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2nd Report of Session 2021–22

Nature-based solutions: rhetoric or reality?

The potential contribution of nature-based solutions to net zero in the UK

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Evidence is published online at https://committees.parliament.uk/work/1294/naturebased-solutions-for-climate-change/publications/ and available for inspection at the Parliamentary Archives (020 7219 3074).

Q in footnotes refers to a question in oral evidence.

SUMMARY

The term "nature-based solutions" is used to mean working with the grain of nature to achieve a range of benefits, including enhanced biodiversity, flood alleviation, better livelihoods for local communities, and contributing to greenhouse gas reductions, either by storing carbon or by preventing its release. Our focus in this report is on the role of nature-based solutions in reducing carbon emissions and sequestering carbon, as part of the Government's plan to achieve net zero emissions of greenhouse gases by 2050.

Nature-based solutions are not a get out of jail free card. The primary aim must be to reduce carbon emissions from all sectors. However, they can, in principle, play an essential role in taking carbon out of the atmosphere to compensate for the UK's "residual" emissions from the sectors where total elimination of carbon emissions will be impossible to achieve by 2050.

The Government has ambitious plans for nature-based solutions, but our evidence suggests that these plans are at severe risk of failure for the following reasons.

First, there are significant scientific uncertainties in how much carbon is stored in habitats now, how much can be sequestered by different habitats in the future, and for how long it will remain stored. More research is urgently needed to reduce these uncertainties for all habitats, but especially on farmland and for marine environments. Importantly, nature-based solutions are not just about tree planting. Carbon can be sequestered by many terrestrial and marine habitats and all have a role to play if the Government is to meet its net zero target. Some of these habitats are in poor condition and others are being exploited in ways that release rather than retain and store carbon. In many cases, it is hard to measure progress against environmental targets as a result of a lack of baseline data, or a lack of certainty in how these pledges are defined.

Second, the UK does not have the requisite skills to deliver nature-based solutions at scale. The Government acknowledges this but there has been no formal assessment of the skills needed, nor a route to providing training in the timescales required for a transition over the next decade. The skills deficits range from forestry, ecology, and peatland restoration, to advice for local authorities.

Third, there is huge uncertainty about the details of policies that will incentivise nature-based solutions. The Government has said in broad terms that Environmental Land Management schemes, the new agri-environment subsidy regime, will be a central mechanism for subsidising farmers and other landowners to deliver nature-based solutions, but the details of how these will work have not been developed. The Government says it will learn from schemes as they are piloted, which will be vital. But nature-based solutions must be deployed now, alongside measuring and monitoring their effects to establish best practice. Land-managers need some certainty if this is to happen.

Fourth, more funding is required in several key areas. Funding is needed for research: from practical field monitoring and trials with farmers, to basic science in areas like soil and marine carbon sequestration. Additional funding is needed to support an accelerated skills programme, and key public delivery bodies that will have to provide environmental research, advice and regulations are currently inadequately funded to meet the Government's targets.

Fifth, those responsible for farming the UK's land need to be fully engaged; around 72% of the UK's land is farmed. They need a training and an advisory service to help them negotiate a new and complex funding landscape, and support to change farming methods where appropriate. Tenancy agreements may need to change to make shifts in land use possible. Furthermore, farmers need long term funding, and they need to be engaged in on-farm research. Nature-based solutions in support of net zero emissions will not work without the support of farmers and land managers.

Sixth, the Government hopes that private finance will help to fund nature-based solutions, by creating markets for carbon credits that can be used to offset residual emissions, as well as markets for other ecosystem services. However, these markets will only deliver the desired results if they are properly regulated and verified to prevent inaccurate claims of carbon offsetting. Carbon and nature credits must be for benefits that are additional, measurable, and permanent.

Seventh, the Government has not said how it will resolve the many competing demands on the land. Land is used to produce food and timber, to provide space for nature, to alleviate flood risk, to provide space for housing, infrastructure and other development, as well as to sequester and retain carbon. We did not hear evidence that the Government has an effective plan for reconciling these competing demands. Failure to do so risks relying on increased imports for food or timber and offshoring emissions and environmental degradation elsewhere.

In short, while the Government's ambitions for nature-based solutions are admirable, there is a clear and present danger that they will not be achieved, and this could undermine the target of net zero by 2050, as well as the agricultural sector, with a failed transition.

We recommend that the Government, as a matter of urgency, invests in research, skills training, and delivery of nature-based solutions. At the same time, the Government needs to tell land managers how they will be paid for delivering nature-based solutions, to set out how competing demands on land will be balanced, and to facilitate private investment in high-quality nature-based solutions.

Nature-based solutions: rhetoric or reality?

The potential contribution of nature-based solutions to net zero in the UK

CHAPTER 1: INTRODUCTION

Background

1. This report seeks to understand the role that nature-based solutions can and should play in the UK's path to net zero. Nature-based solutions are actions that involve working with nature to address the climate and biodiversity crises, as well as other societal challenges. They include actions that protect or restore natural ecosystems, or that manage working land sustainably. They can also help the UK and the world to achieve net zero emissions. The means by which they can mitigate climate change include by drawing down greenhouse gases from the atmosphere and by preventing further emissions from habitat degradation. But nature-based solutions are not a substitute for decarbonising all sectors of the economy, which remains the main task. Their potential contribution to a net zero world should not be overstated. However, compared to other means of drawing down greenhouse gases, they may have substantial co-benefits. These co-benefits include mitigating flood-risk and reducing other climate impacts, improving water and air quality, increasing biodiversity, and providing areas for human recreation.

2. Not every scheme that uses natural processes to sequester greenhouse gases is a nature-based solution. Establishing a single species (monoculture) tree plantation on formerly species rich grassland would sequester CO_2, but it would provide fewer biodiversity benefits than the grassland it replaced, so it would not be an effective nature-based solution. Some practices may be nature-based solutions in one area, but not in another. Planting the right tree in the right place is certainly beneficial. But tree-planting on deep peat, as occurred in the UK in the 1970s, leads to net environmental harm. Careful, ecologically sensitive, location and future climate specific planning are essential to attaining the emissions reductions and the attendant co-benefits of nature-based solutions.

3. Schemes must be monitored to ensure that any carbon sequestered, and any other benefits, are permanent (at least on societally relevant timescales) and additional. Additional means that more CO_2 is sequestered than there would have been in the absence of the interventions. In the absence of regulations to reduce emissions at source, schemes that treat nature-based solutions as a way of offsetting ongoing greenhouse gas emissions could allow polluters to continue polluting—acting as a sort of 'get out of jail free card'. In the climate change context this is called "mitigation deterrence."

4. In October 2021, we wrote to the President for COP26, Rt Hon Alok Sharma MP, calling for nature-based solutions to be included in the COP decision text.[1] At COP26, the UK Presidency's initial draft of the text

1 Letter from the House of Lords Science and Technology Committee to the Rt Hon Alok Sharma MP, COP26 President, 15 October 2021: https://committees.parliament.uk/publications/7506/documents/79045/default/

included a reference to "nature-based solutions". This was later changed to "protecting, conserving and restoring nature and ecosystems", which echoes the International Union on the Conservation of Nature definition of nature-based solutions.[2] In the letter, we outlined principles that should underpin the roll-out of nature-based solutions:

(a) Nature-based solutions are not a substitute for rapid decarbonisation of all sectors of the economy.

(b) Nature-based solutions should involve a wide range of ecosystems on land and in the sea, not just tree-planting.

(c) Nature-based solutions should be designed and implemented in partnership with local communities and stakeholders.

(d) Nature-based solutions should provide measurable benefits to biodiversity.

(e) Protection of existing ecosystems should be emphasised.

(f) Resilience must be a key factor in design and implementation.

(g) Any carbon benefits claimed must be rigorous in their accounting.

(h) Substantial financing and expertise should be provided by wealthy nations to poorer nations, subject to suitable regulations.

5. The Government has committed to domestic and international targets that will require nature-based solutions to be deployed at scale. To achieve the domestic net zero target by 2050, the Government's indicative pathway is that net emissions from the agriculture, forestry and other land use sector must fall by between 70 and 80% by 2050.[3] Internationally, the UK has committed to "reverse global biodiversity loss", and to ensure that 30% of land and 30% of marine areas are "protected for nature" by 2030.[4] Even with optimistic assumptions about productivity increases in agricultural land, meeting these targets will require widespread changes in land-use.[5] Experience has shown how much easier it is for governments to announce targets than to meet them.

6. Environmental policy has been devolved to the nations of the UK, and the conclusions and recommendations in this report are aimed at the UK Government. But many of the issues identified and suggestions made apply equally to the devolved nations, which will all need ambitious policies to meet the challenge of climate change.

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2 Carbon Brief, 'COP26: Key outcomes for food, forests, land use and nature in Glasgow' (17 November 2021): https://www.carbonbrief.org/cop26-key-outcomes-for-food-forests-land-use-and-nature-in-glasgow; and IUCN, 'IUCN Global Standard for NbS': https://www.iucn.org/theme/nature-based-solutions/resources/iucn-global-standard-nbs [accessed 17 December 2021]

3 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 169: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 17 December 2021]

4 HM Government, 'Global Ocean Alliance: 30 by 30 Initiative': https://www.gov.uk/government/topical-events/global-ocean-alliance-30by30-initiative/about [accessed 29 November 2021]

5 The Committee on Climate Change estimate that to meet net zero by 2050, a fifth of agricultural land will have to be converted to some form of carbon sequestration or practice that reduces emissions: The Committee on Climate Change, *The Sixth Carbon Budget The UK's path to Net Zero* (December 2020) p 170: https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf [accessed 17 December 2021]

Our inquiry

7. On 21 July 2021 we launched our inquiry into nature-based solutions for climate change. We heard oral evidence from multiple witnesses and we received over 40 written submissions. We invited experts to comment on our letter to the President of COP26. We are grateful to all who provided evidence and contributed to our seminar discussions. We thank our specialist advisor for this inquiry, Professor Pete Smith, Professor of Soils and Global Change, University of Aberdeen.

Structure of the report

8. Chapter 2 of this report outlines the key habitats in the UK for nature-based solutions. It discusses the state of the UK's natural environment and outlines the scientific uncertainties that remain for each habitat, as well as their potential contributions to achieving net zero emissions. Chapter 3 of the report discusses the Government's policy. It outlines the targets that the Government has set and the mechanisms that it must put in place to support these, as well as the obstacles to deploying nature-based solutions.

CHAPTER 2: NATURE-BASED SOLUTIONS IN THE UK

The state of the UK's natural environment

9. The UK's natural environment is degraded, and its biodiversity has declined over many decades. An index from the Royal Society for the Protection of Birds and the Natural History Museum ranked the UK as the 12th worst country in the world, and the worst in the G7, in terms of the amount of its biodiversity it has destroyed.[6] The State of Nature Report has tracked biodiversity in the UK since the 1970s. The 2019 report found that 41% of the wild species monitored in that period had declined, 15% were at risk of extinction from the UK and 2% had already disappeared.[7] The Government legislated in the Environment Act 2021 to halt species decline by 2030 in the UK.[8]

10. There are many reasons for the decline in biodiversity, but the State of Nature Report identified land use as the single biggest driver. The majority, 72% (17.3m ha), of the UK's land is primarily managed for agriculture. Peatland covers 2.6 million hectares; 10% of the UK's land area. But the International Union for the Conservation of Nature estimates that only 20% of UK peatland is in a near-natural state. A recent reassessment found that UK peatland is so degraded that, overall, it is emitting more CO_2 than it is sequestering.[9] Around 13% of the UK's land area is forest, but just 44% of the forested area is sustainably managed.[10] Only half of the UK's fish stocks are sustainably managed and 57% of the seafloor in UK waters was disturbed by bottom contact fishing gear between 2010 and 2015.[11]

Key environments in the UK

11. There is potential for nature-based solutions to be deployed across UK habitats. We go into more detail below, but Natural England recently estimated carbon stores and potential sequestration rates for a range of different habitats.

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6 Royal Society for the Protection of Birds, *Biodiversity Loss* (2019): https://www.rspb.org.uk/globalassets/downloads/about-us/48398rspb-biodivesity-intactness-index-summary-report-v4.pdf The conclusions are based on an underlying study by Sanchez-Ortiz et al, *Landuse and related pressures have reduced biotic integrity more on islands than on mainlands*, (March 2019): https://www.biorxiv.org/content/10.1101/576546v1.full.pdf [accessed 17 December 2021]

7 State of Nature Partnership, *State of Nature 2019* (2019) p 13: https://nbn.org.uk/wp-content/uploads/2019/09/State-of-Nature-2019-UK-full-report.pdf [accessed 17 December 2021]

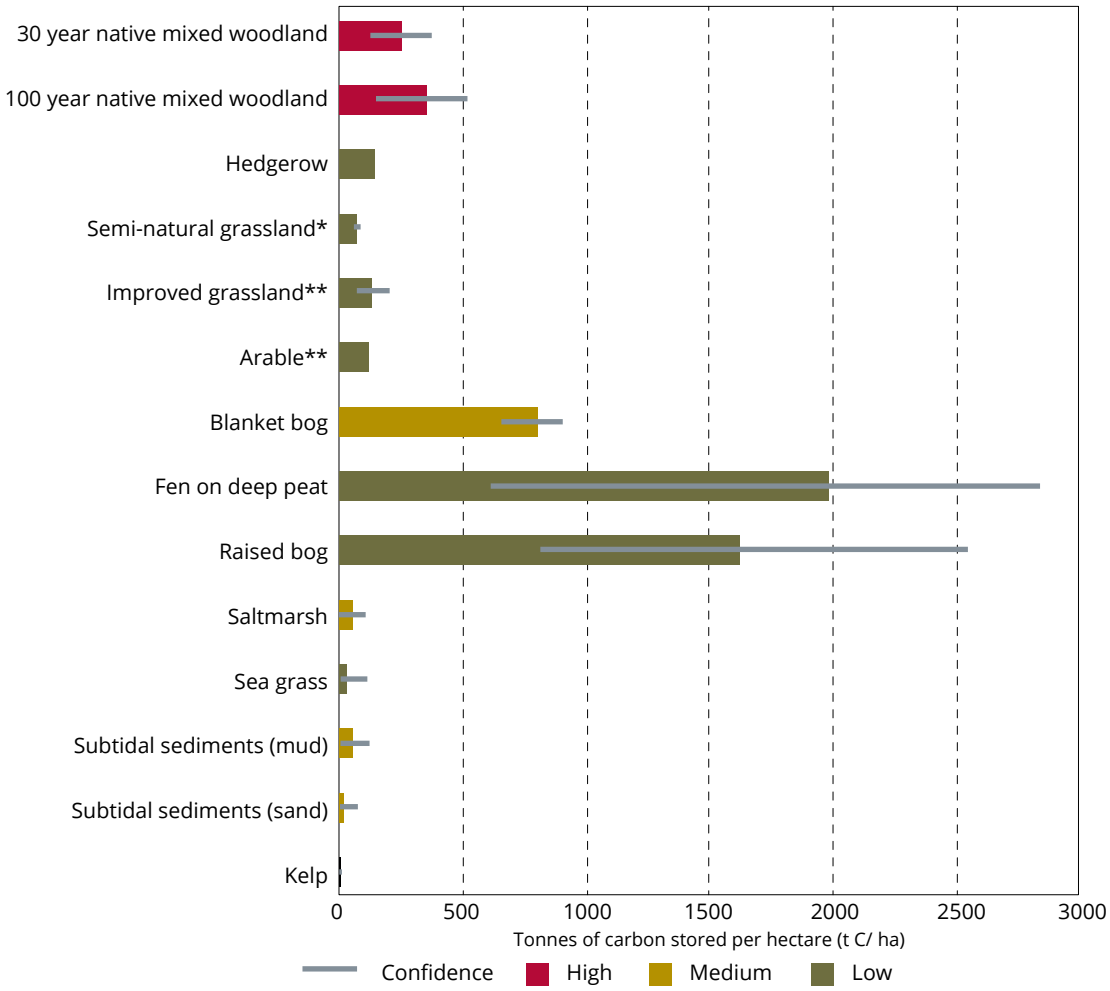
8 Environment Act 2021, section 3

9 International Union on the Conservation of Nature, 'Peatland Damage' (2021): https://www.iucn-uk-peatlandprogramme.org/about-peatlands/peatland-damage [accessed 25 November 2021]

10 There are debates around the terms "sustainable" and "protected". For example, while 26% of the UK's land is regarded as protected, as little as 5% may be effectively protected for nature in accordance with the IUCN definition. The amount of UK land that is "sustainably managed" may be even smaller than numbers suggest. Starnes *et al.*, 'The extent and effectiveness of protected areas in the UK', *Global Ecology and Conservation*, vol. 30 (October 2021): https://www.sciencedirect.com/science/article/pii/S235198942100295X [accessed 17 December 2021] and Wilder Carbon (NSD0043)

11 National Biodiversity Network, *The State of Nature Partnership* (2019): https://nbn.org.uk/wp-content/uploads/2019/09/State-of-Nature-2019-UK-27-09-19.pdf [accessed 17 December 2021]. State of Nature Partnership, *State of Nature 2019* (2019) p 60, 'extent of physical damage': https://nbn.org.uk/wp-content/uploads/2019/09/State-of-Nature-2019-UK-full-report.pdf [accessed 14 January 2022]

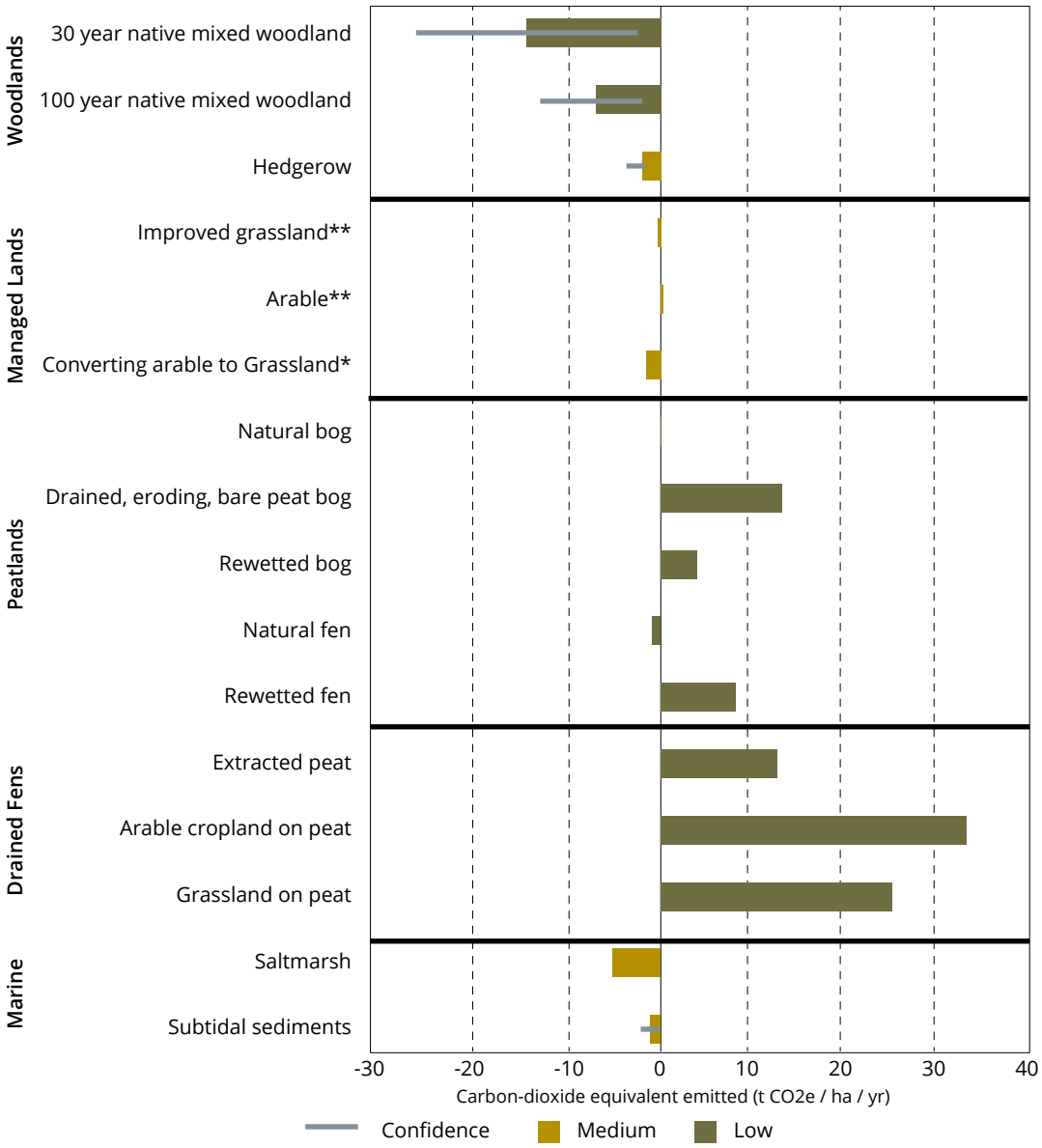
Figure 1: Carbon storage by habitat



Source: Natural England, Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence, second edition (20 April 2021) pp 210–221: http://publications.naturalengland.org.uk/file/6726246198411264 *[accessed 12 January 2022] Colour-coding indicates the level of scientific certainty around this ecosystem, as assessed by Natural England. The grey bars illustrate the range of values measured across different sites by Natural England's meta-analysis, while the solid bar gives a best estimate. For most land ecosystems, these figures show soil carbon to the depth of the ecosystem and carbon stored in vegetation.*

**For grasslands, the data is shown for the top 15cm of soil only, and the range is across three types of semi-natural grassland—acid, calcareous, and neutral—for more information, see the Natural England report. ***For the managed areas of arable and improved grasslands, only soil carbon to 1m depth is included, as the vegetation stocks are removed annually by management.*

Figure 2: Greenhouse gas emission rate by habitat



Source: Natural England, Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence, second edition (20 April 2021) pp 210–221: http://publications.naturalengland.org.uk/file/6726246198411264 *[accessed 12 January 2022] Colour-coding indicates the level of scientific certainty around this ecosystem, as assessed by Natural England. The grey bars illustrate the range of values measured across different sites by Natural England's meta-analysis, while the solid bar gives a best estimate. These sites will vary in condition and age; the value given is an indicative estimate of the average sequestration rate for sites of this type. Negative values indicate that the habitat sequesters carbon.*

**For grasslands, the data is shown for the top 15cm of soil only, and the range is across three types of semi-natural grassland—acid, calcareous, and neutral—for more information, see the Natural England report. ***For the managed areas of arable and improved grasslands, only soil carbon to 1m depth is included, as the vegetation stocks are removed annually by management.*

Forests

12. In the past, much of the UK was forested.[12] But many trees were lost as part of the gradual conversion of land to agricultural uses, and later to the urbanisation that accompanied the industrial revolution. This decline

12 "Forest" in this report will refer to an area of trees. More specific terms such as "mixed woodland" or "commercial forestry" will be used as appropriate.

continued into the 20th century. Forest cover in the UK has increased significantly from the low point in the 20th century after governments supported large scale tree planting. This averaged up to 40,000 hectares a year in the 1970s.[13] Many of the trees planted were conifers, which are non-native species, with the exception of Scots' pine. They account for 51% of the UK's tree cover and 92% of timber harvested in the UK.[14] Most of the remainder is broadleaved woodland, which includes species such as oak, beech and birch.[15] Flexibility may be needed in the future to determine what constitutes a native species as the climate changes. Native trees like beech may struggle in the UK climate of 2050, while trees currently considered non-native will be better suited to these conditions.

