9.
RURAL LAND USE

Photograph: Forest Carbon Ltd

9. Rural land use

9.1 Introduction

9.1.1 In this chapter, the term 'rural land use' covers agriculture and related land use, peatland restoration and forestry. Emissions in these sectors come from livestock, agricultural soils, animal wastes and certain land use changes. Importantly, some biological processes also have the capacity to absorb carbon dioxide from the atmosphere and store carbon in soils and vegetation.

9.2 Our ambitions for rural land use

9.2.1 Our 2009 transformational outcome was to develop a comprehensive approach to ensure that carbon (including the cost of carbon) is fully factored into strategic and local decisions about rural land use through: appropriate protection for Scotland's carbon rich soils; minimising emissions from agricultural and other land use businesses; encouraging the sequestration of carbon, for example, through woodland planting; and the use of natural resources to generate renewable energy.

9.2.2 In RPP1 we set out process and outcome milestones for supporting emissions reduction:

- Completion in 2011 of research on behaviour change in agriculture and the development of indicators to measure progress in reducing agricultural emissions.

- Incorporation of wetland management data into the net Scottish emissions account to enable peatland restoration to be counted towards Scotland's climate change targets.

- Increase the rate of new woodland creation to an average of 10,000 hectares per year from 2015 onwards.

9.2.3 As we move towards 2027 and beyond, low carbon actions that might seem innovative now should be commonplace across the rural land use sector:

- By 2027 land managers will have further optimised the productive use of natural resources, producing food and delivering public goods, such as protecting the natural environment and reducing greenhouse gas emissions;

- With our partners, we are working to ensure that Scotland's peatlands will be managed in ways that conserve their substantial carbon stores and biodiversity. Where peatlands have been damaged, action will be taken to prevent further damage and where practicable to restore them to a favourable condition in which they are no longer a source of greenhouse gas emissions; and

- We will create 100,000 hectares of new woodland by 2022, equivalent to an average of 10,000 hectares per year, and agree targets for subsequent years by 2020.

9.3 Where we are now

9.3.1 Approximately 80% of Scotland is used for **agricultural** purposes.[253] In 2011, emissions from agriculture and related land use accounted for 20% of total Scottish emissions; that is 10.1 $MtCO_2e$, a decrease of 4.2 $MtCO_2e$, or 29.3%, from 1990.[254]

9.3.2 **Peatlands** cover about 20% of Scotland, some 1.7 million hectares, much of which have been drained or damaged in the past. They contain an estimated 1,600 million tonnes of carbon. It is estimated that 47,000 hectares of peatland have benefited from restoration measures since 1990, giving an annual saving that would amount to 0.02 $MtCO_2e$ by 2027.[255]

9.3.3 Scotland has some 1.4 million hectares of **woodland**, which equates to roughly 18% of total land area. Scotland's woodland sequestered a net total of 9.1 $MtCO_2e$ in 2011. Without this, total Scottish emissions would have been 18% higher. However, following a period of low historic rates of woodland planting, net carbon sequestration rates are currently reducing year on year due to the lower proportion of young trees in Scottish forests.[256]

[253] The Scottish Government, Economic Report on Scottish Agriculture 2012, Table C2: www.scotland.gov.uk/Publications/2012/06/6894/102
[254] Scottish Greenhouse Gas Emissions 2011: www.scotland.gov.uk/Publications/2013/06/1558
[255] Once wetland management activities are incorporated into greenhouse gas emissions reporting.
[256] Ibid

9.4 Decarbonisation policies

9.4.1 Our approach to reducing emissions from the rural land use sector is guided by our Land Use Strategy, which sets out three objectives relating to the economy, environment and communities.[257] These support an integrated approach to managing the competing demands we place on our land resource. They seek to balance a productive land-based sector and a successful tourism and leisure industry, with the vital role that our land plays in maintaining Scotland's rich biodiversity and in storing carbon.

Agriculture

9.4.2 Emissions from the rural land use sector, particularly in agriculture, are dominated by methane and nitrous oxide rather than carbon dioxide, but the term "decarbonisation" is used in this report as general shorthand for reducing greenhouse gas emissions. The transition to low-emission agriculture is aided by a number of linked initiatives developed and supported by the Scottish Government, as well as by industry-led action:

- **research** provides innovative and sustainable solutions and advice on improving efficiency and reducing emissions from farming systems;
- **advisory initiatives** promote sustainable farm practices focusing on resource efficiency and advise on cross-cutting benefits of on-farm action; and
- **support mechanisms** like the Scotland Rural Development Programme (SRDP) aid uptake of sustainability measures in agriculture.

