Balancing Act

How farming can support a net-zero emission target in Scotland

A report by RSPB Scotland

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Summary

- Climate change affects us all and the world we live in. It is a huge threat to Scotland's wildlife and to Scotland's ongoing agricultural production. The Climate Change Bill in Scotland must set ambitious new emission reduction targets to comply with the Paris Agreement but these cannot be met without more action in farming - to reduce non-CO_2 greenhouse gas emissions and to use land to sequester carbon from the atmosphere.
- Farming's potential for emission reduction and carbon sequestration is largely untapped at present. If this potential is realised agriculture can go further than the proposed 9% reduction in emissions by 2032 and at the same time put farming on a sound footing for the 21st Century.
- Government policy should aim to find the balance that the targets and the planet need between reducing emissions of methane and nitrous oxide, and action which removes carbon from the atmosphere and locks it away in trees, farm soils and habitats.
- Government must develop and resource a wide-ranging suite of policies for the short-term and long-term. We recommend 10 actions that need to be started now to deliver the emissions reductions through to 2050, 10 measures to improve the current Climate Change Plan and 10 new policies to boost the Climate Change Plan's ambition for agriculture. These positive and forward thinking ideas include; a new post-CAP rural policy to pay farmers for putting in place measures which reduce emissions and sequester carbon, measures to increase the efficiency of farm input use, a plan of action for farm soils, investment in research, training, and advice on the solutions needed, a circular economy for farming and food waste, cheap loans to help farmers innovate and invest, and a new climate footprint indicator for farming to better communicate the beneficial actions taken by farmers.
- If farmers are to keep farming climate change must be halted, however it cannot be tackled without farmers. RSPB Scotland is calling on the Scottish Government to change course and provide the leadership that farming needs for the future so that it can help Scotland meet a net-zero target, and continue to flourish up to 2050 and beyond.

1. Introduction

Climate Change affects us all and the world we live in. As well as threatening society, it is the greatest long-term threat to the wildlife of our planet. Marine[1] and terrestrial[2] species in Scotland are being affected now by the impacts of climate change and The State of the UK's Birds Report 2017[3] showed in detail the impact of climate change on birds. A global study in the journal Nature[4] calculated that using mid-range climate-warming scenarios, by 2050 15–37% of species will be 'committed to extinction'. The most recent IPCC report[5] showed that a half degree difference in warming between 1.5°C and a 2°C of warming would have major consequences for wildlife. It would result in twice as many terrestrial plant species and vertebrate animals losing more than half of their home range, a tripling of the same range loss for insects, and greater impacts on marine species ranges and marine food-webs. It is critical for wildlife and ecosystems that temperature rises are kept to 1.5°C warming.

Climate change has already led to a 1°C rise in temperature globally with a similar rise recorded for Scotland. Our special, precious and often unique wildlife in Scotland has not caused climate change but many species and ecosystems are sensitive and vulnerable to climatic changes and are being affected now. These are the key reasons why RSPB Scotland campaigns to reduce greenhouse gas (GHG) emissions and halt climate change.

The Paris Agreement aims for countries to work to limit warming to well below 2°C and to aim for 1.5°C above pre-industrial levels. The Climate Change Bill laid in the Scottish Parliament aims to set new emission reduction targets for Scotland to ensure Scotland contributes to this Paris Agreement aim. Achieving these new targets will require an increase in ambition and action across Scotland in the short term (to 2030) and long term (to 2050).

The Scottish Government is seeking Parliament's endorsement of its plan to increase its 2050 target of an 80% cut in emissions to a 90% reduction, based on 1990 levels. The Programme for Government[6] clarifies it is planning for Scotland to cut CO_2 emissions to 'net-zero' by 2050, "*The 90% reduction target for all greenhouse gases set out in the Climate Change Bill means achieving net-zero carbon dioxide by 2050.*" This suggests that reducing the non-CO_2 GHG emissions, including methane and nitrous oxide, which mainly arise from agriculture, and balancing these with sequestration from land use activities is now the main stumbling block stopping Government boosting the target to net-zero GHGs by 2050. The urgent focus now must be well and truly on finding and employing methods to cut non-CO_2 emissions and using natural negative emissions technologies to bridge the gap to net-zero GHGs by 2050 – a figure we believe is the very minimum needed if Scotland is to be compliant with the Paris Agreement.

This report investigates the 'balancing act' that Scotland must prepare for now so that agriculture and land use can ensure we meet an ambitious net-zero emissions target by 2050. The chapters below provide a set of recommendations to drive emissions reductions in the short term and to set a pathway for the long-term. The report does

[1] LINK http://www.scotlink.org/wp/files/documents/Climate-Change-and-Marine-Species-1.pdf
[2] LINK http://www.scotlink.org/wp/files/documents/Climate-Change-and-Terrestrial-Species.pdf
[3] https://www.rspb.org.uk/globalassets/downloads/documents/conservation-science/220-0653-17-18-sukb-2017-web-20-3-18.pdf
[4] Nature volume 427, pages 145–148 (08 January 2004), Extinction risk from climate change. https://www.nature.com/articles/nature02121
[5] IPCC, 2018, Global Warming of 1.5C http://ipcc.ch/report/sr15/
[6] Scottish Government, Programme for Government 2018.

not aim to suggest a quantitative detailed pathway to emission reductions with abatement figures for each policy recommendation, rather it shows that the Climate Change Plan ambition for emissions reductions from the agriculture sector can be increased and that there are many more policies that can and should be developed and introduced in the short and long terms.

2. Agriculture's contribution to climate change in Scotland

Agriculture and related land use is the second largest source of emissions in Scotland, by sector - 26.1% in 2016[7] – see figure 1. Its share of emissions has been steadily rising, from 14% in 2008, as emissions from energy generation reduce. With commitments made to reduce emissions from the transport sector, agriculture is likely to become the largest source in the early 2030s.

For Scotland to meet annual emissions reduction targets on route to 2050, farming will have to do its fair share of emissions reductions whilst maintaining food production and providing the other benefits demanded by the public. Farmers and other land users can cut current emission levels but also have the potential for sequestering carbon from the atmosphere and storing it in soil and vegetation. No other sector has this proven potential for sequestration.

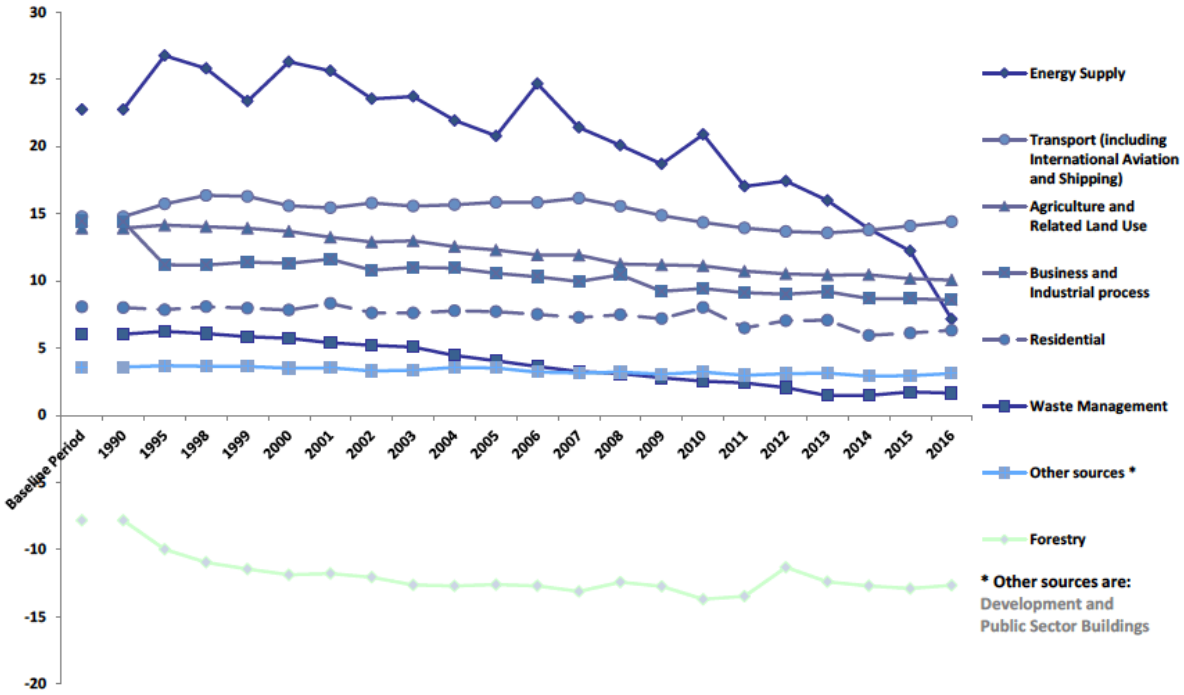

Figure 1: Main Sources of Greenhouse Gas Emissions in Scotland, 1990 to 2016 (source: Scottish Government)

[7] Scottish Government, Scottish Greenhouse Gas Emissions 2016
https://www.gov.scot/Publications/2018/06/6601

2.1. Emissions

Actual emissions have reduced since 1990 by 27.8% although this trend has flatlined in recent years with an average 0.3% reduction per year over the past 5 years[8] and the UKCCC concluded that '*there has been little recent progress in reducing agricultural emissions in Scotland*'[9]. Government's own analysis indicates that these reductions are due to reduced nitrogen fertiliser use, less livestock, efficiency measures, and less conversion of grassland to arable[10]; this is rather than as a result of Government policy.

