

DRAFT FOR CONSULTATION

Delivery

Forestry Commission Scotland

Climate change action plan

2008-2010

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Overview

Introduction

Climate change is one of the most serious threats facing the world today and is already happening. Forestry has a fundamental part to play, with global deforestation being part of the problem, and reforestation and use of forest products being an important part of the solution.

*Changing Our Ways*¹ Scotland's second climate change programme, included annual carbon saving targets for the forestry sector. The Scottish Government is now consulting on proposals for a Scottish Climate Change Bill,² this setting a framework for guiding Scotland to a low-carbon economy, with a mandatory target to cut emissions by 80% by 2050. In addition, the forthcoming consultation on Scotland's Climate Change Adaptation Strategy will seek to help Scotland adapt to unavoidable changes in our climate.

The Scottish Forestry Strategy³ highlights climate change as a major theme, with a key role for forestry in: adaptation; mitigation; carbon capture and storage; and awareness raising. Arising from the Strategy, this action plan describes what Forestry Commission Scotland will do to increase the contribution and response of Scottish forestry to the challenges of climate change. It focuses on what needs to be done both as early actions and to increase future preparedness. It has been screened under the FCS equality impact assessment procedure and was found not to require full equality impact assessment.

This action plan will be reviewed in 2010.

Climate change predictions for Scotland

A Handbook of Climate Trends Across Scotland (SNIFFER⁴) gives a comprehensive account of climate change over the last century. During the last 40 years temperatures have increased in every season, in all parts of Scotland. In the north and west, rainfall has increased by almost 60% in winter months.

Climate change scenarios for the UK have been developed by the UK Climate Impacts Programme (UKCIP02)⁵ up to the 2080s. The projections for Scotland are:

- Warming of up to 0.5°C/decade, with the greatest warming in the autumn.
- An increase in the length of the growing season of between 20 and 60 days, greater in the east than the west.
- Although overall precipitation may show little change, there are likely to be more marked seasonal differences in precipitation between summer and winter, particularly in the east. Summers are likely to be drier and winters wetter.
- Winter snowfall may reduce by 50% and up to 70% in eastern Scotland.
- An increasing number of very hot days and a decrease in the number of very cold days.

¹ www.scotland.gov.uk/Publications/2006/03/30091039/0

² www.scotland.gov.uk/Topics/Environment/Climate-Change/16327/Climate-Change-Bill

³ www.forestry.gov.uk/forestry/inf-d-6aggzw

⁴ Scotland & Northern Ireland Forum for Environmental Research: www.sniffer.org.uk/climatehandbook/

⁵ www.ukcip.org.uk/climate_change/ukcip02scenario.asp

Overview

- Potential increases in severe storm and rainfall events, particularly in the east.
- Summer droughts, winter flooding and waterlogging to become more commonplace.
- Higher evapotranspiration than at present due to increased temperature.
- A declining number of frost days.

Forestry Commission Information Note 069 *Climate Change and British Woodlands*⁶ explains how these environmental changes may affect the growth of trees, including the distribution of individual species, and the implications for woodland practice.

Revised climate change scenarios (UKCIP08) will be produced later in 2008.

The role of forestry

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change⁷ (2007) gave significant weight to the role of forestry in helping to tackle climate change. It stated: "Forestry can make a very significant contribution to a low-cost global mitigation portfolio that provides synergies with adaptation and sustainable development."

The world's forest sector can help tackle climate change through six simple measures: protecting what we already have; reducing deforestation; restoring forest cover; using wood for energy; replacing other materials with wood; and planning to adapt to our changing climate.

This action plan lays out how forestry in Scotland can contribute to tackling climate change and will serve as a focus for Forestry Commission Scotland actions on:

- Protecting and managing existing forests through sustainable forest management, conserving carbon stocks, and minimising deforestation.
- Creating new woodland to capture carbon, produce wood and help adaptation.
- Adapting to climate change by planning and managing forests and woodlands in a way that minimises future risks from climate change, for example through the creation of forest habitat networks, and using different timber species or silvicultural systems.
- Promoting the use of sustainably produced wood for energy and construction.
- Reducing the forestry sector's carbon footprint.
- Raising awareness and understanding of climate change and how forestry can make a positive contribution.
- Measuring progress.

⁶ [www.forestresearch.gov.uk/pdf/fcin069.pdf/\\$FILE/fcin069.pdf](http://www.forestresearch.gov.uk/pdf/fcin069.pdf/$FILE/fcin069.pdf)

⁷ www.ipcc.ch/#

Protecting and managing existing forests

Sustainable forest management

Summary of priorities

- Support completion of the revised UK Forestry Standard and associated guidelines, ensuring that it provides a clear framework for forestry's contribution to the challenge of climate change.

Sustainable forest management in Scotland is defined by the UK Forestry Standard⁸. This sets out legal requirements and sets the standards of good forest practice. It is used to assess whether forest proposals and management activities meet these requirements, and guides those managing forests. By implementing the Standard, managers can demonstrate that their forestry activity is both legal and sustainable. It is the basis by which the UK reports to international forestry processes and it underpins the Scottish Forestry Strategy. The UK Forestry Standard also provides a basis from which the independent UK Woodland Assurance Standard⁹, used for voluntary independent certification, was developed.

The UK Forestry Standard and associated guidelines are currently undergoing comprehensive revision. This will draw out more clearly the legal obligations of forest managers and the management standards expected as part of normal good forestry practice. The new Standard will also identify woodland management practices that can contribute to tackling the impacts of climate change.

Actions

- Participate in the revision of the UK Forestry Standard and ensure that it fully reflects forest management requirements in Scotland and systematically lays out how forestry can increase its contribution to tackling the impacts of climate change.

Minimising deforestation

Summary of priorities

- Implement measures to avoid inappropriate deforestation in Scotland.
- Establish procedures to monitor deforestation.

Globally, forest cover has reduced from 50% to 30% of the world's land area over the last century and now stands at about 4 billion hectares. Net annual forest loss between 2000-2005 has been 7.3Mha compared to 8.8Mha annually between 1990-2000. Deforestation now comprises 18% of the world's greenhouse gas emissions (compared to 25% from electricity and heat generation, 14% from transport and 13% from agriculture).

