and managed by the Forestry Commission on behalf of the Westminster Government, the devolved administrations and their stakeholders.

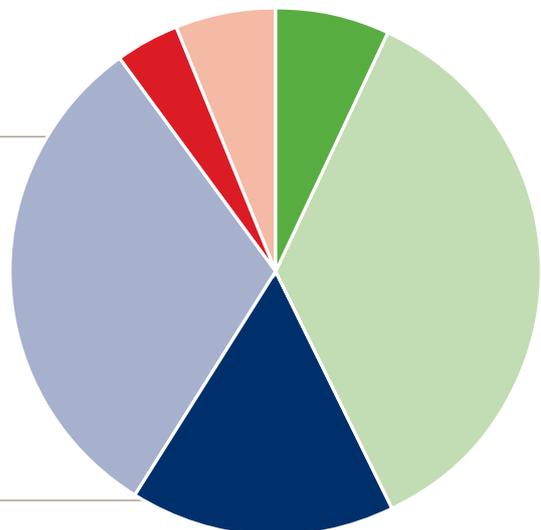
Rationale for government science

Evidence-based policy is a well-established principle in the UK. Thus policy-related research is a key function of government and its non-departmental bodies. The Forestry Commission, both nationally and in the devolved forestry administrations, funds research, contributes to policy development and delivers policy through its support for forest and woodland owners and managers. In addition, the separate administrations share the needs of

private forest and woodland owners for well-founded research to support the management of the public forest estate, currently 27% of the woodland area of Great Britain.

Investment in public science supports successful innovation by providing knowledge assets, infrastructure and trained people that help organisations, whether public or private, make the most of opportunities. The private sector generally does not have the incentive to invest in knowledge made publicly available because it may not deliver a financial return. To reflect this 'market failure', the Forestry Commission undertakes to fund research. This is particularly the more applied, longer-term research that may not always have immediate application, but which has the potential for enabling the forestry sector to address future challenges. This includes a number of research areas such as tree health, tree breeding, climate change adaptation and assessing the non-market benefits of ecosystem services, all of which will have implications for future forestry practice.

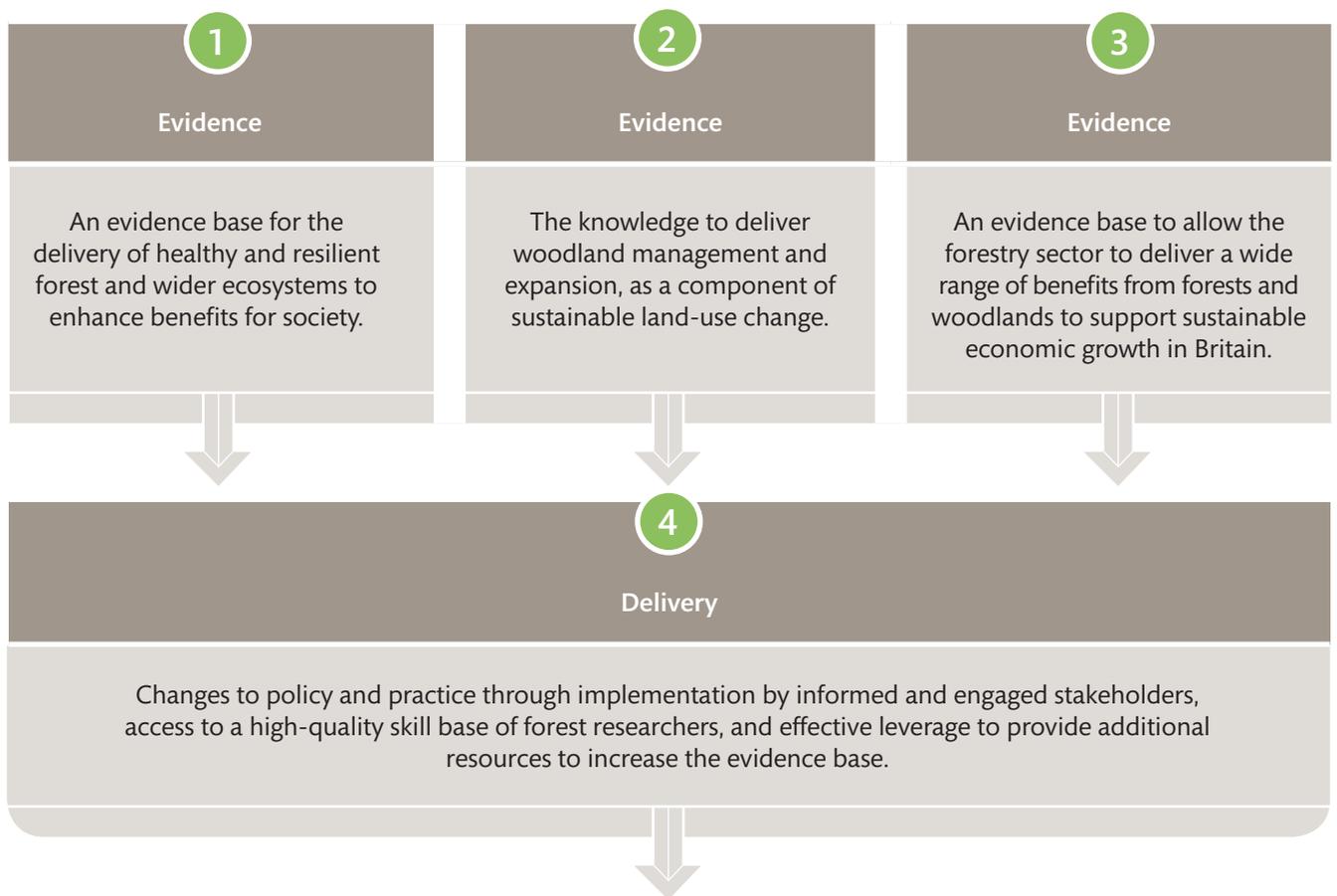
Woodland area in Great Britain at 31 March 2013



³From 1 April 2013 the Forestry Commission in Wales became Natural Resources Wales.

4. Outcomes

The research commissioned under this strategy will be strongly focused on improving the effectiveness of forestry policies and the efficiency of the ways in which they are implemented. It will be cross-cutting and interdisciplinary in nature, and will contribute to the four strategic outcomes outlined in this section.



1. An evidence base for the delivery of healthy and resilient forest and wider ecosystems to enhance benefits for society.

Research commissioned in support of this outcome will be designed to:

- Sustain investor confidence in forests and woodlands.
- Identify new options for forest management to address the threats posed by climate change and pests and diseases.
- Support the delivery of healthy, multipurpose and resilient forests, which will deliver the widest range of benefits.