13. The UK's forests store around 1.1 billion tonnes of carbon and they sequester about 4.6% of the country's total CO_2 emissions annually.[16] The Committee on Climate Change, which is the Government's independent advisor on climate change, has calculated that, if the UK's tree cover were to increase from 13% to 17% by 2050, and if management practices are improved, then 14 megatonnes of CO_2 equivalent ($MtCO_2e$) per year would be sequestered by 2050 with $14MtCO_2e$ per year also stored in harvested materials.[17] This is small compared with the UK's current annual emissions of around $522MtCO_2e$,[18] but it is a significant fraction of the residual annual emissions of about $90MtCO_2e$ that will remain by 2050 under the rapid decarbonisation needed in order to achieve net zero emissions.[19] Professor David Coomes, Director of the University of Cambridge Conservation Research Institute, told us that, with widespread afforestation, by 2030 there could be sequestration by forests of "one or 2 extra megatonnes of CO_2 per year by 2030, compared with 19 megatonnes of CO_2 per year at present."[20] He emphasised that the contribution trees can make to the net zero objective, relative to the UK's overall greenhouse gas emissions, should not be overstated: "most models looking at trends to 2050, when we are

13 The Committee on Climate Change, *The Sixth Carbon Budget Agriculture and land use, land use change and forestry* (9 December 2020) p 8: https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Agriculture-land-use-land-use-change-forestry.pdf [accessed 17 December 2021]

14 Forest Research, *Forestry Statistics 2021* (September 2021) p 16 and p 73: https://www.forestresearch.gov.uk/documents/8205/Complete_FS2021_JvYjBWA.pdf [accessed 17 December 2021]

15 Office for National Statistics, *Woodland natural capital accounts, UK: 2020* (28 February 2020) p 5: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/woodlandnaturalcapitalaccountsuk/2020 [accessed 17 December 2021]

16 British Ecological Society, *Nature-based solutions to climate change in the UK* (2021) p 10: https://www.britishecologicalsociety.org//wp-content/uploads/2021/05/NbS-Report-Final-Designed.pdf [accessed 17 December 2021]

17 Committee on Climate Change, *Land use: Policies for a Net Zero UK* (23 January 2020) p 8: https://www.theccc.org.uk/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK.pdf [accessed 17 December 2021]

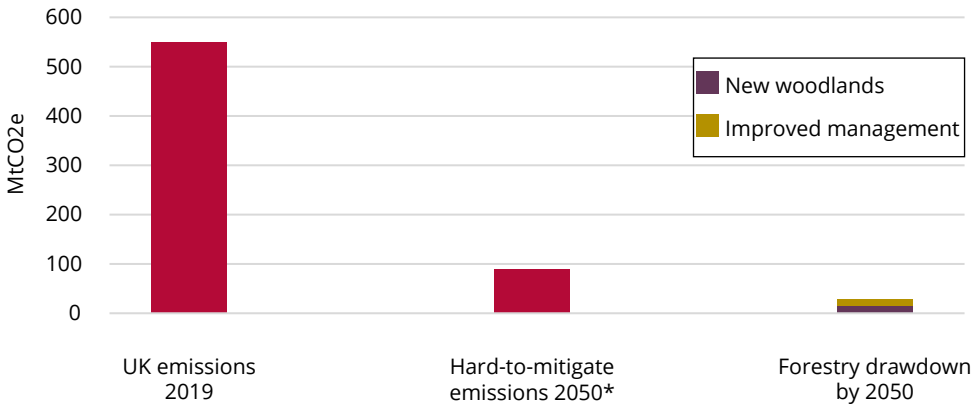
18 Committee on Climate Change, *The Sixth Carbon Budget, The UK's path to Net Zero* (9 December 2020) p 24: https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf [accessed 17 December 2021]

19 Figure 2.18 in the Committee on Climate Change's Sixth Carbon Budget. See Committee on Climate Change, *The Sixth Carbon Budget, The UK's path to Net Zero* (9 December 2020) p 88: https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf [accessed 17 December 2021]. The Committee on Climate Change modelling disaggregates 'engineered' negative emissions from technologies like BECCS and Direct Air Capture and has a separate target for them on the Balanced Net Zero pathway of around 60MtCO2e/yr by 2050. Any negative emissions realised by nature-based solutions would fall under the net emissions in the AFOLU sector in their modelling. So the appropriate comparison is to the figure in this graph, which shows how all remaining net emissions sources are cancelled out by net sinks in 2050, including engineered and natural sinks of greenhouse gases.

20 Q 3 (Professor David Coomes)

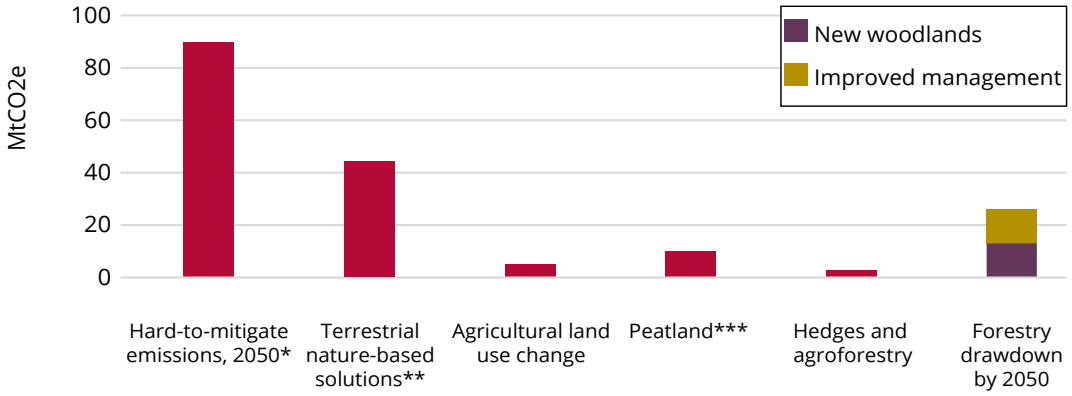
meant to be achieving net zero, say that planting forests now is not going to have a huge impact in that timeframe."[21]

Figure 3: The scale of the contribution of forestry to net zero by 2050



**Hard-to-mitigate emissions are calculated as the residual positive emissions in the Balanced Net Zero pathway after rapid decarbonisation in other sectors of the economy. Source: Committee on Climate Change, The Sixth Carbon Budget, The UK's path to Net Zero (9 December 2020):* https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf *[accessed 17 December 2021]*

Figure 4: The contribution of land-based nature-based solutions to mitigating 'hard to mitigate emissions' by 2050[22]



Source: Committee on Climate Change, The Sixth Carbon Budget, The UK's path to Net Zero (9 December 2020): https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf *[accessed 17 December 2021]; Committee on Climate Change, Updated quantification of the impact of future land use scenarios to 2050 and beyond (UK Centre for Ecology and Hydrology) (9 December 2020):* UK-CEH-Updated-quantification-of-the-impact-of-future-land-use-scenarios-to-2050-and-beyond.pdf (theccc.org.uk) *[accessed 17 December 2021].*

**Hard-to-mitigate emissions are calculated as the residual positive emissions in the Balanced Net Zero pathway*

21 Q 3 (Professor David Coomes)

22 The figures for this graph are taken from the Committee on Climate Change (CCC), *The Sixth Carbon Budget, The UK's path to Net Zero* (9 December 2020): https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf [accessed 18 January 2022]. There are large uncertainties around the carbon storage and sequestration of habitats that make these figures uncertain. The CCC does not estimate the contribution of all habitats, including any marine systems, so these are not included. Other organisations have also provided estimates for the contribution of nature-based solutions that differ from the CCC's estimates. Estimates vary because of scientific and policy uncertainties and the assumptions that are made, for example, the amount of land that can be converted to forestry. This graph merely gives an indication of the scale of the contribution that can be expected from nature-based solutions; the figures should not be considered comprehensive or certain.

*after rapid decarbonisation in other sectors of the economy. ** This bar shows the sum of the nature-based solutions assessed by the Committee on Climate Change (CCC) for its Balanced Net Zero pathway. *** The contribution of peatland restoration is largely in the carbon emissions restoration prevents, rather than the active sequestration of additional carbon.*

14. The Government aims to increase tree planting to 30,000 hectares a year by 2025.[23] In 2019 and 2020, 13,500 hectares were planted.[24] As part of its plan for the UK to meet the net zero target by 2050, the Committee on Climate Change recommends that tree cover in the UK is increased from 13% to 17% by 2050, with 460,000 new hectares of mixed woodland planted by 2035.[25] This could constitute 1.5 billion new trees by 2050. The Government signed the 2014 New York Declaration on Forests, which aimed to halve international deforestation by 2020 and end it by 2030.[26] The 2020 target of the New York Declaration was not met. At COP26, nations restated the target to end deforestation by 2030.

15. Planting trees removes from the atmosphere CO_2 that would otherwise contribute to the greenhouse effect.[27] Existing forests are carbon stores; protecting or restoring them can ensure that carbon remains locked away. Forests, as well as urban trees, have wider benefits: they support biodiversity; they mitigate flood risk; they provide space for recreation; and, crucially in a warming climate, they provide shade and help reduce the urban heat island effect.

23 Department for Environment, Food and Rural Affairs, Forestry Commission and the Rt Hon Lord Goldsmith, 'Consultation launched on the England Tree Strategy' (19 June 2020): https://www.gov.uk/government/news/consultation-launched-on-the-england-tree-strategy [accessed 8 November 2021]

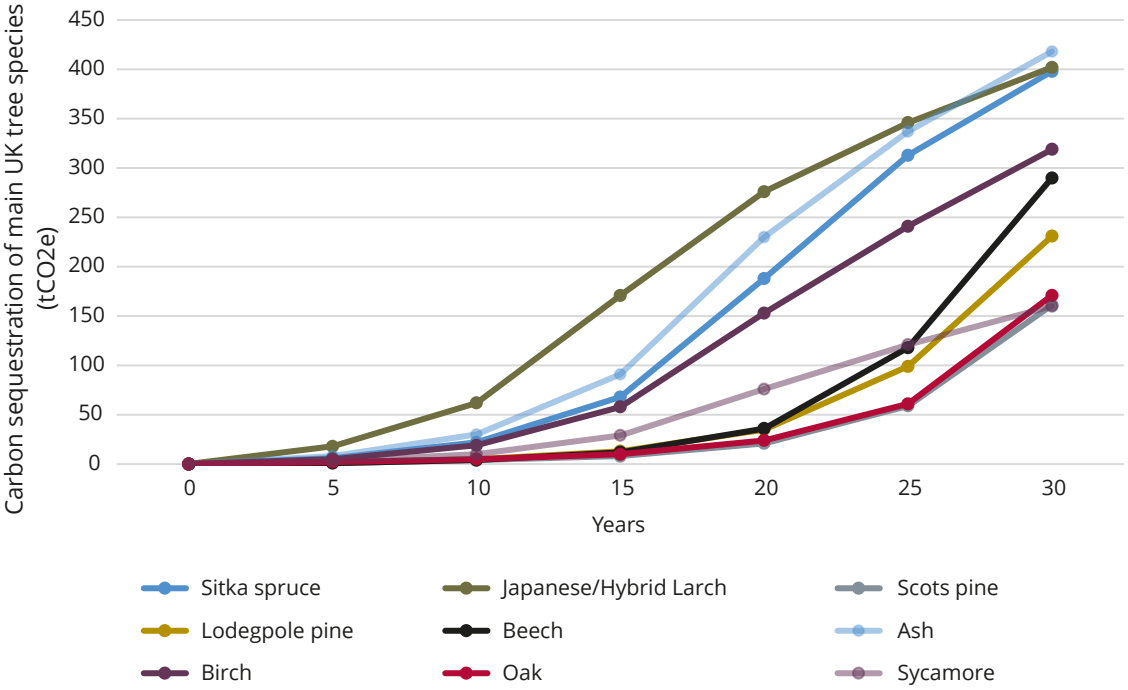
24 Steve Marsh, 'Disappointing planting figures in England still far below Government target', *Woodland Trust* (11 June 2020): https://www.woodlandtrust.org.uk/press-centre/2020/06/government-planting-figures/ [accessed 17 December 2021]

25 Committee on Climate Change, *Land use: Policies for a Net Zero UK* (23 January 2020) p 8: https://www.theccc.org.uk/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK.pdf [accessed 17 December 2021]

26 United Nations Framework Convention on Climate Change (UNFCCC), *Forests: Action Statements and Action Plans* (23 September 2014): https://unfccc.int/media/514893/new-york-declaration-on-forests_26-nov-2015.pdf [accessed 17 December 2021]

27 Afforestation is the conversion of previously unforested land to forestry, while reforestation restores a forest that has been lost.

Figure 5: Carbon sequestration over time for the main UK tree species[28]



Source: Written evidence from the Royal Society (NSD0050). Note that the area under the curve shows the total amount of carbon stored by the tree at a given time after planting.

16. There are different factors to consider when using trees in nature-based solutions. The amount of carbon that trees sequester varies over their lifespan and from species to species. Slow growing trees will not sequester much CO_2 shortly after being planted. This means that some slow growing native species, not frequently used for commercial forestry, such as oak and Scots pine will not sequester much carbon before 2050. Fast-growing non-native species sequester carbon relatively rapidly. They are often grown commercially for timber due to their rapid growth.

17. There is a distinction between carbon sequestration (net removal of CO_2 from the atmosphere) and carbon stocks (the amount of carbon stored in an ecosystem.) Newly established forests may sequester carbon at a similar or faster rate than old-growth forests as their trees grow rapidly initially. But they store much less carbon than old-growth forests, which have a greater overall biomass, and which store additional carbon in the soils. The destruction of existing forests is therefore likely to release more carbon than the growth of new forests can take up, at least within 30 years of their planting. The rates and timescales of carbon sequestration, as well as the ultimate amount of carbon storage, also depends on the species of tree and woodland type.

18. Carbon sequestration is not the only consideration. The British Ecological Society told us "native broadleaf forests provide considerably better biodiversity benefits … over conifer plantations".[29] Richard Greenhous, Director of Forest Services at the Forestry Commission, clarified that the Forestry Standard would no longer allow a monoculture plantation.[30] He

28 All species have a sigmoid (s-shaped) growth curve, but species such as larch and Sitka spruce, grow more rapidly, and therefore sequester more carbon, in the first few decades after planting.

29 Written evidence from British Ecological Society (NSDOO13)

30 Q 91 (Richard Greenhous): "there is no such thing as a 100% Sitka spruce plantation that could be planted any more. The UK forestry standard, for some time now, has not allowed that to happen"

challenged "the idea … that productive forestry does not deliver biodiversity benefits." But he agreed that "undoubtedly, a native broadleaf woodland would deliver more biodiversity benefits".[31]

19. It is important to consider the properties of the site chosen for tree planting. In the 1970s and 1980s, much of the planting was on peatlands. Some of these peatlands are now being restored.[32] This is because planting on peatlands (or wildflower meadows) disturbs the CO_2 stored there and it damages that habitat. Other habitats are important for sequestering and storing carbon, and planting trees in these areas may do more harm than good. For example, converting land from productive agriculture or commercial forestry to forests planted primarily as a permanent carbon store could increase reliance on overseas imports for food or timber. This creates the risk that environmental degradation is merely "offshored."[33] Shifting emissions to other parts of the economy can make accounting for the overall impact of an intervention difficult. Studies have suggested that if you accounted for imports, 46% of the UK's overall emissions would be associated with goods manufactured overseas but consumed in the UK.[34]

20. The long-term storage of carbon is another important consideration. Nature-based solutions schemes must be resilient to pests and diseases. Ash dieback, which is likely to kill 80% of one of the UK's most common trees, illustrates how devastating diseases can be.[35]

21. Trees will also need to be resilient to future climate change. The Government is aware of this risk, cautioning "under a hotter, drier climate removal mechanisms may alter substantially. Traditional approaches to woodland management and selection of planting stock (species and seed origins) may no longer provide the level of removals expected, with difficult cultural discussions around selection of species and cultivars for future climates."[36] We heard that more biodiverse forests are more resilient because "some species are going to succumb to them [pests and diseases] but, because there is diversity, other species can quickly take their place and refill the woodlands."[37]

22. Trees sequester carbon at different rates at different stages of their life, and this sequestration profile depends on the species of the tree. As they grow, trees sequester carbon rapidly, before becoming saturated when they are fully mature. This must be considered when determining which tree will sequester and store carbon over which timescale.[38] Consequently, a way of sequestering more carbon in existing forests is to lengthen rotations and allow trees to grow for longer before harvesting them. Sir Harry Studholme,

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31 Q 91 (Richard Greenhous)
32 See for example: The Flow Country, 'Restoring the Flows': https://www.theflowcountry.org.uk/flow-facts/flow-fact-4/?web=1&wdLOR=c021A8F38-658D-45BF-809D-1D6B2230B4B6 [accessed 8 November 2021]
33 80% of timber used in the UK is exported: NSD0052 (Alan Hampson)
34 World Wildlife Fund, *Carbon Footprint; Exploring the UK's Contribution to Climate Change* (March 2020) p 5: https://www.wwf.org.uk/sites/default/files/2020–04/FINAL-WWF-UK_Carbon_Footprint_Analysis_Report_March_2020%20%28003%29.pdf [accessed 8 December 2021]
35 Woodland Trust, 'Ash Dieback': https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/tree-pests-and-diseases/key-tree-pests-and-diseases/ash-dieback/ [accessed 17 November 2021]
36 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
37 Q 6 (Professor David Coomes)
38 Forest 360, *What carbon accounting model is best for my forest in the Emissions Trading Scheme?* (2020): https://forest360.nz/wp-content/uploads/2020/09/What-carbon-accounting-V2.pdf [accessed 17 December 2021]

Former Chair of the Forestry Commission, thought this could increase carbon stock more quickly than new plantations.[39] However, these forest management techniques would not be incentivised under tree planting schemes that focus on meeting the 30,000 hectare target for additional tree planting.

23. The evidence base for how much forests sequester carbon is more developed than for other habitats, but uncertainties remain. Professor Henderson, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs, described the evidence for the carbon storage and sequestration of trees as "not perfect but … pretty good."[40] Dr Bonnie Waring, Senior Lecturer, Grantham Institute on Climate and Environment, Imperial College London told us there was "tremendous uncertainty" around the carbon sequestration of soils, which will be discussed below, and:

> "Predictions of how much carbon a woodland can capture are based on our measurements of the stem. We know much less about allocation to roots and branches, particularly outside the most commercial species, and that could be important.
>
> The other thing is that we can model carbon uptake fairly well in, essentially, plantations where there is a single species in the same age cohort. We have much less data to model what a naturally regenerating forest would look like with lots of different species all at different ages."[41]

24. Many of the estimates of greenhouse gas emissions from different areas of land rely on emissions factor methodology. Emissions factors predict emissions from an area of land by sorting areas into categories, using estimates of emissions per unit area from a limited number of studies for land for each category, and multiplying the area by the emissions factor. It is a useful method for providing an estimate on a national scale but leaves uncertainty as to the condition of an individual site. Moving from broad emissions factors towards more comprehensive greenhouse gas accounting would improve the accuracy of the data but requires much more on-the-ground monitoring. In many cases, emissions factors themselves are uncertain, and based on limited data.

25. There is uncertainty around the long-term fate of the CO_2 sequestered in trees. Forests that survive are a stable carbon sink into the future. For commercial forestry, long term carbon sequestration depends on how the wood is used once it is harvested. Wood used in construction will store its carbon for the relative long term, while wood used to make paper will release its carbon into the atmosphere quickly as the paper decomposes. We heard that, at present, "between a third and a half of the timber harvested is going into long-term storage".[42]

26. **Faster growing trees sequester carbon more quickly, but surviving, old growth, mixed woodlands are large stores of carbon. The scale of the contribution that fast growing, commercial, forestry can make to net zero by 2050 is significant, but it depends on how harvested wood is used.**

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39 Q 3 (Sir Harry Studholme)
40 Q 124 (Professor Gideon Henderson)
41 Q 4 (Dr Bonnie Waring)
42 Q 113 (Alan Hampson)

27. ***We recommend that a life-cycle analysis be undertaken to calculate the carbon benefits of tree-planting. The fate of the carbon must be monitored beyond harvesting: it is not enough to plant a tree and consider that carbon "sequestered". When deciding which trees to plant, the Forestry Commission must consider factors including resilience to climate change, disease, the risk of fire and potential release of carbon, carbon storage potential, including in the soils, and biodiversity benefits.***

Peatlands

28. Peatland ecosystems are wetland habitats that contain a layer of semi-decomposed organic matter, or peat. The organic matter is semi-decomposed because the waterlogged, nutrient poor, and often acidic, conditions prevent it from being broken down. Peat forming plants consist mostly of sphagnum moss. Peaty soils are defined in England and Wales as those with a 30cm layer of soil comprised of more than 30% organic (carbon-containing) matter.[43] Peatland covers 3 million hectares in the UK—around 12% of the UK's land area.[44] Most of the UK's peatland is in Scotland.

29. Peatland in the UK consists of three main types: blanket bog, raised bog, and fens.[45] Bogs are peatland areas that are mainly fed by rainwater, which makes them nutrient-poor and acidic. Raised bogs are relatively small areas in the lowlands where peat has accumulated to a depth of more than 10m. Blanket bogs consist of extended areas where the peat has formed a layer of 0.5m over lowland, or upland, areas. Fens are areas of peatland that are fed by both groundwater and rainwater, and therefore contain nutrients from the underlying rock. The UK is among the top 10 nations in the world in terms of peatland area, containing 9–15% of Europe's peatland and about 13% of the world's blanket bog.[46] A distinction is often made between lowland and upland peats. Lowland peats are predominantly fens, which are good for agriculture due to their nutrient content.

30. The partially decomposed organic matter contains large stocks of carbon, which makes peatlands the most carbon-dense terrestrial systems on the planet. Peatlands store at least 550 gigatonnes of carbon worldwide, which is twice the amount of carbon stored in the biomass of all vegetation, including forests, while covering an area amounting to only 10% of the area covered by forests.[47] When the peat is disturbed, the carbon locked in the organic matter can be released into the atmosphere as CO_2. Globally, emissions

43 In Scotland the soil layer must be 40cm deep to meet the definition of peat. There is no universally agreed definition for peat.