⁸ [www.forestry.gov.uk/pdf/fcfc001.pdf/\\$FILE/fcfc001.pdf](http://www.forestry.gov.uk/pdf/fcfc001.pdf/$FILE/fcfc001.pdf)

⁹ [www.forestry.gov.uk/pdf/ukwasguide.pdf/\\$FILE/ukwasguide.pdf](http://www.forestry.gov.uk/pdf/ukwasguide.pdf/$FILE/ukwasguide.pdf)

Protecting and managing existing forests

In Scotland, extensive deforestation has occurred since prehistoric times, mainly for agriculture. By 1900 only 5% of our land cover was woodland, of which less than a third comprised ancient, semi-natural woodland. Reforestation during the 20th century increased the resource to 17% of land area (1.3Mha) by 2005. About one third of this comprises native species. Since 1990 there has been a rising trend of significant woodland removals associated with landscape design, restoration of priority habitats, wind farms and other types of development. The second National Inventory of Woodlands and Trees¹⁰ (2009/2010) will enable the scale of change to be assessed.

At world, EU, UK and Scottish levels there is a strong presumption against deforestation. The Forestry Act is the basis for the regulation of felling through the felling licence system. Other statutory powers apply to sites designated for their special interest or permitted and approved developments covered by the Town and Country Planning (Scotland) Act 1997. Deforestation also comes within the scope of the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999. Deforestation resulting from lack of active management or overgrazing is managed primarily through advice and incentives.

Forestry Commission Scotland is in the process of reviewing policy on deforestation to ensure it accounts for current and future circumstances. These include the increasing need to protect natural carbon sinks, debate on the future of inaccessible and remote forests, and the increasing number of planning consents involving large-scale forest removal such as those associated with wind farm developments.

Principles emerging from the policy review process are:

- A strong presumption in favour of protecting Scotland's woodland resources with support for deforestation only where, on balance, it would achieve significant and clearly defined additional public benefits.
- Recognition that compensatory planting may form part of this balance, particularly in relation to consented developments.
- Where felling is permitted but deforestation is not supported, a requirement to maintain conditions conducive to woodland regeneration.

Actions

- Finalise and publish deforestation policy for Scotland.
- Promote deforestation policy through the National Planning Framework, Scottish Planning Policy and associated guidance notes.
- Facilitate progress of the second National Inventory of Woodlands and Trees to provide updated information on woodland cover in Scotland.
- Establish a process for recording and monitoring known woodland losses through the forest plan/felling licences process and the development control and consent system.

¹⁰ www.forestry.gov.uk/inventory

Protecting and managing existing forests

Conserving forest carbon stocks

Summary of priorities

- Promote the use of silvicultural systems and practices that safeguard carbon stocks.
- Minimise civil engineering-related carbon losses.

Promoting the use of silvicultural systems and practices that safeguard carbon stocks

Carbon accumulating in forest biomass and soils is liberated through organic matter decomposition, and in some instances, burning. As forests develop they tend to be net accumulators of carbon. Eventually, sometimes after several centuries, forests reach a steady state where emissions balance sequestration. Management interventions in forests alter this natural dynamic.

The main silvicultural components of forest carbon conservation practice are:

- Ground preparation and tree establishment to conserve soil organic matter.
- Thinning, where possible, to maintain stand growth and long-term carbon uptake.
- Harvesting practices to increase long-term carbon storage.
- Restocking practices that ensure permanence of carbon storage.

In appropriate situations these components can be delivered through lower impact silvicultural systems (LISS) such as continuous cover forestry. In other situations silvicultural practices associated with clear-felling can be readily modified to safeguard forest carbon. The UK Forestry Standard and associated guidelines are currently being revised and will describe management techniques for forest carbon conservation. Work is underway to develop a forest carbon assurance scheme based on the revised UK Forestry Standard.

Actions

- Align land use incentives to support the expansion and management of LISS.
- Establish best practice and incorporate in revision of the UK Forestry Standard and associated guidelines.
- Facilitate development of a forest carbon assurance scheme (see Page 11).

Minimising civil engineering related carbon losses

Forest road building and other civil engineering in forests causes site disturbance, which can lead to locally accelerated breakdown of soil carbon. Planning and implementing civil engineering projects to minimise site disturbance reduces carbon loss.

Protecting and managing existing forests

Action

- Publish industry-wide guidance on minimising carbon losses in forest-based civil engineering.

Example of action

The Forestry Commission's *Science and Innovation Strategy for British Forestry* (2005) made 'changing silviculture' one of eight strategic research priorities in recognition of the need to adapt silvicultural practices to changing climate and objectives. The resulting research programme supports a network of demonstration sites and forest transformation experiments on the national forest estate throughout Britain.

Woodland creation

Carbon sequestration through woodland creation

Summary of priorities

- Encourage the creation of woodlands where this will contribute to carbon sequestration.
- Ensure guidance on woodland creation takes into account climate change considerations.
- Establish a robust carbon sequestration monitoring framework.

Many types of woodland creation can contribute towards net emissions reduction. Scotland's Climate Change Programme recognises this contribution. The Scottish Forestry Strategy includes an aspiration to achieve 25% woodland cover in Scotland by the second half of this century, requiring the creation of about 10,000 ha of new woodlands each year.

Delivery mechanisms are being put in place to encourage woodland creation. The 2007 three-year spending review has allocated sufficient resources to achieve this target, principally through the new Rural Development Contracts grant mechanism, and in part through increased planting activity on the national forest estate.

Land availability for woodland creation is a constraint. Extensive woodland creation is not appropriate on bog systems and planting on other deep peats may not result in net carbon accumulation. Scottish soils account for some 70% of the terrestrial storage of carbon in Great Britain and peaty soils account for the majority of this.

High quality semi-natural habitats are important in their own right and woodland creation will not be appropriate within some designated areas. The most productive arable and improved grassland are profitable in agriculture and less likely to be made available for tree planting. However, there are significant opportunities for creating native woodland habitat networks, urban and community woodlands and larger-scale productive woodlands on the upland fringes. A new generation of Indicative Forestry Strategies¹¹ is helping to identify these opportunities.

Actions

- Clarify the drivers for new woodland creation and set these out in a woodland expansion strategy.
- Promote national coverage of a new generation of Indicative Forestry Strategies through revised national planning guidance and partnership support to local authorities.
- Introduce new woodland creation support measures through Rural Development Contracts, using regional prioritisation to focus resources on highest priority situations.