Context

Forest and woodland managers, whether public or private, need to have confidence that their assets are sufficiently resilient to deal with the environmental and societal challenges their woodlands are faced with in the course of a long life. More frequent extreme weather events and the recent increase in threats from new forestry pests and diseases require expert and timely science to ensure this confidence is maintained, and the benefits from the ecosystems remain sustainable.

The National Ecosystem Assessment (NEA) concludes that:

‘The natural world, its biodiversity and its constituent ecosystems are critically important to our well-being and economic prosperity, but are consistently undervalued in conventional economic analyses and decision making’ (uknea.unep-wcmc.org).

The assessment highlights the benefits that woodlands do, and can, provide to society – such as the role of safeguarding biodiversity and ecosystem resilience. However, it acknowledges that the evidence base linking changes in ecosystems to human well-being is incomplete, and tends to be biased towards assessments based on economic value, largely ignoring less well quantified health values and non-quantified shared social values.

Plant and tree health is a major priority for all countries within the UK, and this outcome needs to be delivered in a collaborative way across governments, academia and the research sector, working closely with stakeholders. The joint Forestry Commission/Defra Tree Health and Plant Biosecurity Action Plan⁴ was developed with help from a wide range of stakeholders from across the forestry and research sectors, including the devolved administrations.

It sets out an integrated approach to dealing with the increasing biosecurity threats to Britain’s forests and woodlands, and emphasises the need for an effective evidence base to inform decisions, particularly when addressing emergencies. The Forestry Commission collaborates on research to deliver this outcome and others through memoranda of understanding with the Food and Environment Research Agency (Fera) and the Royal Botanic Gardens at Kew.

Forestry Commission biosecurity research will complement work being undertaken by Defra through its Evidence Investment Strategy and the Living With Environmental Change Tree Health and Plant Biosecurity initiative, and support the delivery of the recommendations of the Defra Biosecurity Taskforce.

Through its Strategic Alignment programme, Defra and its wider network (core department, Forestry Commission, executive agencies and non-departmental public bodies) will increasingly operate as ‘one business’. This means developing a future network business model that is more strategic, flexible and resilient, bringing together the structures, systems and processes to deliver a better customer experience at a lower cost.

As part of this, Defra will be seeking improvements in the use and delivery of evidence, including a more coordinated approach to the identification of evidence and science needs and the means to meet them. This joined-up approach to evidence will be set out in a new Evidence Investment Strategy, which is due to be published in May 2014. This will also set out evidence priorities across the Defra network and describe work to identify efficiency savings from monitoring.

⁴www.defra.gov.uk/food-farm/crops/plant-health/action-plan

Research areas

Evidence requirements to deliver this outcome will address:

- Understanding the impact of invasive pest species⁵ at the ecosystem level and finding technically and financially effective ways of anticipating new threats, rapid detection and identification, monitoring and improving response strategies⁶, modelling, biosecurity controls and practical measures for addressing them through:
 - horizon scanning to detect and prepare for new pest and disease threats before they arrive;
 - understanding the nature, condition and distribution of forest types and species within British woodlands through the National Forest Inventory, including their silviculture, ecology, growth and yield, and exploring the future opportunities and threats identified;
 - learning how to manage forests at multiple scales to ensure that they are more resilient to tree health threats, through management practices and tree breeding approaches to identify a wider variety of ‘future-proofed’ tree species and understand their silviculture including establishment requirements, production cycle and timber qualities.
- The increasing importance of the need to consider the ‘basket’ of ecosystem services when evaluating the benefits provided by woodland to society at both landscape and ecosystem scales, such as flood and climate change mitigation and the role of trees.
- Evaluating approaches to woodland adaptation and increasing resilience, focusing on the composition (species, origin, diversity and stability of ecological communities) and management systems (silviculture and regeneration systems) that effectively address climate change concerns. This should include understanding of forestry from regions that currently experience climates similar to those anticipated in Britain in the future.
- Maintaining or improving woodland biodiversity, halting species decline where possible but recognising limitations and seeking sustainability of long-term interventions. Considering the value of ‘new’ natives and ensuring both species choice and management build resilience in native forest ecosystems now and in the future.

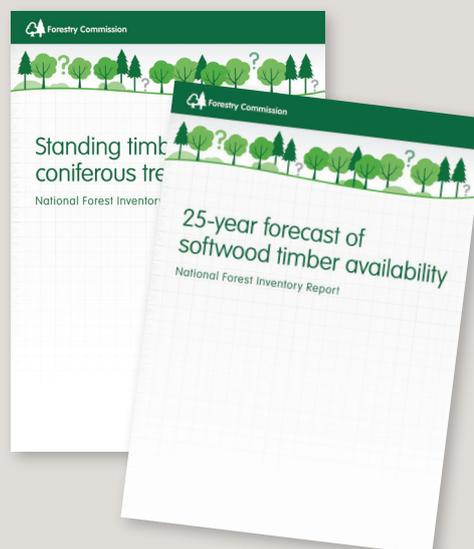
⁵ Pest species in this context include alien and native insect pests, diseases, vegetation and vertebrates.

⁶ These include developing practical control measures using integrated pest management and, if necessary, chemical techniques.

National Forest Inventory

Accurate and up-to-date information about the size, distribution, composition and condition of Britain’s forests and woodlands is essential for developing and monitoring policies and guidance to support sustainable forest management. To gather this information and keep it up to date, the Forestry Commission carries out the National Forest Inventory of forests and woodlands.

The National Forest Inventory provides both strategic and tactical information, which is useful to many people and organisations involved in forestry and land management, as well as in the wider world of planning, policy development and business. Current users of data include the forestry and timber industries; the Inventory produces information on how much timber Britain could sustainably produce over time. This has helped to stimulate interest in establishing ten new industrial facilities such as sawmills or biomass power stations, representing over one billion pounds in investment. Other users are organisations concerned with nature conservation, ecology and biodiversity, or those working to protect our forests and woodlands from pests and diseases. Key information supplied by the Inventory includes the observable infection rate of *Chalara fraxinea* (ash dieback), the distribution of ash in Great Britain, and a rapid assessment of the impact of ‘St Jude’s storm’, the severe windstorm that hit north-western Europe in October 2013, on forests and woodlands.



2. The knowledge to deliver woodland management and expansion, as a component of sustainable land-use change.

Research commissioned in support of this outcome will be designed to:

- Support increased societal use of forests and the services they can provide.
- Enable forest management and woodland expansion as part of an integrated approach to sustainable land use.
- Enable forests and woodlands to play their part in addressing issues such as flooding and biodiversity loss.