44 Office for National Statistics, *UK natural capital: peatlands* (22 July 2019): https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapitalforpeatlands/naturalcapitalaccounts#peatland-extent [accessed 17 December 2021]

45 International Union on the Conservation of Nature, *IUCN UK Committee Peatland Programme Briefing Note Complete set 1–10* (5 November 2014): https://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/1-10%20Peatland%20Briefings%20-%205th%20November%202014.pdf [accessed 20 December 2021]

46 International Union on the Conservation of Nature UK Committee Peatland Programme, *Commission of Inquiry on Peatlands Summary of Findings* (October 2011), p 2: https://www.iucn-uk-peatlandprogramme.org/sites/default/files/header-images/Resources/IUCN%20UK%20Commission%20of%20Inquiry%20on%20Peatlands%20Summary%20of%20Findings%20spv%20web.pdf [accessed 20 December 2021]

47 International Union on the Conservation of Nature, 'Peak District study reveals depths of carbon stored in threatened landscapes' (7 October 2021): https://www.iucn-uk-peatlandprogramme.org/news/peak-district-study-reveals-depths-carbon-stored-threatened-landscapes [accessed 20 December 2021]

from degraded peatland contribute 5.6% of all human-caused emissions (1.3GtCO_2).[48]

31. It is not known how much carbon is stored in UK peats. One study estimated 11700MtCO_2e, but the inadequate mapping of peatlands makes this a speculative figure.[49] Despite the uncertainty, there is consensus that peatlands are the UK's largest natural carbon store, holding roughly 40% of the UK's soil carbon.[50]

32. The Royal Society told us "peatlands in a near-natural state have a moderate carbon sequestration effect."[51] This occurs as new layers of carbon-rich peat form on top of the peatland. But the UK's peatlands are highly degraded—only 20% are in a near-natural state, and much of them no longer form new peat.[52] Forty-one per cent are in a semi-natural state, but they have been affected by drainage, managed burning, livestock grazing, and peat harvesting. Woodland accounts for 16% of peatlands, the majority of which has been drained and planted with conifers; 15% is covered by cropland and grassland; and 0.15% is subject to peat extraction for horticulture.[53] This degradation means that peatlands, instead of sequestering carbon, are emitting around 21.3MtCO_2e each year.[54] Dr Rebekka Artz, Senior Research Scientist, Ecological Sciences, James Hutton Institute, told us that this added 3.5% to the UK's total emissions and that it is "the same as … the entire forestry carbon sink at present … all but cancelling out the uptake by the forestry sector."[55]

33. The causes of this degradation vary but are mainly: drainage for agriculture or forestry, air pollution, fire (managed or otherwise), and the extraction of peat for horticulture.[56] These activities disturb new peat formation and they release the carbon stored in old peat. Draining peat lowers the water level, allowing air to penetrate the peat and to convert stored carbon into CO_2. Bare peat associated with fires or cultivation loses particles of peat, which can erode into streams. In oxygen-rich stream water, the peat can release its carbon as CO_2. Similar processes account for CO_2 emissions from soil erosion and heavily tilled agriculture. Dissolved organic carbon in water, to

48 International Union on the Conservation of Nature, 'Issues Brief: Peatlands and Climate Change': https://www.iucn.org/resources/issues-briefs/peatlands-and-climate-change [accessed 18 November 2021]

49 Natural England, *Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence*, second edition (20 April 2021) p 103: http://publications.naturalengland.org.uk/file/6726246198411264—the estimate was given in terms of megatonnes of carbon which we have converted to MtCO2e [accessed 20 December 2021]

50 Written Evidence from the Royal Society (NSD0050)

51 Written Evidence from the Royal Society (NSD0050)

52 International Union on the Conservation of Nature, 'Peatland Damage' (2021): https://www.iucn-uk-peatlandprogramme.org/about-peatlands/peatland-damage [accessed 19 November 2021]

53 UK Centre for Ecology and Hydrology, *Peatlands factsheet*: https://www.ceh.ac.uk/sites/default/files/Peatland%20factsheet.pdf [accessed 20 December 2021]

54 Written Evidence from the Royal Society (NSD0050)

55 Q 23 (Dr Rebekka Artz)

56 International Union on the Conservation of Nature (IUCN), *Peatland Restoration* (December 2010) p 7: https://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/Review%20Peatland%20Restoration,%20June%202011%20Final.pdf [accessed 20 December 2021] The practice of managed or rotational burning on peatlands, often undertaken on grouse moors, is controversial and now subject to a partial ban in UK. The IUCN has recommended that healthy peatlands do not require burning for their maintenance. IUCN National Committee UK Peatland Programme, *Position statement: Burning and peatlands* (March 2020): https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2020–04/IUCN%20UK%20PP%20Burning%20and%20Peatlands%20Position%20Paper%202020%20Update.pdf [accessed 20 December 2021]

which eroded peatlands can contribute, must be removed by water treatment plants for most uses.

34. Different methods of land use affect peat differently. In the UK, most emissions come from lowland peats used for cropland. They account for just 7% of peatlands, but they are responsible for 32% of emissions from all peatlands.[57]

Figure 6: Peatland area breakdown by peatland category[58]

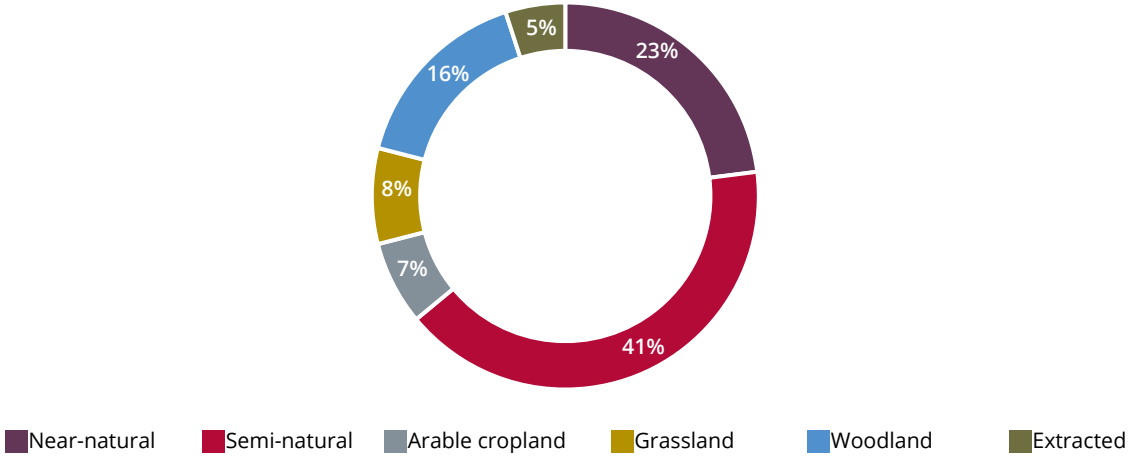
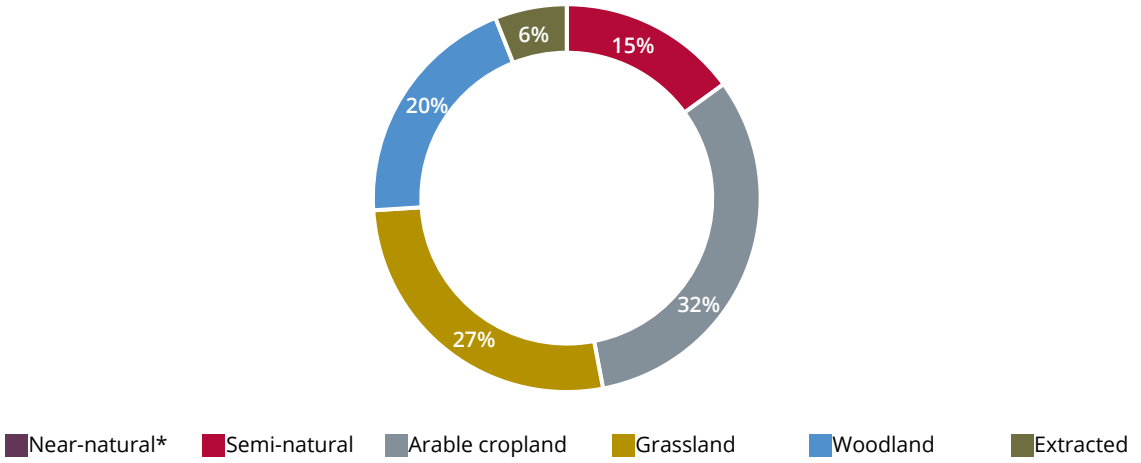


Figure 7: Greenhouse gas emissions breakdown by peatland category



Source: Office for National Statistics, UK natural capital: peatlands (22 July 2019): https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapitalforpeatlands/naturalcapitalaccounts *[accessed 12 January 2022] *Note that near-natural peatlands do not emit greenhouse gases, so do not appear on this chart. While they account for a substantial fraction of peatland area they do not account for any of the emissions associated with peatlands.*

35. Restoring peatlands is a nature-based solution to climate change. Once peatland is rewetted and restored, CO_2 emissions are significantly reduced, due to the return to anaerobic conditions for the peat. Eventually, active peat formation and sequestration of atmospheric carbon can recommence.

57 Office for National Statistics, *UK natural capital: peatlands* (22 July 2019): https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapitalforpeatlands/naturalcapitalaccounts [accessed 20 December 2021]

58 "Peatland category" includes habitats that have been partially converted from peatlands. "Woodland" for example, refers to peatlands that have trees growing on them; "arable cropland" refers to peatlands that are used for agriculture.

But the real carbon benefits in the short term are in protecting the stock that is there and preventing emissions. We heard that the sequestration rate for peatlands is relatively uncertain, but "there is really large vacant storage capacity in that landscape. Peatlands are intrinsically favourable to carbon accumulation given the right conditions."[59] Restoration also improves biodiversity, and it can reduce water purification costs by improving water quality. Peatlands can contribute to flood prevention, as they absorb water and slow its flow across land.[60] In contrast, when peatland has been drained for agriculture "the idea is to remove the water as quickly as possible, and it all collects downstream in the towns."[61]

36. Due to the potential of peatlands to keep carbon in the ground, sequester atmospheric carbon, and provide co-benefits, the Government has ambitious restoration targets. The Government aims to restore 35,000ha by 2025[62] and 280,000ha of English peatland by 2050.[63] Since 1990, 110,000ha of peatland has been restored in the UK.[64] The Office for National Statistics estimated that the cost of restoring all UK peatlands to near-natural condition would be £8.4–21.3 billion, but that this would deliver carbon benefits of £109 billion.[65] The World Wildlife Fund and Royal Society for the Protection of Birds suggested that 23–34MtCO_2e of emissions would be prevented by peatland restoration to 2030 and 63–122MtCO_2e by 2050.[66]

37. The big challenge presented by this ambitious policy is balancing competing demands for land use. As set out above, lowland peats cover a small area and are responsible for a large proportion of the UK's emissions from all peatlands. They are an obvious target for restoration. But they are also among the most productive agricultural lands in the UK. The East Anglian Fens hold 50% of the Grade 1 agricultural land in England and they support a food supply chain worth over £3 billion.[67] Changes to these sites would require addressing the trade-off between the UK's agricultural needs, economic concerns and the carbon benefits of restoration.

38. The main uncertainties in relation to the condition of peatlands include where the peat is, how extensive it is and its depth. Richard Lindsay, Head of Environmental and Conservation Research, Sustainability Research Institute, explained: "we do not know what the peatland floor is like in the UK … because we have not developed the technology to be able to show just

59 Q 23 (Professor Chris Evans)
60 Some examples of restoration schemes with multiple benefits can be found at: The Wildlife Trusts, 'Peatlands—examples of our work': https://www.wildlifetrusts.org/peatlands-examples-our-work [accessed 19 November 2021]
61 Q 27 (Richard Lindsay)
62 Department for Environment, Food and Rural Affairs, *Policy paper: Nature for people, climate and wildlife* (18 May 2021): https://www.gov.uk/government/publications/nature-for-people-climate-and-wildlife/nature-for-people-climate-and-wildlife [accessed 17 December 2021]
63 HM Government, 'UK's path to net zero set out in landmark strategy' (19 October 2021): https://www.gov.uk/government/news/uks-path-to-net-zero-set-out-in-landmark-strategy [accessed 17 December 2021]
64 IUCN Peatland Programme, *UK Peatland Strategy 2018–2040*, p 38: https://portals.iucn.org/library/sites/library/files/documents/2018–015-En.pdf [accessed 20 December 2021]
65 Office for National Statistics, *UK natural capital: peatlands* (22 July 2019): https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapitalforpeatlands/naturalcapitalaccounts [accessed 17 December 2021]
66 World Wildlife Fund and Royal Society for the Protection of Birds, *The Role of Nature in a UK NDC* (November 2020) p 8: https://www.rspb.org.uk/globalassets/downloads/Nature_Based_Solutions_NDC_ReportV2.pdf [accessed 17 December 2021]
67 UK Centre for Ecology and Hydrology, *Peatlands factsheet*: https://www.ceh.ac.uk/sites/default/files/Peatland%20factsheet.pdf [accessed 20 December 2021]

how much peat there is in any given area … we cannot see the depth. We do not actually know the extent either."[68]

39. Dr Artz added that it is unknown "what condition our [the UK's] peatlands are in".[69] Peatland condition is estimated by sorting peatland into categories, based on satellite proxy data. Emissions are then calculated by multiplying these areas by emissions factors. Uncertainties arise from the process by which peatland is sorted into categories. These categories are based on a relatively small set of direct measurements at specific sites. Emissions factors are also uncertain. The most-recent estimates of emissions from UK peatlands, using revised emission factors for peatlands, discovered they were so degraded, that they are a net source of carbon, rather than a sink, as had previously been believed.[70] These are not small uncertainties.

40. Another uncertainty surrounds the effect of methane emissions. When a bog is rewetted, microorganisms return, which emit methane as a by-product when they break down organic material. If this were to result in methane emissions, depending on the relative effects of the methane and CO_2 emissions, it could change the net climate impact of rewetting. This is because methane is also a greenhouse gas; indeed, it is a more potent greenhouse gas than CO_2 before it breaks down into water and CO_2. Professor Chris Evans, Biogeochemist, UK Centre for Ecology and Hydrology, explained "you start to get methane emissions once your water table gets really close to or above the surface. You can over-rewet a peatland … to the point that you will start to see methane, in climate terms, outweighing the carbon benefits."[71] However, he explained that this occurred when a restoration was poorly managed. For a well-managed restoration, he did not consider methane emissions to be a "deal breaker."[72]

41. Restoring degraded peatlands will reduce their emissions. Dr Artz told us that "over the long term, peatlands, if they are in their natural or intact state, are net carbon sinks. We are not yet sure whether restored sites will be able to do the same over the long-term period, but there are ongoing research projects."[73] Professor Chris Evans speculated that there "could be quite a large carbon gain there," but cautioned that this needs to be monitored.[74] We heard suggestions for programmes of long-term, on-the-ground, peatland monitoring using a network of sites to determine the effectiveness of restoration techniques.[75] Earth Observation techniques, including satellite observation, can be helpful in determining peatland condition. We heard in written evidence that Interferometric Satellite Radar (InSAR) can measure the surface motion of peatlands, which provides information about the water depth of peatland.[76]

42. Managing the drainage depth of peatlands used for agriculture could also reduce emissions. Professor Evans told us about research that suggested that

68 Q 23 (Richard Lindsay)
69 Q 23 (Dr Rebekka Artz)
70 Centre for Ecology and Hydrology, *Implementation of an Emissions Inventory for UK Peatlands* (20 December 2017) p 2: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1904111135_UK_peatland_GHG_emissions.pdf [accessed 20 December 2021]
71 Q 24 (Professor Chris Evans)
72 Q 24 (Professor Chris Evans)
73 Q 23 (Dr Rebekka Artz)
74 Q 23 (Professor Chris Evans)
75 Written evidence from Professor David Large (NSD0002) and Dr Jonathan Walker (NSD0034)
76 Written evidence from Professor David Large (NSD0002)

"if you halved the average drainage depth in agricultural peatlands … you could reduce emissions by about 3.5 megatonnes of CO_2 equivalent per year … That is in itself about 1% of UK greenhouse gas emissions."[77] These are opportunities that should be explored.

43. Nature-based solutions must be resilient to a changing climate, and we heard this has not been established for peatlands. Climate change will lead to more rain. Dr Artz explained that it is possible "there are issues with increased methane production during those periods of temporary inundation, but that is probably a relatively minor factor if the water table can be engineered in restoration projects … to be far enough away from the surface to avoid significant methane emissions."[78] Climate change will result in more summer droughts and there "is some emerging evidence … that certainly younger restoration projects are not yet able to modulate their water table in the same way that a fully self-regulating natural peatland ecosystem is able to … One potential danger is that these restored sites may be less resilient to future droughts in particular."[79] The Committee on Climate Change found in its recent advice report to the Government on UK Climate Risk that the effects of higher temperatures and droughts on peatland could be severe. It found that emissions from peatlands could increase substantially in a world that is 4 degrees warmer without further restoration.[80]

Agricultural lands and grasslands

44. Of the UK's land, 72% (17.3 million hectares) is managed for agricultural purposes. Of this, 31% (6 million hectares) is suitable for crops, 10 million hectares (60%) is grazing land, mostly grasslands, and 1 million hectares (6%) is woodland.[81] Agriculture accounted for around 10% of the UK's emissions in 2019 and reducing these emissions will be critical for reaching net zero by 2050.[82]

45. What is the definition of nature-based solutions in agriculture? Professor Chris Collins, Professor of Environmental Chemistry, University of Reading, provided his preferred definition: "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience."[83] Dr Lynn Dicks, University Lecturer in Animal Ecology, University of Cambridge, refined this to include only "things that would naturally occur there and native species only."[84] This means that practices such as minimum tillage, or

77 Q 24 (Professor Chris Evans)
78 Q 24 (Dr Rebekka Artz)
79 Q 25 (Dr Rebekka Artz)
80 UK Climate Risk, UK Climate Risk Independent Assessment (CCRA3), *Technical Report, Chapter 3: Natural Environment and Assets* (2021): https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA3-Chapter-3-FINAL.pdf [accessed 20 December 2021]
81 Department for Environment, Food and Rural Affairs; Department of Agriculture, Environment and Rural Affairs (Northern Ireland); Welsh Government, Knowledge and Analytical Services; and The Scottish Government, Rural and Environment Science and Analytical Services, *Agriculture in the United Kingdom 2020* (22 July 2021) p 9: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034693/AUK-2020–19nov21.pdf [accessed 20 December 2021]
82 Department for Business, Energy and Industrial Strategy, *2019 UK greenhouse gas emissions: summary* (2 February 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957687/2019_Final_emissions_statistics_one_page_summary.pdf [accessed 20 December 2021]
83 Q 9 (Professor Chris Collins) Although, Professor Collins did wish that "inspired ... could be a bit harder".
84 Q 9 (Dr Lynn Dicks)

improved crop rotations to reduce reliance on chemical fertilisers, which may be beneficial, are not considered to be nature-based solutions.

46. Some agricultural land will have to be taken out of production to meet Government targets for afforestation and peatland restoration: this is "land sparing". Other agricultural nature-based solutions are "land sharing": approaches where the land remains productive from a farming perspective but is managed differently or incorporates new features. There is evidence that land sparing approaches are better for biodiversity and carbon sequestration than land sharing approaches, but they involve more substantial land use change and a trade-off in reduced food production.[85]

47. There are several proposed agricultural nature-based solutions in the UK. Innovative farming practices could reduce emissions from agricultural peat. Paludiculture refers to farming on wetlands. By partially rewetting peatland, CO_2 emissions would be reduced (or cease, in the best case) but certain crops could still be grown. Professor Chris Evans cautioned against expecting too much from this approach: "Paludiculture/wetland agriculture … does not really produce food at the moment and it is not as profitable, so it is a real challenge. It is an ongoing research need … if we can find a solution I think everyone would be happy, but we are not there yet."[86]

48. Hedgerows can be planted or allowed to expand, or trees can be included in them. Hedgerows sequester some carbon in the vegetation and soil through plant growth, they provide a habitat for wildlife, and they provide a corridor for wildlife to move along and genetically mix, alongside other co-benefits.[87] Features such as ponds and meadows can be expanded within agricultural land to enhance biodiversity.[88] Agroforestry is an umbrella term referring to the practice of mixing trees with a productive crop or grazing land (silvopasture). The trees sequester more carbon than the crops or grazing grasses, they reduce soil erosion, and they diversify the ecosystem. These are land-sharing approaches.

49. Untilled, species-rich grasslands sequester carbon. They provide a habitat for pollinators, they improve the health of grazing animals and they reduce flood risk by absorbing water.[89] Written evidence from Plantlife says that over the last century, 97% of the UK's species rich grasslands have been destroyed by agricultural processes.[90]

50. There is no formal target for emissions reductions from the agricultural sector. The agricultural sector is combined with the forestry and other land-use sectors in the Net Zero Strategy. The strategy includes an indicative pathway that net emissions from agriculture, forestry and other land use

85 Andrew Balmford, 'Concentrating vs. spreading our footprint: how to meet humanity's needs at least cost to nature', *Journal of Zoology*, vol.315 (2021) pp 79–109: https://zslpublications.onlinelibrary.wiley.com/doi/epdf/10.1111/jzo.12920 [accessed 17 December 2021]

86 Q 32 (Professor Chris Evans)

87 Written evidence from the Farming Grassroots Forum (NSD0003) and Dr Alexander Waller (NSD0005)

88 Written evidence from Emeritus Professor Chris Spray (NSD0004) and the Food, Farming and Countryside Commission (NSD0010)

89 Written evidence from Plantlife (NSD0039); and Scottish Agricultural College (SAC), Technical Note TN614, *Biodiversity and animal health* (March 2009): https://www.sruc.ac.uk/media/hnmhjwqm/tn614-biodiversity.pdf [accessed 20 December 2021]

90 Written evidence from Plantlife (NSD0039)

should fall by 27–43% by 2035 and 70–80% by 2050.[91] The Government will be introducing environmental land management schemes to replace existing subsidies. The Government anticipates that Environmental Land Management schemes and other farming offers will reduce greenhouse gas emissions from agriculture by "up to a total of 6MtCO_2e in Carbon Budget 6 (2033–7) in England", but has not set out how contributions from different schemes will add up.[92] A range of environmentally friendly practices will be encouraged by the Environmental Land management schemes. We cover these in more details below.