9.4.3 RPP1 described our ambition to influence farming and land management practices through a programme of best practice advice and demonstration. Our ***Farming For A Better Climate*** **(FFBC)** programme, delivered by Scotland's Rural College (SRUC), is designed to encourage voluntary uptake of win-win actions in five key areas:[258]

- farm energy and fuel efficiency;
- renewable energy generation;
- locking carbon into soils and vegetation;
- optimised fertiliser and manure management; and
- optimised livestock management through improved breeding and feeding practices.

[257] The Scottish Government, Land Use Strategy: www.scotland.gov.uk/Topics/Environment/Countryside/Landusestrategy

[258] SRUC, Farming For a Better Climate: www.sruc.ac.uk/climatechange/farmingforabetterclimate/

9.4.4 Given the cost effectiveness of the measures in FFBC, we anticipate that better information provision will increase voluntary uptake by **around 50%** (from starting level) for most of the measures. Some of the livestock measures, particularly those relating to improved breeding practices, may experience lower uptake in the short term due to learning barriers that may make time to overcome.

9.4.5 Estimates of uptake have been taken from published work[259] on behavioural responses to incentives, taking into account issues such as acceptability and costs of implementation. We are developing a monitoring framework, and we intend to survey farmers in 2013 to measure progress towards meeting uptake targets. The information we gather will inform our decision on whether regulation is necessary to secure sufficient emission savings, as discussed further in our proposals outlined in section 9.5 below.

9.4.6 Advisory activities such as FFBC and Future Proofing Scotland's Farming[260] also promote the uptake of adaptation measures, which help to increase the resilience of agriculture to climate change.

9.4.7 It is important to understand the wide range of factors influencing farmer behaviours and decision making, because it will ultimately have an effect on greenhouse gas emission from farming activity. In liaison with stakeholders, the Scottish Government has therefore undertaken a comprehensive study on behavioural change in agriculture.[261] The research is being used to inform and refine the way advisory activities, like FFBC, are carried out.

[259] ADAS, RMP/5142 Analysis of Policy Instruments forReducing Greenhouse Gas Emissions from Agriculture, Forestry and Land Management: http://archive.defra.gov.uk/foodfarm/landmanage/climate/documents/climate-ag-instruments.pdf

[260] Soil Association, Futureproofing Scotland's Farming: www.soilassociation.org/innovativefarming/futureproofingscotlandsfarming

[261] The Scottish Government: Agriculture and Climate Change: Evidence on Influencing Farmer Behaviours - Research Findings: www.scotland.gov.uk/Publications/2012/10/8893

Putting Farming For a Better Climate into practice

FFBC provides best practice information, including practical tutorials and workshops on four 'climate change focus farms' to showcase steps under the FFBC key action areas. It allows visiting farmers to see how the individual measures are being implemented on the focus farm, what business benefits these bring and consider how these might work on their own farms. In addition to the focus farms, farmer meetings and events are held across Scotland on working farms to demonstrate steps other farmers are already taking to reduce emissions. Examples of measures taken on the climate change focus farms include:

Ross Paton, Organic Dairy Farmer, Nr Castle Douglas

After benchmarking energy use in the dairy, Ross Paton identified a number of ways to reduce electricity use. One of the measures, retrofitting variable speed control on vacuum pumps in the dairy, could save around £5,500 over ten years based on current energy prices.

Robert and Jac Neill, Beef and Arable, Nr Jedburgh

Linking GIS technology to soil sampling has allowed Robert and Jac Neill to accurately assess nutrient requirements across the farm. Precision fertiliser application will allow optimum use of nutrients and lead to improved efficiency and profitability through more uniform yields, whilst at the same time nitrous oxide emissions are reduced.

Neil and Linsey Butler, Mixed Dairy Farm, Nr Perth

Improved use of clover in silage fields, tailoring application of manures based on soil analyses and topping up with nitrogen, associated savings in fuel use are just some of the measures Neil and Linsey are implementing. Savings could be in the region of £10,000 with no loss of production.

David Houstoun, Upland Beef and Sheep Farmer, Nr Blairgowrie

Following analysis of pit silage, David was able to feed concentrates to his 1,042 ewes two weeks later than usual, and reduce the amount of feed for the remaining six weeks based on silage quality. This was a saving of just under £3,000 and nearly five tonnes of carbon with no loss of production from the farm.

Peatland Restoration

9.4.8 When peatlands are drained or otherwise disturbed, they are liable to lose carbon through oxidation to form carbon dioxide. Where they are in good condition, or restoration has resulted in the re-growth of sphagnum moss, they can sequester carbon dioxide. In RPP1, we recognised that **peatlands should be conserved and where practicable restored**. The Land Use Strategy also recognised the potential importance of peatlands in climate change mitigation.[262]

9.4.9 While little new drainage of peatland has been carried out in Scotland in the past two decades, there has been some restoration work. Historical data about areas of restored peatland is limited, and projections of the emissions abatement potential of peatland may also be subject to revision in light of developing scientific knowledge and the outcomes of the IPCC process. Already it is clear that re-wetting of peatland that has been drained can prevent losses of carbon to the atmosphere.