Context

In relation to other European countries with an average of 37% woodland cover, Great Britain is lightly wooded at 13% of the total land area (around three million hectares). While much woodland is well managed in accordance with the UK Forestry Standard, other areas would benefit from improved management. This strategy will deliver the evidence to allow managers to protect and improve the forests and woodlands they already have, and to provide a solid foundation for woodland expansion to increase the many benefits woodlands can deliver, for example:

- supporting green growth in a productive and sustainable rural economy by increasing the value of natural resources, sequestering carbon and helping to tackle greenhouse gas emissions, and producing timber and fuel to substitute for carbon-intensive products;
- providing places that people and communities value highly and want more of for recreation, health benefits, and enhanced rural and urban landscapes;
- restoring disturbed habitats, developing habitat networks and creating new native and non-native woodlands to increase biodiversity and support adaptation to climate change;
- helping to manage ecosystem services, such as sustainable flood management, and protection of soil and clean water resources.

Woodland expansion is a significant land-use change that requires a sound evidence base for effective policy and investment decisions. It can be best delivered through close integration with agriculture. For example, forestry can complement and support agriculture by reducing carbon footprints and increasing the amenity of farms.

Research areas

Evidence requirements to deliver this outcome will address:

- Identifying methods⁷ to successfully increase Britain's woodland cover and the percentage of woodlands under recognised forest management plans.
- Developing a greater understanding of the human impact on forest management, including forestry culture and community woodland ownership/governance, and approaches to human interactions with wildlife.
- Quantifying the location, scale of delivery and physical benefits of woodland creation and management on ecosystem services (such as improving water quality, soil conservation, flood prevention) and comparing different woodland types with different types of existing land use.
- Developing multidisciplinary tools to help managers identify and evaluate those new woodland sites that may offer the best potential to deliver the most ecologically efficient basket of ecosystem services.
- Developing advice on approaches to address forest fragmentation and land-use connectivity issues.
- Integrated and interdisciplinary social research across the rural and environmental sectors to understand what motivates landowners and managers to take up incentives and adopt other delivery mechanisms for land-use change through long-term management.
- Research to better understand the demographics of the forestry workforce to predict future requirements. This is vital to ensure an adequate workforce profile is available to meet future projected timber forecasts and ambitions to expand the forestry sector.
- Assisting the development of a skilled forestry work force by promoting and increasing the number of forestry qualification opportunities (e.g. silviculture practices and woodfuel systems) before and at degree level.

⁷ This includes understanding landowner behaviour, sensitive silvicultural techniques and improved regeneration techniques. 9

3. An evidence base to allow the forestry sector to deliver a wide range of benefits from forests and woodlands to support sustainable economic growth in Britain.

Research commissioned in support of this outcome will be designed to:

- Support a thriving and sustainable rural economy.
- Ensure that forestry can play a significant role in delivering a low-carbon economy.
- Produce new tools for more effective decision making.

Context

The natural capital in woodlands can make a significant contribution to the British economy from the value that is added to forestry goods and services in addition to providing many public benefits. For example, the wood-processing industry is internationally competitive, regional economies benefit from a wide range of tourism facilities, and the screening and aesthetic effects of forests and trees can significantly increase the value of housing, and of land for development. Research shows how sustainably managed forests and woodlands can help mitigate climate change, provide means of flood management control, and help to cool towns and cities. These are issues of direct relevance to both the rural and urban environments.

Valuing and accounting for natural capital is a major step in enabling the benefits of forest ecosystem services to be realised in the economy. Work will also continue to incorporate forest ecosystem services values into cost-benefit analyses and to build on the UK NEA. Two further important initiatives were introduced in the 2011 Environment White Paper. The Natural Capital Committee aims to improve understanding of the value of natural capital to help set priorities for actions to support and improve the UK's natural assets. The Ecosystem Market Task Force has set out a vision for how nature is critical to achieving economic objectives, and has recommended market opportunities to work towards this vision.

The forestry sector has a key role to play in supporting the rural and wider economy by increasing the value of the market and non-market benefits of forests. Science will provide knowledge for use by policy makers, by forestry and woodland owners and practitioners, and by users of forestry goods and services to bring about this outcome.

Research areas

Evidence requirements to deliver this outcome will address:

- Supporting the forest industry with research to optimise timber growth, recovery and use. This will be delivered through the maintenance of a network of permanent sample plots, and by adopting a sustainable multi-benefit forest management approach, which will investigate the potential for alternative silvicultural systems, regeneration and novel tree species.
- Improving the efficiency of the timber value chain. This will focus on improvements in tree breeding in relation to wood and timber properties to develop methods and technologies that deliver market requirements and wider forest products that add most value.
- The development of forest ecosystem service markets to support economic growth and contribute to averting risks from ecosystem degradation. This will concentrate on understanding the value of rural and urban ecosystem services, whether cultural, social, environmental or economic, and devising mechanisms for their associated evaluation and payment, and developing systems for natural capital accounting.
- The development and use of sophisticated interdisciplinary tools and models to support decision making in forest, ecosystem and wider land management to achieve sustainable and beneficial outcomes and better understanding between foresters and other parts of society. This will ensure that forestry contributes to the low carbon economy by using data from the National Forest Inventory, linked to financial and yield appraisal through production forecasting. Carbon and timber production will be assessed, to allow scenario planning for different management options including the development of renewable energy policy.

4. Changes to policy and practice through implementation by informed and engaged stakeholders, access to a high-quality skill base of forest researchers, and effective leverage to provide additional resources to increase the evidence base.

Research commissioned in support of this outcome will be delivered by:

- An interdisciplinary approach to ensure that science and research is fit for purpose, credible and robust.
- Collaboration and partnership to enhance capability and deliver more effective results.
- Stakeholder engagement in the design of research programmes to improve uptake and application of research.

Context

Research Councils (UK) define⁸ economic and societal impacts as 'the demonstrable contribution that excellent research makes to society and the economy'.

The 2013 evaluation of the Science and Innovation Strategy identified a number of important impacts that were attributable to the research commissioned under the strategy. However, it also identified some areas, particularly in knowledge exchange and stakeholder engagement, where the delivery of the strategy could be improved. This strategy addresses these in a number of ways:

- It commits to greater involvement of stakeholders in the setting of research priorities, and the way in which research knowledge is exchanged.
- It adopts an interdisciplinary approach to specifying the research programmes to be commissioned.
- It is focused on the outcomes it will achieve, and the impacts they will deliver for the UK forestry sector and wider society.

The strategy will balance the need for high-impact peer-reviewed journal papers, and applied science made available for practitioners through effective dissemination. This will maintain the respect for British forestry research within Europe and further afield, which has been earned by scientists with a sound understanding of forestry practice, combined with many years of international collaboration with organisations such as the International Union of Forest Research Organisations (IUFRO) and European Forest Institute (EFI).