In 2016 agriculture was responsible for 10Mt CO_2e of which 2.9 was CO_2, 4.4 Methane and 2.7 Nitrous Oxide (N_2O). Figure 2 shows that Agriculture and related land use is by some distance the largest source of both methane (68%) and N_2O (79%) in Scotland and therefore there needs to be a particularly focussed effort from Government and the agriculture industry on reducing these non-CO_2 emissions. These gases cannot be ignored because they are both more dangerous in the atmosphere that CO_2 with methane having 25 times more global warming potential and N_2O being 300 times more powerful than CO_2. However, methane is short lived in the atmosphere (14 years), compared to CO_2, which stays in the atmosphere for centuries, and therefore action now to reduce methane emissions from agriculture can help global warming under control more quickly.

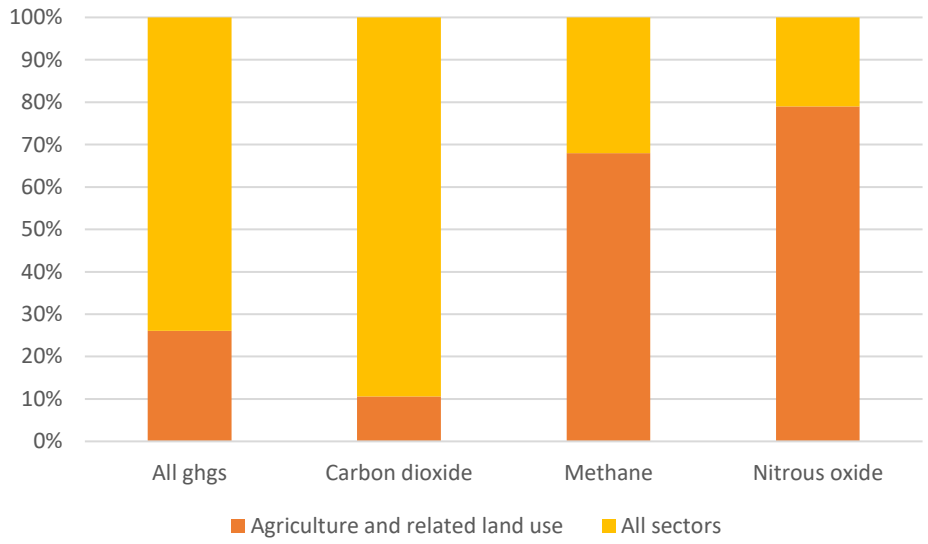

Figure 2. Scottish Greenhouse Gas Emissions from agriculture as % of total emissions, 2016.

Renewable energy, electric vehicle and energy efficiency technologies have the potential to reduce some of the CO_2 emissions from farming. Other CO_2 emissions, such as from arable cropping and land use change must be addressed with new solutions and policies.

[8] As above – Agriculture and related land use sector.
[9] UKCCC, Reducing emissions in Scotland – 2018 Progress Report to Parliament https://www.theccc.org.uk/publication/reducing-emissions-in-scotland-2018-progress-report-to-parliament/
[10] Scottish Government, Climate Change Plan https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/

2.2. Sequestration

Hidden in the emissions statistics for the Agriculture and Related Land Use sector is an amount of negative emissions as a result of sequestration – CO_2 removed from the atmosphere by natural processes and stored in soil and vegetation – See Appendix 1. In 2016 sequestration from farming reported in the statistics amounted to approximately 3MtCO_2e mainly from grassland and from arable land being converted into grassland. Figure 1 above also shows that forestry is a sink for CO_2 of 12.7Mt CO_2e. Some of these negative emissions can be the result of planting trees on farmland but do not appear in the agriculture and related land use sector's 'footprint'.

Farmers have traditionally farmed the land with the purpose of growing food but with 5.7million hectares of farmland in Scotland there is the potential for farmers to balance this with farming for the climate and store carbon in soils, trees and habitats for the long-term whilst maintaining viable farm businesses.

3. Impact of climate change on farming

'*Evidence of climate-change impacts is strongest and most comprehensive for natural systems*' said the IPCC in its 5th impact assessment[11], and explains why we are observing the impacts of climate change on wildlife and farming so strongly already. The impacts on Scottish farming are only predicted to continue and worsen as global warming continues.

In 2018 alone farming in Scotland has experienced multiple hardships and tragedies because of the types of extreme weather events that are predicted to increase in frequency and intensity because of global warming. The winter of 2018 saw the 'Beast from the East' blanketing Scotland in snow and making it difficult to feed livestock and get milk to dairies, in addition to the reported farm building damage caused by the weight of snow. The prolonged hot dry weather in the summer has affected grass growth across Scotland to an extent that the NFUS launched a Straw and Feed Campaign[12] and the Scottish Government announced an emergency support fund[13] for those hit the worst.

The IPCC's recent report[14] warns of climate change reducing livestock production for a variety of reasons and '*changes in CO2 concentration and extreme weather events indicate that a global warming of 2°C is projected to result in a greater reduction in global crop yields and global nutrition than a global warming of 1.5°C*'. These effects on agricultural production, including in temperate areas such as Scotland, are expected to have a negative impact on global food security in the 21st Century.

The UK Climate Change Risk Assessment[15] explained that expected climate trends will also have benefits such as more land becoming suitable for agriculture, some crops such as maize preferring warmer temperatures and pastures benefiting from a long growing season. However, the 2016 LWEC Report Card of impacts on

[11] IPCC, 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf

[12] https://www.nfus.org.uk/news/news/nfus-launches-straw-and-feed-campaign

[13] https://news.gov.scot/news/support-for-farmers-1

[14] IPCC, 2018, Global Warming of 1.5C http://ipcc.ch/report/sr15/

[15] UK CCRA 2017 – summary report for Scotland https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf

agriculture[16] warned that as warming continues the impacts will change and the benefits will be outweighed by more challenging conditions for farming. The IPCC report[17] is more stark in its reporting of global observations which show that declining crop yields '…*as result of climate change remain more common than crop yield increases, despite increased atmospheric CO_2 concentration*'. All three reports major on the risks to agricultural production with the UKCCRA forewarning of threats in Scotland, such as;

- Warmer drier summers increasing the risk of heat stress in sensitive crops, e.g. winter wheat, and problems for crops with high water demands, e.g. potatoes.
- Severe drought risks affecting 40-50% of prime agricultural land in the 2050s
- Increasingly frequent and intense heavy rainfall events causing greater soil erosion, flooding and crop damage.
- Increased risk of livestock diseases such as bluetongue, Foot and Mouth, fluke and parasitic nematodes.

As the century progresses, farming will struggle because of climate change impacts. Small initial benefits will be wiped out by extreme weather events and growing climatic trends. Farmers will be able to adapt but even adaptation will not prevent the negative economic impacts predicted for the industry.[18]

If farmers are to keep farming climate change must be halted, however it cannot be tackled without farmers. **The fortunes of farming are in farmers own hands**.

4. Agriculture and land use can help achieve a net-zero target

Farming and land use will be key to meeting a net-zero target in future by performing a delicate balancing act of emission reduction and sequestration. A recent study[19] showed that 'natural climate solutions' can provide 37% of the mitigation needed to keep global average temperature rise to well below 2°C. The study analysed 20 measures which '…*increase carbon storage and/or avoid greenhouse gas emissions across global forests, wetlands, grasslands, and agricultural lands*'. At a global scale this shows a significant role for farming and land use in meeting our Paris Agreement obligations. We need to understand the potential for this in Scotland, which measures are appropriate, and what policies are needed to change behaviours and make this a reality.

4.1. Cutting non-CO2 emissions and achieving net-zero emissions.

A report by the Tyndall Centre and Uppsala University[20] (Tyndall) showed that non-CO_2 agriculture emissions can be - and need to be - cut 3% per year, starting now, to meet Scotland's share of Paris Agreement obligations. This is compared with their calculation of a 10% per year cut needed for CO_2. Tyndall proposes that technology

[16] Living with Environmental Change, Agriculture and Forestry Climate Change Impacts Report Card 2016, https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/agriculture/

[17] IPCC, 2018, Global Warming of 1.5C http://ipcc.ch/report/sr15/

[18] Frances C Moore et al 2017 Environ. Res. Lett. 12 065008 http://iopscience.iop.org/article/10.1088/1748-9326/aa6eb2

[19] Natural Climate Solutions, PNAS October 31, 2017 114 (44) 11645-11650; published ahead of print October 16, 2017 http://www.pnas.org/content/114/44/11645

[20] SCCS, http://www.stopclimatechaos.org/sites/www.stopclimatechaos.org/files/TyndallReport.pdf

can cut CO_2 emissions to zero and therefore the cessation of farming's CO_2 emissions is also possible by 2050. Tyndall indicates that with the 3% per year cuts, the emissions of non-CO_2 gases can fall to 4.8MtCO_2e by 2050 – a 58% reduction on 2016 levels.

The global study of Natural Climate Solutions[21], mentioned above, calculated the potential for increasing mitigation and storage from agriculture and land use whilst maintaining global food security, fibre security and biodiversity safeguards. Tyndall also calculates Scotland's share of the 'emissions floor' – the level of emissions that it is challenging to reduce beyond without compromising global food production. It does this by using a global emissions floor figure and calculating Scotland's share on a per capita basis. This, somewhat, crude methodology may hide the potential for a lower emissions floor in Scotland, a country with access to greater levels of technology and support for farmers to make greater efficiencies.