9.4.10 It is our policy to incorporate the restoration work across Scottish peatlands in Scottish emissions accounting. There is already funding for peatland conservation measures, such as moorland management, and restoration, such as peat dams, in the Rural Priorities part of the Scottish Rural Development Programme. However the rate of restoration activity needs to be stepped up. We have announced funding of £1.7 million for peatland restoration from 2012 to 2015.

9.4.11 We intend to assess the effects of these measures with a view to developing an enhanced approach to peatland restoration, where possible and as described further in paragraphs 9.5.10-9.5.13 below.

[262] The Scottish Government, Land Use Strategy: www.scotland.gov.uk/Topics/Environment/Countryside/Landusestrategy

Emissions accounting for peatlands

The effects of drainage or of restoration to avert such effects are not included in the current Scottish Greenhouse Gas Inventory unless land use change is involved. However, at the 2011 UN Climate Change Conference in Durban, agreement was reached on the principle of allowing countries to include the effects of wetland management (which includes peatland restoration) since 1990 within their greenhouse gas emissions reporting.

The Scottish Government hosted a meeting of the Intergovernmental Panel on Climate Change (IPCC) Technical Group in 2012. This was part of the IPCC's programme to develop Technical Guidelines for the inclusion of wetland management within national greenhouse gas inventories. Hosting the meeting provided Scottish organisations with opportunities to showcase examples of peatland restoration. The IPCC's Technical Guidelines are expected in mid-2013 and this internationally validated methodology for estimating carbon benefits will assist us in making informed decisions about further action on peatlands. The emissions estimates used in this draft RPP2 are the best available at this time and will be shared with the IPCC Technical Group to help inform their deliberations.

Forestry

9.4.12 During the 1970s and 1980s there was a period of major forest expansion which declined in the 1990s and 2000s. As the average age of Scotland's forests has increased, the quantity of carbon dioxide that they are able to remove from the atmosphere has reduced. We are taking action to reverse this trend. As a result of improvements to the Scotland Rural Development Programme and activity on the national forest estate, new woodland creation nearly doubled between 2009-10 and 2010-11, from 2,700 hectares to 5,100 hectares. A further significant increase was achieved in 2011-12 with a rise to 9,000 hectares.

9.4.13 In RPP1 we committed to **boosting the rate of new woodland creation to 10,000 hectares per year** from 2015 onwards. Forestry Commission Scotland (FCS) is continuing to promote this policy and administer grant support. Forest Enterprise Scotland is delivering afforestation on the National Forest Estate. New forest carbon regulatory mechanisms such as the Woodland Carbon Code will be facilitated by FCS and governed in partnership with industry stakeholders.[263]

[263] Forestry Commission, Woodland Carbon Code: http://www.forestry.gov.uk/forestry/INFD-863FFL

9.5 Decarbonisation proposals

9.5.1 The following Scottish proposals are being developed or are under consideration by Scottish Ministers.

Agriculture

9.5.2 One of the areas with the greatest potential to cut greenhouse gas emissions in agriculture is to optimise the use of nitrogen-based fertilisers and manures. Excess fertiliser, and fertiliser applied at the wrong time using inappropriate application methods, leads to nitrogen leakage to the air as nitrous oxide, a greenhouse gas.

9.5.3 Our FFBC programme seeks to encourage best practice in nitrogen efficiency, emphasising the win-win nature, and the benefits to water and air quality of many of the steps that farmers and land managers can take.

9.5.4 Considerable emission reduction could be achieved if farms in Scotland would optimise their nitrogen usage. The proposal aims at achieving a 90% uptake of nitrogen efficiency measures identified as cost-effective, i.e. resulting in emission reduction without incurring costs at farm level. Discussions as part of the Agriculture and Climate Change Stakeholder Group reinforced the willingness of the agriculture industry to achieve a 90% uptake via a voluntary approach using farm advisory services. The Scottish Government will keep this voluntary framework under review and, depending on the progress that is achieved, will **consider whether measures to regulate nitrogen fertiliser use are also needed**.

9.5.5 Those farmers who adopt efficiency measures early will not be penalised by a regulatory approach. Rather, early adopters will benefit from greater farm business savings. Any action would of course also be sensitive to the level of emissions per unit of food produced. Cutting emissions in a way that could risk undermining Scotland's food-producing sector, at a time when global population and demand for food are growing, is not the way forward.

9.5.6 **Developments in technology** will influence farming practices in the time period to 2027. Some measures which seem costly and or impractical today could become widespread in the future. Although it is not possible to predict precisely, a judgement can be made of which measures may be implemented within the industry post-2020.