51. We have outlined the uncertainties in relation to peat, many of which apply to agriculture on peatland. There are uncertainties that are specific to agriculture and grasslands. Dr Dicks told us "there is good evidence that carbon storage is higher with agroforestry, which is mostly because of the carbon stored in the trees."[93] Studies found that silvopasture does not sequester as much carbon as replacing the land with a forest, but the land is still productive. Dr Dicks noted that the studies have focused on silvopasture, rather than trees mixed with crops. Overall, she considered the evidence "established but incomplete because there are not very many studies."[94]

52. We heard that there is a small carbon sequestration benefit to hedgerows and field margins. Field margins also sequester a small amount of carbon in the soil. Dr Dicks said there was "well-established evidence that you get good climate carbon sequestration from hedgerows and field margins."[95] Combining the three practices, the National Farmers' Union estimated that carbon storage in soils, hedges and trees could increase by 9MtCO_2e a year.[96]

53. Dr Lisa Norton, Agroecology researcher, UK Centre for Ecology and Hydrology, told us that "converting arable to grassland is a good way of storing carbon. It can very quickly build up carbon in soils under grassland; even temporary leys[97] in the arable land have been shown to help with that."[98] She argued that, in the short term, converting arable land to grassland sequesters carbon more quickly than converting it to forest. But she identified evidence gaps around the permanence of the carbon and how grazing animals affect the rate and permanence of sequestration.[99] Dr Mike Morecroft from Natural England agreed that grasslands were "very important" but thought there had been "remarkably few" studies on their sequestration rate, "particularly in semi-natural grasslands."[100] Plantlife called for long-term studies to understand carbon sequestration by grasslands, with a particular focus on carbon in different depths of soil.[101]

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91 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 169: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 20 December 2021]

92 Department for Environment, Food and Rural Affairs, *Environmental land management schemes: outcomes*, policy paper, (6 January 2022), https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 11 January 2022]

93 Q 11 (Dr Lynn Dicks)

94 Q 11 (Dr Lynn Dicks)

95 Q 11 (Dr Lynn Dicks)

96 Written evidence from the National Farmers' Union (NSD0017)

97 A ley is when arable land is temporarily converted to grassland (for hay or grazing)

98 Q 18 (Dr Lisa Norton)

99 Q 18 (Dr Lisa Norton)

100 Q 90 (Dr Mike Morecroft)

101 Written evidence from Plantlife (NSD0039)

54. A major uncertainty for nature-based solutions and agriculture is the question of whether they will reduce yield. Growing less food in the UK risks increased reliance on imports from overseas, where the agricultural emissions and environmental damage may be greater.[102] Part of the Committee on Climate Change's path to net zero relies on agricultural land (perhaps as much as 22%) being taken out of production so it can sequester carbon. To do this without offshoring emissions, the Committee says people must eat less land-intensive food (i.e. meat and dairy), food waste must be reduced and agricultural productivity must increase.[103]

55. The evidence is mixed on whether nature-based solutions reduce agricultural productivity. We heard from Dr Dicks that, for agroforestry, one study found an increase in yield, another a decrease. In the vicinity of a hedge that borders a field, there is a slight drop in yield, due to the shade and the increased competition for water and soil nutrients. But, further into the field, there is an increase. This may be because the hedges reduce soil erosion. Overall, fields with increased hedgerows have a higher yield. The evidence for the effect of field margins on yields is "unresolved"; "there is usually an increase in yield, but it does not go very far into the field".[104] There are likely to be co-benefits that may increase yield, since flowery field margins support pollinators and insects that predate on crop pests, but there is insufficient evidence. We heard that uncertainties remain because "there are not enough long-term studies, so if the effect takes four, five or 10 years to build up, you do not see it in a three-year study."[105] Dr Lisa Norton echoed the call for better long-term data, asking Government "to reconsider funding the UK Countryside Survey, which UKCEH [UK Centre for Ecology and Hydrology] used to run alongside Defra [Department for Environment, Food and Rural Affairs] … It has been going since 1978 and provides useful contextual information about how the landscape is changing in relation to current land use and climate change."[106] The Committee welcomes the Government's renewed commitment to this survey.[107]

56. Further research and development will be needed to establish the impacts of new agricultural techniques on carbon storage and sequestration. We heard that, in some cases, the testing of novel or recycled fertiliser that could sequester additional CO_2 is hampered by regulatory barriers.[108]

Soil

57. Soil carbon storage is important for many of the habitats described above. It is increasingly recognised as a vital carbon store and as a potential sink. Soil health underpins the sustainability of agriculture, forests and grasslands. The Sustainable Soil Alliance told us that there are around 9.8 billion tonnes of carbon in Britain's soils. This is about "80 times more carbon … than in the above ground vegetation."[109] It estimated that agricultural soils have lost

102 Written evidence from the Food, Farming, and Countryside Commission (NSD0010)
103 Committee on Climate Change, *Land use: Policies for a Net Zero UK* (23 January 2020) p 9: https://www.theccc.org.uk/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK.pdf [accessed 17 December 2021]
104 Q 11 (Dr Lynn Dicks)
105 Q 11 (Dr Lynn Dicks)
106 Q 12 (Dr Lisa Norton)
107 UK Centre for Ecology and Hydrology, 'UKCEH Countryside Survey': https://countrysidesurvey.org.uk/ [accessed 25 November 2021]
108 Written evidence from CCM Technologies (NSD0009)
109 Written evidence from the Sustainable Soil Alliance (NSD0033)

over half of their carbon from human activity. The Government concludes that "the available evidence indicates that soils sequester approximately 1 $MtCO_2e/yr$, although healthy soils deliver a range of ecosystems services and could unlock further emissions savings across agricultural systems in particular."[110]

58. Due to the relationship between the productivity of land and soil health, improving soil condition is a co-benefit of other nature-based solutions. Hedgerows, for example, reduce soil erosion. The mycorrhizal network in woodland soils is increasingly recognised as vital to overall woodland health. The Government has recognised that:

> "Encouraging the uptake of sustainable soil management practices for agriculture and other sustainable land uses that improve soil health will in turn underpin a range of environmental, economic and societal benefits, including, food production, biodiversity, carbon storage and flood mitigation."[111]

59. There is uncertainty about the potential of soils to sequester carbon. For example, the Royal Society Greenhouse Gas Removal report estimated that 1–31Mt CO_2e/yr of greenhouse gas removals could be achieved if the majority of farms adopt soil carbon sequestration practices.[112] In particular, there is uncertainty on how soil at different depths is affected by different practices and on the effectiveness of practices intended to increase the carbon content of soil. Professor Henderson also told us that it is difficult to measure carbon in soils because of the variation across small spatial scales as well as with depth.[113]

60. For example, it is now recognised that tree planting on deep peats is harmful, but it is less clear whether, on shallower peaty soils, the carbon sequestered by the tree would offset carbon released by the disturbance when planting. Dr Mike Morecroft from Natural England told us "soil is often not studied to depth. A lot of the data that we draw on are at a 15-centimetre depth of soil. Soil is much deeper than that in many places."[114]

61. ***We recommend that the Government sets a target for emissions reductions from the agriculture, forestry and other land use sector in line with the Committee on Climate Change's recommendations and interim targets.***

62. ***We recommend that, as part of the agricultural transition, research and development is conducted on farms to better understand carbon emissions from farms and the practices that can reduce them. The Department for Environment, Food, and Rural Affairs should fund on-farm research projects and it should monitor them to ensure research is conducted to an appropriate standard. This could be funded through tax credits and grants. The Department should investigate and address any regulatory barriers to conducting this research and development.***

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110 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
111 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
112 The Royal Society and Royal Academy of Engineering, *Greenhouse Gas Removal* (September 2018) p 33: https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf [accessed 20 December 2021]
113 Q 133 (Professor Gideon Henderson)
114 Q 90 (Dr Mike Morecroft)

63. ***We recommend that the Forestry Commission should keep its policy on tree-planting on peaty soils under review. The policy may need to be strengthened if evidence about the net carbon balance of planting shows that it is negative.***

Marine environments

64. Marine, coastal and ocean (hereafter "marine") ecosystems are an important store for carbon. Carbon stored in marine and coastal ecosystems is sometimes referred to as blue carbon.[115] The location, extent and potential importance of marine environments in climate change mitigation are less well understood than land habitats. This means that the possible scale of marine nature-based solutions is also less well-understood. Well-known marine habitats include coral reefs and mangroves. The marine habitats in the UK are less known, but they support a unique biodiversity and they may contain significant stocks of carbon. Our report focuses on habitats in UK waters, but many of the recommendations apply to the important blue carbon habitats in the British Overseas Territories.

65. Shelf sediments are the layers of sediment on the ocean floor. Although sediments are likely to sequester CO_2 very slowly, they cover such a large area that, overall, they will sequester a significant amount of carbon.[116] More importantly, they "contain huge stores of carbon".[117] Estimates are uncertain, but there may be as much as 1900MtCO_2e stored in the top 10cm of the sediments in the UK's exclusive economic zone,[118] with sequestration rates between 0.4–1MtCO_2e/yr.[119] Disturbance of marine sediments, through activities like bottom trawling, results in carbon emissions. It is not yet certain how much CO_2 is released by these processes, but there are growing calls for the carbon stocks in marine sediments to be better protected.[120] Thirty eight per cent of the UK's seas are in Marine Protected Areas, but in only 5% of these bottom trawling is banned.[121]

66. Kelp is a marine alga. It is a seaweed that forms underwater forests. Carbon is sequestered when dead kelp ends up in ocean sediments. The extent of the habitat is uncertain: estimates range from around 40,000ha to 80,000ha. Restoration projects are in their early stages in the UK, so their effect is unclear.[122] The Department for Environment, Food and Rural Affairs estimated a sequestration rate of 0.27 Mt CO_2e/yr across all kelp in the UK, but this is uncertain.[123] As co-benefits, kelp forests improve water quality, they provide habitats (specifically nurseries) for marine life and they may reduce coastal erosion. Seaweed aquaculture could be used in producing foods, medicines, bioplastics or biofuels.

67. Saltmarshes are coastal ecosystems that are flooded at high tide but are exposed at low tide, and they are a unique ecosystem. Saltmarshes sequester

115 National Oceanic and Atmospheric Administration U.S. Department of Commerce, 'What is Blue Carbon?': https://oceanservice.noaa.gov/facts/bluecarbon.html [accessed 20 December 2021]
116 Q 37 (Professor Rick Stafford)
117 Written evidence from Mr Euan Nicholas Furness (NSD0001)
118 An exclusive economic zone is an area of the sea where a state has special rights to the marine resources in that area.
119 Parliamentary Office for Science and Technology, Blue Carbon, PostNote 651, September 2021
120 Written evidence from Blue Marine Foundation (NSD0023)
121 Marine Conservation Society, 'Marine unProtected Areas': https://www.mcsuk.org/ocean-emergency/marine-protected-areas/marine-unprotected-areas/ [accessed 20 December 2021]
122 A project in Sussex introduced a trawling exclusion zone for kelp forests to regenerate 3040ha.
123 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

carbon as the organisms they support are buried in the sediment. There are about 44,100 hectares of saltmarshes in the UK; which represent around 30% of the saltmarshes in Europe.[124] Since 1870, 85% of the UK's saltmarshes may have been destroyed.[125] Saltmarshes have an estimated carbon stock of 48MtCO_2e in the UK, with a sequestration rate of 0.24MtCO_2e/yr.[126] They can also improve water quality, improve flood defences and support biodiversity. The Steart Marshes provide an example of a saltmarsh restoration project.[127]

68. Seagrasses are underwater plants that form meadows on shallow sediments. Their UK range is estimated at 7,000–9,000ha, which is one of the largest seagrass stocks in Europe.[128] Seagrasses have declined by as much as 92%, due to disease and the pollution of coastal waters.[129] There may be up to 410 tonnes of CO_2e/ha in these seagrasses, depending on the species, the water quality and the sediment type, with a total stock, including the sediment, of 3.3MtCO_2e.[130] The annual sequestration rate is uncertain, but it is estimated at 0.02MtCO_2e/yr.[131] Seagrasses provide co-benefits of improved water quality, a habitat for economically valuable fish and increased biodiversity.

Table 1: Estimates for sequestration and storage of CO_2e across different marine habitats, UK-wide

Marine habitat	Storage (t CO_2e/ha)*	Sequestration rate (t CO_2e/ha/yr)*	Approximate Extent (ha)
Sediments[132]	25	0.005–0.013	75,000,000
Kelp	N/A	4.5	60,000
Saltmarsh	1090	5.44	44,100
Seagrass**	410	0.000003	8,000

Sources: Parliamentary Office for Science and Technology, Blue Carbon, PostNote 651*, September 2021; Written evidence from Department for Environment, Food and Rural Affairs (*NSD0042*); Natural England, Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence, second edition (20 April 2021), Section 6.6, pp 162–164:* http://publications.naturalengland.org.uk/file/6726246198411264 *[accessed 12 January 2022]*

124 Rosie Miles and Nathan Richardson for the Royal Society for the Protection of Birds, *Sustainable Shores (Technical Report)*, (February 2018): https://www.rspb.org.uk/globalassets/downloads/projects/sustainable-shores-project---technical-report.pdf; and Burden, A. *et al.* for the Marine Climate Change Impacts Partnership (MCCIP), *Impacts of climate change on coastal habitats, relevant to the coastal and marine environment around the UK* (15 January 2020), Science Review 2020, pp 228–255: https://research-repository.st-andrews.ac.uk/bitstream/handle/10023/19428/11_coastal_habitats_2020.pdf?sequence=1&isAllowed=y [accessed 4 January 2022]

125 Parliamentary Office for Science and Technology, Blue Carbon, PostNote 651, September 2021

126 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

127 Wildfowl and Wetlands Trust, 'Steart Marshes': https://www.wwt.org.uk/wetland-centres/steart-marshes/ [accessed 29 November 2021]

128 Luisetti *et al.*, 'Quantifying and valuing carbon flows and stores in coastal and shelf ecosystems in the UK', *Ecosystem Services*, (February 2019) Vol. 35, pp 67–76: https://www.sciencedirect.com/science/article/pii/S2212041618300536 [accessed 4 January 2022]

129 Parliamentary Office for Science and Technology, Blue Carbon, PostNote 651, September 2021

130 Natural England, *Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence*, second edition (20 April 2021), Section 6.6, pp 162–164: http://publications.naturalengland.org.uk/file/6726246198411264—Note that one figure was converted from tonnes of carbon to tonnes of CO2e, multiplying by 44/12. [accessed 12 January 2022]

131 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

132 Measured across the top 10cm of sediment only

**Storage and sequestration rates have been divided by the approximate extents to determine storage and sequestration rates per hectare. **Seagrass carbon storage estimates include the sediment beneath the grass.*

69. The evidence base for marine environments is sparse. The extent of many of these habitats is unknown, as is the rate at which they sequester carbon. Professor Hilary Kennedy, Emeritus Professor, School of Ocean Sciences, Bangor University, referred to being "an order of magnitude out on knowing [the] total area" of seagrasses.[133] Estimates for other habitats also have large uncertainty ranges. Without knowing their extent, it is impossible to know what the stock of carbon is in each environment. As the Government told us, "we do not yet have sufficient data to accurately quantify the baseline and potential contribution of coastal habitats to emissions reductions in the UK".[134]

70. There are not enough studies globally, and especially studies in the UK, to know the sequestration rates of UK coastal habitats. Dr Mike Morecroft of Natural England told us that the numbers for the sequestration rate of seagrass came from "one study on the other side of the Atlantic".[135] Professor Ian Bateman identified the interaction between terrestrial land use and seagrasses as another uncertainty.[136] There are numbers around the sequestration and carbon stock of kelp and marine sediments, but Professor Kennedy did not consider them reliable.[137]

71. There are no specific targets for carbon emissions from marine ecosystems. The uncertainties are such that "the coastal environment does not currently contribute to carbon accounting and reporting due to a lack of appropriate data."[138] There is no blue carbon inventory setting out the carbon stocks of coastal and marine habitats in the UK, as there is for ecosystems on land.[139] The Scottish Government has established a research programme to create an inventory for its blue carbon.[140] Work is under way to include saltmarshes in forthcoming assessments, with other marine ecosystems to be included at an earlier stage. The Government is "actively exploring" the potential of marine environments to contribute to nature-based solutions and it is committed to strengthening the evidence base. The paucity of evidence means there are not specific targets for restoration.

72. **There are large gaps in the evidence pertaining to carbon sequestration and storage in marine habitats. Saltmarshes and seagrasses are better understood, but uncertainties remain. The understanding of other habitats for nature-based solutions, such as, kelp forests, shelf sediments and algae, is less mature.**

73. ***We recommend that the Department for Environment, Food and Rural Affairs supports research that focuses on establishing the***

133 Q 37 (Professor Hilary Kennedy). An order of magnitude means by an order of 10. Ten is an order of magnitude from 100, 6 from 60, etc.
134 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
135 Q 90 (Dr Mike Morecroft)
136 Written evidence from Professor Ian Bateman (NSD0011)
137 Q 37 (Professor Hilary Kennedy) "The potential is there for kelp and marine sediments, but we do not have enough evidence yet to be able to give good values."
138 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
139 Natural England, *Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence,* second edition (20 April 2021): http://publications.naturalengland.org.uk/file/6726246198411264—includes only saltmarshes [accessed 14 January 2022]
140 Scottish Blue Carbon Forum: https://www.bluecarbon.scot/ [accessed 14 January 2022]

current and historical extent of marine habitats, their carbon sequestration rates, and their long-term potential for carbon storage.

74. ***We recommend that a blue carbon mapping exercise for the UK exclusive economic zone be undertaken, learning from the Scottish Blue Carbon Forum. This should involve collaboration between Natural England, the Crown Estate, the Marine Management Organisation, academics, and other relevant public bodies.***

75. ***We recommend that the Marine Management Organisation establishes research programmes to investigate the cause of the decline of marine habitats, such as seagrasses, and the potential effects of eliminating bottom trawling on carbon sequestration in the marine environment.***

Urban

76. There are nature-based solutions that could be deployed in urban spaces. In cities and towns trees could be planted, urban wildlife reserves could be created and gardens might be allowed to grow "wilder". Due to the limited available space, urban nature-based solutions are likely to be justified more on their co-benefits than on their potential carbon sequestration. Nevertheless, urban nature can store a large amount of carbon, with stock estimates of around 610MtCO_2e in UK cities.[141]

77. Urban trees could improve adaptation to climate change, because the cooling effect of shade and the transpiration from plants will become more important as the climate warms. Green roofs, where plants, rather than building materials, are exposed to the sun, could help to reduce the urban heat island effect and they could mitigate extremes of temperature in cities.[142] This would reduce reliance on air conditioning, which has high environmental costs.[143] There is also a potential for nature to mitigate flood risk in cities and to reduce the impact of exposure to pollution. Bright Blue pointed to the biodiversity benefits of connecting isolated pockets of nature via wildlife corridors.[144]

78. The Government has supported urban tree-planting and has committed to funding community forests.[145] The Government recognises that these forests can support "urban and peri-urban regeneration in some of the most deprived areas, delivering multiple social, economic and environmental outcomes."[146] The Government referred to the role that nature-based solutions could play in "natural flood management or urban cooling".[147]

141 Written evidence from Professor Harriet Bulkeley (NSD0015)
142 T Suca et al., 'Positive effects of vegetation: Urban heat island and green roofs', *Environmental Pollution*, (2011) Vol. 159, pp 2119–2126: http://www.cspinconline.com/resources/2016-Leadership/Susca2011-PositiveEffectsVegUrbanHeatIslandGreenRoofs.pdf [accessed 12 January 2022]
143 Q 7 (Sir Harry Studholme)
144 Written evidence from Bright Blue (NSD0012)
145 Department for Environment, Food and Rural Affairs, '500 hectare planting boost for England's Community Forests' (6 December 2020): https://www.gov.uk/government/news/500-hectare-planting-boost-for-englands-community-forests [accessed 12 January 2022]
146 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)
147 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

Need for further research

79. It is hoped that nature-based solutions will help to mitigate climate change. For nature-based solutions to fulfil their promise, they need to be based on robust scientific evidence. There are a number of gaps that need to be addressed—some are specific to habitats and others are more general. But the restoration of nature has benefits that are certain. It is important that a lack of evidence does not lead to a lack of action. Lord Goldsmith of Richmond Park, Minister for the Environment and the Pacific, told us that scientific uncertainty should not be used as "an excuse not to do things that we know are good".[148]

80. **While it is important that gaps in the evidence base are filled, the gaps should not act as a barrier to the large-scale adoption of nature-based solutions. The exact impact of nature-based solutions will be known only after they have been tried and monitored in the long-term, but evidence already indicates a positive impact. Given the urgency of the climate and biodiversity crises, there is no time to waste. The fact that it is not possible to quantify exactly the carbon loss due to marine shelf sediment disturbance, or to other activities, should not prevent the protection of these habitats.**

81. ***We recommend that, where there are gaps in the evidence, policy should adopt a precautionary approach, weighted in favour of nature.***

82. **There is uncertainty about the long-term sequestration potential of nature-based solutions across habitats. Nature-based solutions that are not resilient to adverse weather, human activity, a changing climate, or pests and disease risk being ineffective and releasing any carbon they sequester. Monitoring will allow lessons to be learned from schemes that succeed, and from those that fail.**

83. **Monitoring technologies such as Earth Observation are potentially important. However, they cannot substitute for direct measurements on the ground. Uncertainties have direct implications for policy. They are greater for ecosystems that are less well-understood than woodlands and peatlands. Emissions factors are useful for estimating the contribution of habitats to greenhouse gas emissions across the UK. But nature-based solutions are inherently local and must be understood on a local level.**

84. ***We recommend that long-term research and monitoring be supported and overseen by the relevant departments and their public bodies, including Natural England and UK Research and Innovation, to ensure schemes are resilient and deliver as promised. The research and monitoring programmes should support direct and indirect measurements of greenhouse gas fluxes on a range of representative sites for key habitats in the UK to address uncertainties concerning the timescale and duration of carbon storage and sequestration for all habitats.***

148 Q 139 (Lord Goldsmith of Richmond Park)

Other conclusions and recommendations

85. **The Government's focus has been mostly on large-scale land sparing approaches, such as large-scale tree planting and peatland restoration, for which the evidence base is strongest, rather than land sharing approaches and improved management of ecosystems. Land sparing is likely to sequester more carbon than land sharing, but it may entail more trade-offs.**

86. ***We recommend that research programmes be established to fill uncertainty gaps in the impact of land sharing techniques, including hedgerow planting, silvopasture and agroforestry and the effect of these practices on soil carbon storage and sequestration.***

87. **Restoring nature is often more complex and costly than protecting it. Restored ecosystems may take a long time to recover biodiversity and carbon stores, if they ever do. Policy should not assume that it is possible to 'recreate' in another place the natural systems that are destroyed.**

88. ***We recommend that the Government makes it a priority to protect the natural ecosystems that remain wherever this is possible to ensure the significant stores of carbon in these habitats are not emitted.***

CHAPTER 3: SUPPORTING NATURE-BASED SOLUTIONS AT SCALE IN THE UK

Turning pledges for nature into plans

89. The Government has targets for nature restoration and emissions reduction or sequestration that will rely on nature-based solutions. The targets are ambitious, but many previous promises to protect and restore nature have not been met. For example, a 2015 manifesto target to plant 11 million trees in England by 2020, matching the planting rate from 2010–5, was missed when planting rates fell.[149] International targets have been missed: none of the 20 Aichi global targets for biodiversity restoration were met.[150] Table 2 summarises Government pledges related to nature-based solutions.

Table 2: Government pledges related to nature-based solutions

Policy area	Pledge	Context
Tree planting	Plant 30,000ha per year in the UK by 2025; triple tree-planting rates in England (to 9,000ha) by the end of this Parliament.	13,000ha planted UK-wide in 2019 and 2020. The Net Zero Strategy pledges to consult on a long-term target.
Peatland restoration	Restore 280,000ha of English peatland by 2050, and at least 35,000ha by 2025.	Over 110,000ha of peatland has been restored in the UK since 1990.[151] The Net Zero Strategy does not have separate targets for lowland and upland peat.