¹¹ www.scotland.gov.uk/Publications/1999/04/circular-9-1999-root/circular-9-1999-strategy

Woodland creation

- Monitor uptake of Rural Development Contracts and adjust, if necessary, to promote creation of the desired range of woodland types.
- Increase the capacity for new woodland creation on the National Forest Estate.
- Ensure guidance on woodland creation takes into account climate change considerations.
- Establish a robust carbon sequestration monitoring and reporting framework, working with CEH¹² over model refinement.

Examples of action

In 2006, as part of the FCS carbon sequestration project, FES embarked on a three-year, 3000 ha woodland creation programme. One of the first schemes was the purchase of 218 ha of better quality agricultural land at East Grange in Fife, this including 134 ha of arable land, and will result in some 125ha of planting on low carbon soils, as well as creation of an energy forestry research and demonstration facility.

Establishment of energy crops

Summary of priorities

- Through research, demonstration and grant support encourage adoption of short rotation coppice and short rotation forestry for wood energy production.

Interest in woody energy crops is increasing. Use for heat or for combined heat and power is the most carbon-efficient way of utilising such crops. Establishment of short rotation coppice (SRC) has been on a small scale to date, but the emergence of functioning markets is likely to stimulate additional activity, particularly if current proposals for higher Renewable Obligation Certificate (ROC) banding for electricity generation from energy crops are implemented in Scotland. However, current agricultural economics is likely to focus SRC on the more marginal improved ground. Short rotation forestry may provide a better alternative in such situations. While untried in the UK and Scottish energy crops context, short rotation forestry systems use established forestry knowledge and techniques.

The 2008 Wood Fuel Task Force report¹³ identified a number of barriers to increasing wood fuel supply from energy crops. These were addressed in its recommendations:

- Improve and disseminate knowledge on the potential for SRC, particularly on more marginal ground.
- Develop support mechanisms, through grants and buyer contracts, to bridge the initial SRC establishment period.

¹² Centre for Ecology and Hydrology (www.ceh.ac.uk)

¹³ www.forestry.gov.uk/forestry/INFD-7APFXA

Woodland creation

- Support favourable ROC banding for biomass and SRC in Scotland.
- Research short rotation forestry establishment, species choice, economics of production and environmental impacts, and demonstrate operational short rotation forestry production systems.

Action

- Implement the agreed recommendations of the Wood Fuel Task Force to encourage adoption of SRC and short rotation forestry for wood energy production.
- Establish a network of energy forestry trial sites on the national forest estate.

Regularising the woodland carbon offsetting sector

Companies and organisations with a commitment to the environment have long been involved with initiatives to create woodlands for delivering environmental and community benefits – part of a sphere of activity known as corporate and social responsibility (CSR). In recent years this interest has extended to include offsetting carbon emissions either corporately or on behalf of customers. There have been a wide variety of schemes with varying offers and different carbon offset prices. Some schemes are opaque as to what precisely is being bought, the degree of additionality, and the approach to permanence issues.

The Forestry Commission is working with stakeholders to regularise the woodland carbon offset sector. Actions defined in previous sections aim to:

- establish a protocol for carbon conservation in forests;
- facilitate development of a forest carbon assurance scheme; and
- establish a robust carbon sequestration monitoring and reporting framework.

These elements will contribute to regularising the woodland carbon offsetting sector. The fourth necessary element is the development and promotion of a 'code of practice' for woodland carbon offsetting.

Action

- With stakeholders develop and promote a code of practice for woodland carbon offsetting as one element of a four-part package on forest carbon management.

Adapting to climate change

Facilitating ecological adaptation

Summary of priorities

- Counter woodland fragmentation.
- Promote low impact woodland management in core networks.
- Focus on the most vulnerable woodland types.
- Increase the contribution of plantation origin woodlands.
- Develop a better understanding of key species responses, and adapt priorities and management strategies accordingly.
- Improve understanding of the implications for climate change for genetic conservation.

Countering woodland fragmentation

Since prehistory, native woodland cover and other habitats have been fragmented by human action - from grazing of livestock, through clearance for agriculture, to urban expansion. Many remaining woodlands have become virtual 'islands' for some species, restricting their 'mobility' and genetic adaptation, and hindering ecosystem adjustments in response to climate change. A key need is to build their capacity to adapt.¹⁴

A key approach to help restore and maintain the ecological function of woodlands at the landscape scale is the development of forest habitat networks (FHNs). It is now considered likely that habitat networks can increase the resilience of an ecosystem to external pressure such as climate change. Forest habitat networks encourage woodland species' dispersal by providing a more permeable landscape. This is particularly beneficial when woodland mosaics link to high biodiversity native woodland habitat. Network developments must recognise the biological and physical needs of key plant and animal communities, and must also enable altitudinal, as well as latitudinal, mobility. Development must also provide adequate buffering around high quality core areas to increase their robustness and, in the long term, expand the area of high quality woodland.

Actions

- Publish GIS-based maps of FHNs, based on BEETLE¹⁵, at the national and regional scale, and encourage their incorporation into strategic land-use plans such as Indicative Forestry Strategies, Local Forestry Frameworks and long-term forest plans.
- Encourage FHN creation and maintenance through land use support measures.
- Monitor woodland connectivity using woodland distribution spatial data.

¹⁴ For example see: 'Conserving biodiversity in a changing climate: guidance on building capacity to adapt': (www.ukbap.org.uk/library/brig/BRIGGuidanceWebpdf.pdf)

¹⁵ Biological and Environmental Evaluation Tools for Landscape Ecology (www.forestry.gov.uk/fr/infid-69pla5)

Adapting to climate change

Promoting low impact woodland management in core networks

Inappropriate management can disrupt the integrity of a habitat network as well as soil carbon stocks. For most Scottish native woodland types, minimal disturbance, with low intervention or continuous cover management, will be most appropriate.

Actions

- Define core FHNs.
- Develop guidance on the use of low impact silvicultural systems (LISS) in Scotland.
- Include LISS considerations in long-term forest plans.
- Align land use incentives to support LISS in core FHNs.

Focus on the most vulnerable woodland types

The species assemblages in native woodlands will change under the influence of climate change as individual species react differently to the subtle changes. We will need to accept this process and facilitate it through increased habitat connectivity and by allowing a dynamic interface between wooded and open habitats, particularly at high elevation. The most vulnerable woodland types are those which are most highly fragmented; have a narrow biophysical niche; and are dependent on narrow climatic characteristics.