9.5.7 For example, a combination of an increased uptake of **livestock management measures** that ensure the maximum production from each animal, along with increased uptake of **anaerobic digestion** technology to transform **animal waste into electricity** and heat could contribute additional abatement in 2027.

9.5.8 Modern approaches to the use of forage legumes, such as white clover, red clover and lucerne, as well as grain legumes, have the potential to reduce emissions by lessening the amount of inorganic nitrogen needed. The development of **precision agricultural technology**, such as the use of GPS, may also influence farming practices. We estimate that these activities could contribute approximately 0.3 $MtCO_2e$ of additional abatement in 2027. These estimates are based on research carried out by SRUC, and are set out in detail in the Technical Appendix to this report.

9.5.9 However, we acknowledge that many of the factors that will influence this outcome, such as the pace of technological progress and the price of inputs such as oil and fertiliser, are largely outside the control of government. Given the number of variables, these measures are classed as proposals in this report. However, we will work with industry to consider how best opportunities such as these might be maximised.

Peatland restoration

9.5.10 We want to maximise the ecosystem and emissions benefits that **restoring degraded peatland** can achieve. This is an area where the science is developing, and new evidence could lead to changes in the estimated benefits, as well as the associated financial costs of carrying out restoration work.

9.5.11 We are working with Scottish Natural Heritage (SNH) to develop a **Peatland Plan**. The Plan will encourage partnerships with private land interests as well as action based on land designated for protection or land that is owned or managed by public bodies or environmental NGOs.

9.5.12 Depending on the final methodology (see 'Emissions Accounting for Peatland' earlier in this chapter) and on-going work to assess the scope for projects in Scotland, it may be possible to achieve significantly greater levels of annual peatland restoration than at present. For example, if the restoration rate were increased to 21,000 hectares per annum, which would be technically feasible, abatement of 0.5 $MtCO_2e$ per year could be achieved by 2027.

9.5.13 With this technical potential in mind, the Scottish Government and SNH will be working with interested parties, represented in the Peatland Working Group (convened by the Moorland Forum). However, achieving substantial increases in the area of peatland restored will depend on collaboration with land managers. In this way, it should be possible to bring about substantial increases in the funding, both public and private, for peatland restoration. One development under consideration is a Peatland Carbon Code, which could reflect the success of the Woodland Carbon Code.

Forestry

9.5.14 Since the publication of RPP1, Forestry Commission Scotland has continued to investigate the potential for emissions abatement by **increasing the amount of Scottish timber used in the construction and refurbishment of buildings.** The CCC has identified timber in construction as a cost effective carbon abatement technology and in its Bioenergy Review it published a carbon hierarchy which placed timber in construction at the top of that hierarchy. [264]

9.5.15 Timber has the lowest embodied energy of any mainstream building material and has the potential to deliver a wide range of benefits, from the substitution impacts of replacing more energy-intensive materials, to the market opportunities presented by increased demand for Scottish timber (which, in turn, would help to incentivise investment in woodland creation) and the future scope for production in Scotland of wood products for export.

9.5.16 Forestry Commission Scotland is working with the Scottish Innovation Gateway research programme aimed at developing and commercialising wood products, processes and systems utilising Scottish timber. Key projects include work on timber panel construction systems and exploring the potential for manufacturing cross laminated timber panels using Scottish softwood.

9.5.17 Achieving these kinds of outcomes over the long-term may require more than simply promoting the benefits of timber as a construction material. The potential role of planning, building standards, local authorities and building design will be considered, as must issues of competitiveness and the need to avoid perverse incentives that might encourage use of timber in inappropriate circumstances.

[264] Committee on Climate Change, Bioenergy Review: www.theccc.org.uk/publication/bioenergy-review

9.5.18 In taking forward this work to promote the low carbon agenda and increased use of timber in construction, Forestry Commission Scotland will co-ordinate and co-fund the project, working in partnership with those identified above alongside others such as Scottish Enterprise and Wood for Good. As part of this project, work has already been commissioned to provide transparent, freely available carbon data for timber products used in construction to ensure that carbon values in buildings can be estimated more accurately.

9.5.19 Given the transformation required in both policy and practice, estimates for potential emission abatement from this proposal do not commence until 2022. However, as we develop this work we will accelerate progress wherever possible.

Additional technical potential from peatland restoration and woodland creation

9.5.20 Some of the work that we carried out to identify emissions abatement potential in the rural land use sector involved modelling variables associated with extending and restoring Scotland's natural carbon sinks and stores. Using this approach, our analysis suggests that an additional abatement potential of approximately 0.75 $MtCO_2e$ in 2027 could be realised through greater levels of peatland restoration and woodland creation than those currently envisaged in the policies and proposals already outlined in this chapter. Scotland's soils contain about 3,000 $MtCO_2e$. The additional abatement potential is a small proportion of the total stock of soil carbon, but it represents a potential reduction of around 20% in the annual emissions from UK peatlands.