Effective collaboration and partnership working will allow the research budget to extend its reach. As Europe is an important collaborator with and contributor to UK forestry research, the strategy acknowledges the important role it has to play through engaging in networks such as 'COST Actions' and ERA-NETs. This will deliver the best value for money as well as excellent and interdisciplinary science. British forestry research is already well networked, both nationally and internationally, with a large number of partnerships and collaborative projects. Leverage in the context of this strategy is as much about broadening expertise, skills and capability, as it is about funding. The Forestry Commission will work to promote and facilitate opportunities for collaboration through its programmes with Forest Research, and the readily applied science it commissions from other providers.

Strengthening environmental partnerships

The Forestry Commission belongs to the Living With Environmental Change partnership. This comprises 22 public sector organisations that fund, carry out and use environmental research and observations. They include the UK Research Councils, government departments with environmental responsibilities, devolved administrations and government agencies. Collaborative projects include the National Ecosystem Assessment, the UK Earth Observation Framework and the Tree Health and Plant Biosecurity initiative. These, and others, bring together pooled resources to deliver much more impact than individual organisations could deliver on their own.

See www.lwec.org.uk for more information.

⁸ www.rcuk.ac.uk/kei/impacts/Pages/meanbyimpact.aspx

Delivery actions

The actions required to deliver this outcome will include:

- Active engagement with stakeholders in specifying the research programmes and their outputs to deliver the strategic outcomes, and understanding the barriers to behaviour change which will ensure that the results of research are adopted and become part of mainstream activity.
- Ensuring academic credibility and career progression by specifying outputs in the scientific literature and at conferences and science workshops in the development of research projects and programmes.
- Additional support for new skills and capability delivered through the joint Bursary Award Scheme set up by the Forestry Commission in partnership with the Scottish Forestry Trust. This benefits PhD and Masters research, and will continue through the life of this strategy.
- Continued support for young researchers to gain experience and qualifications through mentoring and expert supervision. Holding annual seminars to bring together students, supervisors, policy makers and practitioners to provide an opportunity to learn more about postgraduate environmental research being funded by the Forestry Commission. These will provide opportunities for knowledge exchange that will shape future research.
- Support for all researchers funded by the Forestry Commission to attend relevant international conferences to communicate regularly with colleagues abroad and to keep forestry research in touch with foreign opinion relevant to sustainable forest management in the UK. Where feasible, secondments and exchange visits will be used. In addition, visiting scientists from outside the UK will be encouraged to participate in research programmes to bring new perspectives, and share their knowledge and experience.
- Encouraging innovation through forestry researchers working with experts in other sectors, such as finance and animal genomics, to share knowledge and skills.
- Partnership working and active liaison with other organisations and government departments, by highlighting the role that forestry can play in delivering their agendas to optimise the efficiency and impacts of research commissioning. This includes developing business partnerships with stakeholders and experts from beyond the forestry sector to develop a network of knowledge and expertise that will foster interdependence between business and ecosystems.
- Improving the levels of co-funding with the devolved forestry administrations and the forestry sector, through making the research agenda more transparent and cross-cutting.
- Developing formal, productive links with professional bodies and academic establishments to generate research synergies, and increasing the uptake of the outputs of commissioned research by offering continuing professional development hours at structured dissemination events.
- Establishing better connections with professional and trade bodies inside and outside the traditional forestry sector to integrate forestry research with that being undertaken in other land uses.

5. How research is commissioned

The strategy has been designed to accommodate flexibility in addressing future research needs. There is a stronger focus on peer review of research programmes than in previous strategies, and the design of future research programmes will follow a new process with much greater stakeholder involvement. Research themes and programmes delivered under the strategy will take a British perspective, but will also address devolved administration needs, and complement their own directly commissioned research.

This strategy has been developed to be flexible enough to cope with many possible changes to the operating environment. These include the need for UK deficit reduction, the outcome of the referendum on independence for Scotland and structural changes for forestry responsibilities in Wales. However, some key principles underpin the future commissioning of research:

- Maintaining a critical mass of core capability to enable rapid response to emerging issues.
- Collaborative commissioning to access and develop new expertise and capability will complement that available from Forest Research.
- External peer review of research commissioning proposals will ensure that the science to be delivered is of the highest quality, relevant and appropriate.
- Providing opportunity for stakeholders, both public and private, to engage in the formulation of the research briefs to improve transparency and ownership of results. However, this must be done in a proportionate way to avoid diverting scarce resources from research.

Research proposals must be explicit about the short-term impacts they are expected to deliver on application.

Responsibilities

Responsibility for this strategy, and for the research programmes commissioned under it, lies with the Forestry Commission Research Strategy Management Board. The Board is chaired by the Forestry Commission's Director of Corporate and Forestry Support and membership comprises the Forestry Commission's Chief Scientific Advisor, Head of Analysts, and senior policy leads from Forestry Commission England, Forestry Commission Scotland and the Welsh and Northern Ireland governments.

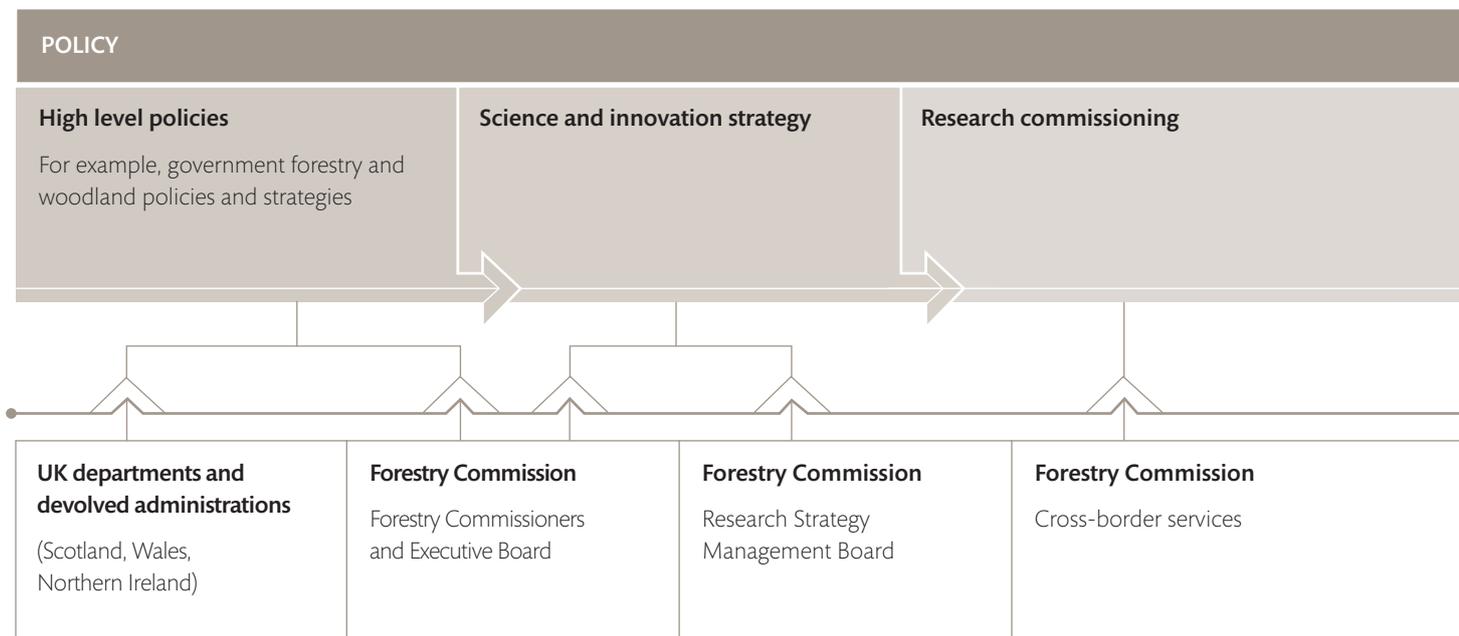
This enables the strategy to take a British perspective to make the best use of the research commissioned. At the same time it is able to address short- to medium-term country requirements, while ensuring that the long-term needs of British forestry are also accommodated.