Research¹⁶ has suggested the following trends associated with climate change:

- Pinewoods
 - A shift to higher elevation and further west.
 - A greater broadleaf component in current pinewoods.
 - Opportunity for development of higher elevation scrub communities.
 - Potentially greater incidence of fires.
- Oakwoods
 - Greater seasonal variation in rainfall affecting lower plant assemblages.
 - Increased presence of other broadleaf species, including beech (west) and sycamore (east).
- Birchwoods
 - This pioneer species will become abundant in natural colonisation and regeneration after disturbance.
- Mixed broadleaf woodlands
 - Increased storm and fire damage.
 - More beech and sycamore.
 - Spread of bramble
- Ashwoods

¹⁶ 'Impacts of climate change on forestry in Scotland' (www.forestresearch.gov.uk/climatechangescotland)

Adapting to climate change

- Likely to be a relatively resilient woodland type.
- Ash increasingly planted for timber and woodfuel on improved ground.
- Wet woodlands
 - More winter flooding may affect species mix.
 - Increased wet woodland creation as a flood, erosion and water quality management tool.

Actions

- Refine initial models on the potential impact of climate change on native woodland type and distribution.
- Through spatial modelling and the use of decision support tools like Ecological Site Classification identify priority sites for woodland expansion or restoration.
- Target incentives to maintain, enhance and expand vulnerable woodland types.
- Measure progress as part of the Scottish Biodiversity Strategy monitoring framework.

Increase the contribution of plantation-origin woodlands

Plantation origin woodlands can acquire biodiversity quickly and make an important contribution to climate change adaptation. Management practices that enhance structural and species diversity will increase their usefulness as part of forest habitat networks. Long-term protection of significant 'old growth' stands offers opportunities to buffer woodland species, even if in 'new natural' ecological communities. These principles are embedded in currently recommended forest design and management practices.

Actions

- Promote adoption of guidance on enhancing plantation origin woodlands, including the designation and management of old-growth stands and sites of minimal intervention.
- Target incentives to enhance plantation biodiversity, particularly the appropriate management of old growth stands and woods integral to forest habitat networks.
- Encourage the use of long-term forest plans as a basis for restructuring and diversifying and connecting high biodiversity woodlands.

Develop and use a better understanding of key species responses

Species level responses to climate change will often be complex and are generally poorly understood. Asynchronisation of conditions necessary for successful reproduction is emerging as a threat, most obviously for some woodland birds where climate change is desynchronising hatching date and peak insect food supply. Work is underway to understand the requirements of the most rapidly declining species.

'Climatic release' of potentially invasive species is an indirect climate change threat to habitats and species. Further work is needed to identify species that might be put at future risk by climate change.

Adapting to climate change

Actions

- Promote research on species/climate change interactions and incorporate research findings into best practice guidance.

Better understand the implications of climate change for genetic conservation

FCS has published guidance on seed sources for planting native trees and shrubs in Scotland¹⁷. This encourages the use of natural regeneration and colonisation where feasible. Where planting is required, the aim is to promote the sourcing and use of planting stock to:

- be both fit for purpose and ecologically adapted to the planting site;
- maintain or enhance genetic adaptation/fitness of our tree and shrub populations, and their capacity to adapt to changing environmental conditions;
- sustain sufficient genetic variation to provide for future uses of trees for all purposes;
- help to maintain and restore natural genetic processes in tree populations, especially gene flow and natural selection; and
- help conserve those patterns of the genetic structure of tree populations that reflect their evolutionary history.

Actions

- Embed genetic resource guidance in forestry support measures.
- Update guidance as research understanding develops.

Examples of action

In 2003 Forestry Commission Scotland and Scottish Natural Heritage published guidance on '*habitat networks for wildlife and people*'. More recently a number of Forest Habitat Networks (FHNs) have been published e.g. Edinburgh and the Lothians¹⁸.

In 2005 FCS commissioned Macaulay Research Consultancy Services to investigate possible opportunities for future forest development in Scotland, including expansion to favour biodiversity. This work was further developed by Forest Research in 2006 to look at policy priorities, including biodiversity enhancement focused on functional FHNs¹⁹.

In 2007 Forest Research published guidance on the role of forest genetic resources in helping British forests respond to climate change²⁰.

¹⁷ www.forestry.gov.uk/forestry/infd-6uu3

¹⁸ <http://www.forestresearch.gov.uk/fr/INFD-6V4CWF>

¹⁹ www.forestry.gov.uk/forestry/infd-6mgfky

²⁰ [www.forestry.gov.uk/PDF/FCIN086.pdf/\\$FILE/FCIN086.pdf](http://www.forestry.gov.uk/PDF/FCIN086.pdf/$FILE/FCIN086.pdf)

Adapting to climate change

Pests, diseases and weather threats

Summary of priorities

- With FC's Plant Health Branch secure research and seek stakeholder advice on pest/disease risks in Scotland and implement agreed precautionary actions.
- Monitor principal risks.
- Maintain emergency response readiness.
- Ensure that potential climate change interactions are considered in management plans.

Climate change is predicted to bring new and intensified threats to forestry and woodlands. Some existing benign species may undergo 'climatic release' and become problematic. New pests and diseases may reach Scotland either naturally or linked to human travel and transport. A warming climate is predicted to result in an increased frequency of intense and extreme weather events like storms and droughts. A risk management framework is used to review biological and weather threats and determine appropriate action. The focus here is on climate change aspects of threats to forestry and woodlands; only those threats that may have a significant climate change dimension are covered.

By agreement with the devolved administrations the Forestry Commission (through its Plant Health Branch) develops and implements Plant Health regulations at EU and GB level. This has the vital task of protecting UK and EU forests from harmful pests and diseases.