9.5.21 This abatement potential remains "technical" for the time being due to uncertainties that currently surround scaling up action beyond existing commitments. The availability of and ability to access suitable land is uppermost within these considerations, but so is the possible long-term effectiveness of peatland restoration. We believe we have used fairly conservative estimates for the impact of peatland restoration in RPP2 and the numbers could increase when the IPCC validates the international accounting methodology later in 2013.

9.5.22 As well as the potential from peatland, there may also be scope, albeit limited due to the lead in time, to achieve some additional abatement by further increasing the woodland creation rate in the 2020s, following a review of current commitments. In preparing the next RPP, further work will be taken forward to help define the place for, and scale of, future woodland creation potential through initiatives such as the third National

Planning Framework, Woodlands In and Around Towns, and the Land Use Strategy for Scotland Action Plan.

9.5.23 The emissions abatement from this land use technical potential proposal has been factored in to the RPP2 calculations for the years 2023, 2024, and 2025. This may appear rather "sudden", but it simply reflects the limitations of currently available information and we cannot at this stage be precise in predicting technical advances or further land use changes. In reality, any emissions savings are likely to build more gradually over a longer period of time. Work to develop and refine these proposals will continue and it is our intention to set out more information in RPP3 about how this emissions abatement might be realised.

9.6 Supporting and enabling measures

9.6.1 Together with the other UK administrations, the Scottish Government is supporting research projects to improve the accuracy and resolution of the part of the **Greenhouse Gas Emissions Inventory** that estimates emissions from **agriculture, land use, land use change and forestry.**[265] The outcome of this work will be advanced greenhouse gas emission factors and farm practice data with which to calculate a more accurate emissions baseline and better forecast the outcomes of proposed policy measures. With an improved inventory and evidence base, the agriculture and other land use industries will be better equipped to assess progress, and focus emission reduction activity where it is needed and most effective.

9.6.2 We are also working with the other UK Administrations to reduce and eventually **phase out the use of peat in horticulture.** Three million cubic metres of peat are sold in the UK annually, most of it imported. Scotland's share is estimated to be 10%. 500,000 cubic metres of peat were extracted in Scotland in 2009 (the output varies with the dryness of the summer), and the effects are counted as part of Scotland's greenhouse gas emissions, amounting to 0.1 $MtCO_2e$. If such peat were to be sourced from other countries, the quantity extracted would be recorded elsewhere; real improvement requires the marketing and distribution of alternatives to peat in horticulture. Sites from which peat has been extracted can be restored in many cases, but this may require work over several years.

[265] Agricultural Greenhouse Gas Inventory Research Platform: www.ghgplatform.org.uk/Home.aspx

9.6.3 In response to the Woodland Expansion Advisory Group's recommendations (see below) and building on improvements in planning guidance such as FCS's 'Right Tree in the Right Place' (2010), a series of regional and sub-regional **approaches to understanding woodland creation constraints and opportunities** are being piloted in partnership with local authorities and other public sector bodies.[266] Alongside this, there will be an enhanced role for Regional Forestry Forums in providing FCS and local authorities with advice. This will include opportunities for implementation of **Forestry and Woodland Strategies** as well as the implications of woodland creation for other land-based objectives.

9.6.4 In recent times, Scotland's trees have been faced with an increase in the instances of new pests and diseases. Advice from Forest Research indicates that climate change may create the conditions for even more pest and disease activity and these heightened threats require us to take a **strategic approach to forest and tree health given the importance of woodlands for carbon storage and to the commercial timber sector**. Action is being coordinated across the UK as part of the Forestry Commission's Biosecurity Strategy.[267] This aims to preserve the health and vitality of our forests, trees and woodlands by excluding, detecting and responding to existing and new pests, whether of native or exotic origin.

9.6.5 The **wood fuel market for renewable power and heat** has developed rapidly over the last five years largely because of support for biomass electricity and CHP plants under the Renewable Obligation (RO) Scotland. The RHI is now providing significant support for the installation of biomass heat (and CHP plants) in commercial, industrial and public buildings with a household RHI to follow in 2013.

9.6.6 We are providing additional impetus to the uptake of the RHI and encouraging better woodland management on the back of increased demand for wood fuel through regional wood fuel forums.