4.2. Sequestration through Negative Emissions Technologies.

The Tyndall report shows (Figure 4 below) that by the same mid-century point annual sequestration of -6.8MtCO_2e in the Land Use, Land Use Change, and Forestry (LULUCF) sector[22] can outweigh Scotland's non-CO_2 emissions. Recent peer-reviewed research found that Scotland was "exceptionally well suited" for natural negative emissions solutions and has the potential to abate 90-100% of its annual CO_2 emissions through Negative Emissions Technologies (NETs) employed in the land use sector[23]. Analysis at an EU level shows the potential for mitigation from forestry to double using 'Climate Smart Forestry'[24].

Negative emissions technologies (NETs) in the natural environment, such as afforestation and peatland restoration, are proven and working now to sequester carbon[25]. A joint report by the Royal Society and the Royal Academy of Engineering[26] explains that these technologies are needed alongside emissions reductions to fulfil the aims of the Paris Agreement. However, Scotland's large potential for NETs should not be used as an excuse to not cut emissions from farming. Instead, Scotland's natural advantage should be used to go beyond current targets and to play its fair share in reducing global emissions.

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[21] Op cit

[22] The LULUCF sector includes emissions from land and land use change that the Scottish Government includes within the Agriculture and Related Land Use sector in its annual Scottish Greenhouse Gas Emissions reports – See Appendix 1.

[23] *The potential for implementation of Negative Emission Technologies in Scotland*, Juan Alcade, Pete Smith, Stuart Hazeldine and Claire Bond, September 2018: https://www.sciencedirect.com/science/article/pii/S1750583617310794

[24] Nabuurs, G.-J.; Delacote, P.; Ellison, D.; Hanewinkel, M.; Hetemäki, L.; Lindner, M. By 2050 the Mitigation Effects of EU Forests Could Nearly Double through Climate Smart Forestry. Forests 2017, 8, 484. https://www.mdpi.com/1999-4907/8/12/484

[25] Natural NETs are wholly different to unproven Carbon Capture and Storage (CCS) technologies or geoengineering.

[26] Greenhouse Gas Removal, https://royalsociety.org/~/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf

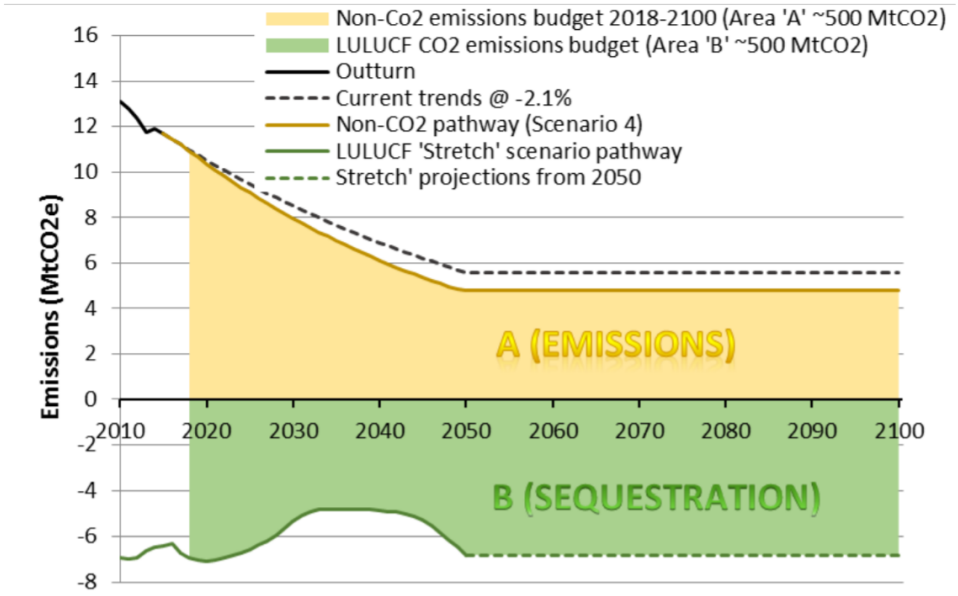

Figure 4. Projected emissions pathways for Scotland's LULUCF sector and non-CO2 emissions. (Source - The Tyndall Centre and Upsalla University)

4.3. Getting the right balance.

Figure 4 shows visually the balance in emissions and sequestration that RSPB Scotland wants to see in Scotland's rural environment by 2050 and beyond. We are not proposing that Figure 4 shows the exact pathway that Scotland should follow but rather shows figuratively the type of pathways for these sectors and that by 2050 sequestration in the rural environment can and must significantly outweigh emissions from farming and the rural environment. This net negative relationship can help to ensure Scotland can achieve a net-zero target for all emissions by 2050 at the latest.

5. Untapped potential in farming

The state of farming today, the mindset of farmers, and a focus only on technologies known to be in the pipeline today must not be a reason to avoid setting an ambitious net-zero target date now. What is seen now as on the border of feasibility, even by CCC experts, should not be used as a measure for what will be possible in a few years or beyond 2030. We believe that setting ambitious targets will drive the innovation and technology change needed to meet them. Scotland can be a leader in developing these new technologies, thereby creating jobs and economic benefits for agricultural industries and for farmers. Combining this with appropriate levels of support and incentives for farmers will see climate friendly farming activities being taken up widely across Scotland. This would help realise the untapped potential for the farming sector to contribute positively to Scotland having an overall zero impact on the climate.

Outlined below are a number of reasons why we believe there is huge untapped potential in farming to deliver emissions reductions.

5.1. Farmers are already reducing emissions.

Examples from the Farming for a Better Climate Focus Farms show the amount of carbon savings that can be made quickly. Torr organic dairy farm reduced emissions

by 11% over a three-year period[27]. Glenkilrie beef and sheep farm cut its carbon footprint by 10% over the same timescale[28]. To date, the reach of this initiative has been limited; there are thousands more farmers who could be helped to reduce their emissions through some simple steps if this approach was rolled out more widely.

5.2. Farmers in other countries are reducing emissions too.
Ireland's Origin Green showcases farmers finding efficiencies and reducing environmental impact[29]. Origin Green has helped farmers achieve preferential access to markets for their produce. New Zealand[30] has a series of projects aimed at reducing emissions from farming. There is an urgent need to start now in Scotland and keep a competitive advantage.

5.3. There is broad support for action.
A Joint letter to Ministers[31] calling for a 'just transition to carbon-neutral farming' was signed by 50 organisations, farmers, experts and academics. The signatories recognise that farming needs to reduce emissions significantly by mid-century and that the transition needs to be a just and fair one. Crucially the letter outlined 4 measures that the signatories agreed are critical to driving a just transition to carbon-neutral farming. These are:

- Introducing a Nitrogen Balance Sheet
- Investing in soils
- Promoting productive and profitable carbon neutral farming
- Promoting agroforestry

5.4. We can use much less inorganic fertiliser in Scotland.
Surplus nitrogen fertiliser, not taken up by the crop, can pollute watercourses or break down and be released as nitrous oxide. Defra statistics from 2017[32] show that in Scotland we apply a large surplus of nitrogen fertiliser. 364,000t of Nitrogen were spread to land, of which 164,000t was in inorganic fertiliser, with 188,000 taken up by crops and grass. This left a surplus of 176,000t of nitrogen or 92kg per hectare of agricultural land.

This excess use of fertiliser is, sadly, to be expected because so few farmers are regularly completing a nutrient management plan (NMP) – only 17% of grassland farmers carry out this most basic of planning exercises and 42% of those farmers with other land types perform an NMP[33]. The same survey showed that only 7% of farmers had tested the nitrogen content of the manures and slurries they applied.

5.5. There is huge potential for efficiency savings to reduce emissions including methane from the livestock sector.
If fertilisers and other farm inputs are planned well and systematically by all farmers there could be huge efficiency savings which benefit the farmer financially and the climate through lowered emissions intensity. In general, increasing efficiency of farm operations, such as increasing the uptake of fertiliser or reducing livestock disease

[27] SRUC, http://www.sruc.ac.uk/downloads/file/2745/torr_organic_dairy_-_efficiency_findings
[28] SRUC, http://www.sruc.ac.uk/downloads/file/2752/glenkilrie_-_benefits_from_reducing_emissions
[29] Origin Green https://www.origingreen.ie/who-is-involved/meet-a-member/
[30] WWF, https://www.wwf.org.uk/sites/default/files/2016-12/New%20Zealand%20-%20agriculture.pdf
[31] RSPB Scotland, http://ww2.rspb.org.uk/community/ourwork/b/scotland/archive/2018/03/26/open-letter-calls-for-transition-to-carbon-neutral-farming.aspx
[32] Defra 2017, unpublished statistics for Scotland forming part of Soil Nutrient Balances UK, 2017 https://www.gov.uk/government/statistics/uk-and-england-soil-nutrient-balances-2017
[33] Scottish Government, https://beta.gov.scot/publications/scottish-survey-farm-structure-methods-2016/pages/11/

incidents, will lower greenhouse gas emissions per unit of production, e.g. per tonne of crop or per litre or milk. A report on Resource Use Efficiency for Scottish Agriculture by SRUC[34] shows the differences in efficiencies between high and low performers in a variety agriculture sectors. The greatest differences were seen in the dairy sector and between arable farms.