Risk	Impact	Likelihood	Response	Control	Action
Green spruce aphid impacts on stressed spruce	Medium	High	Treat	Avoid vulnerable tree species on sites likely to lead to tree stress.	Undertake research needed to develop specific guidance.
Increased over-winter survival of pine weevils - a major pest of newly planted trees	High	Medium	Treat	Implement Integrated Pest Management strategy currently in development ²¹ , with targeted, minimal use of insecticide treatment.	Promulgate best practice guidance.
Increased prevalence of Red Band Needle Blight in	High	High	Monitor and adapt forest practices such as early	None as yet. Planting of Corsican pine has been suspended	Through research, identify climate change interactions,

²¹ www.forestry.gov.uk/fr/INFD-62WKG9

Adapting to climate change

Risk	Impact	Likelihood	Response	Control	Action
Corsican pine and Lodgepole pine and possible increase in other pines			thinning.	due to the growing impacts of this disease.	alternative species and appropriate disease management strategies.
Spread of the fungal-like pathogens <i>Phytophthora ramorum</i> (the agent of sudden oak death), and <i>P. kernoviae</i> .	Medium	High	Monitor	SGRPID ²² inspection programme of nursery visits and subsequent eradication measures if required. SGRPID/FC Plant Health Branch have outbreak procedures in place and undertake intensive surveys around outbreak areas.	Research climate change and species interactions.
Increased activity of tree damaging bark beetle eg <i>Ips cembrae</i> , <i>Dendroctonus micans</i> .	Medium	Medium	Monitor	Prevent ingress of new species into UK through import controls and, for existing species, implement pest management programmes.	Research climate change interactions.
Impact from new or previously benign pests and diseases	Low to High	Medium	Monitor	Maintain a pest monitoring and alert service through Forest Research, FC Plant Health Branch and SGRPID (tree imports).	Take immediate action on relevant alerts. Hold periodic regional forest health days for practitioners. Amend import and/or domestic phytosanitary

²² Scottish Government Rural Payments and Inspections Directorate

Adapting to climate change

Risk	Impact	Likelihood	Response	Control	Action
					regulations as required.
Increased survival and fecundity of deer	Medium	High	Treat	Accommodated by existing deer management strategies.	Monitor deer numbers and impacts.
Spread of grey squirrels and increased competitive advantage over red squirrels	Medium	High	Treat	Existing squirrel strategies.	Ensure climate change implications are built into squirrel population models.
Spread of new or existing invasive plant species	Low to High	Low to High	Treat	Identify species likely to experience climatic release. Monitor feedback from field staff on emergence of invasive plant species. Plan collaborative control strategies and early eradication where impacts are likely to be significant.	Work with partners through the Species Action Framework process ²³ .
Catastrophic windblow	Medium	Medium	Treat/ tolerate	Diversify forest age structures to reduce impact. Ensure readiness through contingency plans	Develop, and maintain in readiness, catastrophic windblow contingency plans.
Increased risk of forest fires, particularly in late summer.	Low/ medium	Medium	Tolerate	Existing fire plans and procedures.	Monitor forest fire trends in Scotland through the Scottish Wildfire Forum ²⁴ .

²³ www.snh.org.uk/speciesactionframework/default.asp

²⁴ www.scotland.gov.uk/Topics/Justice/Fire/15130/wildfireforum

Adapting to climate change

Examples of action

Forestry Commission Operational Guidance Booklet 17 *Planning for the Unexpected* was published in 2003 and revised in January 2008. It provides a preparation and response framework for a range of management risks including those relating to storms and fires.

A *Contingency Plan for Serious Pest Outbreaks in British Trees* has been prepared by FC Plant Health Branch.

Silviculture and forest operations

Summary of priorities

- Identify where change of species or increase in species or provenance diversity is advisable.
- Identify situations where climate change may affect choice of silvicultural system or practice.
- Identify appropriate modifications to civil engineering specifications and advice.

Identify where change of species or increase in species or provenance diversity is advisable

Commercial tree species and provenances have different site and climatic preferences. Some aspects of climate change and increasing atmospheric CO₂ concentrations may be beneficial to tree growth, but species with exacting requirements, or which are being used on the edge of their range, are more vulnerable to climate change. Likewise, species in locations and on soil types likely to be subject to greatest change are more vulnerable. Vulnerability may show as poor establishment, poor growth rates, susceptibility to pests and diseases, poor form or poor timber characteristics. While use of natural regeneration may increase site/species compatibility, this does not take into account future climate and is often influenced by a range of other factors.

Mixing species in stands, regardless of management system, will help to spread the risk associated with biotic and abiotic impacts. Where LISS is inappropriate, use of mixed species within stands can help spread risk under clearfelling-restocking management systems.

More work is needed to identify situations where deliberate species or provenance change may be advisable within a silvicultural time-scale. It is too early to give definitive recommendations but initial research²⁵ has provided the following pointers:

- Productivity is likely to increase (with another 2–4m³/ha/yr likely for Sitka spruce) as a result of warmer summers where nitrogen and water resources are not limited.
- The suitability distribution of Sitka spruce (and certain other species) will change in

²⁵ Impacts of climate change on forestry in Scotland' (www.forestresearch.gov.uk/climatechangescotland)

Adapting to climate change

Scotland, with declining suitability in the east. Where Sitka spruce is used in Scotland, the choice of provenance, predominantly Queen Charlotte Island, should not be changed.

- Initial investigations suggest that climate change is unlikely to have a significant effect on the proportion of structural-grade Sitka spruce timber in Scotland. However, it is uncertain whether an increase in leader breakage in winter months will have an impact on timber quality.
- Douglas fir provenance should be reviewed for Scotland: some material currently used in France may become well suited to Scottish conditions.
- However, for most species, continental provenances tend to be unsuitable in Britain, and will continue to be so. Although the climate will change, it will not become continental – just a little more Mediterranean, with warmer, drier summers and milder, wetter winters. However, more temperate provenances may be vulnerable to frost damage as the growing season will lengthen, and for some tree species bud-burst will occur earlier, and dormancy will occur later.
- Using plant material from a wide range of ‘families’ will help maintain and improve the genetic diversity of forest material.
- Several alternative species for a warmer climate might become suited on specific site types in Scotland like Monterey pine, Maritime pine, Southern beech (*Nothofagus*) and walnut.

Actions

- Through continued research, identify locations where species choice and/or diversification should be considered for climate change reasons.
- Develop a programme of research to evaluate productive species and provenances that may be more suited to Scotland’s future climate.

Identify situations where climate change may affect choice of silvicultural system or practice

Climate predictions suggest that the climate will become more variable, with greater risk of extreme events. Therefore, a primary objective of silviculture and management should be to spread risk in a way that reduces the impact of damaging events and increases the resilience of Scottish forests.