Review of woodland creation rates

9.6.7 In RPP1 we proposed that it might be appropriate to increase new woodland planting rates towards 15,000 hectares per year. This was subject to a number of conditions. In response to Proposal 7 in the Land Use Strategy, the Woodland Expansion Advisory Group (WEAG), with members representing the interests of agriculture, forestry, communities and the environment, was established to provide the Cabinet Secretary for

[266] Forestry Commission Scotland, The right tree in the right place: www.forestry.gov.uk/pdf/fcfc129.pdf/$FILE/fcfc129.pdf
[267] Forestry Commission, Biosecurity Strategy: www.forestry.gov.uk/forestry/infd-8gykba

Rural Affairs and the Environment with advice identifying which types of land are best for tree planting in Scotland, in the context of other land-based objectives. The WEAG published its report in 2012.[268] It endorsed our policy of increasing the woodland creation rate to 10,000 hectares per year, recommending that the focus of activity should be on creating 100,000 hectares of new woodland between 2012 and 2022, equivalent to an average of 10,000 hectares per year over this 10 year period.

9.6.8 The WEAG also recommended that there should be a review, initiated no later than 2020, in order to set targets beyond 2022. We have accepted this recommendation as an important step in setting longer-term targets for woodland expansion, and ensuring an appropriate balance between alternative land uses. The need to achieve our ambitious greenhouse gas emission reductions targets should be a key factor in the review.

9.6.9 Pending this review, the estimates of emissions abatement presented in the RPP2 are based on a continuation of the current 10,000 hectare per year policy over the period 2022–2027 and do not include projections for either an increased rate of 15,000 hectares per year, nor any reduced rate.

9.7 Costs and benefits

Agriculture and related land use

9.7.1 Improving efficiency of agriculture and related land use systems will yield financial benefits as well as supporting the transition to a low carbon economy. Due to the cost effective nature of those measures promoted by FFBC, the policy is estimated to result in overall reduction in costs to farm businesses of around £240 million (undiscounted over the period to 2027). These savings arise largely from productivity increases resulting from improved efficiency in input use.

9.7.2 A change to more efficient farm practices will not only reduce emissions, but will result in farm business savings and make businesses more resilient. In many cases, improvements to water and air quality, as well as biodiversity and longer-term sustainability will also have been achieved through farming which is more integrated with wider land management practices.

[268] Forestry Commission Scotland, Woodland Expansion Advisory Group: www.forestry.gov.uk/weag

9.7.3 With cost savings and emissions reductions, the overall cost effectiveness of FFBC works out on an undiscounted basis, at approximately £160 per tonne of saved emissions. Increasing the uptake of fertiliser efficiency measures as proposed will lead to further savings. The overall cost effectiveness of the proposal (undiscounted with no allowance for policy costs) is estimated to be around £90 per tonne of saved emissions.

9.7.4 The cost-benefit analysis covering agricultural policies is detailed in the Technical Annex. It is based on research undertaken by SRUC and was commissioned by the Committee on Climate Change. A European level assessment of the costs and benefits of nitrogen fertiliser use outlines the considerable adverse effects of nitrogen leakage.[269] The analysis highlights how the overall environmental costs of all nitrogen losses in Europe (estimated at €70–€320 billion per year at current rates) outweigh the direct economic benefits of nitrogen use in agriculture. The highest societal costs are associated with loss of air quality and water quality, linked to impacts on ecosystems and especially on human health.

9.7.5 Whilst this study used aggregate data for Europe only, it highlights the importance of tackling nitrogen as a key threat which cuts across several policy areas and environmental outcomes.

Peatlands

9.7.6 The cost of an enhanced peatland (optimised current) restoration programme of 6,500 hectares a year is estimated at approximately £5 million a year, the larger part of which would be from public funds; if this was to be tripled to some 20,000 hectares a year, the cost would be around £15 million per year. There should be some private sector expenditure, for instance for projects part-funded through the SRDP.

9.7.7 Peatlands in good condition provide many ecosystem benefits. They include sites for wildlife and are valued for biodiversity. Blanket bog is protected under the Habitats Directive and is included in the UK Biodiversity Action Plan as Priority Habitat. Lowland raised bogs are less common in Scotland and many are greatly valued by their local communities, such as Langlands Moss (East Kilbride) and Blawhorn Moss, administered by Scottish Natural Heritage. Peatlands retain and filter water, thus providing benefits for both the flow and quality of water. They are valued for leisure activities, landscape and tourism.

[269] European Science Foundation: European Nitrogen Assessment: www.nine-esf.org/ENA

Forestry

The Milton of Mathers Woodland Project

Forest Carbon[270] has developed a new woodland at Milton of Mathers near St Cyrus in Aberdeenshire on behalf of the arable farming landowner, Messrs JD Reid and Partners. The woodland creation and management is overseen by the Scottish Rural College.[271] The aims of the new woodland are to reduce pollution from the nearby farm and act as a buffer to the burns, improve farm conservation and provide a safe haven for animals as well as provide access for people to enjoy them. About 1,600 plants per hectare will be planted by the time the canopy closes. Over 70 years, the 17.4 hectare woodland will sequester 4.77 $ktCO_2e$.