Research on trees, woods and forests is a highly specialised area, and has been successfully led by Forest Research for many years. This, coupled with the lack of commercial opportunities and the wide application of much of the research, has resulted in most of the core capacity being provided by the public sector. Around 90% of the research commissioned by the Forestry Commission to deliver its evidence base has been provided by its Forest Research agency. The remainder of the funding has been used to build additional capacity, and provide a benchmark for the rest of the research. The diagram overleaf illustrates the research governance and process.

To deliver the strategy's outcomes, the Forestry Commission will use and comply with the Government Chief Scientific Adviser's guidelines on the use of scientific and engineering advice in policy making. This sets out four key messages for government departments to:

- identify early the issues which need scientific and engineering advice and where public engagement is appropriate;
- draw on a wide range of expert advice sources, particularly when there is uncertainty;
- adopt an open and transparent approach to the scientific advisory process and publish the evidence and analysis as soon as possible;
- work collectively to ensure a joined-up approach throughout government to integrating scientific and engineering evidence and advice into policy making.

Research process, from policy to practice, and associated governance and implementation bodies.



Quality assurance

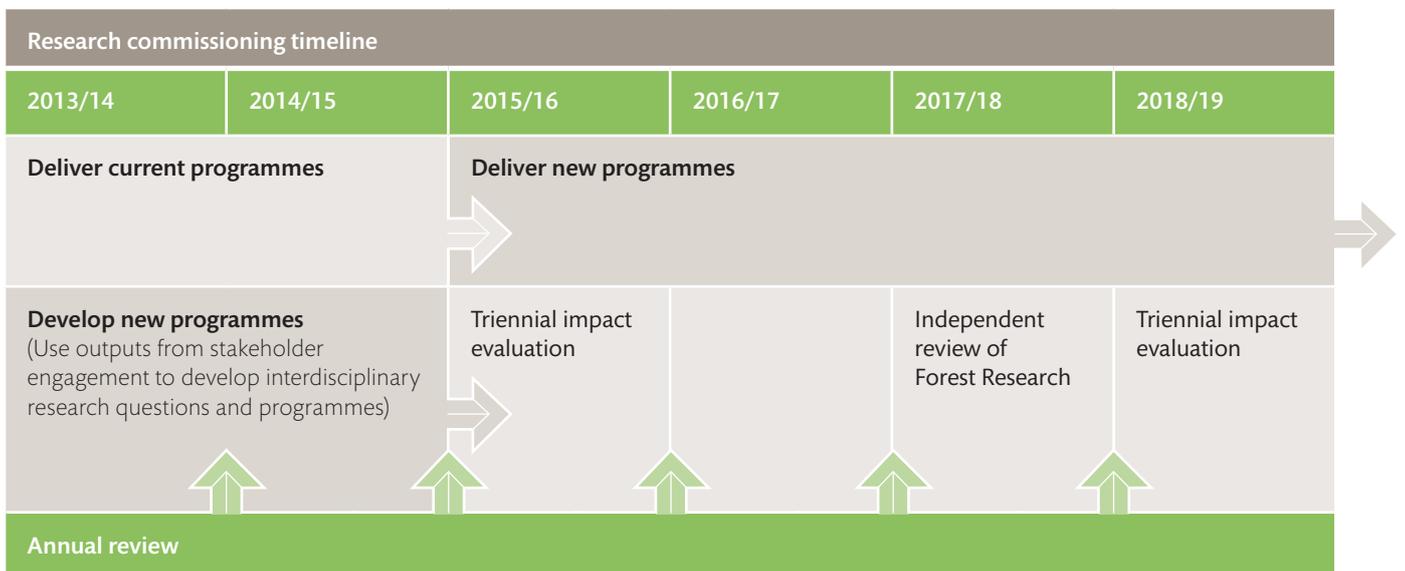
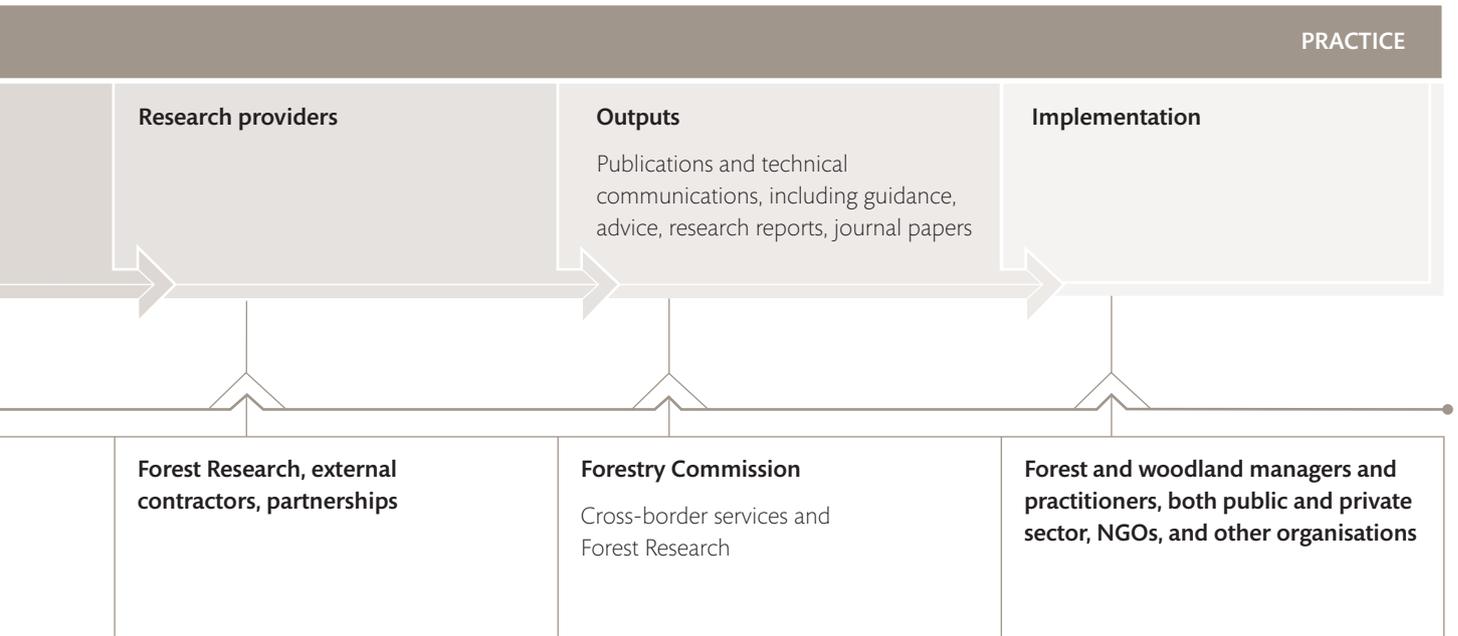
Quality assurance through external peer review of research proposals is now best practice in a number of other departments, and will be implemented in a proportionate way under the strategy for both research commissioned from Forest Research and from other providers. Peer review in this context will cover the science methodology and programme outline in the proposal, as well as the science that is being commissioned. This should ensure that the quality and relevance of the science remains high.