Where exposure allows, lower impact silvicultural systems may become more appropriate where carbon conservation is a high priority or where reducing the degree of change to the microclimate of woodland sites can increase the robustness of the forest system. Managing stands to maintain a more continuous and even canopy roughness will also help to reduce the risk of wind damage, as will early and more frequent thinning interventions.

The increasing variability of the wind climate is likely to reduce the productive potential of the most exposed areas of forest. In the future climate, the distribution of extreme wind speeds will change and Scotland is likely to be exposed to an increased frequency of high-

Adapting to climate change

magnitude events. Therefore, the productive limit of exposure will need to be reviewed if evidence emerges of increased windthrow risk on exposed sites.

Increased winter rainfall may affect the ability to undertake repeated stand management (such as thinning) on some soils due to reduced accessibility for machinery and increased risk of windthrow. Research is needed to identify situations where thinning or continuous cover management opportunities can be maintained or sought and others where they may become more limited.

The window for lifting nursery stock will be reduced by the lengthening growing season and wetter winter conditions. This will constrain the planting season for bare-rooted stock, as will the likelihood of spring drought in eastern areas. There will be a much greater need for irrigation systems in Scotland's easterly tree nurseries.

Actions

- Undertake research and monitoring to identify situations where silvicultural practices are becoming inappropriate to Scotland's changing climate and to provide practical alternative systems.

Identify appropriate modifications to civil engineering specifications and advice

Increased intensity of rainfall needs to be taken into account when specifying civil engineering structures such as bridges and culverts within forests, and in site-by-site application of specifications for roadside drains and batter slopes.

Actions

- Following consultation with SEPA²⁶, publish forest civil engineering guidance compliant with the spirit of the Water Environment and Water Services (Scotland) Act 2003.

Examples of action

In 2007 FCS and SEPA held a 'Controlled Activities Regulations' seminar for FCS and FES field staff.

In January 2008 a Forest Research Note 'Impacts of climate change on forestry in Scotland'²⁷ set out an initial assessment of how forests and forestry in Scotland will be affected by climate change.

²⁶ Scottish Environmental Protection Agency

²⁷ www.forestresearch.gov.uk/climatechangescotland

Adapting to climate change

Environmental protection

Summary of priorities

- Help tackle slope instability issues in sensitive locations.
- Increase the contribution of woodland in mitigating riverbank erosion.
- Establish the practical potential for forestry in flood risk management.

Climate change predictions suggest a possible increase in extreme rainfall events. Water management is already a major feature of Scottish forestry practice and is subject to tried and tested Forests and Water Guidelines. However, risks and opportunities may be accentuated by climate change.

Tackle slope instability issues in sensitive locations

There is limited need for 'continental style' protection forestry, which, in Europe, is used mainly to protect settlements from avalanche and rock fall. In Scotland, slope instability and landslides are greater problems. In sensitive locations plantation forestry has sometimes been detrimental to slope stability by accelerating runoff from site drainage, a reduction in ground vegetation under tree canopies and windthrow. Clearfelling, machine trafficking and in-forest civil engineering can also contribute to slope instability with a subsequent risk of watercourse sedimentation.

Woodlands managed using lower impact systems can aid slope stability compared to intensively grazed land. However, this is unlikely to be more effective than lightly grazed or ungrazed swards, particularly given the long-term risk of soil disturbance by windthrow.

Actions

- Monitor the occurrence of landslides within forests.
- Identify at-risk locations and facilitate the implementation of local site management strategies to help combat slope instability.

Increase the contribution of woodland in mitigating riverbank erosion

Closed canopy conifer stands can sometimes be detrimental to riverbank stability. It has been established practice for many years to prevent such situations occurring and to rectify, at the appropriate intervention window, those sites currently at risk. Conversely, establishing native trees and shrubs is one of the most effective ways of stabilising riverbanks, as well as giving wider biodiversity benefits. This approach should continue to be promoted as a sustainable, natural solution to undesirable riverbank erosion.

Action

- Through the River Basin Management Planning process, help develop erosion management strategies in vulnerable areas.

Adapting to climate change

Establish the practical potential for forestry in flood risk management

Forestry is unlikely to have a major role in flood avoidance in Scotland, with evidence suggesting that forestry has an overall neutral affect on flood flows. However, in critical catchments, varying the proportions and types of woodland cover in tributary catchments may help to desynchronise peak flows sufficiently to reduce flood spate. This has been evident in computer modelling and needs to be empirically tested.

Floodplain woodland could make a significant contribution to sustainable flood management in Scotland. If initial research findings are confirmed, there would be significant scope for using floodplain woodland in the middle and upper reaches of catchments to delay and reduce downstream flood flows. In larger catchments this strategy would complement other flood defences. In smaller catchments, floodplain woodlands could be the principal defence. Whilst taking several decades to establish fully, this time scale is consistent with the rate of climate change.

Actions

- Continue to investigate the role of floodplain woodlands in sustainable flood management, promoting the establishment of catchment-scale, integrated land use flood management studies in Scotland.
- Through Scotland's Flooding Bill Advisory Group and the River Basin Management Planning process advise on woodland related opportunities for sustainable flood management.
- Provide advice to Ministers on forestry-related aspects of the Flooding Bill²⁸.

Example of action

FCS is a partner in the SAFER (Strategies and Actions for Flood Emergency Risk Management)²⁹ EU Interreg project. One project action is development of an emergency response plan for the community and stakeholders at risk from flooding by the river Enrick in Glen Urquhart, Highland. The plan uses a web-based automated emergency system that contacts stakeholders through a range of communication channels.

FCS is a Responsible Authority under the Water Environment and Water Services (Scotland) Act 2003 {Designation of Responsible Authorities and Functions} Order 2006 and participates actively in River Basin Area Advisory Groups as well as the National Advisory Group for the Scotland River Basin District.

²⁸ www.scotland.gov.uk/Publications/2008/02/13095729/4

²⁹ www.eu-safer.de/

Sustainably produced wood for energy and construction

Increase wood use for renewable energy

Summary of priorities

- Supporting the use of woody biomass for energy.
- Facilitating supply chain development for wood fuel.
- Supporting implementation of the Biomass Action Plan for Scotland, Scotland's Renewable Heat Strategy and the agreed recommendations of the Wood Fuel Task Force.
- Acting as an exemplar for the use of biomass heating in new developments.