A peer-reviewed farm-based study, also by SRUC researchers, concluded that there are '*huge differences between farms in terms of animal productivity and environmental performance*'[35]. This bears out when studying the differences between the 'High performers' and 'Low performers' in Farm Business Survey data[36] . Despite a lack of benchmarking data on emission intensity in the livestock sector it is safe to assume that if efforts were made to support and advise those farmers with the highest levels of emissions per unit of product (high emissions intensity), in order to bring them up to the level of those with the lowest emissions intensity, it could save significant amounts of methane each year. However, the SRUC Resource Use Efficiency Report also found that farms in the lowest efficiency quartile have only a 7% chance of moving up to the highest efficiency quartile meaning that a good proportion of farms remain stuck as low performers. It concluded that education is key to moving a farm out of the lowest performance bracket. We believe Government incentives and advice could therefore be targeted at these lower performing farms to bring up their efficiency and reduce emissions.

A carbon footprint study of a Scottish livestock farm[37] found that emissions could minimised and carbon uptake maximised in the following ways and achieve the savings indicated in Table 1 below.

Large reductions (40-80%) could be achieved by:	Smaller improvement (20-40%) would be possible by:
• Planting more trees • Reducing animal stocking rates • Reducing fertiliser N application rates	• Altering animal diet/breeds • Increased N uptake efficiency • Improved manure management • Improved cultivation practices (minimum tillage, one-pass)

Table 1. Management techniques to reduce emissions and potential savings from livestock farms in Scotland. (Source – SRUC)

As the following sections of this report show, there are many solutions and management techniques available for realising the potential of farming to increase action for reducing emissions. Many policies and techniques have not been fully exploited by Government to make these techniques widely adopted.

[34] A report on Resource Use Efficiency for Scottish Agriculture: trends, causes and constraints, https://www.sruc.ac.uk/downloads/file/3704/a_report_on_resource_use_efficiency_for_scottish_agriculture_trends_causes_and_constraints

[35] Dominic Moran, Eileen Wall; Livestock production and greenhouse gas emissions: Defining the problem and specifying solutions, Animal Frontiers, Volume 1, Issue 1, 1 July 2011, Pages 19–25, https://doi.org/10.2527/af.2011-0012

[36] Farm Business Survey 2017, https://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/Publications/FASdata

[37] SAC, Carbon footprint reporting for a Scottish livestock farm, Kairsty Topp & Bob Rees https://www.sruc.ac.uk/info/120352/greenhouse_gases/344/carbon_footprint_reporting_for_scottish_livestock_farming

6. Policy opportunities to increase action

There are several policies in place or in the pipeline which can deliver action from farming and land use in the long-term. These policies must put in place the measures needed to change behaviour, and deliver emissions reductions and sequestration from farming and land use in the short and long term.

6.1. The **Climate Change Bill** can be amended to include legislation which drives forward action from the agriculture sector for reducing emissions. The Bill can establish specific policies for action or 'make provision about advice, plans and reports' to support the agriculture and land use sectors meeting the targets.

6.2. The **Climate Change Plan** is Government's blueprint for achieving emission reductions targets to 2032. It contains policies covering the agriculture and land use sectors. Progress in the agriculture sector will always be viewed as hard to achieve if short term action is not pursued and remains only voluntary across the industry. Certainly, we believe that the 9% emission reduction expected in the Climate Change Plan is inadequate and sends the wrong signals. Early action is essential in all sectors if Scotland is to achieve ambitious 2050 targets.

6.3. With post-Brexit planning in place, a **new rural policy** must be designed to drive actions which support the achievement of Scotland's climate targets - in addition to achieving other objectives such as for biodiversity - through new schemes and payments. The UKCCC recommends that this policy incentivises emission reductions in agriculture, forestry, peatland and other land use areas[38]. A well-designed policy with the right level of regulation, incentives and advice can drive behaviour change and the roll out of climate beneficial measures and activities throughout the countryside.

6.4. **Scotland's Land Use Strategy** was a requirement of the Climate Change (Scotland) Act 2009. It is now in its second iteration[39] but has not fully realised its potential to guide land use planning across Scotland and influence policies designed to reduce emissions reductions.

6.5. A new **Environment Strategy** for Scotland could set climate change action within an overarching vision and strategy for the environment in Scotland which influences all sectors and parts of Government. This strategy should bring together our existing climate targets, vision and action into the suite of measures for the environment and identify where other targets and action are needed to drive forward mitigation in the agriculture sector.

6.6. The **Forestry Strategy** in Scotland must support the delivery of the tree planting targets in the Climate Change Plan but ensure this is met in a sustainable way - which does not harm other elements of the environment. With forestry providing many other public benefits, such as climate adaptation, reducing flood risk, and providing wildlife habitats, a healthy balance needs to be struck under the guidance of the Forestry Strategy.

6.7. A **Circular Economy Bill** for Scotland, promised in the SNP manifesto[40], must put a legislative backing to the commitments outlined in the Scottish Government's Making Things Last Strategy[41] and integrate farm wastes into a circular economy for biological materials. It should also recognise the role that farms and land can plan in accepting and reusing the biological materials.

[38] UKCCC – Reducing emissions in Scotland, 2018 Progress Report to Parliament, Sept 2018

[39] Scottish Government, Land Use Strategy, https://www.gov.scot/Resource/0050/00505253.pdf

[40] SNP Manifesto 2016 https://www.snp.org/manifesto_2016

[41] Scottish Government, https://www.gov.scot/Publications/2016/02/1761/12

7. The leadership gap

Government must see the potential for farming to meet the climate challenge and provide the leadership needed. Farmers must not be seen as powerless in the face of climate impacts or the nationwide movement to cut emissions. **There must not be a false dichotomy of food production vs cutting emissions – both can happen together**. Farmers must be supported to do both in ways which are resilient and sustainable. Government leadership is needed to make this happen.

An inquiry into climate change by the Royal Society of Edinburgh[42] recommended that all Government policies need to change if we are to meet the climate challenge.

8. 10 things to start now to achieve long-term targets

RSPB Scotland agrees with scientists that there is potential to cut emissions from agriculture and balance these with sequestration from land use by 2050. This is not just possible but is also the right thing to do. Government and Parliament can be more confident that technology and knowledge can improve to provide the pathway to this vision. Whilst this is a long-term vision, action is needed now to develop policies and put the right measures in place to make it happen. **RSPB Scotland recommends that Government focus on the following 10 actions which will put Scotland in the right place to achieve the new climate targets by 2050**:

8.1. **Aim for minimising emissions from farming, especially methane and nitrous oxide.** The UKCCC[43] has called for better monitoring and reporting, and '*targets on emissions from nitrogen fertiliser, and from the beef, sheep and dairy sectors'*. We believe the following 3 targets need to be in place by 2020.

8.1.1. **Set more ambitious emission reduction target for 2032.** Review the 9% emission reduction target for agriculture in the CC Plan and set more ambitious emission reduction target for 2032 which shows the real potential for agriculture**.** Whilst this is a short-term target it is needed in order to set the trajectory and the direction needed for the long-term.

8.1.2. **Set a target for reducing nitrous oxide emissions from nitrogen fertiliser by 2020.** Government has committed to setting this target in the Climate Change Plan and the Programme for Government, however, we want Government to prioritise this target setting and have it fixed by 2020. A Nitrogen Balance Sheet for Scotland (see more information below) is essential to making this target meaningful and workable, along with cross-sectoral targets and polices for reducing nitrogen consumption, policies for cutting food and biological waste.

8.1.3. **Set a target to reduce methane emissions.** Scotland emitted 6.5 MtCO2e of methane in 2016, 16.8% Scotland's total GHG emissions. The 2018 Climate Change Plan commits developing actions to reduce emissions of methane from agriculture, however, the policy proposals are undeveloped, vague and voluntary with no timescale for delivery. To drive forward action to reduce methane emissions within a fixed timescale the Climate Change Bill should

[42] RSE, Facing up to climate change. http://www.rse.org.uk/wp-content/uploads/2016/09/RSE-Inquiry-Facing-up-to-Climate-Change-Full-Report-med-res.pdf

[43] UKCCC – Reducing emissions in Scotland, 2018 Progress Report to Parliament, Sept 2018 https://www.theccc.org.uk/publication/reducing-emissions-in-scotland-2018-progress-report-to-parliament/

include a duty on Ministers to set reduction targets for methane emissions in Scotland, and set it by 2020.

8.2. **Calculate Scotland's emission floor.** The Tyndall report uses a share of a global emissions floor in its report and recommends that Scotland can cut non-CO2 emissions to 4.8MtCO2e by 2050. However, the report bases its calculations on one of 4 possible emissions floor estimates suggesting a variety of methods used by the scientists. The IPCC 1.5C report also includes an emission floor for non-CO2 emissions in its models. Further work to understand more precisely Scotland's emission floor would help to guide policy and achieve reductions whilst maintaining a viable farming sector and food production.

8.3. **Calculate the full potential for sequestration in Scotland.** The Climate Change Plan expects that by 2032 Scotland's Land Use sector will sequester 6.7MtCO2e. We recommend that Government puts a strategy in place for further boosting sequestration and storage of carbon in Scotland's landscapes through natural NETs. This Strategy should also cover how NETs can be best employed on farmland. **The strategy should aim for sequestration from land use to outweigh the total emissions from the agriculture sector by 2050 at the latest** whilst recognising the value of the many other benefits to society from these activities and ecosystems, and taking care to minimise any negative environmental impacts from the activities. The list of NETs below should be considered, some will need further development.