Members of the Forestry Commission Expert Committee on Forest Science will have a major role in the external review of the commissioning documents alongside other external reviewers from academia and the forestry sector.

This period will also allow engagement with a wide range of stakeholders to consider how best to set priorities which meet their needs and aspirations, within the resources available. This strategy will start the process, which will be managed by the Forestry Commission. It will result in a detailed research programme, which is fit for purpose, forward-looking and will meet the needs of the sector towards 2020.

Research timeline

Research programmes funded under Spending Review 10 (SR10) will continue to run until 2014/15 (see the timeline opposite), by which time future funding and organisational structures should be clearer. This provides time to consider what research needs to be commissioned to follow on. For this reason, the strategy is not prescriptive in the way that previous ones have been. The inter-regnum will provide time for reflection on future policy needs to build interdisciplinarity, and outcome-focused research proposals.



6. How research is communicated

Communication of research delivered under the strategy will be designed to provide the maximum impact for policy development and the delivery of good practice on the ground. Science will be published in ways which provide an accessible knowledge and evidence base for UK forestry, and technology and new media will be used wherever possible to make access to research simple and universal. The strategy will adopt a targeted approach to knowledge brokering to improve dialogue and increase stakeholder uptake and adoption.

Science is not an end in itself. The outcomes of research should inform forestry policy and guide forestry practice to ensure that Britain's forests and woodlands continue to be managed as a sustainable and resilient resource. This requires a strengthened knowledge base to allow future decisions to be based on robust, reliable and up-to-date evidence. This knowledge base will be open and accessible to create an environment that stimulates innovation and the development of products and services that will be of benefit to both the forestry sector and wider society.

Communication will be more than an activity carried out at the end of research programmes. The ongoing exchange of knowledge between those who carry out the research and its end users are key issues for this strategy. The most effective way to strengthen communication is through the direct involvement of the user communities in both the conduct of research and the formulation of research programmes – and knowledge exchange mechanisms will be established to achieve this. Direct participation will not only promote shared understanding and collaboration but will also increase the resources available for disseminating it to as wide an audience as possible and provide feedback for changes to the strategy.

Harnessing all available resources will be important over the period of this strategy. Reducing budgets and tighter controls on expenditure mean traditional and passive approaches to communication, such as printed publications, will be replaced, where appropriate, with newer and more innovative communication technologies – especially where these will be more effective in reaching target audiences. Such technologies also have the advantage of being faster and more far-reaching – critical in the face of emerging threats and rapidly changing situations that have

characterised forestry in the past five years, most recently the responses required to tackle *Phytophthora ramorum* disease of larch and Chalara 'ash dieback' disease.

Audiences and end users

Key stakeholders for research communication activities are policy makers and forestry practitioners, but work will also be done to identify new audiences and end users who can help bring about the changes necessary to deliver the outcomes in this strategy. This will mean improving targeting, and tailoring communications channels to ensure that the right messages reach the right people at the right time.

Working with policy makers (providing the evidence base)

The need for scientists and policy makers to work together has never been greater. Gaps in the two-way flow of policy and science information can lead to key emerging scientific findings not being reflected in government policy in a timely manner and funding opportunities being missed. The strategy will improve and build on science-to-policy activities, identify opportunities and routes that best inform decision making. This will ensure that outputs of research are relevant, fit for purpose and communicated in an appropriate, accessible and timely way.

Working with forestry practitioners (delivering the UK Forestry Standard)

The governments in the UK have set out their approach to sustainable forest management in the UK Forestry Standard and its series of supporting Guidelines. This approach is based on internationally recognised science and best

practice. The research commissioned under the strategy will continue to support and develop the guidance and other material underpinning the UK Forestry Standard to ensure that forest managers and practitioners are able to cope with issues such as the impacts of climate change and pest and disease outbreaks. This will be reviewed regularly during the lifetime of this strategy, and updated to take account of legislative and regulatory changes.

Working with other stakeholders

Modern forestry has a wide reach and strong associations with a range of environmental, economic and social agendas, which provide a range of public benefits. While the Forestry Commission will continue to work with traditional stakeholder groups in the forestry and rural land-use sectors, it also has a strategic commitment to continue to work to identify wider audiences that can benefit from forestry and tree-related research. This strategy will therefore seek to engage interest from a range of non-governmental organisations, businesses and those involved in urban and social sustainability – both as end users of research and, where possible, by making use of their capacity for knowledge exchange.

Putting it into practice

There are a number of ways in which the impacts and application of commissioned research can be improved, and these are detailed below.

Improving stakeholder engagement

The strategy aims to improve dialogue with external and internal stakeholders by creating more open channels of communication. It will increase the number of programmes with steering groups and user groups to promote wider involvement of end users in research projects. New technology will be explored to crowd-source ideas and opinion online from a wider range of stakeholders – this will feed into the formulation of the research proposals and support innovation.

Getting the balance right

A total of 25% of research spend across the whole research programme will be allocated to communication activities. While this might mean less (or slower delivery of) research,

it is a worthwhile trade-off on the grounds that research effectively communicated is an excellent investment. Communication activities will be properly accounted for within the specifications of individual programmes – whether provided by Forest Research or through external organisations – to ensure that dissemination is seen as an integral part of every project. This will help communications planning to maximise the impact of the research.