Supporting the use of wood for energy

The Scottish Government is committed to sourcing 50% of Scotland's electricity demand from renewables by 2020. It is also committed to increasing the contribution of wood fuel in tackling climate change. Use of wood for fuel is a key component of Scotland's forestry carbon saving target³⁰. The Biomass Action Plan for Scotland³¹ and the forthcoming Scotland's Renewable Heat Strategy (see also the recent FREDS recommendations³²) map how this will be done.

A suite of grant incentives have been designed to encourage installation of biomass energy systems, including the Scottish Community and Household Renewables Initiative³³, the Scottish Biomass Support Scheme³⁴, and through Rural Development Contracts from 2008. FCS is taking opportunities to install exemplar biomass heating schemes in its own new and refurbished offices and buildings.

Examples of action

- Establishment of a Wood Fuel Information Officer Network.
- Delivering the Scottish Biomass Support Scheme.
- Launching the one-stop-shop "Wood Energy Scotland" web site in 2006 (www.usewoodfuel.co.uk).
- FCS has installed 4 biomass heating systems in its own new or refurbished buildings.

³⁰ *Changing Our Ways* – Scotland's Climate Change Programme
www.scotland.gov.uk/Publications/2006/03/30091039/0

³¹ www.scotland.gov.uk/Publications/2007/03/12095912/0

³² Forum for Renewable Energy Development in Scotland: "Scotland's Renewable Heat Strategy: Recommendations to Scottish Ministers" www.scotland.gov.uk/211131

³³ www.energysavingtrust.org.uk/schri

³⁴ www.scotland.gov.uk/Topics/Business-Industry/Energy/19185/BioSupport/BioSupportIntro

Sustainably produced wood for energy and construction

Facilitating supply chain development for wood fuel

A Wood Fuel Task Force was established by the Environment Minister in 2007 to examine how to mobilise wood fuel resources from woodlands, energy crops, landscaping activity and waste streams. It reported in January 2008³⁵.

FCS is playing a significant role in the development of the wood fuel supply chain. A network of Wood Fuel Information Officers as been established across Scotland and a wood fuel web site (www.usewoodfuel.co.uk/) provides a wealth of information. Regional events are held to promote biomass energy opportunities, and a network of energy forestry demonstrations are being developed. FCS funds an annual survey of wood fuel use and is working to further develop production forecasting procedures to include wood fuel. Research and development plans are being prepared to improve techniques for wood fuel production and recovery from forests and through short rotation coppice and short rotation forestry systems.

A suite of grant incentives have been designed to stimulate wood fuel supply chain development, including the Scottish Biomass Support Scheme and through Rural Development Contracts from 2008. An increasing amount of material suitable for wood fuel from the national forest estate is being put on the open market

Actions

- Take a leadership role for actions to develop Scotland's wood fuel supply chain as identified in the Biomass Action Plan and Renewable Heat Strategy.
- Increase the supply of material suitable for wood fuel by implementing the agreed recommendations of the Wood Fuel Task Force.
- Increase environmentally sustainable wood fuel recovery from the national forest estate.
- Undertake regular wood fuel availability and usage surveys.

Examples of action

- Implementation of an 'energy from woodland' pilot for wood energy supply-chain development, and incorporation into Rural Development Contracts.
- Convening of the Wood Fuel Taskforce.
- Tendering an additional 115,000 green tonnes in 2006 and a further 75,000 green tonnes of material suitable for wood fuel from the national forest estate

³⁵ www.forestry.gov.uk/forestry/INFD-7APFXA

Sustainably produced wood for energy and construction

Encouraging other forms of renewable energy

Summary of priorities

- Encourage other forms of renewable energy production on forest land.

Given the Scottish Government's commitment to source 50% of Scotland's electricity demand from renewables by 2020, there may be significant further opportunities for income generation on forest land from wind, hydro and micro power. Planning and environmental safeguards will need to be in place to ensure that such generation is compatible with sustainable forest management and the forthcoming deforestation policy for Scotland (see page 6).

Action

- Support the development of appropriate planning guidance on renewable energy.
- Promote the use of forest land for all forms of renewable energy production, subject to appropriate environmental and planning safeguards.

Increase the use of timber

Summary of priorities

- Increase the use of timber, and in particular local timber, as a substitute for more energy intensive materials.

FCS has published a Timber Development programme³⁶ to improve the value of, and access the most appropriate markets for, homegrown timber, focusing on four objectives:

1. Promoting a predictable and stable timber supply. One aim is to produce a more accurate long-term forecast of timber production from the private sector. This will provide the industry with greater confidence to identify and plan for development and investment opportunities.
2. Encouraging more use of timber and timber products. A key output is to continue to support specific activities where there is a clear market opportunity for home-grown timber. Work is also to be commissioned to compare the carbon impact of wood with other materials in a range of building types.
3. Encouraging improvements to the timber supply chain efficiency. Initiatives such as the Strategic Timber Transport Fund³⁷ are designed to minimise the impact of timber transport on the environment and rural communities. Encouraging haulage via rail or sea

³⁶ www.forestry.gov.uk/forestry/INFD-7BMMPR

³⁷ www.forestry.gov.uk/forestry/infd-6w2f7a

Sustainably produced wood for energy and construction

and opening up access to landlocked forest areas will allow more timber to be harvested. This flow of timber is essential for satisfying increasing demand for existing and emerging markets for wood products such as wood fuel.

4. Encouraging improvements to the quality of the growing stock. A series of projects will be carried out to improve the fitness-for-purpose of timber including encouraging growing quality broadleaves for the domestic hardwood sector.

Action

- Implement the FCS Timber Development Programme.

Examples of action

The FCS Timber Development Programme was launched in December 2007 with 60 actions towards increasing value-added from Scottish timber and the competitiveness of Scotland's timber supply chain.

The Centre for Timber Engineering (CTE)³⁸, based at Napier University, was opened in January 2003 and serves a focus for excellence in providing education, research and consultancy in the various constructional uses of timber.

Wood for good. www.woodforgood.com/about/index.html is a generic wood campaign started in 2000 and sponsored by the Confederation of Forest Industries (UK) Ltd, the Nordic Timber Council, Forestry Commission and the Forest Service of Northern Ireland. It is the largest timber promotional campaign ever undertaken in the UK.