A combination of Scottish Government grant and private investment secured the project. The carbon capture resulting from the project is quality assured through independent verification under the Woodland Carbon Code; and details are included within the Forestry Commission's Registry of UK Woodland Carbon Projects.[272]

9.7.8 We estimate that the current programme of 10,000 hectares of new woodland creation per year could provide lifetime savings of around 4.8 $MtCO_2e$ by 2027. Further emissions savings will continue throughout the lifetime of the woodland. The cost of achieving this over the period 2013-2022 will be around £450 million and average around £57 million per year thereafter to 2027. Much of this will come from financial support through the SRDP, but there will also be additional planting on the national forest estate.

9.7.9 Opportunities for developing the market for timber construction materials lie primarily in the growing utilisation of cross-laminated timber (CLT) products. Currently, around 75% of new homes built in Scotland use timber frames CLT is a solid wood engineered product which extends timber's attractiveness to developers beyond building frames as it can be used as walls, floors and roofs. Investment (largely private sector) in new cross-laminated timber production facilities using Scottish timber could offer an opportunity for significant market development. In this case an investment in two new plants of around £40 million by 2022 and around a further £10 million by 2025 to expand production capacity, could potentially achieve cumulative emissions abatement of the order of 606 $ktCO_2e$ by 2027.

[270] Forest Carbon: www.forestcarbon.co.uk/
[271] Scotland's Rural College: www.sruc.ac.uk/
[272] Forestry Commission: www.forestry.gov.uk/website/carbonregistry.nsf/byprojectid

Blue Carbon

The term 'blue carbon' refers to the carbon sequestration benefits of marine ecosystems such as salt marshes, seagrass beds, maerl beds and kelp forests. The process acts as partial mitigation of anthropogenic carbon release. Due to their high productivity and high carbon sequestration capacity per unit area, recent estimates suggest that the standing stock of carbon in these ecosystems can be of a similar magnitude to many of the larger terrestrial green carbon sinks, such as forests and grasslands. However, blue carbon is a relatively new concept and our understanding of its potential is not yet well developed.

Saltmarshes, seagrass beds and kelp forests are potentially quantitatively important 'blue' carbon sinks in Scotland . Whereas Scottish saltmarsh habitats are relatively well identified and quantified in terms of their locations and areal coverage, further investigations are needed on standing stocks and areal coverage of seagrass beds and kelp forest communities in Scottish waters before a more reliable quantitative assessment can be made in terms of their total carbon sequestration potential. That said, current literature indicates that these habitats might be relatively abundant in Scottish waters compared to other coastal areas in UK and Europe.

Protection of Blue Carbon Ecosystems

The degradation or damage of these systems can increase carbon release to the atmosphere and all three habitat types are suffering from degradation due to both human and natural activities, including climate change.

About 80% of Scottish saltmarshes and around 50-60% of known seagrass beds in Scottish waters are currently managed within protected or managed fisheries areas. The Marine Protected Area (MPA) network is also being developed in Scotland's seas, with 33 MPA proposals identified and reported to Parliament in December 2012. The proposals for inclusion in the MPA network include seagrass beds, maerl and kelp forests. Saltwater marsh habitat is also included in Special Protection Areas for seabirds designated under the EU Wilds Birds Directive.

The Scottish Government plans to consult on a draft National Marine Plan during Summer 2013. In accordance with the Marine (Scotland) Act, the Plan will include objectives and policies related to climate change mitigation and adaptation. It will propose that developments or activities should not result in the complete loss of or damage to natural carbon sinks.

In addition, the sectoral marine planning process will produce a revised offshore wind energy plan and wave and tidal energy plans during 2013. These will cover issues such as strategic cable installation and will highlight any potential for interaction with blue carbon resources.

Next Steps

Our current state of knowledge and scientific understanding mean it is not possible for RPP2 to set out detailed policies and proposals on blue carbon. The evidence base on blue carbon is not yet mature enough to allow a credible estimate of its potential contribution to emissions reduction.

The Scottish Government is working with Scottish Natural Heritage to continue to develop our understanding of blue carbon. It is envisaged that this work will:

a) increase understanding of the distribution of blue carbon habitats, their condition and potential contribution; and

b) review and develop policies on blue carbon and consider proposals to capture their potential.

It is hoped that this will allow us to build a foundation from which it may be possible to develop policies and proposals for inclusion in the next RPP in order to contribute to the efforts necessary to meet Scotland's annual greenhouse emissions reduction targets.