Working in partnership

The Forestry Commission is committed to working with a wide range of other organisations, institutions and individuals – to share knowledge and expertise and work towards partnership in communication as well as in research. Key partners in communication are:

- Environmental partnerships – making best use of communications networks through, for example, the Living With Environmental Change partnership.
- Professional bodies and educational establishments – collaboration on continuing professional development.
- Business community – effective communication through industry placements, trade articles and the financial press, and making use of stakeholder capacity for wide and effective knowledge exchange.
- Scientific community – through the recognised route of published papers.
- General public – by encouraging participation in scientific research or ‘citizen science’.

Engaging citizens in science

Public participation in scientific research is an important new area for this strategy. Volunteers now have the opportunity to contribute to a wide range of research projects using social media and other web-based technologies. The recording capabilities of smartphones and other mobile devices can be used for easy data collection and make mass data collection more feasible.

The Forestry Commission is piloting and evaluating the use of citizen science to assess the extent to which the forestry sector can use these new techniques. For example, recent tree pest and disease outbreaks have been reported using mobile internet ‘apps’, such as TreeAlert, and the further use of this technology will be explored.

Knowledge brokering and technical communications

Forestry Commission analysts and the technical communications team in Cross-border services will provide a link between scientists and end users of research such as policy makers and practitioners. They will co-ordinate communications about commissioned research and analyse and repurpose outputs to add value to the results and ensure their applicability to target audiences across a wide range of networks throughout the UK.

The Strategic Publications Group, made up of technical communication experts and policy advisors from Forestry Commission Cross-border Services, the Forestry Commission in England and Scotland, and Natural Resources Wales, will provide a framework for technical publishing activities across the Forestry Commission and act as a source of expertise and guidance on good practice.

Improving communication channels

A wide range of communication channels will be employed over the period of this strategy to improve the accessibility of forestry research and ensure that key outputs are better targeted towards end users. Effective

targeting will involve adapting content and considering whether outputs will be published digitally or in print, or via new media such as mobile apps, or via face-to-face events and webinars.

Open access publishing

The Forestry Commission will publish more research in open access and hybrid journals over the period of this strategy. This is in line with the clear policy direction of the UK Government towards open access publishing – where publishers receive their revenues from authors rather than readers, and so research articles become freely accessible to everyone immediately upon publication. However, it is recognised that there could be significant costs associated with this and so targeted forestry research will also continue to be published in appropriate forestry journals.

Online research archive

A new online web portal for forestry research will replace the existing suite of web pages and improve the accessibility of commissioned research. The archive will have a dedicated search facility for all forestry research carried out across Great Britain, with options to search on a range of metadata. It will also have options to view current programmes, the latest outputs of research, forest

Developing guidance on ash dieback disease

The discovery of ash dieback in Britain in 2012 led to a demand for specialist information on the disease and guidance on its containment. Media and public interest levels were unprecedented. Urgent advice was required on a range of practical forestry and arboricultural issues, from the management of ash woodlands and forest trees, to urban and hedgerow trees.

Defra and the Forestry Commission were tasked with the development of a disease control strategy and producing management guidance for landowners and practitioners. A stakeholders' meeting was convened with the aim of developing and producing rapid guidance in the face of the emerging threat and a rapidly changing situation. Video and tele-conferencing facilities were used to gather scientists and forestry experts from Forest Research and elsewhere, and practitioners, arboriculturists, landowners and non-government organisations from across the UK were invited to share knowledge and ideas, and explore options for a range of scenarios. Information was also provided from European research institutions.

This use of new technologies enabled the stakeholder group to respond with suggestions and comments on very short deadlines. This resulted in the collation of information and expertise to produce robust and wide-ranging advice to woodland owners and managers in just three weeks. The guidance (which can be found at www.forestry.gov.uk/chalara) is subject to ongoing dialogue and will be updated as new information emerges.

and woodland statistics and datasets. The site will be supported by links to other research libraries and data repositories. It is intended that RSS feeds and other social media channels will supply partner organisations with breaking news on research.

Applied research

In addition to the publication of scientific papers, applied research that is fit for purpose and application in everyday practice must be delivered. This requires a balance between the demands for peer-reviewed scientific publication and the need for operational outputs; the commissioning process will therefore be actively managed to ensure an appropriate balance.

The series of Forestry Commission Research Notes will be expanded and improved, and will be used to present key research outputs and interim results for policy makers and practitioners in a concise, accessible way. These will summarise lengthy or complex science papers and replace internal reports and grey literature.

Magazine articles will also be produced for the business and trade press to disseminate information about work programmes, including initiatives such as the Woodland Carbon Code and work on ash breeding and resistance.

Research commissioned under this strategy provides the evidence base that underpins the UK Forestry Standard and its supporting suite of guidance.

Guidance and practical outputs

The outputs of research and guidance on good forestry practice will be published in a new rationalised framework outlined in the UK Forestry Standard (see below). The online publications catalogue will continue to be developed and expanded as the repository for all official publications, which will include all guidance and formal research reports. All new publications will be available digitally as ebooks. In some cases, and in particular for Field Guides, hard copy will be the preferred format.

New media

The opportunities for interacting with target audiences through new media are growing. These will be exploited wherever they can help to reach target audiences in a cost-effective and efficient way.

Decision support tools

Decision support tools are an effective way of translating research into operational practice. Where this is appropriate they will be developed. One recent example is the Forester system, which underpins the Forestry Commission's inventory and forecasting capability. The wider forestry sector has access to other tools such as ForestGALES and the Ecological Site Classification Decision Support System.



Tailored communication activities

Over the past five years, tailored communication activities have been designed to disseminate the results of forestry science to a wide range of stakeholders. Conferences, seminars and workshops, where researchers can talk about their work and its results, are well received. For audiences of practitioners, workshops that combine a presentation with a practical demonstration – seminar room with forest excursion – are especially appreciated. These events also increase the opportunity for the feedback of ideas from the field to scientists. These activities supplement traditional approaches, such as published papers and reports, and have proved to be successful.

However, while face-to-face communication of this type is highly effective, and experience strongly reinforces the value that it provides, it demands a committed and expert staff resource that requires careful development and deployment. Opportunities to improve activities in this area will be explored throughout the lifetime of the strategy.

Access to information and data

Forestry Commission information and data policies comply with the UK Government's initiative on unlocking the potential of public sector information and its strategies for open data⁹, which are designed to promote innovation by encouraging the re-use of government information and providing easy access to data.

Spatial data also complies with European Union (EU) INSPIRE directive, which seeks to create an EU spatial data infrastructure. This is designed to facilitate the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe (<http://inspire.jrc.ec.europa.eu>).