³⁸ www.cte.napier.ac.uk/

Reducing the forestry sector's carbon footprint

Timber transport

Summary of priorities

- Promote measures that minimise roundwood road miles.
- Promote local processing and use of timber.

As three-quarters of the UK's wood requirements are met from imports, the use of home-grown timber represents a significant reduction in 'timber miles', and hence the carbon footprint, required to supply our needs. Nevertheless, with transport accounting for 20-50 per cent of the cost of roundwood delivered to Scottish mills, it is a major factor affecting the profitability of the Scottish forest industries.

Currently over 90% of all roundwood entering Scottish mills is moved by road and there would be social, environmental and economic benefits in reducing timber lorry miles by, for example, transfer to rail and sea, and by encouraging the development of local timber markets, particularly those based on wood fuel.

The Strategic Timber Transport Scheme³⁹ (and associated Fund) administered by FCS in association with the Timber Transport Forum, helps to support projects that reduce the impact of timber lorries on Scotland's rural roads. Other Scottish Government support measures include the Freight Facilities Grant⁴⁰ (FFG) and the Waterborne Freight Grant⁴¹ (WFG).

Actions

- Establish a baseline index against which roundwood road transport miles can be monitored.
- Promote practical measures and facilitate sustainable projects that minimise roundwood road miles per unit of timber.
- Increase local use and processing of timber through implementation of the FCS Timber Development Programme, Biomass Action Plan and Renewable Heat Strategy.

Example of action

Following a Public Service tender by FCS, the Timberlink Service was established to ship around 100,000 tonnes of timber a year from Argyll to Ayrshire. The service removes around 8,000 lorry journeys – or nearly one million lorry miles – a year from mainland roads.

³⁹ www.forestry.gov.uk/forestry/inf-d-6w2f7a

⁴⁰ www.scotland.gov.uk/Topics/Transport/FT/freightgrants1

⁴¹ www.scotland.gov.uk/Topics/Transport/FT/WFGapp

Reducing the forestry sector's carbon footprint

Forestry Commission Scotland corporate activity

Summary of priorities

- *Maintain a clear sector and corporate framework for responding to climate change.*
- *Reduce the carbon footprint of FCS.*

The development of a forestry sector climate change action plan was a key need identified in the Scottish Forestry Strategy. This Plan is Forestry Commission Scotland's response to that need and will be kept under regular review, consulting with stakeholders to ensure it keeps pace with emerging priorities. At a corporate level climate change considerations will be embodied in the Commission's Corporate Plans.

Forestry Commission Scotland will 'lead by example' in the way it manages its corporate management activities and by investigating and demonstrating opportunities for carbon footprint reductions in the management of the national forest estate.

Actions

- Review the FCS Climate change action plan in 2010.
- Participate in the Greener Government Programme.
- Embody climate change considerations in the 08/09 – 10/11 FCS Corporate Plan.
- Develop the exemplar role of the national forest estate in woodland creation, reducing the carbon footprint of forestry practices, and the siting of appropriate renewable energy developments.
- Through participation in the FC *Greenerways* project establish a baseline carbon footprint for FCS and set appropriate targets to reduce that footprint.

Examples of action

By 2007 the Forestry Commission had 115 vehicles in Scotland using bio-diesel refined from vegetable oil including used cooking oil. By 2008/09 the target is for 30% of its fleet's road fuel to be sustainably produced bio-diesel (based on 5% equivalent).

The Forestry Commission Scotland's new Inverness District Office was opened in January 2007 and is recognised as one of the best examples of quality, sustainable construction in the country. It flagships what can be achieved with Scottish grown and certified timber, with every component of the building's structure and fabric green-book A rated. Additional heating, when required, is provided by a carbon-friendly wood fuel boiler.

Awareness raising

Awareness raising

Summary of priorities

- *Build a sound evidence base for developing and monitoring forestry's contribution to tackling climate change.*
- *Raise awareness of the contribution that forests, woods and trees can make to tackling climate change in Scotland.*

Scotland's Climate Change Programme identified forestry as having a key role in helping to tackle climate change. Developing and communicating that role further, based on a sound evidence base, is essential if forestry is to be fully assimilated in climate change policy and practice across the state, private and voluntary sectors in Scotland.

Actions

- Provide advice to Ministers on forestry-related aspects of the Scottish Climate Change Bill.
- Promote forestry's role in tackling climate change through engagement with appropriate Governmental, sectoral and cross-sectoral forums.
- Commission or support relevant research through the FCS and Scottish Government research commissioning processes.
- Support the development of a Centre for Forestry and Climate Change as a focal point for Forestry Commission expertise.
- Enhance the dissemination of forestry & climate change information relevant to Scotland through the FC Climate Change Communications Strategy, and the continued development of the Forestry Commission climate change web site.
- Through Forest Research and best practice seminars promote understanding and delivery of climate change actions in the forestry sector.
- Ensure wide dissemination of the FCS Climate change action plan to stakeholders.
- Through regular 'Public Opinion of Forestry Surveys'⁴² monitor public awareness of forestry's role in helping to combat climate change.

Examples of action

To promote the role of forestry in helping to tackle climate change, the Forestry Commission has produced innovative DVDs entitled "[Forests and climate change: A convenient truth?](#)"

The Forestry Commission launched its [Forestry and Climate Change web-site](#) in 2006.

⁴² www.forestry.gov.uk/statistics

Measuring progress

Measuring progress

Summary of priorities

- *Monitor forestry's contribution to tackling climate change.*

To track progress and allow the periodic reassessment of priorities, corporate and sectoral monitoring frameworks for forestry & climate change will be established, and reports produced annually. These will include quantitative and qualitative assessments.

Actions

- Establish and maintain an appropriate climate change & forestry monitoring framework for the forestry sector as a component of Scottish Forestry Strategy Implementation Plans⁴³.
- Report progress on climate change actions in FCS Annual Reports.
- Present an annual progress report on the FCS Climate change action plan to the Scottish Forestry Forum and publish this on the FCS website.

Examples of Action

The Scottish Forestry Strategy 2006 included a suite of indicators for each of the seven key themes, including climate change. These have been developed, and baseline assessments initiated, as a key component of the 2007-2008 Implementation Plan.

⁴³ www.forestry.gov.uk/sfs

Forestry Commission Scotland serves as the forestry department of the Scottish Government and is responsible to Scottish Ministers

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