149 An October 2019 written response from the Government did not specify how many trees had been planted in the period from 2015 but said that "15 million trees have been planted since 2010", which would appear to leave a substantial shortfall. Hectare data from Forest Research statistics would support this. House of Commons Library, Tree Planting in the UK, Briefing Paper 9084, June 2021. Written Answer UIN 7178, Session 2019. Forest research, ' New planting in England, 1971–2021': https://www.forestresearch.gov.uk/documents/8179/planting1976–2021revised.xlsx [accessed 13 January 2022]. The Conservative Party Manifesto 2015, p 54: https://manifesto.deryn.co.uk/wp-content/uploads/2021/04/ConservativeManifesto2015-1.pdf [accessed 13 January 2022]

150 In the UK, five of the targets—set in 2010—were on track to be achieved by 2020, but 14 were not. Joint Nature Conservation Committee (JNCC), *Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland* (March 2019): https://data.jncc.gov.uk/data/527ff89f-5f6b-4e06-bde6-b823e0ddcb9a/UK-CBD-6NR-v2-web.pdf; and JNCC, *Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland, Overview of the UK Assessments of Progress for the Aichi Targets* (March 2019): https://data.jncc.gov.uk/data/527ff89f-5f6b-4e06-bde6-b823e0ddcb9a/UK-CBD-Overview-UKAssessmentsofProgress-AichiTargets-web.pdf [accessed 12 January 2022]

151 IUCN Peatland Programme, *UK Peatland Strategy 2018–2040*, p 38: https://portals.iucn.org/library/sites/library/files/documents/2018–015-En.pdf [accessed 7 January 2022]

Policy area	Pledge	Context
Agriculture, forestry and other land use sector emissions	Indicative pathway that emissions from the agriculture, forestry and other land use sector should fall by 27–43% by 2037 and 67–78% by 2050.[152]	Emissions have remained flat in this sector since 2007. The CCC noted that progress in this sector "repeatedly failed to meet the indicators" set out in its reports.[153]
Agriculture	75% of farmers to be "engaged in low-carbon practices" by 2030, rising to 85% by 2035.[154] Fraction of farms in agri-environment schemes to increase to 70% by 2028. Up to 60% of England's agricultural soil to be under sustainable management by 2030.	"Low carbon practices" are not defined. The Government defines 'engagement' as interacting with the Sustainable Farming Incentive, but the environmental benefits that will result remain unclear as a number of practices are covered by the Sustainable Farming Incentive. .[155] Emissions have remained flat since 2007. 32% of farms are in agri-environment schemes today.
Protected areas	"Effectively protect" 30% of land and marine areas for nature by 2030 (30by30 pledge).	The Government considers 26% of land (in England) and 38% of marine areas to be protected.[156]

152 The Net Zero Strategy does not set an emissions target for this sector but it does include an "indicative pathway", illustrating the scale of the contribution expected from the sector. It outlines policies that are intended to contribute to meeting the target but does not set out how these add up to the proposed fall in emissions. DEFRA officials told us they will announce a target shortly and it will likely follow this indicative pathway. Q 122 (Janet Hughes). The Committee on Climate Change maintains a series of key progress indicators for the sector and outlines gaps between targets and policies in its reports. Committee on Climate Change, *Progress in reducing emissions, 2021 Report to Parliament* (June 2021) Table 3.4, p 119: https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf [accessed 7 January 2022]

153 Committee on Climate Change, *Progress in reducing emissions, 2021 Report to Parliament* (June 2021) p 93: https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf [accessed 7 January 2022]

154 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 167: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 7 January 2022]

155 In the Net Zero strategy, the Government acknowledges that the definition of this pledge is not clear commits to "continue to improve this metric in future years" due to "key limitations in the current approach." HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 171: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 7 January 2022]

156 Prime Minister's Office, 'PM commits to protect 30% of UK land in boost for biodiversity' (28 September 2020): https://www.gov.uk/government/news/pm-commits-to-protect-30-of-uk-land-in-boost-for-biodiversity; Marine Conservation Society, ' Protected seas around the UK': https://www.mcsuk.org/ocean-emergency/marine-protected-areas/uk-protected-areas/ [accessed 7 January 2022]

Policy area	Pledge	Context
General environment	The 25 Year Environment Plan sets out goals related to the environment over the next 25 years.[157]	These targets include metrics for clean air, clean water, biodiversity, and climate change mitigation and adaptation.[158]
Biodiversity	Halt biodiversity loss by 2030.[159]	The Environment Act 2021 provides for setting a specific target to halt species loss that is consistent with this pledge.[160]
Private finance for nature	Raise £500 million annually in private finance to support nature's recovery by 2027 in England, rising to more than £1 billion by 2030.[161]	It is unclear how this will be defined and there are not figures for the amount of private finance currently being directed to nature recovery.
Global methane emissions	Reduce global methane emissions by 30% (on 2020 levels) by 2030.[162]	Global Methane Pledge (COP26). Global methane emissions rose almost 10% since 2000.[163]
Global forests and land use	Working collectively to halt and reverse forest loss and land degradation by 2030.[164]	Glasgow Leaders' Declaration on Forests and Land Use (COP26). The 2014 New York Declaration on Forests also promised to halt deforestation by 2030 but missed its 2020 target to halve deforestation.[165]

157 Department for Environment, Food and Rural Affairs, 'At a glance: summary of targets in our 25 year environment plan' (22 October 2021): https://www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance [accessed 7 January 2022]

158 The 25 Year Environment Plan was adopted based on recommendations from the Natural Capital Committee. This advice included setting specific, legally binding targets for air and water quality, biodiversity, resource efficiency and waste. The Environment Act 2021 gives the minister power to set these targets by regulation and establishes the new Office for Environmental Protection for monitoring progress. Natural Capital Committee, *End of Term Report* (November 2020) p 3: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/931695/ncc-end-of-term-report.pdf [accessed 7 January 2022]

159 Leaders pledge for nature: https://www.leaderspledgefornature.org/ [accessed 7 January 2022]

160 Environment Act 2021, section 3

161 HM Treasury, *Autumn Budget and Spending Review 2021*, HC 822 (October 2021) p 72: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1029974/Budget_AB2021_Web_Accessible.pdf [accessed 7 January 2022]

162 UN Climate Change Conference UK 2021, 'World leaders kick start accelerated climate action at COP26' (2 November 2021): https://ukcop26.org/world-leaders-kick-start-accelerated-climate-action-at-cop26/ [accessed 7 January 2022]

163 Quirin Schiermeier, 'Global methane levels soar to record high', *Nature* (14 July 2020): https://www.nature.com/articles/d41586–020-02116-8 [accessed 7 January 2022]

164 UN Climate Change Conference UK 2021, 'Glasgow leaders' declaration on forests and land use' (2 November 2021): https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/ [accessed 7 January 2022]

165 New York Declaration on Forests, *Protecting and Restoring Forests A Story of Large Commitments yet Limited Progress—5-year assessment report* (September 2019): https://forestdeclaration.org/wp-content/uploads/2021/10/2019NYDFReport.pdf [accessed 7 January 2022]

90. The terms used in some pledges lack clarity. For instance, the absence of a definition for "effectively protect" undermines the pledge to effectively protect 30% of terrestrial and marine environments by 2030 (the 30-by-30 pledge). In chapter 1, we noted concern that bottom trawling is permitted in many Marine Protected Areas. While the Government considers 26% of land in England to be protected in some form, only 5% may be effectively protected under the definition of the International Union for the Conservation of Nature.[166] The Government says it will support the 30-by-30 biodiversity target by bringing 50,000ha of protected sites into a "favourable condition". It also says that there is "potential to create or restore 300,000ha of habitat by 2042, and bring over half of our [England's] Sites of Special Scientific Interest into favourable condition by 2042."[167] But this is a small fraction of the 6.8Mha that has been designated as protected, much of which remains in an unfavourable condition or is not classified.[168] The Environmental Audit Committee recommended that areas should be recorded as 'conserved' only if the measures to protect them are sufficient to restore them to good ecological status.[169]

91. The Committee on Climate Change has set out in its *Land Use for a Net Zero UK* strategy a set of policies that would be consistent with achieving net zero carbon emissions. Many of the Government's pledges are aligned with the Committee on Climate Change's recommendations, but some are not. For instance, the Committee on Climate Change calls for 67,000ha of peat restoration per annum by 2025, and for the full restoration of upland peat by 2045 (around 355,000ha in England) and for the re-wetting or sustainable management of 60% of lowland peat by 2050.[170] But the Government has not matched the target for upland peat and it has no specific target for lowland peat. It will await the recommendations of the Lowland Agricultural Peat Taskforce.[171] The Government is also committed to exploring a long-term

166 Prime Minister's Office, 'PM commits to protect 30% of UK land in boost for biodiversity' (28 September 2020): https://www.gov.uk/government/news/pm-commits-to-protect-30-of-uk-land-in-boost-for-biodiversity [accessed 7 January 2022]. The Government aggregates a number of different designations for areas into "protected areas" for the 30by30 pledge, including Areas of Outstanding Natural Beauty, National Scenic Areas, National Parks, National Nature Reserves, Sites of Special Scientific Interest, Special Protection Areas and Special Areas of Conservation. These will all have different definitions and applicable standards for protection. Starnes *et al.*, 'The extent and effectiveness of protected areas in the UK', *Global Ecology and Conservation*, vol. 30 (October 2021): https://www.sciencedirect.com/science/article/pii/S235198942100295X [accessed 7 January 2022]

167 Department for Environment, Food and Rural Affairs, *Environmental land management schemes: outcomes*, policy paper, (6 January 2022), https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 11 January 2022]

168 Joint Nature Conservation Committee (JNCC), 'UK Biodiversity Indicators (UKBI) C1. Protected areas' (October 2021): https://jncc.gov.uk/our-work/ukbi-c1-protected-areas/#background-figure-c1iv-cumulative-proportion-of-special-areas-of-conservation-sac-in-favourable-or-unfavourable-recovering-condition-2005-to-2021 [accessed 10 January 2022]

169 Environmental Audit Committee, *Biodiversity in the UK: bloom or bust?* (First Report, Session 2021–22, HC 136)

170 Committee on Climate Change, *Progress in reducing emissions, 2021 Report to Parliament* (June 2021) p 120: https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf; and Committee on Climate Change, *The Sixth Carbon Budget, The UK's path to Net Zero* (9 December 2020) p 72, 170: https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf [accessed 13 January 2022]

171 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 178: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 13 January 2022]

tree planting target in the Net Zero Strategy, but it has not set one for 2050 as the Committee on Climate Change has done.[172]

92. **The Government's pledges for nature restoration are welcome and are largely consistent with the recommendations of the Committee on Climate Change (CCC). But some of its pledges are not aligned with those from the CCC. The pledges are undermined by a lack of clarity on the meaning of terms such as "protected areas" or "engagement with low-carbon farming practices."**

93. ***We recommend that the Government follows the recommendations from the Committee on Climate Change in setting targets for nature-based solutions. Where it does not do so, it should provide an evidence-based explanation as to why not, and how it can still reach net zero. It should define terms in its pledges where definitions are contested; this applies particularly to the term "protected".***

Public delivery bodies

94. Three bodies are mainly responsible for the delivery of the Government's targets for nature and nature-based solutions on land in England: Natural England, the Environment Agency and the Forestry Commission.[173] Marine nature-based solutions are in their early stages but are likely to fall under the joint remit of the Marine Management Organisation and Natural England.[174]

95. Natural England was established by the Natural Environment and Rural Communities Act 2006.[175] Its purpose is "to help conserve, enhance and manage the natural environment for the benefit of present and future generations."[176] It aims to ensure that "nature-based solutions [contribute] fully to tackling the climate change challenge and wider environmental hazards".[177] It produces research into nature—for example, a recent report reviewed carbon storage and sequestration of habitats in England, which

172 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) pp 178–9: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 13 January 2022]

173 These bodies have jurisdiction over England; the situation in the devolved administrations differs. Natural Resources Wales consolidates the responsibilities of the three delivery bodies listed for England into one body. Scotland has NatureScot as its equivalent of Natural England, the Environment Agency Scotland, and Scottish Forestry as its equivalent of the Forestry Commission, as well as Forestry and Land Scotland which manages the national forests in Scotland.

174 Natural England's research projects have included mapping potential nature-based solutions in marine and coastal territories, but the Marine Management Organisation has a remit which includes protecting the marine environment and has written about the importance of nature-based solutions. Marine Management Organisation, 'MMO and COP26' (2 November 2021): https://www.gov.uk/government/news/mmo-and-cop26 [accessed 10 January 2022]. For this reason, it is unclear how responsibility for marine nature-based solutions will be divided between these two delivery bodies.

175 Natural Environment and Rural Communities Act 2006

176 Natural England, 'About us': https://www.gov.uk/government/organisations/natural-england/about#our-vision-and-mission [accessed 10 January 2022]

177 Natural England, 'About us': https://www.gov.uk/government/organisations/natural-england/about#our-vision-and-mission [accessed 10 January 2022]

set out eight priorities for nature-based solutions in the UK.[178] Its work in mapping and understanding nature will be supported by the £140 million in funding for the Natural Capital and Ecosystem Assessment project.[179] It has an annual budget of £200 million and a staff of 2,000.[180]

96. The Environment Agency was established by the Environment Act 1995, and came into existence in 1996. It is the main organisation in charge of flood prevention and of setting regulations on air, land and water quality.[181] It supports nature-based solutions that contribute to meeting these aims. For example, it designated 531 hectares of blanket bog, and restored a further 2,148 hectares, in 2019–20 to improve water quality and mitigate flood risk.[182]

97. The Forestry Commission is responsible for managing publicly owned forests and for regulating both public and private forestry in England.[183] Its responsibilities include protecting and expanding woodlands, promoting their sustainable management and setting regulations for tree-planting.[184]

98. The Marine Management Organisation was created in 2009 by the Marine and Coastal Access Act.[185] Its remit is to "protect and enhance our [the UK's] precious marine environment, and support UK economic growth by enabling sustainable marine activities and development."[186] Alongside the Joint Nature Conservation Committee and Natural England, they have created and managed marine protected areas. They also aim to develop a marine planning system for the UK and set up a centre of excellence for marine information. As marine nature-based solutions remain largely at

178 The eight priorities were: "Protect and restore peatlands; create new native broadleaved woodlands; protect and restore natural coastal processes; protect existing semi-natural habitats; target incentives for NbS to places where they can have most benefit; integrate NbS for climate into landscapes which are primarily devoted to agriculture or production forestry; carry out research and monitoring to fill evidence gaps; ensure mitigation and adaptation to climate change are planned together." Natural England, *Natural England Research Report (NERR094) Carbon storage and sequestration by habitat: a review of the evidence*, second edition (20 April 2021) p viii: http://publications.naturalengland.org.uk/file/6726246198411264 [accessed 10 January 2022]

179 HM Treasury, *Autumn Budget and Spending Review 2021*, HC 822 (October 2021) p 118—refers to £140 million being provided over the next three years for the Natural Capital and Ecosystem Assessment: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1029974/Budget_AB2021_Web_Accessible.pdf [accessed 10 January 2022]

180 Natural England, 'About us': https://www.gov.uk/government/organisations/natural-england/about#our-vision-and-mission [accessed 10 January 2022]

181 Natural Agency, 'About us': https://www.gov.uk/government/organisations/environment-agency/about; and Environment Act 1995 [accessed 10 January 2022]

182 Speech by Emma Howard Boyd, Chair of the Environment Agency at the ClimateExpo, 'The crucial role of nature-based solutions in addressing the climate crisis' (18 May 2021): https://www.gov.uk/government/speeches/the-crucial-role-of-nature-based-solutions-in-addressing-the-climate-crisis; and the Environment Agency, 'Use nature-based solutions to reduce flooding in your area' (25 June 2021): https://www.gov.uk/guidance/use-nature-based-solutions-to-reduce-flooding-in-your-area [accessed 10 January 2022]. The RSPB's report on the role of nature-based solutions in climate change adaptation policy includes examples of projects which have been used in the UK for climate change adaptation purposes. WWF-UK and RSPB, Nature based solutions in UK climate adaptation policy (2021): https://www.rspb.org.uk/globalassets/downloads/policy-briefings/nature-based-solutions-adaption-report.pdf [accessed 10 January 2022]

183 Also Wales until 2013, and Scotland until 2019, when devolved public delivery bodies were set up.

184 Forestry Commission, 'About us': https://www.gov.uk/government/organisations/forestry-commission/about [accessed 10 January 2022]

185 Marine and Coastal Access Act 2009, Chapter 1

186 Marine Management Organisation (MMO), 'About us': https://www.gov.uk/government/organisations/marine-management-organisation/about [accessed 10 January 2022]

the research stage, the Marine Management Organisation's activities in deploying them are limited mainly to establishing protected areas.[187]

99. Collaboration between the bodies charged with delivering nature-based solutions can help to achieve the Government's targets.[188] We heard about a £12.5 million project involving all the delivery bodies (and Kew Gardens) for nature-based solutions at the landscape level.[189] The organisations will each take responsibility for the elements of the scheme that fall in their remit. Natural England will identify the sites and the appropriate interventions, the Environment Agency will ensure that the schemes contribute to co-benefits such as flood mitigation and it will work on funding mechanisms for co-benefits, while the Forestry Commission will set the regulations for carbon standards. Melissa Swartz, the catchment funding senior advisor at the Environment Agency, hoped that this scheme would "provide an example … of how public delivery bodies can work with each other … to enable the deployment of nature-based solutions at scale."[190]

100. We heard concerns about the level of funding available to these organisations. Thomas Lancaster of the Royal Society for the Protection of Birds described a "hollowing out" of Natural England's capacity "over the past 10 years."[191] The Environment Agency's budget has been cut by around two-thirds since 2010, from £120 million to £40 million. Its chief executive said this affected its ability to monitor water pollution.[192] Thomas Lancaster considered the agencies' limited budgets to be inconsistent with the Government's "ambitious agenda" and he thought that they would "need a lot more capacity than we currently have."[193] The Minister, Lord Goldsmith of Richmond Park, agreed that the Environment Agency and Natural England are being asked "to do more" and that they will need "more resources over time".[194]

101. **Collaboration between the delivery bodies is welcome and should be encouraged. But the Government's targets for nature restoration demand a great deal of these bodies and their budgets are not adequate to meet the challenge.**

102. ***We recommend that the budgets of the delivery bodies be increased to allow them to support the Government's ambitious targets. The delivery bodies should be encouraged to collaborate so that the multiple benefits of nature-based solutions are realised. The Department for Environment, Food, and Rural Affairs should provide clarity over which responsibilities are delegated to each public delivery body for regulating and delivering nature-based solutions, especially for marine nature-based solutions.***

187 Tom McCormack, 'The MMO and climate change', *Marine Management Organisation (MMO)* (22 October 2021): https://marinedevelopments.blog.gov.uk/2021/10/22/the-mmo-and-climate-change/ [accessed 10 January 2022]

188 We heard from Dr Morecroft about successful, small scale, examples of collaboration between Natural England and the Environment Agency on saltmarsh restorations at Steart Marshes, Aldborough and Wallasea. Q 85 (Dr Mike Morecroft)

189 Q 92 (Dr Mike Morecroft, Richard Greenhous and Melissa Swartz)

190 Q 92 (Melissa Swartz)

191 Q 102 (Thomas Lancaster)

192 Oral evidence taken before the Environmental Audit Committee, 23 June 2021 (Session 2020–21), Q 213 (Sir James Bevan)

193 Q 102 (Thomas Lancaster)

194 Q 138 (Lord Goldsmith of Richmond Park)

Relevant policies

103. The Government has announced several policies to enable the roll out of nature-based solutions in the UK. The policies are at different stages of development and some details remain unclear. Table 3 sets out what is known so far.

Table 3: Government policies to support nature-based solutions

Scheme	What does it do?	How much funding will it have?	Context
Environmental Land Management schemes (ELMs) [195]	These schemes will replace the agricultural subsidies of the EU's Common Agricultural Policy (CAP) in England.[196] They will move from the area-based payments used in the CAP, to "public money for public goods."[197] There will be three environmental land management schemes, which aim to incentivise practices at different scales. These schemes are set out below.	Current agricultural subsidies are £2.4bn per year in England, and the Department for Environment, Food and Rural Affairs has committed to the same overall level of spending in this Parliament as CAP is phased out and ELMs are phased in.[198]	The CAP will be phased out by 2028. ELMs are intended to replace the CAP as it is phased out.

195 Department for Environment, Food and Rural Affairs and Rural Payments Agency, 'Environmental Land Management schemes: overview' (15 March 2021): https://www.gov.uk/government/publications/environmental-land-management-schemes-overview/environmental-land-management-scheme-overview [accessed 10 January 2022]

196 This is a devolved area of policy, with Environmental Land Management schemes applying to England. Scotland has its own Agri-Environment Climate Scheme which covers and supports similar practices. Scottish Government, Rural Payments and Services, 'Agri-Environment Climate Scheme' (28 October 2021): https://www.ruralpayments.org/topics/all-schemes/agri-environment-climate-scheme/ [accessed 10 January 2022]

197 Area based payments are when a farmer receives a fixed subsidy per hectare of farmland they farm. Public money for public goods will pay land managers for practices that enhance and protect nature. Department for Environment Food and Rural Affairs, 'Agriculture Bill to boost environment and food production' (16 January 2020): https://www.gov.uk/government/news/agriculture-bill-to-boost-environment-and-food-production [accessed 13 January 2022]

198 "We will maintain current average levels of investment in farming of £2.4 billion per year in England over the life of this Parliament. … Over this Parliament, we envisage spending 30% of the funding released for environment, climate and animal health and welfare outcomes on farm-level actions such as the Sustainable Farming Incentive. The remainder will be spent on locally tailored initiatives (such as through Local Nature Recovery and Countryside Stewardship) and landscape-scale interventions (such as Landscape Recovery and Nature for Climate projects). By 2028, we currently expect spending to be evenly split across farm-level, locally tailored, and landscape-scale investment. We will keep these allocations under review as we progress through the transition and learn more about the demand for and outcomes and value for money from each scheme." Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

Scheme	What does it do?	How much funding will it have?	Context
Sustainable Farming Incentive (part of ELMs)	This will direct money towards environmentally sustainable on farm activities. The scheme will begin being rolled out in 2022 with an initial set of three standards.[199] The Government aims for at least 70% of farmers, covering 70% of farmland, to take up Sustainable Farming Incentive agreements.[200]	One-third of overall funding for ELMs, subject to review.	It will be the main incentive for on-farm activities. There have been pilot schemes.[201]
Landscape Recovery Scheme (part of ELMs)[202]	This will support long-term, large-scale landscape level projects such as tree-planting and peatland restoration. Pilot scheme sites are set to be between 500–5,000ha and the pilot scheme is set to begin in 2022.[203] The Government has said it will deliver at least 10 Landscape Recovery projects covering 20,000ha between now and 2024.[204]	One-third of overall funding for ELMs, subject to review.	This will replace the Nature for Climate Fund as the main funding for land sparing approaches.[205]

199 Department for Environment, Food and Rural Affairs, 'Sustainable Farming Incentive: how the scheme will work in 2022' (2 December 2021): https://www.gov.uk/government/publications/sustainable-farming-incentive-how-the-scheme-will-work-in-2022/sustainable-farming-incentive-how-the-scheme-will-work-in-2022 [accessed 10 January 2022]

200 Department for Environment, Food and Rural Affairs, *Environmental land management schemes: outcomes*, policy paper, (6 January 2022), https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 11 January 2022]

201 The pilot scheme supported eight standards (activities) at three levels of ambition. The standards were: arable and horticultural land; arable and horticultural soils, farm woodland, hedgerows, improved grassland, improved grassland soils, low and no input grassland, and water body buffering.