- Peatland restoration
- Peatland protection, from extraction for horticulture and from development.
- Agricultural (especially arable) soil management, to increase soil carbon
- Afforestation
- Better woodland management
- Blue carbon[44] habitat protection and restoration

8.4. **Pay farmers for meaningful action to meet Scotland's emission targets.** Design a post- Brexit Rural Policy, including a new Environmental Land Management Scheme (which is adequately funded), to reward farmers for reducing emissions on farm and for action to create, restore and maintain carbon-rich habitats. We urge that, in developing the scheme, multiple benefits of policies are sought, recognised and valued, especially those where actions benefit wildlife and climate objectives.

8.5. **Establish regional land use frameworks in all areas of Scotland.** Scotland's Land Use Strategy (LUS) was a requirement of the Climate Change (Scotland) Act 2009 and includes the principle '*Land use decisions should be informed by an understanding of the opportunities and threats brought about by the changing climate. Greenhouse gas emissions associated with land use should be reduced and land should continue to contribute to delivering climate change adaptation and mitigation objectives.'* Up to the current time the LUS has not contributed to meeting climate objectives, and its powers and influence are limited.

Crucially, subsidies, agri-environment measures, advice and regulation which influence land use and deliver emissions reductions need to be better aligned and targeted at the regional scale needed. This regional approach was a primary recommendation the Royal Society of Edinburgh back in 2016[45]. RSPB Scotland

[44] Blue carbon is the carbon stored in marine and coastal environments, such as saltmarsh and mudflats.
[45] RSE, http://www.rse.org.uk/wp-content/uploads/2016/09/RSE-Inquiry-Facing-up-to-Climate-Change-Full-Report-med-res.pdf

recommends that the Climate Change Bill requires Ministers to establish Regional Land Use Frameworks, covering all of Scotland, by 2024.

8.6. **Skill and train farmers to meet the challenge.** The Agriculture Champions have recommended the need for a change in the mindset of farmers if the environmental sustainability, and other objectives they seek from farming, are to be met[46]. We recommend that policies and measures put in place to facilitate this mindset change must include changing farm practices to reducing the emissions and increase sequestration as a priority area. With 72% of farmers in Scotland without formal agricultural training and only 1% having received vocational training in the year before the Farm Structure Survey was published in 2016[47] much more needs to be done to introduce continual training throughout the Industry. Many actors have a role to play in integrating these skills, training and messages into their activities, including: agriculture colleges, ongoing professional development providers, advice givers, consultants, agrochemical and agritech companies.

8.7. **Ensure the Just Transition Commission advises on farming.** Government has promised to establish a Just Transition Commission[48]. RSPB Scotland recognises that farmers are essential to managing the land in the future in ways which cut emissions but also sequester carbon in the land. There will inevitably be a transition to new ways of farming and support, and this needs to be a fair one which keeps farmers farming the land. We therefore recommend that the Just Transition Commission includes a remit to advise on a just transition in the agriculture sector.

8.8. **Create a circular economy for biological materials in Scotland.** A commitment to 'Recovering value from biological resources' has been made in the Scottish Government's Making Things Last Strategy[49] and a forthcoming Circular Economy Bill provides the legislative backing for this. RSPB Scotland recommends that Government aims not just to recover the biological resources from waste but to **create and develop a fully circular economy for biological resources**. It should ensure that biological materials, such as farmyard manure and slurry are included in the scope of the resources. We urge that Government does not assume that all of these farm generated wastes are utilised fully on farm or other land so that the nutrients they contain are recycled. As explained above, there are large surpluses in nitrogen applied to land, including from farmyard manure and slurry, and too few farmers regularly plan their manure and slurry applications.

In addition, we recommend that farms and rural land used for growing grass or crops are included in the circular economy as locations to make use of the biological resources for the nutrients they contain and the carbon which can be added to soil to improve soil condition and increase sequestration from the atmosphere. Processed food waste can be used on farm in the form of compost or digestate from anaerobic digesters to replace the need for importing chemical fertiliser which has a high embedded carbon content from its manufacture. Farming has a pivotal role to play in ensuring a circular economy for biological resources works and we recommend that this work is kickstarted as soon as possible.

8.9. **Reprioritise research and solution design.** We believe that research must change to support farmers in meeting the climate targets. Research, especially Government funded research, must align to the new objectives and provide solutions which farmers and landowners will increasingly need, such as:

[46] A future strategy for Scottish agriculture, https://www.gov.scot/Resource/0053/00536005.pdf

[47] Scottish Survey of Farm Structure and Methods, 2016. https://beta.gov.scot/publications/scottish-survey-farm-structure-methods-2016/pages/1/

[48] Programme for Government 2017 https://www.gov.scot/Resource/0052/00524214.pdf p39

[49] Scottish Government, https://www.gov.scot/Publications/2016/02/1761/12

- Reducing emissions and increase climate resilience rather than research purely for boosting production.
- Increasing sequestration and new negative emissions technologies
- Reversing soil degradation and erosion and building soil organic carbon
- Recognising and valuing multiple benefits rather than increasing production or profits only.
- Understanding the long-term value of non-conventional systems, such as organic farming, agroforestry and agroecological systems[50].

8.10. **Research long-term scenarios for change.** We recommend that Government develops policies and measures to drive change in farming from the outside. Positive changes in society, such as healthy eating, could drive changes in food purchases and demand for farm products which reduce emissions from the agriculture sector in Scotland. These demand -side drivers could also change how land is used or what is grown on the land, again with positive effects for the climate. We recommend that Government researches these dynamic scenarios and their benefits, including:

- Healthy eating schemes, and particularly eating less meat and dairy.
- Increase in demand for more locally grown food or seasonal produce, especially fruit and vegetables, reducing dependency on imported food and animal feed.
- Public procurement change towards healthy or sustainably produced food.
- Increase in vegetarian and vegan diets to 2050.
- Increase in demand for organically produced food.
- Development of shorter supply chains and local food economies and increasing levels of home grown food.

9. Greater ambition needed to 2032

The Scottish Government has proposed a 66% reduction in emissions, based on 1990 levels, by 2030 in the Climate Change Bill. RSPB supports an emission reduction target for Scotland of 77% by 2030 as an appropriate interim target to ensure early action and a safer trajectory to 2050. The Climate Change Plan outlines Government's plan for achieving emission reduction targets to 2032 and sets an expectation of a 9% cut for agriculture over that period. The UKCCC points out that the 9% cut for agriculture by 2032 is less that that proposed in the draft Climate Change Plan and 1.3MtCO2e higher than the CCC scenario[51]. We believe that it should have been more ambitious and that its aim for a 9% reduction in emissions from agriculture between 2018 and 2032 is particularly weak.

The 9% reduction target is one of the lowest emissions reduction projections in the Plan; by contrast a 53% cut is expected from non-domestic buildings. **The Climate Change Plan shows that Government is deliberately giving agriculture 'an easy ride' by asking it to do less than other sectors in achieving Scotland's 2030 target and beyond.** In addition to the lack of ambition, the Climate Change Plan

[50] Natural England, The role of agroecology in sustainable intensification (LUPG05) http://publications.naturalengland.org.uk/publication/6746975937495040

[51] UKCCC - Reducing emissions in Scotland, 2018 Progress Report to Parliament, Sept 2018, Op cit.

demonstrates a lack of leadership and urgency in the agriculture sector. Whilst there are 7 policies, 6 policy development milestones and 9 proposals included (see Appendix 2), the majority need further development, clarity and indicators before policy outcomes can be met. A more stretching aim in the Plan is needed not only to provide the stable climate that farming needs but also to realise the efficiency measures needed in farming to make it profitable and viable for the long term.

In contrast the Climate Change Plan includes greater expectation and stretching policies for the LULUCF sector, including targets for increased tree planting and peatland restoration. Farmers can be part of rolling out these sequestration activities across Scotland.

10. 10 ways to strengthen policies in the Climate Change Plan

RSPB welcomed the broad package of measures in the Climate Change Plan, especially the 5 Policy Outcomes for the agriculture sector. As the broad package of measure shows, there is no silver bullet for agriculture to reduce emissions. All sectors of the agriculture industry and all farmers need to act and adapt farming practices to meet the challenge otherwise some will suffer more than others.

RSPB Scotland believes that the agriculture sector can cut emissions more than 9% by 2032 – banking the savings proposed in the draft Plan and following the UKCCC recommendations would be a start to finding more savings. We don't have access to huge amounts of data or a model to crunch it but a simple review of the Climate Change Plan shows areas where action can be committed to earlier (making meeting targets more likely) or upgrading to stronger action (making uptake more likely). **We recommend that the package is strengthened in the following 10 ways**:

10.1. **Turn all proposals into policies**. All nine proposals are sensible and all are needed in the suite of measures. All the proposals are commitments to *develop* actions rather than commitments *for* action so we recommend that these proposals be developed now along with the policies which also need development.

10.2. **Strengthen commitment to ensure outcomes are met.** Too many policies are vague in terms of commitment or how they will lead to policy outcomes. For example, as currently worded we believe that the two policies under policy outcome 3 will not deliver the outcome of 'reduced emissions from red meat and dairy through improved emissions intensity'. Policy 1 - Commissioning and publishing a report, and Policy 2 - working with industry stakeholders 'to encourage improved emissions intensity' are not firm and directive enough and cannot with confidence lead to the desired outcome.