Table 9.1: Highlights of progress since publication of RPP1

Rural Land Use	Summary
Policies	
Farming For a Better Climate (FFBC)	This policy has continued in RPP2. The FFBC programme and Focus Farms are now well established, with regular on-farm advisory events well attended. Since inception of the programme in 2010, and estimated 2000 farmers have participated in FFBC and partner events. The FFBC webpage continues to be expanded and updated with relevant information, including case studies illustrating the greenhouse gas emission and business savings resulting from uptake of mitigation measures. The advice provided by the Scottish Government is being supported by complementary industry-led action, such as *Future Proofing Scotland's Farming,* an advisory initiative delivered by Soil Association Scotland with industry support from QMS, SAOS and NFUS[273] and *Scotland's Farming Innovation Network.*[274]
Support for anaerobic digestion through the SRDP	This is now covered by RPP2 proposal '*Developments in technology'.* Although funding is still available through the SRDP, in practice this has largely been superseded by financially more attractive Feed-in-Tariffs, RHI and the Scottish Government's CARES loan scheme.
Increase afforestation rate to 10,000 hectares per year	As a result of improvements to the Scotland Rural Development Programme and activity on the national forest estate, new woodland creation nearly doubled between 2009-10 and 2010-11, from 2,700 hectares to 5,100 hectares. A further significant increase was achieved in 2011-12 with a rise to 9,000 hectares.
Proposals	
Mandatory regime to secure 90%	RPP1 set out a proposal to potentially drive 90% uptake of nitrogen efficiency measures through

[273] www.soilassociation.org/innovativefarming/futurefarminginscotland/futureproofingscotlandsfarming
[274] www.soilassociation.org/innovativefarming/futurefarminginscotland/scotlandsfarminginnovationnetwork

uptake of nitrogen efficiency measures.	mechanisms under EU Common Agricultural Policy (CAP) cross-compliance if the current voluntary fails to deliver sufficient emission reductions. However, subsequent revisions to the CAP mean that post-2013, cross-compliance will not be suitable to enforce these measures. Consideration is now being given to how equivalent regulation might be implemented in Scotland, including what parameters might be set to "trigger" the implementation of regulation. This is a key focus of the Agriculture & Climate Change Stakeholder Group's current work programme.
Increase afforestation rate to 15,000 hectares per year	RPP1 set out a proposal to increase woodland planting rates to 15,000 hectares per year from 2015. This proposal was presented with the caveat that implementation would depend on whether this could be shown to be practicably achievable, in particular in relation to the availability of more privately owned land becoming available than has been the case in recent years. In response to questions that had been raised about balancing land use, the Woodland Expansion Advisory Group recommended in June 2012 that afforestation targets remain at the current 10,000 hectares per year level until 2022, with a review to be conducted by 2020. For the purpose of estimating emissions abatement in RPP2, our calculations focus on the 10,000 hectares per year policy and do not include projections for an increased rate of 15,000 hectares, nor any reduced rate.

Table 9.2: Summary of Rural Land Use policies and proposals

Rural Land Use	EU, UK or Scottish	Maximum abatement potential ($KtCO_2e$) in 2020	Maximum Abatement potential ($KtCO_2e$) in 2027	Earliest start date
Policies				
Farming For a Better Climate (FFBC) Programme of best practice advice and demonstrations designed to encourage farmers to and land managers to adopt business efficiency measures that also reduce emissions.	Scottish	103	107	2010
Increase afforestation rate to 10,000 hectares per year Commitment to increase planting rates to an average of 10,000 per year by 2015. Emissions abatement estimates assume that this rate is maintained from 2015 onwards.	Scottish	310	687	2015
Proposals				
90% Uptake of fertiliser efficiency measures Transition from a voluntary approach to a mandatory regime designed to optimise the use of nitrogen fertilisers. To be introduced only if voluntary approach (policy - FFBC) does not result in sufficient uptake.	Scottish	260	260	2018
Developments in agricultural technology post 2020 Potential emissions abatement from a range of measures that are currently considered marginal and less than cost-effective in some circumstances. However, analysis suggests that these may become more feasible after 2020. The measures include anaerobic digestion, plant varieties with improved nitrogen use efficiency, improved livestock management and precision farming.	Scottish	310	310	>2020
Accelerated restoration of degraded peatland	Scottish	177	515	2013

Maximisation of the ecosystem and emissions benefits from restoring degraded peatland. Research has suggested that it may be technically feasible to restore up to 21,000 hectares of peatland per year. Work is currently underway to explore how to realise this technical potential subject to developing scientific understanding and international emissions accounting methodology.				
Wood First - Timber Construction Programme A package of measures designed to increase the amount of Scottish timber used in the construction and refurbishment of buildings, displacing higher-carbon materials.	Scottish	0	125	2022
Additional technical potential from peatland and woodland Estimated long-term emissions abatement potential that Scottish Government analysis suggests might be technically feasible from increasing peatland restoration and woodland creation rates beyond the levels already set out in the policies and proposals above.	Scottish	0	750	2025