202 Department for Environment, Food and Rural Affairs and Rural Payments Agency, 'Environmental Land Management schemes: overview' (15 March 2021): https://www.gov.uk/government/publications/environmental-land-management-schemes-overview/environmental-land-management-scheme-overview [accessed 10 January 2022]

203 Jason Beedell, 'A quick guide to Defra's Landscape Recovery Scheme', *Strutt & Parker* (3 September 2021): https://rural.struttandparker.com/article/a-quick-guide-to-defras-landscape-recovery-scheme/ [accessed 10 January 2022]

204 Department for Environment, Food and Rural Affairs, 'Environmental land management schemes: outcomes' (6 January 2022): https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 12 January 2022]

205 Written evidence from Department for Environment, Food and Rural Affairs (NSD0042)

Scheme	What does it do?	How much funding will it have?	Context
Local Nature Recovery scheme (part of ELMs) [206]	This will support nature recovery projects which deliver local environmental priorities. The Government has listed activities that the scheme will support (see Box 1), but which activities will be supported in each location is likely to be identified by Local Nature Recovery Strategies when they are rolled out in 2022 (see below.) The Government intends to pilot the Local Nature Recovery Scheme in 2023 and roll it out nationwide in 2024.[207]	One-third of overall funding for ELMs, subject to review.	The Local Nature Recovery Scheme can be combined with the Sustainable Farming Incentive, providing different activities are paid for. The full details of payment rates and conditions that must be met have not yet been determined.[208]

206 Department for Environment, Food and Rural Affairs and Rural Payments Agency, 'Environmental Land Management schemes: overview' (15 March 2021): https://www.gov.uk/government/publications/environmental-land-management-schemes-overview/environmental-land-management-scheme-overview [accessed 10 January 2022]

207 Department for Environment, Food and Rural Affairs, 'Local Nature Recovery: more information on how the scheme will work' (6 January 2022): https://www.gov.uk/government/publications/local-nature-recovery-more-information-on-how-the-scheme-will-work/local-nature-recovery-more-information-on-how-the-scheme-will-work [accessed 13 January 2022]

208 Department for Environment, Food and Rural Affairs, *Environmental land management schemes: outcomes*, policy paper, (6 January 2022), https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 11 January 2022]

Scheme	What does it do?	How much funding will it have?	Context
Local Nature Recovery Strategies[209]	These will involve the comprehensive local mapping of 50 "strategy areas" across England to identify priorities for nature recovery and a map of habitats to conserve and restore. They are intended to bring together local expertise to identify and carry out local priorities for nature recovery.	Unclear; intended to be a mix of private and public including the Local Nature Recovery ELMS.	Will be introduced in England in April 2022 after recent piloting. Many of the details are yet to be confirmed.[210]
Nature for ClimateFund[211]	Provides public funding for tree planting and peatland restoration.	£750 million up to 2025.[212]	This will be the main source of funding for tree planting and for peatland restoration until 2025, when it will be replaced by ELMs.[213]

209 See Box 1 for further detail. Parliamentary Office for Science and Technology, Local nature recovery strategies, PostNote 652, September 2021; and Department for Environment, Food and Rural Affairs, 'September 2021: Nature and conservation covenants (parts 6 and 7)' (6 September 2021)): https://www.gov.uk/government/publications/environment-bill-2020/10-march-2020-nature-and-conservation-covenants-parts-6-and-7 [accessed 10 January 2022]

210 Department for Environment, Food and Rural Affairs, *Local Nature Recovery Strategy pilots: lessons learned* (12 July 2021): https://www.gov.uk/government/publications/local-nature-recovery-strategy-pilots-lessons-learned/local-nature-recovery-strategy-pilots-lessons-learned [accessed 10 January 2022]

211 HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 168: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 10 January 2022]

212 'Budget and Spending Review—October 2021: What you need to know', *HM Treasury* (27 October 2021): https://www.gov.uk/government/news/budget-and-spending-review-october-2021-what-you-need-to-know [accessed 10 January 2022]

213 Over £500m of this is intended to be dedicated to tree-planting and £50m to peatland restoration, according to the Net Zero Strategy. HM Government, *Net Zero Strategy: Build Back Greener* (October 2021) p 168: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf [accessed 10 January 2022]

Scheme	What does it do?	How much funding will it have?	Context
England Trees and Peat Action plan 2021–24[214]	This sets out policies for meeting the targets for peatland and trees. It aims to increase the use of timber in construction; to increase the supply of qualified foresters; to map England's peatlands by 2024; to phase out sales of horticultural peat and restrict managed burning; and to publish a new Forestry Standard practice guide.	N/A	The restoration of peatland and trees will be funded by the Nature for Climate Fund.
Natural Environment Investment Readiness Fund[215]	This offers grants of £10,000–£100,000 to support environmental projects in England. These projects would support research that enables a market-based approach to restoring nature.	£10 million	It will be replaced by the £30 million Big Nature Impact Fund.[216]

Barriers to adoption of nature-based solutions

Transition to Environmental Land Management schemes

104. We heard that policy uncertainty is limiting the adoption of nature-based solutions. Farmers are caught between the phase-out of the EU's Common Agricultural Policy (CAP) subsidies and the introduction of their replacements, which are Environment Land Management schemes (ELMs). The Environment Act 2021 provides that subsidies under ELMs will move from area-based payments to "public money for public goods."[217] ELMs will be more complicated than the pre-existing subsidies because they aim to achieve objectives for agriculture, nature, climate and biodiversity. But the details have not been set out. It is not clear how applications for ELMs will be assessed, or how the success of schemes will be measured. Richard Bramley,

214 Department for Environment, Food and Rural Affairs, *The England Trees Action Plan 2021–2024* (8 May 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/987432/england-trees-action-plan.pdf; and Department for Environment, Food and Rural Affairs, *England Peat Action Plan* (18 May 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1010786/england-peat-action-plan.pdf [accessed 10 January 2022]

215 Environment Agency, 'How to apply for a natural environment investment readiness fund grant' (10 November 2021): https://www.gov.uk/government/publications/apply-for-a-grant-from-the-natural-environment-investment-readiness-fund/how-to-apply-for-a-natural-environment-investment-readiness-fund-grant [accessed 10 January 2022]

216 Bidstats, 'Big Nature Impact Fund—Request for Proposal' (22 November 2021): https://bidstats.uk/tenders/2021/W47/763363529 [accessed 14 January 2022]

217 Department for Environment, Food and Rural Affairs, *Environmental Land Management and Public Money for Public Goods* (January 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/955920/ELM-evidencepack-28jan21.pdf [accessed 10 January 2022]

Chair of the National Farmers' Union's Environment Forum, who is enrolled in the Sustainable Farming Incentive pilot scheme, said "I am one of the farmers in question whom these policies are directed at … and do not have a clue how this is going to take shape".[218] The minister also acknowledged that "there is uncertainty on their (farmers') part as regards what they need to do differently to ensure that the flow of income they depend on continues".[219]

105. We heard from the Government that some uncertainty is inevitable due to the necessity of maintaining flexibility in the schemes as they are developed. Janet Hughes told us of the need to "strike a balance" between providing policy certainty and retaining "the ability to flex and adapt and learn as we go". This "test-and-learn approach" means that "it [is] impossible for us to say … every single thing that we are going to do over the next seven years" without providing "false confidence."[220]

106. Stakeholders are unclear about the duration of funding under ELMs. This is important because farmers "do not work, necessarily on Government five-year cycles."[221] It is also not yet known which activities will be supported.[222] A landholder may want to adopt a nature-based solution on their land but be unwilling to invest in it because they are not sure that it will qualify for subsidies. For example, the Local Nature Recovery ELMs will support activities identified by Local Nature Recovery Strategies. But these activities that Local Nature Recovery Strategies will support cannot be identified before the intended introduction in April 2022.

Box 1: Local Nature Recovery Strategies

- Local Nature Recovery Strategies will be introduced in England in April 2022. These strategies will map the opportunities to restore, conserve, or connect natural habitats in 50 'strategy areas' covering all of England. Each strategy will include a list of priority opportunities for habitat improvement and restoration in the target area as well as a local habitat map of existing ecosystems.
- The Department for Environment, Food and Rural Affairs will designate a "responsible authority" to guide the delivery of each strategy.[223] Depending on the region, this may be a local authority, a public body like Natural England, or an organisation like the Wildlife Trusts or National Parks Authority.

218 Q 102 (Richard Bramley)
219 Q 148 (Lord Goldsmith of Richmond Park)
220 Q 130 (Janet Hughes)
221 Q 15 (Professor Chris Collins)
222 Q 77 (Harry Greenfield); Q 101 (Thomas Lancaster); and Q 102 (Richard Bramley)
223 Department for Environment, Food and Rural Affairs, 'Local Nature Recovery Strategy pilots: lessons learned' (12 July 2021): https://www.gov.uk/government/publications/local-nature-recovery-strategy-pilots-lessons-learned/local-nature-recovery-strategy-pilots-lessons-learned https://www.gov.uk/government/publications/local-nature-recovery-strategy-pilots-lessons-learned/local-nature-recovery-strategy-pilots-lessons-learned[accessed 10 January 2022]

- Five short pilot projects of Local Nature Recovery Strategies took place from August 2020 to May 2021, and the outcomes of these short pilots will help in formulating policy, guidance, and regulations for local natural recovery strategies.[224]
- These pilot schemes developed both a statement of biodiversity priorities and a local habitat map for each of the pilot areas. It is unclear what actions have followed the development of the strategies and whether the pilot projects were long enough for lessons to be learnt. The Government states that they are intended to be used by "a range of potential end users (including local authorities, Defra [The Department for Environment, Food and Rural Affairs], public bodies, landowners, Local Nature Partnerships, environmental organisations and developers)."
- The pilots identified the importance of strong leadership, effective governance and collaboration between stakeholders. A lack of solid, accessible local data was a barrier, as were limited resources, with local areas not necessarily having the appropriate expertise and capacity to develop the strategies.
- While the actions prioritised by the strategies will vary from place to place, the Government has stated that the Local Nature Recovery ELM will "particularly contribute to our targets for trees, peatland restoration, habitat creation and restoration and natural flood management.
- The Government has outlined some activities that are expected to be supported by the schemes.[225] These are intended to support: net zero; improved water and air quality; climate change adaptation; biodiversity; natural flood management; heritage; and coastal erosion mitigation. Some of these activities may also be supported by other schemes. It is not yet known what payment rates will be. The Government said it will publish additional details later in 2022.

Source: Department for Environment, Food and Rural Affairs, 'Local Nature Recovery Strategy pilots: lessons learned' (12 July 2021): https://www.gov.uk/government/publications/local-nature-recovery-strategy-pilots-lessons-learned/local-nature-recovery-strategy-pilots-lessons-learned *[accessed 10 December 2021]*

107. There are also uncertainties about how schemes will interact with each other.[226] For example, Professor Reed told us that land managers are unclear whether payments under ELMs can be combined with private finance under carbon codes.[227]

224 Department for Environment, Food and Rural Affairs, 'Local Nature Recovery Strategy pilots: lessons learned' (12 July 2021): https://www.gov.uk/government/publications/local-nature-recovery-strategy-pilots-lessons-learned/local-nature-recovery-strategy-pilots-lessons-learned [accessed 10 January 2022]. The pilots took place in Buckinghamshire, Cornwall, Cumbria, Greater Manchester, and Northumberland.

225 Activities that will be supported by the Local Nature Recovery schemes will include: restoring feeding, shelter and breeding areas for wildlife on farms; managing, restoring, and creating grassland, wetland, and heathland habitats, including species-rich grassland, ponds, lakes, and fens; managing and restoring upland and lowland peat and moorland; coastal habitats such as dunes, marshes, and shingles; managing and creating trees and woodlands, including agroforestry; restoring rivers, streams, floodplains, runoff management through buffer strips or vegetation in fields; and targeted reintroduction and recovery measures for particular wildlife species. Department for Environment, Food and Rural Affairs, 'Local Nature Recovery: more information on how the scheme will work' (6 January 2022): https://www.gov.uk/government/publications/local-nature-recovery-more-information-on-how-the-scheme-will-work/local-nature-recovery-more-information-on-how-the-scheme-will-work [accessed 12 January 2022]

226 Q 101 (Thomas Lancaster); written evidence from National Association for Areas of Outstanding Natural Beauty (NSD0021); and written evidence from The National Trust (NSD0049)

227 Q 81 (Professor Mark Reed)

108. The Government wants farmers to be able to access private finance alongside government schemes and ensure that farmers are better off when they seek private financing, but consultations are ongoing as to how this can work .[228] Janet Hughes of The Department for Environment, Food and Rural Affairs explained that the Government does "not know yet" whether there will be overlap between public and private schemes as "these markets are nascent and the rules are not yet well established."[229] Within ELMs, the Government has said that farmers will be able to apply for both the Sustainable Farming Incentive and the Local Nature Recovery scheme, providing they do not pay for the same activity.

109. Thomas Lancaster summarised the consequences of this lack of clarity:

> "Lots of farmers and land managers, when they are looking at whether they should engage with the nature-based solutions agenda and the broader sustainable land management agenda, can be forgiven for hesitating and thinking, 'Well, should I go now, or should I wait to understand what the best returns are going to be for me? If I go into this scheme that's currently available, will I get paid less than if I were to wait for a scheme that might be available in two or three years' time.'"[230]

110. **The transition from the Common Agricultural Policy to Environmental Land Management schemes will require long-term changes to land use, but funding is not yet guaranteed in the long term.**

111. ***We recommend that the Department for Environment, Food and Rural Affairs provides urgent clarity about the nature of Environmental Land Management schemes and which activities they will subsidise. Funding should be assured in return for a long-term commitment to good practice. The new schemes that are introduced should be based on proper and transparent evidence. They must have defined metrics to evaluate success or failure so that they can be adapted to evolving evidence. It must be clear how these schemes will interact with wider agricultural and environmental policies.***

112. We heard that some stakeholders do not support the proposed shift from productive farming to the provision, under the Environment Land Management Schemes, of "public money for public goods".[231] Professor Rosemary Hails, the Director of Science and Nature at the National Trust, said: "some farmers very much want to continue doing what they have always done … an element of cultural change is needed."[232] Harry Studholme described a cultural barrier to turning land over to tree-planting with "people who have spent their lives farming finding it difficult" to "make sense of an increasingly forested environment."[233] We were told that farmers are "embattled" rather than "enthuse[d]" and that they feel

228 Department for Environment, Food and Rural Affairs, 'Local Nature Recovery: more information on how the scheme will work' (6 January 2022): https://www.gov.uk/government/publications/local-nature-recovery-more-information-on-how-the-scheme-will-work/local-nature-recovery-more-information-on-how-the-scheme-will-work [accessed 12 January 2022]
229 Q 128 (Janet Hughes)
230 Q 101 (Thomas Lancaster)
231 Written evidence from the Landscape Decisions Programme Network (NSD0014)
232 Q 79 (Professor Rosemary Hails)
233 Q 2 (Sir Harry Studholme)

blamed for agricultural emissions from livestock.[234] Both the Country Land and Business Association and the National Farmers' Union warned that the absence of effective communications about the transition could lead to mistrust, misinformation and confusion.[235] The Public Accounts Committee similarly found that the "lack of information" from DEFRA is causing "anxiety in the sector" and that the "engagement" had "a long way to go".[236]

113. Land-sharing practices like agroforestry or paludiculture (farming on wetlands) can be integrated with productive farming. Farmers are likely to be less reluctant to move to practices that allow them to continue farming, rather than a large-scale move away from food production. The National Farmers Union told us in its written evidence that "our vision is based on land sharing, not land sparing."[237] However, as set out above, the carbon accountancy of land-sharing practices is less certain, the carbon savings are smaller and many farmers have no experience of using these methods.

114. **The transition to Environmental Land Management schemes demands a lot from land managers and farmers. Some of them feel that they do not have sufficient support. Poor communication and a failure to convince land-managers of the benefits of the change will lead to a transition that fails. Maintaining flexibility in Environmental Land Management schemes to permit land sharing approaches could help to address the lack of engagement and reluctance from land managers.**

115. ***We recommend that the Government improves communication with land managers. Land sparing approaches will have to play a significant role in reaching net zero targets, but land-sharing approaches should be included in Environmental Land Management schemes where possible, and where evidence suggests they deliver carbon benefits. This will make the transition to providing "public money for public goods" easier and more acceptable for land managers.***

Knowledge and skills

116. We heard that there is a knowledge and skills gap in planning and carrying out nature-based solutions. Many farmers are unable to assess which nature-based solution is most appropriate for their land. Richard Bramley described "fundamental challenges when it comes to measuring carbon" and greenhouse gas accountancy on existing holdings.[238] Harry Greenfield, the Senior Land Policy Adviser of the Country Land and Business Association, said schemes should be "frontload[ed] … with advice and training" so that land managers can establish "the baseline environmental value of their land and what they could deliver."[239] With no baseline, land managers cannot predict and measure the impact of a shift to low-carbon practices.

117. Skills gaps exist in other sectors. The support of local authorities for the Local Nature Recovery Strategies will be essential, but the Association of Local

234 Q 102 (Richard Bramley)
235 Q 78 (Harry Greenfield); Q 104 (Richard Bramley)
236 Committee of Public Accounts, *Environmental Land Management Scheme* (Thirty-First Report, Session 2021–22, HC 639)
237 Written evidence from the NFU (NSD0017)
238 Q 103 (Richard Bramley)
239 Q 84 (Harry Greenfield)

Government Ecologists noted that fewer than a third of local authorities have ecological expertise.[240] The Institute of Chartered Foresters said that a skills gap in tree-planting could undermine climate targets, and we heard from Professor Henderson that forestry skills "have deteriorated in the country over recent decades".[241] Richard Lindsay told us that, for the heavily emitting lowland peats, "the hoped-for strategy/solution" is "this new concept of wetland farming" but the skills required for that do not exist.[242] Professor Stead, Chief Scientific Adviser, Marine Management Organisation, told us of marine nature-based solutions for which "the training and capacity-building is not at a mature stage."[243]

118. We heard that land managers will require additional training. Managing land for the climate and nature is different from maximising yield.[244] Advice to engage with the schemes will be particularly important given the lack of clarity around them and their complexity, which we set out above. In the past, Natural England helped farmers to engage with agri-environment schemes, but Thomas Lancaster told us that "if you speak to most farmers, they will say they have not seen anyone from Natural England for a long time."[245] We were told of an erosion of trust between farmers and government agencies.[246] The Government has indicated that communications will improve by 2024, from when "it will no longer be necessary for people to navigate multiple schemes and forms … both the Sustainable Farming Incentive and the Local Nature Recovery will be accessible through a simple digital service which shows each farmer all options available to them."[247]

119. Professor Chris Collins said that "the key thing is education for the farmers. We used to have a fantastic advisory service … A lot of farmers cannot afford consultants, and if we are really going to change behaviour … We need to think about a national advisory service."[248] Harry Greenfield of the Country Land and Business Association said "Each farm should have a land management plan that sets out what they are currently doing on their land and what they would like to do over the next years of the agreement they might be in."[249] The Government agreed that land management plans were "a good way to assess the potential to deliver environmental benefits on [land manager's] land … " and it has committed to explore how they might be used.[250] The Government is currently providing £10.7m of grants

240 Association of Local Government Ecologists (ALGE), *Implications for Local Government of delivering the Environment Bill and the Government's 25 year plan to improve the environment* (January 2020): https://www.alge.org.uk/wp-content/uploads/sites/15/2020/03/ALGE-Response-to-Implementation-of-25-Year-Plan-January-2020.pdf [accessed 12 January 2022]

241 Institute of Chartered Foresters, 'Forestry skills crisis puts climate targets at risk' (10 October 2021): https://www.charteredforesters.org/forestry-skills-crisis-puts-climate-targets-at-risk [accessed 12 January 2022]; and Q 147 (Professor Gideon Henderson)

242 Q 28 (Richard Lindsay)

243 Q 97 (Professor Selina Stead)

244 Q 102 (Richard Bramley, Thomas Lancaster)

245 Q 101, Q 102 (Thomas Lancaster)

246 Q 83 (Harry Greenfield)

247 Department for Environment, Food and Rural Affairs, 'Environmental land management schemes: outcomes' (6 January 2022): https://www.gov.uk/government/publications/environmental-land-management-schemes-outcomes/environmental-land-management-schemes-outcomes [accessed 12 January 2022]

248 Q 13 (Professor Chris Collins)

249 Q 84 (Harry Greenfield)

250 Department for Environment, Food and Rural Affairs, 'Local Nature Recovery: more information on how the scheme will work' (6 January 2022): https://www.gov.uk/government/publications/local-nature-recovery-more-information-on-how-the-scheme-will-work/local-nature-recovery-more-information-on-how-the-scheme-will-work [accessed 12 January 2022]

to third-party advisors to help farmers understand the agricultural transition through the Future Farming Resilience Fund.[251]

120. Lord Goldsmith of Richmond Park acknowledged the scale of the skills challenge, saying that "we are at the beginning of one of the greatest transitions this country has ever been through … on a par with the Industrial Revolution."[252] However, he said "it would be wrong to pretend, at this stage, that the skills that will be needed in the medium and long term have been fully mapped out and identified, and that our workforce of the future, based on where we are today, will be ready for that challenge."[253] He told us that the Department for Environment, Food and Rural Affairs are currently talking to the Department for Education to identify and address these skills gaps but he acknowledged that the urgency of the agricultural transition leaves little time: "to hit the 2030 targets on biodiversity, we cannot wait until 2028 to have people doing that work."[254]

121. **We welcome that the Government recognises the existence of gaps in the skills and knowledge needed to carry out nature restoration, but we are concerned that plans to address the gaps lack urgency.**

122. ***We recommend that the Government establishes ambitious skills and training programmes for land managers, authorities developing Local Nature Recovery Strategies and public delivery bodies. Training in surveying, monitoring and verifying, carbon accountancy, forestry, ecology, and planning and carrying out nature-based solutions needs to be expanded urgently. The Department for Education and the Department for Business Energy and Industrial Strategy must allocate some of their funding to this effort to make schemes accessible to land managers and provide sufficient skilled personnel to meet targets.***

123. **Land managers cannot assess the best actions to take without assistance. While the Committee welcomes the Government's commitment to making its schemes easier to access, and providing support to third-party advisors through the Future Farming Resilience Fund, it is difficult to see how widespread engagement with schemes will be achieved without a significant expansion in advisory services and support.**

124. ***We recommend that the Government provides additional support as a matter of urgency for land managers, in the form of a dedicated advisory service, to help them engage with Environmental Land Management Schemes. The advisory service should be delivered in collaboration with public delivery bodies and should help land managers through the application process. It should help farms to identify the most appropriate actions to take, the support they need and can expect, and the likely environmental impact of their actions.***

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251 Department for Environment, Food and Rural Affairs and Victoria Prentis MP, 'Future Farming Resilience Fund to open in August' (13 July 2021): https://www.gov.uk/government/news/future-farming-resilience-fund-to-open-in-august [accessed 12 January 2022]

252 Q 146 (Lord Goldsmith of Richmond Park)

253 Q 146 (Lord Goldsmith of Richmond Park)

254 Q 146 (Lord Goldsmith of Richmond Park)

Tenancies

125. Tenancy arrangements can be a barrier to tenant farmers implementing nature-based solutions. Tenant farmers work around 30% of land in the UK.[255] But their tenancy contracts can contain clauses that require them to manage land only for agricultural purposes.[256] There is also little motivation for tenants to invest in nature-based solutions if the long-term benefits will accrue to the landowner rather than to them. We heard that this can incentivise suboptimal land management, because the focus is on generating profit from the land in the short term.[257] Furthermore, short term tenancy contracts mean that tenant farmers do not have sufficient time to oversee changes in land use. Lord Goldsmith of Richmond Park acknowledged that the Government would "not be able to meet our targets" without the full involvement of tenant farmers, but that he would "not pretend that we [the Government] have resolved those issues."[258]

126. Professor Mark Reed, the Professor in Rural Entrepreneurship, at Scotland's Rural College, told us of a possible solution. There are "contractual arrangements" where "the units are owned by the landowner" but where the "benefits" are shared between landowners and tenants.[259]

127. **Tenancy contracts impede the implementation of nature-based solutions. More flexibility in these contracts is needed for the Government's schemes to be a success.**

128. ***We recommend that the Government urgently addresses the barriers tenant farmers face to engage with the Environmental Land Management Schemes. This could include mechanisms for landlords and tenants to negotiate arrangements that allow them to share the costs and benefits of improvements.***

Supply chains

129. We heard concerns that an insufficient supply of the resources needed for nature-based solutions could slow their adoption. From Dr Waring, we heard concern about ensuring sufficient "nurseries and … seed stock to support the scale of expansion".[260] Dr Lisa Norton told us that for "productive, species-rich grassland", it is "difficult to get hold of suitable seed."[261] Relying on overseas imports of trees risks importing pathogens. Professor David Coomes said that "there are horrifying statistics about how many new pests and diseases arrive each day" and he urged the Government to counter these risks with phytosanitary measures.[262] We have already emphasised the importance of resilience, and imported diseases threaten the long-term future of many trees.