10.3. **Include indicators of uptake and abatement.** Government expects all the policies in the agriculture section to achieve a 9% reduction in emissions by 2032. However, the policies do not set out expected uptake levels or greenhouse gas emission savings so it is unclear what a successful outcome for each policy looks like. We recommend the Climate Change Plan includes clear indicators of success for each.

10.4. **Start all policies by 2020.** With so many policies needing development there is no time to waste in developing them and rolling out the finalised versions. Otherwise there is likely to be only a few years for farmers to adopt the measures before 2030. Government will need more resources in order to develop the policies but this reapportioning of resources is essential.

10.5. **Stop relying on the Voluntary Approach.** The UKCCC's 2018 progress report for Scotland[52] concluded that in agriculture *'the voluntary-only approach has not led to significant emissions reductions to date.*' Up to this point the Scottish Government has relied on its flagship Farming for a Better Climate (FFBC)[53] initiative to inform farmers about how to reduce emissions, however, the UKCCC found that not enough farmers are aware of it[54]. We believe FFBC should be rolled out further as a basis of increased efforts to train and advise farmers and to demonstrate solutions. It also needs better monitoring and evaluation.

All policies included in the agriculture section of the Climate Change Plan are similarly voluntary. The Environment, Climate Change and Land Reform Committee (ECCLR) agreed[55] with the UKCCC's recommendation that '*If the government continues with voluntary measures [it] must be clear how they will be judged and if found to not be working consider other options'*. RSPB Scotland agrees that there needs to be more active policies to drive uptake of the most basic of interventions, such as soil testing (see below). However, we want to see smart regulation wherever possible which does not increase burdens on farmers but which provides a clear signal of long-term policy intent. Furthermore, regulations should be introduced first which can demonstrate an efficiency benefit and financial saving for those performing the measure for the first time.

We also want to see Government consider making some measures conditional on receiving support payments in future post-Brexit Rural Policy, rather than introducing full regulation. Finally, Government should at least set a regulatory backstop for voluntary measures, setting out explicitly the uptake and action required by when, which if not met will trigger regulation.

10.6. **Introduce a Nitrogen Balance Sheet.** A national Nitrogen Balance Sheet[56] must be created for Scotland in order to inform the Climate Change Plan's policy of setting a 'SMART (specific, measurable, achievable, relevant and time bound) target for reducing Scotland's emissions from nitrogen fertiliser'. Nitrous oxide emissions can be mitigated by using nitrogen more efficiently, cutting losses to the natural environment, and recycling nutrients better[57]. A Nitrogen Balance Sheet is an established scientific technique for understanding how nitrogen flows through sectors of the economy and the environment. This data can then be used by Government to design fair and effective policies and action to reduce nitrous oxide emissions and pollution, and set a fair and stretching target for reducing Scotland's emissions from nitrogen fertiliser. The Scottish Parliament's Rural Environment Committee recommended Government to '*create a Nitrogen Budget[58] for Scotland*' in its report on the Climate Change Plan[59].

The Climate Change Bill should set a duty on the Scottish Government to regularly commission and publish nitrogen balance sheets, with the first one published no later than 2020.

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[52] UKCCC – Reducing emissions in Scotland, 2018 Progress Report to Parliament, Sept 2018, Op cit.
[53] Farming for a Better Climate, https://www.farmingforabetterclimate.org/
[54] UKCCC 2018, Op cit
[55] ECCLR Committee report on the Climate Change Plan, http://www.parliament.scot/parliamentarybusiness/CurrentCommittees/103917.aspx#ww
[56] Also known as a Nitrogen Budget.
[57] A nitrogen budget for Scotland, Nourish Scotland briefing http://www.nourishscotland.org/wp-content/uploads/2017/03/A-Nitrogen-Budget-for-Scotland-Nourish-Scotland-briefing.pdf
[58] Or Nitrogen Balance Sheet
[59] REC report on the Climate Change Plan https://digitalpublications.parliament.scot/Committees/Report/REC/2017/3/10/Report-on-the-Draft-Climate-Change-Plan--the-draft-Third-Report-on-Policies-and-Proposals-2017-2032-2

10.7. **Introduce compulsory soil testing.** We believe that the wording of this policy to 'expect farmers to test the soil on all improved land every five or six years' is not forceful enough. It includes no regulatory backstop of intended consequence for farmers if they do not comply. The UKCCC's recent progress report[60] calls for a regulatory backstop and Parliament's ECCLR Committee also '*remains convinced of the need for soil testing to be subject to regulation*'[61]. We believe that a compulsory pH test is a bare minimum of appropriate fertiliser planning that farmers should be undertaking on a regular basis.

This policy makes sense when we believe that the cost, 'red tape' and burden can be kept to a minimum, and the considerable financial benefits that can be had from understanding soil pH and acting on the information. The Climate Change Plan itself outlined the case of a farm[62] which saved £5500 through testing soils and making efficiency savings.

10.8. **Roll out carbon audits to all farmers by 2024.** The Rural Economy Committee (REC) in its report[63] on the Climate Change Plan urged more ambition regarding '*targets for carbon audit uptake and make public the detail on how it plans to implement its carbon audit roll out up to 2032*'. We agree with the REC recommendation and want to see carbon audits rolled out fully. The transition to a new post-Brexit Rural Policy (from 2019 to 2024) needs to embed carbon audits and support roll out with the advice needed to interpret audit findings and support behavioural change based on the results. We therefore recommend that a carbon audit is made a condition of receiving financial support. However, to cover the cost of the audit and advice we recommend that Government uses the proceeds of capped payments to 2024 to pay for this.

10.9. **Set a target for emissions intensity for livestock by 2020.** Policies under policy outcome 3 commit to action around improving emission intensity (see point 2 above). We believe that Government must be committed and clear that it intends to drive down emission intensity of products (emissions per unit of product) from the livestock sector where there are a great many opportunities to make this possible[64] . We recommend that Government sets a target for this by 2020 to be viewed in conjunction with an overall methane reduction target. We believe that an emission intensity target should not be set in isolation to avoid the perverse situation where growth of the sector even with reduced emission intensity of production results in an overall increase in emissions, especially methane.

In setting targets and benchmarking it must be recognised that there are large differences in emissions between farming systems[65] and therefore these systems should be benchmarked differently. For example, an upland livestock farm business may have significantly higher emissions and emissions intensity than a lowland farm. However, management changes for this farm type – especially introducing beef into a

[60] UKCCC – Reducing emissions in Scotland, 2018 Progress Report to Parliament, Sept 2018, Op cit,

[61] ECCLR report on the Climate Change Plan
http://www.parliament.scot/parliamentarybusiness/CurrentCommittees/103917.aspx#kkk

[62] Wormiston farm

[63] Scottish Government, Climate Change Plan,
https://digitalpublications.parliament.scot/Committees/Report/REC/2017/3/10/Report-on-the-Draft-Climate-Change-Plan--the-draft-Third-Report-on-Policies-and-Proposals-2017-2032-2

[64] Reducing greenhouse gas emissions from livestock: Best practice and emerging options
http://www.saiplatform.org/uploads/Modules/Library/lrg-sai-livestock-mitigation_web2.pdf

[65] Choi et al, Assessment of beef systems with a multi-criteria tool, Aspects of Applied Biology 121, 2013
https://www.researchgate.net/profile/Patricia_Ricci/publication/269699154_Assessment_of_beef_systems_with_a_multi-criteria_tool/links/57752caa08aead7ba06ff949.pdf

sheep farming system - may help it to become a High Nature Value (HNV) system, benefiting wildlife whilst also reducing emissions[66].

10.10. **Research optimal agroforestry systems.** We welcome the policy under outcome 5 to increase planting of trees and hedgerows which optimise carbon sequestration, including the role of agroforestry. However, we believe there is some way to go to develop agroforestry schemes appropriate for Scottish conditions, and especially those which integrate trees into cropping regimes, rather than blocks of shelter trees. Furthermore, research is needed regarding how to optimise carbon sequestration depending on a wide range of variables including tree species choice, soil type, soil depth and location. The Rural Economy Committee (REC) in its report on the Climate Change Plan[67] asked for greater clarity in the Final Plan *'regarding how much CO2 the planned planting targets are anticipated to capture'* and for the '*Scottish Government to give greater consideration to the research required into the benefits of planting the 'right tree in the right location' in order to achieve optimum carbon capture'*. The latter question of how tree planting can optimally capture carbon has not been answered. The ECCLR committee made a similar recommendation[68] asking for greater clarity in the Climate Change Plan between the emissions savings from woodland and from peatland actions. Furthermore, the optimisation of carbon sequestration needs to be balanced with other outcomes such as, biodiversity provision and flood prevention. RSPB Scotland, therefore, recommends that the Plan includes a Policy Development Milestone to carry out this research at the earliest opportunity.

11. 10 additional things to do now to achieve short-term targets

All Climate Change Plan policies, with the 10 amendments above, need full commitment, proper development and widespread roll out with immediate effect, if the Plan is to meet its own 9% reduction target by 2032. However, the Climate Change Plan must go much further than 9% and aim for the recommendations in the Tyndall report for a 3% year cut in non-CO2 emissions. **RSPB Scotland recommends that the Scottish Government introduces the following 10 measures, in addition to the Climate Change Plan policies, by 2020**. These are needed to ensure we go beyond current emission reduction ambitions and ensure farmers are involved in the roll out of NETs.