Additionally, the Forestry Commission has made a number of its spatial datasets freely available to the GIS (Geographic Information System) community via its Data Download site – a new online system to record the details of Forestry Commission datasets will be made available for anyone who wishes to view it. (www.forestry.gov.uk/datadownload)

New media for delivering the strategy

- Crowd-sourcing technology to engage stakeholders, generate ideas and opinion online and provide opportunities for feedback on research proposals.
- Webinars to share presentations, seminars and workshops over the internet, in real time, with audiences in geographically-dispersed locations.
- Podcasts and video presentations by forestry experts to talk about work, demonstrate practical techniques and engage wider audiences.
- Twitter feeds to send alerts and updates on published research outputs (@FCPubs).
- eNewsletters on published research outputs to website subscribers.
- App-based guides and ebooks for smartphones and tablets – particularly for field identification and other material designed for use on the move.
- Improved metadata and cataloguing to facilitate easier access to research outputs.
- Online access to a digitised back catalogue of forestry publications and reports.

Micro-data may be provided to bona fide researchers in the academic sector and to consultants undertaking research commissioned by government. Data may be released under arrangements described in a service level agreement, a concordat, contracts and confidentiality declarations.

⁹ Open Data White Paper: Unleashing the potential (Cabinet Office)

7. Evaluation

This strategy employs an outcomes-based approach to research and evaluation of its effectiveness will include both contextual measures and direct assessment criteria. Progress on these measures will be reported annually to the Research Strategy Management Board and compiled in a published report to ensure transparency.

Contextual baseline measures

- The National Forest Inventory (NFI) programme reports on the current state of key forest metrics at national level and, over time, trends in these metrics. Data from the NFI will be used to form a judgement on whether British forests are healthy, resilient ecosystems providing a sustainable flow of products and services to society.
- An independent review of the evidence and current scientific capability available to address known and emergent challenges to Britain's forests and woodlands will be undertaken.

Direct assessment criteria

Direct assessment criteria for the evaluation of the strategy are divided into qualitative and quantitative measures.

Qualitative

An independent triennial review of the impacts (policy or land-use/management decisions affected) of research purchased (including associated decision support tools).

Stakeholder feedback on perceptions of the science delivered under the strategy, collected through the use of social media tools.

Independent assessment of science quality by research programme by the Expert Committee on Forest Science.

Quantitative

Number of peer-review publications and citations, through annual collation of research statistics, including both journal papers and technical guidance.

Number of international conference papers presented by Forest Research scientists.

Metrics on how science delivered under the strategy translates into policy documents and good practice guidance.

Leverage achieved by Forestry Commission funded research programmes, by annual collation of additional funding obtained through collaboration and partnership working where Forestry Commission research programmes are included as part of a wider project or programme.

Metrics on the extent of collaborative working (across government and the wider sector) in both commissioning and delivery of research purchased.

Number of PhDs supported by Forestry Commission research to build capacity and expertise in forest science.

Useful sources of information

England

- Government forestry and woodlands policy statement (Forestry Commission England)
- ThinkBIG: How and why landscape-scale conservation benefits wildlife, people and the wider economy (Natural England)
- White Paper – The Natural Choice: securing the value of nature (HM Government)
- UK National Ecosystem Services Technical Report – Chapter 27 Response Options, section 27.5: Forestry (UK National Ecosystem Assessment)

Scotland

- The Scottish forestry strategy (Scottish Executive)
- Scottish forestry strategy implementation plan 2012–15 (Forestry Commission Scotland)
- Strategic directions for the national forest estate 2012–2015 (Forestry Commission Scotland)
- Variety is the spice of life – action for nature on Scotland's national forest estate (Forestry Commission Scotland)
- Getting the best from our land – A land use strategy for Scotland (Scottish Government)
- National Planning Framework 3 – A plan for Scotland: ambition, opportunity, place (Scottish Government)
- Strategic research programme on environmental change (Scottish Government)

Wales

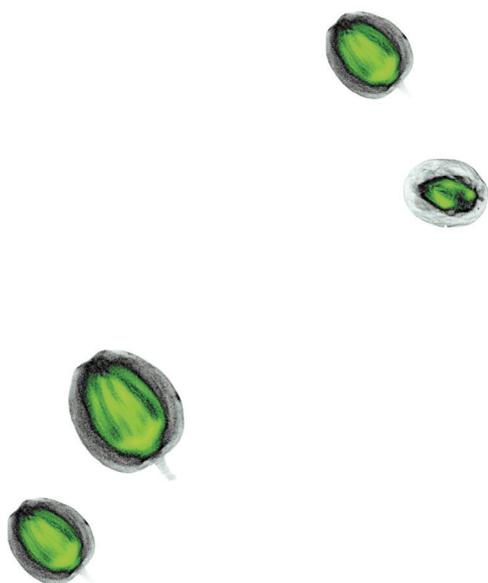
- Woodland for Wales Action Plan 2010–2015 (Forestry Commission Wales)
- Woodlands for Wales (The Welsh Assembly Government's Strategy for Woodlands and Trees)
- Farming, Food & Countryside: Building a secure future – a new strategy for farming (Welsh Government)

Northern Ireland

- Northern Ireland Forestry – A strategy for sustainability and growth (Forest Service – An Agency within the Department of Agriculture and Rural Development in Northern Ireland)

United Kingdom

- Mainstreaming sustainable development – the Government's vision and what this means in practice (Department for Environment, Food and Rural Affairs)
- Science and engineering in government (Department for Business, Innovation and Skills)
- The Government Chief Scientific Adviser's Guidelines on the use of scientific and engineering advice in policy making (Government Office for Science)
- DECC Science and innovation strategy (Department of Energy and Climate Change)
- Defra's Evidence investment strategy: 2010–2013 and beyond (Department for Environment, Food and Rural Affairs)
- Research strategy 2008–2013 (Department for International Development)
- Science and innovation network (Foreign and Commonwealth Office: now managed by Department for Business, Innovation and Skills)
- Together transforming research into Innovation – a review (Research Councils UK)
- Impact evaluation of research undertaken to deliver the Forestry Commission's Science and innovation strategy for British forestry (Report to the Forestry Commission)



Forestry research requires a broad scope of activity. It must be forward-looking to anticipate long-term challenges such as climate change and the impact of novel forestry pests and diseases, strategic to inform emerging policy issues, and technical to support new and more efficient forestry practices. Excellent science and innovation will enable the UK to maintain its position as a world leader in sustainable forest management and ensure that forests and woodlands in Britain continue to provide vital services for the economy, the environment and society. This new Science and Innovation Strategy sets out how the Forestry Commission will commission science to support the development and delivery of policies and practice for sustainable forest management. The strategy has been developed in partnership with a wide range of people with a keen interest in the future of Britain's forests and woodlands.

www.forestry.gov.uk/research



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