130. ***We recommend that the Department for Environment, Food and Rural Affairs supports the domestic industry for seeds and saplings and only imports bio-secure seeds and saplings where necessary, and with stringent phytosanitary safeguards.***

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255 House of Commons Library, Tenant Farmers, Library Note SN/SC/1337, May 2010
256 Written evidence from the NFU (NSD0017)
257 Q 13 (Professor Chris Collins)
258 Q 141 (Lord Goldsmith of Richmond Park)
259 Q 80 (Professor Mark Reed)
260 Q 2 (Dr Bonnie Waring)
261 Q 13 (Dr Lisa Norton)
262 Q 6 (Professor David Coomes)

Private finance for nature-based solutions

Woodland Carbon Code and Peatland Code

131. In England, the Government wants to see £500 million of private finance be directed towards nature restoration annually by 2027, rising to £1 billion by 2030.[263] The Woodland Carbon Code and the Peatland Code (hereafter—the codes) are the main Government-backed schemes to attract this finance. Further carbon codes for different ecosystems, including saltmarsh and soil, are being developed or explored.[264]

132. The codes set out standards and requirements for privately financed, voluntary carbon sequestration projects in woodlands and peatlands.[265] They provide a scientific basis for predicting and for monitoring the carbon sequestration from interventions, and for the independent validation of projects.[266] They allow private investors to pay a landholder to sequester carbon on their land by planting trees or by restoring peatland. They do not issue emissions certificates that can be traded on global carbon markets or in the UK Emissions Trading System.[267] Instead, they issue carbon units that can be counted against greenhouse gas emissions under mandatory greenhouse gas reporting requirements in the UK.[268]

133. The Government supports the Woodland Carbon Code with public money through the Woodland Carbon Guarantee. In this scheme, the Government commits to purchasing Woodland Carbon Units at a fixed price as they mature, over 35 years. The overall sum for the Guarantee is £50 million and land managers bid in competitive auctions for the contracts, which will occur every six months until this funding has been allocated, over a period of 4–5 years.[269] Once this funding has been allocated, it is unclear whether the

263 HM Treasury, *Autumn Budget and Spending Review 2021*, HC 822 (October 2021) p 72: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1029974/Budget_AB2021_Web_Accessible.pdf [accessed 13 January 2022]

264 Environment Agency, Department for Environment, Food and Rural Affairs, and Natural England, 'Innovative nature projects awarded funding to drive private investment' (14 July 2021): https://www.gov.uk/government/news/innovative-nature-projects-awarded-funding-to-drive-private-investment [accessed 12 January 2022]

265 Dr Pat Snowdon of the Woodland Carbon Code identified factors for high-quality carbon standards: permanence; additionality; transparency through the use of a carbon registry; and independent validation to ensure that benefits are real and quantifiable. Q 51 (Dr Pat Snowdon)

266 Forestry Commission, 'The Woodland Carbon Code scheme for buyers and landowners' (9 July 2018): https://www.gov.uk/guidance/the-woodland-carbon-code-scheme-for-buyers-and-landowners [accessed 12 January 2022]

267 UK Woodland Carbon Code (2019): https://woodlandcarboncode.org.uk/about/context [accessed 12 January 2022]

268 Quoted companies are required to report their greenhouse gas emissions, according to the Government's methodology, as part of their annual directors' report. Reporting remains voluntary for smaller companies and limited liability partnerships. Department for Environment, Food and Rural Affairs, 'Measuring and reporting environmental impacts: guidance for businesses' (published 9 April 2013, updated 31 January 2019): https://www.gov.uk/guidance/measuring-and-reporting-environmental-impacts-guidance-for-businesses [accessed 12 January 2022]

269 Forestry Commission, 'Woodland Carbon Guarantee' (published 4 November 2019, updated 7 October 2021): https://www.gov.uk/guidance/woodland-carbon-guarantee [accessed 12 January 2022] In the most recently concluded auction, the average successful bid price for a Woodland Carbon Unit was £17.31. Forestry Commission, *Guide to the Fourth Auction* (2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/989849/Guide_to_the_Fourth_Auction.pdf [accessed 13 January 2022]

scheme will be continued. Four such auctions have taken place so far, with a total of 2,650 hectares of woodland supported by successful bids.[270]

134. Safeguards are in place to ensure that the codes will deliver as promised. The codes issue two types of credit. Pending Issuance Units (PIUs) are promises to sequester a tonne of CO_2-equivalent, while Woodland or Peatland Carbon Units represent a tonne that has actually been sequestered.[271] Projects are checked at five-year intervals to assess their storage of carbon. Only if the PIUs are verified can they be converted into carbon units, which can be counted in greenhouse gas reporting requirements. There are additional safeguards to ensure that the carbon is stored permanently and that additions to the stored carbon are occurring.[272]

135. It is not clear what proportion of PIUs will be converted into verified units. So far, the numbers are small, but this is to be expected, given how recently the schemes were established. Since 2010, over 5.8 million woodland PIUs have been issued and 3.1 million sold, for prices between £7–20, but only 800 had been verified as of September 2021. None of the ~150,000 PIUs issued under the peatland code have been converted to realised credits, since it was developed later than the Woodland Code.[273] Dr Snowdon, the Head of Economics and of the Woodland Carbon Code at Scottish Forestry, and Dr Hermans, the Peatland Code Coordinator at the IUCN UK Peatland Programme, were confident that most projects would succeed.[274] However, James Mansfield of Finance Earth raised a concern with the model of "forward sell[ing]" carbon through PIUs. If landholders spend the up-front capital earned from selling the PIUs the "projects effectively have no future income to support their operating costs."[275] This could result in schemes reverting to their previous state through lack of maintenance. He noted that management of finances could prevent this issue but "because these are voluntary codes, there are no specific rules or even guidance on what that best practice looks like."[276]

136. About 44,700ha of woodland have been registered under the Woodland Carbon Code since 2011. Around 17,000ha of additional projects were

270 UK Woodland Carbon Code, 'Woodland Carbon Guarantee' (2019): https://www.woodlandcarboncode.org.uk/woodland-carbon-guarantee; and Department for Environment, Food and Rural Affairs, 'Third Woodland Carbon Guarantee auction now open for applications' (21 August 2020): https://www.gov.uk/government/news/third-woodland-carbon-guarantee-auction-now-open-for-applications [accessed 12 January 2022] [accessed 12 January 2022]

271 UK Woodland Carbon Code, 'What are PIUs, WCUs and what can I say about them?' (2019): https://woodlandcarboncode.org.uk/buy-carbon/what-are-woodland-carbon-units [accessed 12 January 2022]

272 We heard from Dr Snowdon that, if woodland projects fail to perform as advertised, project managers are obliged to replant trees to achieve the promised number of woodland carbon units before they can be verified. Furthermore, establishing woodland counts as permanent land use change under UK law, so cutting down established trees requires a felling licence which obliges replanting elsewhere. The definitions of "permanence" and "additionality" in this context are set out by the Woodland Carbon Code. Q 64 (Dr Pat Snowdon)

273 . UK Woodland Carbon Code, 'What are PIUs, WCUs and what can I say about them?' (2019): https://woodlandcarboncode.org.uk/buy-carbon/what-are-woodland-carbon-units [accessed 12 January 2022]

274 Q 63 (Dr Pat Snowdon, Dr Renée Kerkvliet-Hermans)

275 Q 67 (James Mansfield)

276 Q 67 (James Mansfield)

submitted in the financial year 2020–21.[277] Projects currently registered under the scheme are projected to sequester 15.4Mt CO_2e over their lifetime of up to 100 years.[278] Under the peatland code, 5,237ha of peatland has been registered, with a Government target of restoring 35,000ha by 2025.[279] We heard from James Mansfield that the carbon units covered by the codes are "seeing massive demand, which is outstripping supply."[280] Improving the engagement of land managers with high quality, scientifically based schemes could correct this shortage of supply.

Co-benefits and the codes

137. We were told that a major gap in the codes is the absence of a mechanism to value co-benefits. David Young identified this as "the very precise reason" that "we see a supply constraint."[281] Investors may informally appreciate co-benefits: Dr Snowdon told us that investors considered Woodland Carbon Credits to be "charismatic carbon."[282] But credits from projects with more co-benefits are of no more value to the investor or the landholder. Annette Burden, wetland biogeochemist, UK Centre for Ecology and Hydrology, who is developing a saltmarsh carbon code, told us that for some ecosystems, projects will not be viable if co-benefits are not taken into account.[283]

138. Various witnesses described the value of enabling "stacked" and "blended" finance to support nature-based solutions. Stacked finance would involve multiple buyers purchasing ecosystem services from the same project, while blended finance is a combination of public and private finance. Annette Burden explained that saltmarsh restoration projects are mostly funded for flood defence, but this may provide only "80% funding … it might then be through carbon financing that we could finance the remaining 20%."[284] This is an example of stacked finance, where one buyer might pay for the flood defences while others pay for the carbon sequestration. Annette Burden noted that this could be "complex, especially if you had different customers for the different services and you had to get them all to agree to commit to funding at the same time", but "not impossible."[285] Dr Snowdon, of the Woodland Carbon Code, spoke of a "discussion … with DEFRA [the Department for Environment, Food and Rural Affairs]" about developing "biodiversity credits" which would be "stack[ed]" on top of carbon credits.[286] Many of the projects supported by the Natural Environment Investment Readiness Fund

277 Comparing figures in Forestry Statistics 2020 and 2021—Forest Research, 'Forestry Statistics 2021' (2021): https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2021/; and Forest Research, 'Forestry Statistics 2020' (2020): https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2020/ [accessed 12 January 2022]

278 UK Woodland Carbon Code, 'UK Land Carbon Registry?' (30 September 2021): https://woodlandcarboncode.org.uk/uk-land-carbon-registry [accessed 12 January 2022]

279 This can be compared to the Government's target of 35,000 hectares of peatland restoration by 2025, although not all peatland restoration projects will be registered under the code. Carbon Brief, 'Analysis: How will England's strategies for trees and peat help achieve net zero by 2050?' (19 May 2021): https://www.carbonbrief.org/qa-how-will-the-uks-strategies-for-trees-and-peat-help-achieve-net-zero-by-2050 [accessed 12 January 2022]

280 Q 67 (James Mansfield)

281 Q 67 (David Young)

282 Q 55 (Dr Pat Snowdon)

283 Q 55 (Annette Burden)

284 Q 55 (Annette Burden)

285 Q 55 (Annette Burden)

286 Q 55 (Dr Pat Snowdon)

are hoping to establish new markets for payments for ecosystem services which could be combined with financing via carbon credits.[287]

139. We heard from Lord Goldsmith of Richmond Park that "if you judge a project purely on the basis of its carbon sequestration value, you can end up with perverse policies". He said that the Government would consider co-benefits in determining which projects it supported, but that "recognition of those benefits by the private sector … is harder."[288]

140. **Monetising co-benefits would make nature-based solutions projects more financially attractive for landholders and investors. Some ecosystem restoration projects will not be viable unless their wider benefits for the environment and for society, including for biodiversity and flood risk mitigation, are valued. Financing projects based on multiple benefits will make more projects viable, but requires central coordination to match buyers and sellers.**

141. ***We recommend, although it will be complex, that the co-benefits of projects under the Woodland Carbon Code and the Peatland Code should be quantified, and that payments for other ecosystem services should be included within current and future carbon codes. This should be facilitated by the Government bodies that manage each carbon code.***

Practices funded by the codes

142. Another potential issue is that a variety of beneficial practices, beyond large scale tree planting or peatland restoration, are not incentivised under the codes. Professor Evans identified an agricultural nature-based solution of draining agricultural peatlands to a lesser depth to reduce emissions.[289] Harry Studholme told us that additional carbon would be sequestered if trees were grown for longer before harvesting. But neither of these improved management practices would fall within the additionality requirements of the codes, despite reducing emissions and benefiting nature when used appropriately.[290]

143. Dr Hermans was concerned that standards for net zero might fail to recognise peatland restoration and that they might reduce demand for the Peatland Code. This is because restoring peatland does not, at least in the short-term, sequester CO_2—it prevents it being emitted. This means the Peatland Code is "selling emissions reductions" rather than active sequestration.[291] Helen Avery, Head of Nature Programmes, Green Finance Institute, told us that this lack of clarity on whether peatland credits will be regarded as offsets under net zero declarations "could discourage investors."[292]

144. **There is a lack of agreed standards for projects and ecosystems other than large-scale tree-planting and peatland restoration. Some beneficial land use practices, such as improved management**

287 Environment Agency, Department for Environment, Food and Rural Affairs, and Natural England, 'Innovative nature projects awarded funding to drive private investment' (14 July 2021): https://www.gov.uk/government/news/innovative-nature-projects-awarded-funding-to-drive-private-investment [accessed 12 January 2022]
288 Q 144 (Lord Goldsmith of Richmond Park)
289 Q 24 (Professor Chris Evans)
290 Q 3 (Sir Harry Studholme)
291 Q 51 (Dr Renée Kerkvliet-Hermans)
292 Q 67 (Helen Avery)

of working forests or agricultural peatlands, that sequester carbon or prevent it from being emitted are excluded from the Woodland Carbon Code and the Peatland Code.

145. ***We recommend that the Woodland Carbon Code, the Peatland Code, and greenhouse gas regulations, incentivise means of actively restoring ecosystems. These practices would prevent additional emissions from ecosystems that would otherwise degrade, even if they did not sequester carbon.***

Net zero and private finance

146. Net zero ambitions should provide an opportunity for directing private finance towards restoring UK nature, as companies buy offsets to reach net zero emissions. We heard that "since the net zero targets came in, there has been a huge surge in interest" for the carbon credits offered by the codes.[293] A recent study by S&P found that the price of nature-based offsets increased threefold between June 2021 and January 2022. [294] A higher carbon price may incentivise more landowners and managers to turn over their land to nature-based solutions, but pressure on suppliers to generate carbon credits quickly may compromise the quality of the offsets.

147. The role of mandatory greenhouse gas reporting, in which carbon code units can be used in calculations and claims of overall emissions, is unclear.[295] There are no regulations on what is required for companies to claim that they have achieved net zero emissions and the high standards set by the carbon codes do not apply to all carbon credits.[296] Companies can make net zero claims by buying cheap, low-quality offsets internationally, which may have unclear benefits for nature.[297] Recent claims by companies of being "carbon negative" may rely on offsets as cheap as $3/tonne.[298] This significantly undercuts existing, well regulated, carbon pricing mechanisms, which are intended to reflect the true cost of avoiding carbon emissions. For example, under the UK's emissions trading scheme, there is a carbon price of around £50 per tonne of CO_2 emitted.[299] We heard from James Mansfield that regulations on net zero emissions were "part of the market infrastructure that … does not really exist … being much clearer about what the net zero pathway looks like and where legitimate offsetting sits … will help to accelerate the growth" of demand for the markets.[300]

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293 Q 51 (Dr Pat Snowdon)

294 Camilla Hodson and Laura Noonan, 'Cost of neutralising carbon emissions soars as demand escalates', *Financial Times* (6 January 2022): https://www.ft.com/content/29565f44-ba71-4a44-8e84-d1e421ddb958 [accessed 14 January 2022]

295 UK Woodland Carbon Code, 'What are PIUs, WCUs and what can I say about them?' (2019): https://woodlandcarboncode.org.uk/buy-carbon/what-are-woodland-carbon-units [accessed 13 January 2022]

296 'Net-zero carbon pledges must be meaningful to avert climate disaster', *Nature* (31 March 2021): https://www.nature.com/articles/d41586–021-00864-9 [accessed 13 January 2022]

297 'Carbon offset market needs radical reform', *UCL News* (4 December 2020): https://www.ucl.ac.uk/news/2020/dec/carbon-offset-market-needs-radical-reform [accessed 13 January 2022]

298 EY's carbon claim under spotlight | Environment Analyst Global (environment-analyst.com)

299 David Sheppard and Camilla Hodgson, 'UK carbon price trades at £50 as market opens for first time' *Financial Times* (19 May 2021): https://www.ft.com/content/56e02d3d-8c31-4937-be50-60d4bf9342f7 [last accessed 14 January 2022]

300 Q 67 (James Mansfield)

148. Some companies have signed up to the definition of net zero in the Science-based Targets Initiative.[301] This scheme allows companies to submit their net zero plans and targets to an expert team for validation. This entails identifying the emissions for which the company is responsible and then setting out a clear and appropriate role for offsetting alongside emissions cuts, and near-term actions and targets. For most corporations, this entails rapidly cutting emissions now, halving emissions by 2030, reducing total emissions by 90–95%, offsetting only the remaining 5–10%, and not claiming net zero until long-term targets are reached.[302] We heard from Lord Goldsmith of Richmond Park that the Government supports the Science-based Targets Initiative, and that it should be expanded to include impacts on nature. But it remains a voluntary standard for corporate net zero plans.[303] The incentive for companies to invest in nature-based solutions so they can reach a net zero target is weaker than it could be.

149. **Offsets cannot be a substitute for reducing emissions. But the drive towards net zero emissions is an opportunity to direct significant private finance to nature recovery in the UK in the form of offsets. The role of carbon credits in net zero declarations remains unclear. Schemes like the Science-based Targets Initiative provide good standards but remain voluntary.**

150. ***We recommend that the Department for Business, Energy and Industrial Strategy must provide clarity about what companies must do to claim net zero emissions. Regulations should include a limited, defined role for high-quality offsets, such as the 10% limit in the Science Based Targets Initiative, alongside incentives to ensure emissions are reduced to the full extent possible at the same time.***

The need for well-regulated environmental markets

151. We heard concerns about using a market-based approach to fund nature-based solutions. For example, David Young told us that in environmental markets around the world "brokers and intermediaries … quite often consume all the value that is created."[304] In the push to create markets for ecosystem services, mistakes made in previous schemes risk being repeated. David Young of Wheatley Young Partners urged the Government to provide "co-ordinated … regulatory frameworks", following the guidance of the Financing UK Nature Recovery project.[305] He told us:

> "We have seen the consequences of a more laissez faire market in the voluntary carbon sector. Mark Carney has now had to come in, 20 years on, and try to put a bit more rigour and discipline into those markets. We are at the beginning of the markets for nature, and it is really important that we put these frameworks in from the outset, so that in 20 years' time we do not have to find another Mark Carney to fix the problem."[306]

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301 Shadia Nasralla, 'First reality check launched for corporate climate claims', *Reuters* (28 October 2021): https://www.reuters.com/business/cop/first-reality-check-launched-corporate-climate-claims-2021–10-27/ [accessed 13 January 2022]

302 Science Based Targets, 'The Net-Zero Standard': https://sciencebasedtargets.org/net-zero [accessed 13 January 2022]

303 Q 144 (Lord Goldsmith of Richmond Park)

304 Q 69 (David Young)

305 Financing UK Nature Recovery, *Recommendations and roadmap* (2021): https://financingnaturerecovery.uk/recommendations-%26-roadmap [accessed 13 January 2022]

306 Q 70 (David Young)

152. The Article 6 rules, agreed at COP26, determine how carbon markets and the associated carbon accountancy should operate internationally. They exclude credits associated with an earlier UN scheme, REDD+, which paid for "avoided deforestation", where the benefits were thought to have been overstated.[307] In this case, a market developed to facilitate the trade of these credits, but poor regulation led to little benefit to the environment.

153. We heard from Professor Henderson, that for habitats such as soil, saltmarsh, or seagrass: "the metrics to measure and understand them are insufficiently mature that you would want to count them at this stage in an offset market or in an accounting scheme".[308] Research and development to improve the evidence base to develop sufficient regulatory standards is part of the purpose of the Natural Environment Investment Readiness Fund.

154. There are unofficial soil carbon markets that demonstrate the importance of Government regulation. The Woodland Carbon Code and Peatland Code have numerous safeguards to ensure that the schemes are robust, but nascent soil carbon markets lack these safeguards. Professor Hails told us that an official soil carbon code is "badly needed" as "farmers think they are dealing with people who are certified" but who are, in fact, operating privately without full certification.[309] Richard Bramley told us that farmers risk being "hoodwinked" in such carbon markets.[310] However, as noted above a soil carbon code will be difficult to develop because of the limited scientific evidence and the range of practices that it will have to cover.[311]

Other concerns

155. We heard concerns that the complexity of the marketplace underpinning the codes could limit the scale of investment. Buying a Woodland or Peatland Carbon Unit requires the buyer, or an appointed carbon broker, to negotiate with a supplier to support a pre-designed project.[312] David Young suggested that the ability of code operators to aggregate multiple projects could increase investment.[313] But Annette Burden was unclear how the current marketplace would coordinate payments from multiple buyers.[314]

156. Witnesses told us that while the private sector can play a role in supporting nature-based solutions, Government support will still be required. On peatlands we heard from Dr Hermans that, "restoration is really pretty expensive. Doing that on just private investments, carbon credits, at the current prices is really difficult, so we still need a blended approach of public and private funding."[315] James Mansfield emphasised the role of price floor mechanisms that should be provided by the Government. These would guarantee a minimum price of a carbon unit for a landholder, providing "confidence and certainty". He suggested that the Woodland Carbon

307 Carbon Brief, 'COP26: Key outcomes agreed at the UN climate talks in Glasgow' (15 November 2021) Article 6 section: https://www.carbonbrief.org/cop26-key-outcomes-agreed-at-the-un-climate-talks-in-glasgow [accessed 13 January 2022]
308 Q 124 (Professor Gideon Henderson)
309 Q 81 (Professor Rosemary Hails)
310 Q 103 (Richard Bramley), Q 78, Q 81 (Harry Greenfield, Professor Rosemary Hails)
311 Written evidence from the Sustainable Soils Alliance (NSD0033); Q 105 (Thomas Lancaster)
312 International Union on the Conservation of Nature, 'For Buyers': https://www.iucn-uk-peatlandprogramme.org/peatland-code/introduction-peatland-code/buyers [accessed 13 January 2022]
313 Q 66 (David Young)
314 Q 55 (Annette Burden)
315 Q 51 (Dr Renée Kerkvliet-Hermans)

Guarantee could act as a model for this approach.[316] Lord Goldsmith of Richmond Park acknowledged that it will be "incredibly difficult to turn nature into a market."[317]

157. **The market can incentivise investment in nature-based solutions. But the rush to develop new markets, with bottom-up initiatives, risks creating inconsistently regulated offsetting markets that do not deliver benefits to nature. Existing carbon markets are also complex.**

158. ***We recommend that the Government provides clear regulatory standards for emerging carbon markets to ensure that any offsets that are claimed are genuine. The Government should make carbon codes easier to use by acting as, or sponsoring, a central broker. Buyers and sellers should be able to aggregate multiple projects and combine public and private funding.***

Conclusions

An overall land-use strategy?

159. As we have argued, the agricultural transition and the push to achieve net zero emissions will place multiple demands on UK land. Land will have to be used for, amongst other things, food production, sequestering greenhouse gases, crops for bioenergy and, havens for biodiversity, as well as demands from entirely different uses such as house building. The Country and Land Business Association describes this as a "radical shift in the land use sector", while the minister compared it to the industrial revolution.[318] In chapter 1, we referenced the land use pathway described by the Committee on Climate Change, which requires up to 22% of UK agricultural land to be taken out of production.[319] In order to reconcile the competing demands on UK land, the Committee on Climate Change has declared that food waste and beef and dairy consumption must be reduced, while yields on remaining agricultural land must be increased.[320] We have also heard concerns about the offshoring of emissions if environmentally damaging activities are displaced elsewhere in the world when they cease in the UK.

160. Concerns have been raised about the structure and the transparency of land ownership in the UK. This report has already discussed the issues facing tenant farmers, who rent from landowners, in deploying nature-based solutions on their land. Determining the ownership of land in the UK is hampered by a lack of transparency, According to the Land Registry, "anyone buying or selling land or property, or taking out a mortgage must apply to us [the land registry] to register".[321] The Land Registry has evidence of ownership for 87% of land mass in England and Wales. But one estimate found that 17% of land in England is not detailed in the Land

316 Q 66 (James Mansfield)
317 Q 152 (Lord Goldsmith of Richmond Park)
318 Q 77 (Harry Greenfield); Q 146 (Lord Goldsmith of Richmond Park)
319 Committee on Climate Change, *Land use: Policies for a Net Zero UK* (23 January 2020) p 9, 30: https://www.theccc.org.uk/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK.pdf [accessed 17 December 2021]
320 The Committee has specific progress metrics for reducing meat consumption, food waste, and livestock numbers and increasing yield per hectare. Committee on Climate Change, *Progress in reducing emissions, 2021 Report to Parliament* (June 2021) p 119: https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf [accessed 7 January 2022]
321 HM Land Registry, 'About us': https://www.gov.uk/government/organisations/land-registry/about [accessed 5 January 2022]

Registry.[322] This may make it difficult for the Government to identify which stakeholders it needs to engage with. However, much of the land relevant to nature-based solutions is owned by a small number of people. For example, it has been estimated that 124 individuals and organisations own around 60% of UK peatlands.[323] The decisions of a small number of individuals could have significant implications for nature-based solutions in the UK. The Government also has direct control of some UK land through bodies like the Ministry of Defence, which owns 1% of UK land.[324] While, in the marine context, the Crown Estate, which was established in its modern form by Act of Parliament,[325] controls the UK's territorial seabed within 12 miles of the shore.