11.1. **Develop a national farm climate footprint indicator.** Farmers must be able to see that their efforts are making a difference if motivation is to grow. As the Scottish Agriculture Champions pointed out[69] positive climate action by farmers to reduce emissions is not always recognised in the Agriculture Sector emissions because some activities are counted in other parts of the inventory, by other countries, or not at all. For example, sequestration from tree planting on farm will be reported in the LULUCF section of the statistics reports. Another example is the carbon savings from manufacturing less nitrogen fertiliser when farmers use fertiliser more efficiently is also not credited to farmers in the statistics reports. These savings will be credited to the industrial sector of other countries because fertiliser is imported into Scotland. Similarly, the full carbon cost of farmers switching away from imported feeds is not

[66] Fraser MD, Moorby JM, Vale JE, Evans DM (2014) Mixed Grazing Systems Benefit both Upland Biodiversity and Livestock Production. PLoS ONE 9(2): e89054. https://doi.org/10.1371/journal.pone.0089054

[67] Op cit - REC report on the Climate Change Plan

[68] ECCLR, Op cit, http://www.parliament.scot/parliamentarybusiness/CurrentCommittees/103917.aspx#ww

[69] A future strategy for Scottish agriculture, https://www.gov.scot/Publications/2018/05/4376/2

recognised in the emissions reporting statistics. Finally, sequestration of carbon in improved grassland is counted in the inventory (see Appendix 1) but not sequestration in rough grazing which covers approximately 50% of Scotland.

In calculating emissions Scotland is bound by the inventory[70] employed globally to monitor and apportion emissions. Emissions from farming are apportioned to the Agriculture Sector and to the LULUCF sector. RSPB Scotland believes that by bringing together data already in existence and using carbon audit data, Government could produce a truer picture of farming's carbon footprint in Scotland. A national indicator would help to recognise the positive action farmers are taking and support positive behaviour change in the farming community.

11.2. **Promote alternatives to inorganic nitrogen fertilisers.** Whilst we welcome the commitment in the Climate Change Plan to setting an emission reduction target from the use of fertiliser, the greater aim and need is to make alternatives, such as manures, slurries and composts, a more attractive, trusted and available source of nitrogen and other nutrients. With chemical fertiliser remaining expensive and the source of emissions through manufacture, importation and use, efforts in the Climate Change Plan must include helping farmers to switch to alternatives sources of nitrogen fertiliser.

Several proposals are included in the Climate Change Plan, such as investigating leguminous crops in rotation and crop varieties with improved nitrogen-use efficiency, however **vigorous effort is needed to develop other options to reduce emissions from fertiliser use** and for farming to do its part in the circular economy for biological materials. For example, the following measures need to be incentivised and the benefits communicated:

- Nutrient management planning, including as part of Carbon Audits
- Use of manures, slurries, composts and digestates on farm
- Nitrogen fixing crops in rotation
- Use of clover in grass leys
- Uptake of cover crops and catch crops
- Reducing barriers to accepting biological materials onto farms

11.3. **Commit to increasing soil carbon.** The Climate Change Plan does not focus on boosting the carbon content of Scotland's farmed soils despite Soil Organic Carbon in arable and horticultural soils declining by 9.3% between 1998 and 2007[71]. Emissions from managing arable land in Scotland was 2.26MtCO2e in 2016[72], a significant amount. Despite this there is no policy in place to start to reduce these losses, and ultimately increase soil carbon levels. We recommend that Scotland signs up to the '4 per 1000' initiative which aims to stabilise the climate and ensure food security by boosting soil carbon by 0.4% in agricultural soils[73]. Being part of the consortium would show leadership, focus research and allow Scotland to take advantage of solutions developed to increase the sustainable intensification of agriculture as the project describes. The initiative points to a number of measures appropriate for Scottish farming and can be implemented including:

[70] National Atmospheric Emissions Inventory http://naei.beis.gov.uk/reports/reports?report_id=958
[71] UKCCRA - 9.3% is a statistically significant decline (from 35.6g/kg to 32.3 g/kg) https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf
[72] National Atmospheric Emissions Inventory http://naei.beis.gov.uk/reports/reports?report_id=958
[73] https://www.4p1000.org/

- not leaving bare soil,
- nourishing the soils with manure and compost,
- planting trees and legumes – to fix nitrogen from the atmosphere in the soil.

11.4. **Modernise manure management.** 38% of slurry storage is not covered in Scotland[74] and therefore losing valuable resources to the atmosphere as well as contributing 14% of agriculture's emissions[75]. We believe that Government should regulate so that newly installed slurry storage must include a cover. Manures and slurry application to land is also a key time when emissions are released into the atmosphere, both climate emissions and ammonia which causes air pollution. We also want to see the phase out high trajectory slurry spreading.

We agree with the UKCCC that these measures are expensive for farmers so voluntary approaches will be insufficient, that is why we propose supportive approaches such as low-cost or no-cost loans to be facilitated (see point 7 below).

11.5. **Champion improved livestock feeds and diets.** Other than a proposal to investigate feed additives, the Climate Change Plan does not include any policies directly dealing with adapting livestock feeds or feeding regimes to reduce emissions. There is good evidence that improved feed, animal management, and grazing on improved types of grasses and legumes in pastures reduces methane emissions[76]. Recent reports also suggest including algae or seaweed in ruminant diets can reduce emissions[77]. Government should champion research on feeds, feed additives, diets, and improved grazing and feeding regimes which reduce emissions, and follow this with recommendations, communications, industry liaison and policies to roll these out throughout the industry.

11.6. **Involve the poultry and pig industries.** The Climate Change Plan includes actions for the beef, sheep and dairy industries. We urge that the poultry and pig industries are not forgotten in the efforts to reduce emissions despite their relative smaller size. They have an important role to play in cutting emissions in Scotland through feed and manure management. Poultry businesses are already well set up to sell manure and be part of the circular economy, for example Edington Mains farm saved £27,300 in Potash and Potassium applications in one year, plus significant savings on nitrogen fertiliser and lime, by utilising the manure from its poultry business back onto arable land[78].

11.7. **Facilitate low-cost or no-cost loans for new equipment.** Precision technology and new modern equipment, such as low trajectory slurry spreading equipment, needed to reduce emissions or comply with new regulation can be expensive to purchase up front, as can equipment to diversify a farm business. We therefore recommend that Government facilitates cheap or zero-interest loans to support farmers, for example, through the UK Green Investment Bank. Another idea to facilitate the purchase of equipment or fund the diversification of a farm business is to support cooperatives or machinery rings to purchase collectively.

11.8. **Set a target for organic production.** Boosting the organic farming sector is a proven effective mitigation strategy for agriculture. Research shows that organic

[74] Scottish Survey of Farm Structure and Methods, 2016. https://beta.gov.scot/publications/scottish-survey-farm-structure-methods-2016/pages/1/

[75] GHG inventory figures for Scotland – 2016.

[76] Griscom et al., 2017. Natural Climate Solutions, 114 (44) 11645-11650. http://www.pnas.org/content/114/44/11645

[77] https://www.independent.co.uk/environment/cows-seaweed-methane-burps-cut-greenhouse-gas-emissions-climate-change-research-a8368911.html

[78] http://www.farmingscotland.com/index.php?controller=Default&action=Shownews&id=8&name=Poultry

farming is effective in reducing emissions[79] and increasing carbon sequestration in soils[80]. We recommend that Government should set an ambitious statutory target for region 1 land[81] to be under organic management by 2030 (which comes up to 6% of Scotland's agricultural land). Government should also look at promoting other agroecological systems and agroecological practices which have climate benefits.

11.9. **Boost advisory schemes**. Advice, training and support needs to be provided to farmers in ways which fits with their busy routines. We strongly recommend that a new Rural Policy post-Brexit has a much expanded and resourced farm advice scheme which can support farmers in delivering the objectives of the Climate Change Plan and the other measures recommended in this report. To make this happen we want to see a plan-led approach to advisory services introduced with access to payments dependent on farmers producing whole farm business and environment plans. These plans would identify current assets, opportunities and constraints, and help farmers identify what actions, including climate measures, will be economically viable and environmentally sustainable.

11.10. **Manage farm woodlands better.** A recent study[82] showed that 'Climate-Smart Forestry' could double the carbon sink from the forestry sector in the EU. This included through better management of existing woodlands. If Scotland adopted the same Climate-Smart Forestry policies and promoted better management of existing woodland then Scotland could save a further 2.12MtCO2e per year. This figure is calculated using the 2015 carbon sink from forestry figure of 7MtCO2e, and applying, proportionally, the additional carbon sink figure used in the study.

12. Conclusion

The IPCC has shown that it is imperative that we limit warming to 1.5°C above pre-industrial levels and act urgently. RSPB Scotland believes this means setting a net-zero emissions target by 2050 in the Climate Change Bill. Meeting this will require decarbonisation of energy and transport but also cuts to non-CO_2 emissions, mainly from agriculture, and using more land in Scotland to sequester carbon. Performing this 'balancing act' will need all farmers, land managers and the wider agriculture industry to take action, and will need every measure possible to achieve the aim. As lead IPCC author Piers Forster put it '*Do everything and immediately – although there are slightly different ways of doing everything*'[83].

The Scottish Government is giving farming an 'easy ride' on climate action by asking for a mere 9% reduction in emissions to 2032 in the Climate Change Plan. It is not a '*do everything and immediately*' approach or strategy. This report has described the untapped potential of farming to go much further than this in the short and long-term. This includes the example of farmers making 10% savings in emissions in only a few years, the approaches in other countries which could be followed, and how savings can be made in increasing efficiency of fertiliser and livestock production. We believe

[79] Lynch, D. et al The Carbon and Global Warming Potential Impacts of Organic Farming: Does It Have a Significant Role in an Energy Constrained World? Sustainability 2011, 3, 322-362; doi:10.3390/su3020322

[80] Gattinger, A. et al http://www.pnas.org/content/109/44/18226

[81] Region 1 land covers 1.8 million hectares in Scotland and is better quality, productive agricultural land typically used for arable cropping, temporary grass and permanent grass https://www.gov.scot/Resource/0045/00456286.pdf

[82] Nabuurs et al, By 2050 the Mitigation Effects of EU Forests Could Nearly Double through Climate Smart Forestry https://www.wur.nl/upload_mm/c/4/6/4fc6f12c-1dae-4d83-9557-20008c311498_forests-08-00484.pdf

[83] Quoted in a presentation to MSPs in the Scottish Parliament on 15 Oct 2018.

that there are many more no-regret actions that must be developed and rolled out now. These will help farmers become more efficient, give competitive advantage, help reduce other societal and environmental problems, such as air pollution and health impacts, and reduce global warming, the impacts of which farmers are already experiencing in Scotland.

We recommend 10 actions that need to be started now to deliver the emissions reductions through to 2050. These include setting targets for farming to help drive the efficiency savings that are possible, supporting farmers with a just and fair transition to climate-neutral farming, and using a new post-CAP rural policy to pay farmers for putting in place measures which reduce emissions and sequester carbon. The long-term recommendations also involve radical rethinking of systems to create a circular economy which includes farming and food waste, improved training, and realigning research to find solutions that farmers need to meet the climate challenge.

RSPB Scotland urges the Scottish Government to rethink its ambition for agriculture in the Climate Change Plan. We recommend 10 actions to improve the measures within the existing Plan and 10 further actions needed by 2030 to drive deeper emissions reductions than the 9% proposed. These recommendations include positive actions such as a new climate footprint indicator for farming to better communicate the beneficial actions taken by farmers, measures to increase the efficiency of farm input use, a plan of action for farm soils, boosting advisory schemes, and introducing cheap loans to help farmers innovate and invest.

RSPB Scotland is calling on the Scottish Government to change course and provide the leadership that farming needs for the future so that it can help Scotland meet a net-zero target, and continue to flourish up to 2050 and beyond. Only farmers can make significant cuts to the non-CO_2 greenhouse gases methane and nitrous oxide. Farmers are also well placed to use land for boosting the amount of negative emissions in Scotland's greenhouse gas footprint through sequestration and storage of carbon in soils, vegetation and trees. Farming and farmers are needed if Scotland is to meet new ambitious emission reduction targets in Scotland and reduce this pressure on our precious and vulnerable wildlife.

RSPB Scotland

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Front cover images

Common alder *Alnus glutinosa*,- Ben Hall (rspb-images.com)

Farming in Stirlingshire - Andy Hay (rspb-images.com)

Appendix 1

Agriculture and Related Land Use Sector Inventory Categories

Greenhouse gas emissions inventory[84] categories from Agriculture and from Land Use Change combined to form the Agriculture and Related Land Use sector used in Scotland's emissions statistics.[85]

Agriculture	1A4ci_Agriculture/Forestry/Fishing:Stationary
	1A4cii_Agriculture/Forestry/Fishing:Off-road
	2D1_Lubricant_Use
	3A1_Enteric_Fermentation_dairy_cattle
	3A1_Enteric_Fermentation_non-dairy_cattle
	3A2_Enteric_Fermentation_sheep
	3A3_Enteric_Fermentation_swine
	3A4_Enteric_Fermentation_other:deer
	3A4_Enteric_Fermentation_other:goats
	3A4_Enteric_Fermentation_other:horses
	3B1_Manure_Management_dairy_cattle
	3B1_Manure_Management_non-dairy_cattle
	3B1_Manure_Management_other_cattle
	3B2_Manure_Management_sheep
	3B3_Manure_Management_swine
	3B4_Manure_Management_other:deer
	3B4_Manure_Management_other:goats
	3B4_Manure_Management_other:horses
	3B4_Manure_Management_other:poultry
	3B4_Other
	3D_Agricultural_Soils
	3D1_Agricultural_soils-Mineralization/Immobilization
	3F_Field_burning
	3G1_Liming - limestone
	3G2_Liming - dolomite
	3H_Urea application
Land Use Change	4_Indirect_N2O_Emissions
	4B1_Cropland_Remaining_Cropland
	4B2_1_Forest Land converted to Cropland
	4B2_2_Grassland converted to Cropland
	4B2_4_Settlements converted to Cropland
	4C_Grassland_Emissions_from_Drainage
	4C1_Grassland Remaining Grassland
	4C2_1_Forest Land converted to Grassland
	4C2_2_Cropland converted to Grassland
	4C2_3_Wetlands converted to Grassland
	4C2_4_Settlements converted to Grassland
	4D_Wetlands_Emissions_from_Drainage
	4D1_Wetlands remaining wetlands
	4D2_Land converted to wetlands

[84] National Atmospheric Emissions Inventory http://naei.beis.gov.uk/reports/reports?report_id=958

[85] Scottish Greenhouse Gas Emissions 2016 https://www.gov.scot/Publications/2018/06/6601

Appendix 2

List of Policy Outcomes, Policies, Policy Development Milestones and Policy Proposals for the Agriculture Sector in the Scottish Government Climate Change Plan

Policy outcome 1:

More farmers, crofters, land managers and other primary food producers are aware of the benefits and practicalities of cost-effective climate mitigation measures and uptake will have increased.

Policies

1) The dissemination of information and advice on climate change mitigation measures in agriculture through a range of communication methods utilising technology and all media to best effect.

2) An agri-tech group will be established to share, disseminate and encourage adoption of advances in agricultural science and technology as widely as possible.

3) Young Farming Climate Change Champions will be recruited and trained to explain, promote and encourage low carbon farming.

Policy development milestones

1) Carbon Audits: in 2018, we will consult on how best to ensure maximum take up of carbon audits and how to enable tenant farmers and crofters in particular to benefit.

2) We will explore with Scottish Tenant Farmers Association how best to engage tenant farmers to increase understanding of the environmental and economic benefits of low carbon farming.

Policy proposal

1) Marketing scheme: Determine the feasibility of a Low Carbon Farming marketing scheme.

Policy outcome 2:

Emissions from nitrogen fertiliser will have fallen through a combination of improved understanding, efficient application and improved soil condition

Policies which contribute to the delivery of policy outcome 2

1) Communicate and demonstrate the benefits of precision farming and nitrogen use efficiency in order to achieve a reduction in GHG emissions.

2) Work with the agriculture and science sectors regarding the feasibility and development of a SMART (specific, measurable, achievable, relevant and time bound) target for reducing Scotland's emissions from nitrogen fertiliser.

3) From 2018 we expect farmers to test the soil on all improved land every five or six years, and we will work with them to establish how best to achieve this.

Policy proposals

1) Investigate the benefits and barriers of leguminous crops in rotation.

2) Crop varieties with improved nitrogen-use efficiency.

Policy outcome 3:

Reduced emissions from red meat and dairy through improved emissions intensity.

Policies which contribute to the delivery of policy outcome 3

1) Commission and publish a report into the establishment of emissions intensity figures for beef, lamb and milk.

2) Work with Quality Meat Scotland, ScotEID[153] and livestock producers to encourage improved emissions intensity through genotyping, improving fertility, reducing animal mortality and improving on farm management practices.

Policy development milestones
1) Determine the practicality of establishing a SMART target for reduction in the intensity of emissions for beef, sheep and dairy sectors.
2) Consult in 2018 to determine the nature of livestock health measures that the sector will adopt from 2019.
Policy proposal
1) Determine the practicalities and feasibility of using livestock feed additives as a means of reducing emissions.

Policy outcome 4:
Reduced emissions from the use and storage of manure and slurry.
Policy development milestones
1) Determine the potential feasibility of self-financing large-scale slurry and manure fed anaerobic digesters.
2) Engaging with farmers to explore their support requirements, establish how they can improve the use and storage of manure and slurry, including the potential for co-operatively owned and managed anaerobic digesters.
Policy proposals
1) Investigate the practicalities of livestock grazing in rotation on current arable land.
2) Conduct a feasibility study for the establishment of manure/slurry exchange.
3) Determine how to consistently minimise emissions from slurry storage.

Policy outcome 5:
Carbon sequestration on agricultural land has helped to increase our national carbon sink.
Policy which contributes to the delivery of policy outcome 5
1) Explore with the farming and forestry sectors how best to increase planting of trees and hedgerows which optimise carbon sequestration, including the role of agroforestry.
Policy proposals
1) Investigate the feasibility of payment for carbon sequestration taking into account any existing schemes such as the woodland carbon code as a means of encouraging the uptake of carbon sequestration on farms.
2) Woodland cover on suitable agricultural land.