161. The Government is aware of the challenges posed by the need to balance competing demands for land use. Professor Henderson noted that "there is limited land and we are trying to get a lot of environmental benefits from it", while Lord Goldsmith of Richmond Park acknowledged that for "lots of land … there will be competition for use".[326] Reconciling food production and the protection of nature was described as a "central challenge for DEFRA [the Department for Environment, Food and Rural Affairs]".[327] Lord Goldsmith of Richmond Park noted that "offshoring of our food production is not a good idea" and described the problem of changing diets as "the hardest nut to crack" politically.[328] Both the Department for Environment, Food and Rural Affairs in its written evidence and Lord Goldsmith in oral evidence set out the importance of a "strategic approach to land management".[329] Lord Goldsmith agreed that there is a "need for greater integration of the needs of the natural environment and the needs of humans". This requires a closer collaboration between the Department for Environment Food and Rural Affairs and Department for Levelling up, Housing and Communities.[330] But Lord Goldsmith was "not convinced that we [the UK] need a single land strategy."[331]

162. The trade-offs in land use must be addressed; and it is difficult to see how this can be done without an overall strategy. Harry Greenfield told us that managing these trade-offs would require thinking "carefully about what each piece of land is used for and how it is managed. For us, that means that policy cannot be delivered in silos. You cannot have targets for development and housebuilding, for example, on one side, then climate and nature, and then food production. They need to be considered holistically, which does not always happen."[332] In their recent report, the Public Accounts Committee

322 Tim Adams, 'Who Owns England? by Guy Shrubsole review – why this land isn't your land', *The Guardian* (28 April 2019): https://www.theguardian.com/books/2019/apr/28/who-owns-england-guy-shrubsole-review-land-ownership [accessed 13 January 2022]

323 Guy Shrubsole, *Who owns our carbon?* from Who Owns England? (November 2021): https://whoownsengland.files.wordpress.com/2021/11/who-owns-our-carbon-nov-2021.pdf [accessed 13 January 2022]

324 Ministry of Defence, 'MOD Land Holdings: 2000 to 2021' (27 May 2021): https://www.gov.uk/government/statistics/mod-land-holdings-bulletin-2021/mod-land-holdings-2000-to-2021 [accessed 13 January 2022]

325 Crown Estate Act 1961

326 Q 144 (Professor Gideon Henderson, Lord Goldsmith of Richmond Park)

327 Q 144 (Lord Goldsmith of Richmond Park)

328 Q 149, Q 152 (Lord Goldsmith of Richmond Park)

329 Q 149 (Lord Goldsmith of Richmond Park), Written Evidence from Department for Environment Food and Rural Affairs (NSD0042)

330 Q 150 (Lord Goldsmith of Richmond Park)

331 Q 149 (Lord Goldsmith of Richmond Park)

332 Q 77 (Harry Greenfield)

noted that "the Department [for Environment Food and Rural Affairs] has given no detail about how either the necessary productivity increases or environmental benefits will be brought about" and that it had not "explained how the Scheme's [ELMs] changes in land use will not simply result in more food being imported."[333]

163. In 2022, a House of Lords special inquiry committee will be established to consider land use in England.[334] Its remit will enable it to investigate current and future demands on land use, their impact on climate change and the decision-making processes concerning land use.[335]

164. **Reaching the net zero emissions target will require managing trade-offs in land use. There is no guarantee that a voluntary or market-driven approach will create local schemes that will achieve the national climate and nature targets.**

165. ***We recommend that the Government develops an overall land use strategy. This should outline how nature-based solutions will contribute to net zero emissions, how they will be integrated with other policies and how trade-offs in land use will be managed. The Government needs to describe how the UK's land can deliver the multiple services demanded of it without offshoring emissions. The Government should work with large landowners, including land and marine managers such as the Ministry of Defence and the Crown Estate, to achieve its objectives.***

Risk of failed transition

166. **The Government's plans are ambitious and have much potential, but there is a clear and present danger that they will not be achieved. There are multiple risks of failure, including a lack of certainty about the science of carbon sequestration in nature-based solutions, a lack of skills and engagement, and a lack of policy coordination, which require urgent actions to address. Failure to deliver risks the livelihoods of farmers, damaging the agricultural sector, undermining the net zero agenda, and risks undermining the UK's biodiversity-recovery.**

333 Committee of Public Accounts, *Environmental Land Management Scheme* (Thirty-First Report, Session 2021–22, HC 639)
334 Liaison Committee, *New committee activity in 2022* (4th Report, Session 2019–21, HL Paper 97)
335 Liaison Committee, *New committee activity in 2022* (4th Report, Session 2019–21, HL Paper 97)

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Nature-based solutions in the UK

1. Faster growing trees sequester carbon more quickly, but surviving, old growth, mixed woodlands are large stores of carbon. The scale of the contribution that fast growing, commercial, forestry can make to net zero by 2050 is significant, but it depends on how harvested wood is used. (Paragraph 26)

2. *We recommend that a life-cycle analysis be undertaken to calculate the carbon benefits of tree-planting. The fate of the carbon must be monitored beyond harvesting: it is not enough to plant a tree and consider that carbon "sequestered". When deciding which trees to plant, the Forestry Commission must consider factors including resilience to climate change, disease, the risk of fire and potential release of carbon, carbon storage potential, including in the soils, and biodiversity benefits.* (Paragraph 27)

3. *We recommend that the Government sets a target for emissions reductions from the agriculture, forestry and other land use sector in line with the Committee on Climate Change's recommendations and interim targets.* (Paragraph 61)

4. *We recommend that, as part of the agricultural transition, research and development is conducted on farms to better understand carbon emissions from farms and the practices that can reduce them. The Department for Environment, Food, and Rural Affairs should fund on-farm research projects and it should monitor them to ensure research is conducted to an appropriate standard. This could be funded through tax credits and grants. The Department should investigate and address any regulatory barriers to conducting this research and development.* (Paragraph 62)

5. *We recommend that the Forestry Commission should keep its policy on tree-planting on peaty soils under review. The policy may need to be strengthened if evidence about the net carbon balance of planting shows that it is negative.* (Paragraph 63)

6. There are large gaps in the evidence pertaining to carbon sequestration and storage in marine habitats. Saltmarshes and seagrasses are better understood, but uncertainties remain. The understanding of other habitats for nature-based solutions, such as, kelp forests, shelf sediments and algae, is less mature. (Paragraph 72)

7. *We recommend that the Department for Environment, Food and Rural Affairs supports research that focuses on establishing the current and historical extent of marine habitats, their carbon sequestration rates, and their long-term potential for carbon storage.* (Paragraph 73)

8. *We recommend that a blue carbon mapping exercise for the UK exclusive economic zone be undertaken, learning from the Scottish Blue Carbon Forum. This should involve collaboration between Natural England, the Crown Estate, the Marine Management Organisation, academics, and other relevant public bodies.* (Paragraph 74)

9. *We recommend that the Marine Management Organisation establishes research programmes to investigate the cause of the decline of marine habitats, such as seagrasses, and the potential effects of eliminating bottom trawling on carbon sequestration in the marine environment.* (Paragraph 75)

10. While it is important that gaps in the evidence base are filled, the gaps should not act as a barrier to the large-scale adoption of nature-based solutions. The

exact impact of nature-based solutions will be known only after they have been tried and monitored in the long-term, but evidence already indicates a positive impact. Given the urgency of the climate and biodiversity crises, there is no time to waste. The fact that it is not possible to quantify exactly the carbon loss due to marine shelf sediment disturbance, or to other activities, should not prevent the protection of these habitats. (Paragraph 80)

11. *We recommend that, where there are gaps in the evidence, policy should adopt a precautionary approach, weighted in favour of nature.* (Paragraph 81)

12. There is uncertainty about the long-term sequestration potential of nature-based solutions across habitats. Nature-based solutions that are not resilient to adverse weather, human activity, a changing climate, or pests and disease risk being ineffective and releasing any carbon they sequester. Monitoring will allow lessons to be learned from schemes that succeed, and from those that fail. (Paragraph 82)

13. Monitoring technologies such as Earth Observation are potentially important. However, they cannot substitute for direct measurements on the ground. Uncertainties have direct implications for policy. They are greater for ecosystems that are less well-understood than woodlands and peatlands. Emissions factors are useful for estimating the contribution of habitats to greenhouse gas emissions across the UK. But nature-based solutions are inherently local and must be understood on a local level. (Paragraph 83)

14. *We recommend that long-term research and monitoring be supported and overseen by the relevant departments and their public bodies, including Natural England and UK Research and Innovation, to ensure schemes are resilient and deliver as promised. The research and monitoring programmes should support direct and indirect measurements of greenhouse gas fluxes on a range of representative sites for key habitats in the UK to address uncertainties concerning the timescale and duration of carbon storage and sequestration for all habitats.* (Paragraph 84)

15. The Government's focus has been mostly on large-scale land sparing approaches, such as large-scale tree planting and peatland restoration, for which the evidence base is strongest, rather than land sharing approaches and improved management of ecosystems. Land sparing is likely to sequester more carbon than land sharing, but it may entail more trade-offs. (Paragraph 85)

16. *We recommend that research programmes be established to fill uncertainty gaps in the impact of land sharing techniques, including hedgerow planting, silvopasture and agroforestry and the effect of these practices on soil carbon storage and sequestration.* (Paragraph 86)

17. Restoring nature is often more complex and costly than protecting it. Restored ecosystems may take a long time to recover biodiversity and carbon stores, if they ever do. Policy should not assume that it is possible to 'recreate' in another place the natural systems that are destroyed. (Paragraph 87)

18. *We recommend that the Government makes it a priority to protect the natural ecosystems that remain wherever this is possible to ensure the significant stores of carbon in these habitats are not emitted.* (Paragraph 88)

Supporting nature-based solutions at scale in the UK

19. The Government's pledges for nature restoration are welcome and are largely consistent with the recommendations of the Committee on Climate Change (CCC). But some of its pledges are not aligned with those from the CCC. The pledges are undermined by a lack of clarity on the meaning of terms such as "protected areas" or "engagement with low-carbon farming practices." (Paragraph 92)

20. *We recommend that the Government follows the recommendations from the Committee on Climate Change in setting targets for nature-based solutions. Where it does not do so, it should provide an evidence-based explanation as to why not, and how it can still reach net zero. It should define terms in its pledges where definitions are contested; this applies particularly to the term "protected".* (Paragraph 93)

21. Collaboration between the delivery bodies is welcome and should be encouraged. But the Government's targets for nature restoration demand a great deal of these bodies and their budgets are not adequate to meet the challenge. (Paragraph 101)

22. *We recommend that the budgets of the delivery bodies be increased to allow them to support the Government's ambitious targets. The delivery bodies should be encouraged to collaborate so that the multiple benefits of nature-based solutions are realised. The Department for Environment, Food, and Rural Affairs should provide clarity over which responsibilities are delegated to each public delivery body for regulating and delivering nature-based solutions, especially for marine nature-based solutions.* (Paragraph 102)

23. The transition from the Common Agricultural Policy to Environmental Land Management schemes will require long-term changes to land use, but funding is not yet guaranteed in the long term. (Paragraph 110)

24. *We recommend that the Department for Environment, Food and Rural Affairs provides urgent clarity about the nature of Environmental Land Management schemes and which activities they will subsidise. Funding should be assured in return for a long-term commitment to good practice. The new schemes that are introduced should be based on proper and transparent evidence. They must have defined metrics to evaluate success or failure so that they can be adapted to evolving evidence. It must be clear how these schemes will interact with wider agricultural and environmental policies.* (Paragraph 111)

25. The transition to Environmental Land Management schemes demands a lot from land managers and farmers. Some of them feel that they do not have sufficient support. Poor communication and a failure to convince land-managers of the benefits of the change will lead to a transition that fails. Maintaining flexibility in Environmental Land Management schemes to permit land sharing approaches could help to address the lack of engagement and reluctance from land managers. (Paragraph 114)

26. *We recommend that the Government improves communication with land managers. Land sparing approaches will have to play a significant role in reaching net zero targets, but land-sharing approaches should be included in Environmental Land Management schemes where possible, and where evidence suggests they deliver carbon benefits. This will make the transition to providing "public money for public goods" easier and more acceptable for land managers.* (Paragraph 115)

27. We welcome that the Government recognises the existence of gaps in the skills and knowledge needed to carry out nature restoration, but we are concerned that plans to address the gaps lack urgency. (Paragraph 121)

28. *We recommend that the Government establishes ambitious skills and training programmes for land managers, authorities developing Local Nature Recovery Strategies and public delivery bodies. Training in surveying, monitoring and verifying, carbon accountancy, forestry, ecology, and planning and carrying out nature-based solutions needs to be expanded urgently. The Department for Education and the Department for Business Energy and Industrial Strategy must allocate some of their funding to this effort to make schemes accessible to land managers and provide sufficient skilled personnel to meet targets.* (Paragraph 122)

29. Land managers cannot assess the best actions to take without assistance. While the Committee welcomes the Government's commitment to making its schemes easier to access, and providing support to third-party advisors through the Future Farming Resilience Fund, it is difficult to see how widespread engagement with schemes will be achieved without a significant expansion in advisory services and support. (Paragraph 123)

30. *We recommend that the Government provides additional support as a matter of urgency for land managers, in the form of a dedicated advisory service, to help them engage with Environmental Land Management Schemes. The advisory service should be delivered in collaboration with public delivery bodies and should help land managers through the application process. It should help farms to identify the most appropriate actions to take, the support they need and can expect, and the likely environmental impact of their actions.* (Paragraph 124)

31. Tenancy contracts impede the implementation of nature-based solutions. More flexibility in these contracts is needed for the Government's schemes to be a success. (Paragraph 127)

32. *We recommend that the Government urgently addresses the barriers tenant farmers face to engage with the Environmental Land Management Schemes. This could include mechanisms for landlords and tenants to negotiate arrangements that allow them to share the costs and benefits of improvements.* (Paragraph 128)

33. *We recommend that the Department for Environment, Food and Rural Affairs supports the domestic industry for seeds and saplings and only imports bio-secure seeds and saplings where necessary, and with stringent phytosanitary safeguards.* (Paragraph 130)

34. Monetising co-benefits would make nature-based solutions projects more financially attractive for landholders and investors. Some ecosystem restoration projects will not be viable unless their wider benefits for the environment and for society, including for biodiversity and flood risk mitigation, are valued. Financing projects based on multiple benefits will make more projects viable, but requires central coordination to match buyers and sellers. (Paragraph 140)

35. *We recommend, although it will be complex, that the co-benefits of projects under the Woodland Carbon Code and the Peatland Code should be quantified, and that payments for other ecosystem services should be included within current and future carbon codes. This should be facilitated by the Government bodies that manage each carbon code.* (Paragraph 141)

36. There is a lack of agreed standards for projects and ecosystems other than large-scale tree-planting and peatland restoration. Some beneficial land use practices, such as improved management of working forests or agricultural peatlands, that sequester carbon or prevent it from being emitted are excluded from the Woodland Carbon Code and the Peatland Code. (Paragraph 144)

37. *We recommend that the Woodland Carbon Code, the Peatland Code, and greenhouse gas regulations, incentivise means of actively restoring ecosystems. These practices would prevent additional emissions from ecosystems that would otherwise degrade, even if they did not sequester carbon.* (Paragraph 145)

38. Offsets cannot be a substitute for reducing emissions. But the drive towards net zero emissions is an opportunity to direct significant private finance to nature recovery in the UK in the form of offsets. The role of carbon credits in net zero declarations remains unclear. Schemes like the Science-based Targets Initiative provide good standards but remain voluntary. (Paragraph 149)

39. *We recommend that the Department for Business, Energy and Industrial Strategy must provide clarity about what companies must do to claim net zero emissions. Regulations should include a limited, defined role for high-quality offsets, such as the 10% limit in the Science Based Targets Initiative, alongside incentives to ensure emissions are reduced to the full extent possible at the same time.* (Paragraph 150)

40. The market can incentivise investment in nature-based solutions. But the rush to develop new markets, with bottom-up initiatives, risks creating inconsistently regulated offsetting markets that do not deliver benefits to nature. Existing carbon markets are also complex. (Paragraph 157)

41. *We recommend that the Government provides clear regulatory standards for emerging carbon markets to ensure that any offsets that are claimed are genuine. The Government should make carbon codes easier to use by acting as, or sponsoring, a central broker. Buyers and sellers should be able to aggregate multiple projects and combine public and private funding.* (Paragraph 158)

42. Reaching the net zero emissions target will require managing trade-offs in land use. There is no guarantee that a voluntary or market-driven approach will create local schemes that will achieve the national climate and nature targets. (Paragraph 164)

43. *We recommend that the Government develops an overall land use strategy. This should outline how nature-based solutions will contribute to net zero emissions, how they will be integrated with other policies and how trade-offs in land use will be managed. The Government needs to describe how the UK's land can deliver the multiple services demanded of it without offshoring emissions. The Government should work with large landowners, including land and marine managers such as the Ministry of Defence and the Crown Estate, to achieve its objectives.* (Paragraph 165)

44. The Government's plans are ambitious and have much potential, but there is a clear and present danger that they will not be achieved. There are multiple risks of failure, including a lack of certainty about the science of carbon sequestration in nature-based solutions, a lack of skills and engagement, and a lack of policy coordination, which require urgent actions to address. Failure to deliver risks the livelihoods of farmers, damaging the agricultural

sector, undermining the net zero agenda, and risks undermining the UK's biodiversity-recovery. (Paragraph 166)

APPENDIX 1: LIST OF MEMBERS AND DECLARATIONS OF INTEREST

Members

Baroness Blackwood of North Oxford
Baroness Brown of Cambridge (co-opted)
Viscount Hanworth
Lord Holmes of Richmond
Lord Kakkar
Lord Krebs
Baroness Manningham-Buller
Lord Mitchell
Lord Patel (Chair)
Baroness Rock
Lord Sarfraz
Baroness Sheehan
Baroness Walmsley
Baroness Warwick of Undercliffe
Lord Winston

Declaration of Interest

Baroness Blackwood of North Oxford

No relevant interests declared

Baroness Brown of Cambridge (co-opted)

Chair of the Adaptation Committee of the Climate Change Committee

Non-Executive Director, Ørsted

Chair of the Carbon Trust

Viscount Hanworth

No relevant interests declared

Lord Holmes of Richmond

No relevant interests declared

Lord Kakkar

Member Advisory Committee, Royal Society

Trustee, Foundation for Science and Technology

Chairman, King's Health Partners (Guy's and St Thomas's NHS Foundation Trust)

Trustee, Ramsbury Manor Foundation

Lord Krebs

Chair of the Advisory Board for the Wellcome Trust Funded research programme at Oxford University on Livestock, Environment and People

Member of the Advisory Board of the Environment and Climate Intelligence Unit

Scientific advisor on sustainability of biofuels to Drax PLC

Scientific advisor to Marks and Spencer PLC

Scientific advisor to Ajinomoto Inc

Member of the Advisory Board of the Cambridge Conservation Initiative

Baroness Manningham-Buller LG DCB

Fellow of Academy of Medical Sciences

Member of the Advisory Board of the Royal Society

Lord Mitchell

No relevant interests declared

Lord Patel KT, Kt, FRSE, FMedSci

Fellow of Royal Society of Edinburgh

Fellow of Academy of Medical Sciences

Baroness Rock

Director, Wrackleford Farms Ltd

Senior Advisor, Newton Europe

Lord Sarfraz

Founder of Better Grain, an agricultural technology business working with smallholder farmers in Asia

Baroness Sheehan

I am taking part in a number of Defra's Countryside Stewardship Schemes, for which I receive financial remuneration

Shareholdings in FIM Sustainable Timber and Energy LP

Baroness Walmsley

I am a supporter and former Chair of Botanic Gardens Conservation International, some of whose reports may be relevant to this inquiry

I am also a small scale active bee-keeper

Baroness Warwick of Undercliffe

No relevant interests declared

Lord Winston

Professor of Science and Society, Imperial College London

Hon Fellow, Royal Academy of Engineering

Fellow, Academy of Medical Sciences

Member, Council of Data Ethics and Innovation

A full list of Members' interests can be found in the Register of Lords Interests: https://members.parliament.uk/members/lords/interests/register-of-lords-interests

Specialist Adviser

Professor Pete Smith, FRS, FRSE, FNA, F.EurASc, FI Soil Sci, FRSB, Professor of Soils and Global Change, Science Director of Scotland's ClimateXChange, University of Aberdeen

Through the University of Aberdeen, recipient of research funding from UKRI, EU, Wellcome Trust and Scottish Government

In a personal capacity, on the science advisory team for Carbon Direct and for the charity The Carbon Community

Trustee for the local environmental action charity, SEAchange

APPENDIX 2: LIST OF WITNESSES

Evidence is published online at https://committees.parliament.uk/work/1294/naturebased-solutions-for-climate-change/publications/ and available for inspection at the Parliamentary Archives (020 7219 3074).

Evidence received by the Committee is listed below in chronological order of oral evidence session and in alphabetical order. Those witnesses marked with ** gave both oral evidence and written evidence. Those marked with * gave oral evidence and did not submit any written evidence. All other witnesses submitted written evidence only.

Oral evidence in chronological order

*	Professor David Coomes, Director, University of Cambridge Conservation Research Institute	QQ 1–8
*	Sir Harry Studholme, Former Chair, Forestry Commission	
*	Dr Bonnie Waring, Senior Lecturer, Grantham Institute on Climate and Environment, Imperial College London	
*	Professor Chris Collins, Professor of Environmental Chemistry, University of Reading	QQ 9–21
*	Dr Lynn Dicks, University Lecturer in Animal Ecology, University of Cambridge	
**	Dr Lisa Norton, Agroecology researcher, UK Centre for Ecology and Hydrology	
	Dr Rebekka Artz, Senior Research Scientist, Ecological Sciences, James Hutton Institute	QQ 22–36
*	Professor Chris Evans, Biogeochemist, UK Centre for Ecology and Hydrology	
*	Richard Lindsay, Head of Environmental and Conservation Research, Sustainability Research Institute, University of East London	
*	Professor Hilary Kennedy, Emeritus Professor, School of Ocean Sciences, Bangor University	QQ 37–50
*	Professor William Austin, School of Geography and Sustainable Development, University of St Andrews	
*	Professor Rick Stafford, Marine Biologist, Bournemouth University	
**	Dr Pat Snowdon, Head of Economics and Woodland Carbon Code, Scottish Forestry	QQ 51–64
*	Dr Renée Kerkvliet-Hermans, Peatland Code Co-ordinator, IUCN UK Peatland Programme	
*	Annette Burden, Wetland Biogeochemist, UK Centre for Ecology and Hydrology	

**	Helen Avery, Head of Nature Programmes, Green Finance Institute	QQ 65–73
*	David Young, Lawyer and Partner, Wheatley Young Partners	
*	James Mansfield, Co-Founder and Managing Director, Finance Earth	
*	Harry Greenfield, Senior Land Policy Adviser, Country Land and Business Association (CLA)	QQ 74–84
**	Professor Rosemary Hails, Director of Science and Nature, National Trust	
**	Professor Mark Reed, Professor in Rural Entrepreneurship, Scotland's Rural College (SRUC)	
**	Dr Mike (Michael) Morecroft, Principal Specialist, Climate Change, Natural England	QQ 85–93
*	Richard Greenhous, Director of Forest Services, Forestry Commission	
*	Melissa Swartz, Catchment Funding Senior Advisor, Environment Agency	
**	Richard Bramley, Chair of the Environment Forum, National Farmers Union (NFU)	QQ 94–105
**	Professor Selina Stead, Chief Scientific Advisor, Marine Management Organisation (MMO)	
**	Thomas Lancaster, Head of Land, Seas and Climate policy, Royal Society for the Protection of Birds (RSPB)	
*	Nick Halfhide, Director of Nature and Climate Change, NatureScot	QQ 106–121
**	Alan Hampson, Head of Policy and Practice, Scottish Forestry	
**	Professor Gideon Henderson, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs	QQ 122–134
**	Edward Barker, Director, Natural Environment, Trees and Landscapes, Department for Environment, Food and Rural Affairs	
**	Janet Hughes, Programme Director, Future Farming and Countryside Programme, Department for Environment, Food and Rural Affairs	
**	Rt Hon Lord Goldsmith of Richmond Park, Minister of State (Minister for Pacific and the Environment), Foreign, Commonwealth and Development Office and the Department for Environment, Food and Rural Affairs	QQ 135–152
**	Professor Gideon Henderson, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs	

**	James Quinault CBE, Director for Environment strategy, Department for Environment, Food and Rural Affairs	

Alphabetical list of witnesses

**	Dr Rebekka Artz, James Hutton Institute (QQ 22–36)	NSD0028
*	Professor William Austin, School of Geography and Sustainable Development, University of St Andrews (QQ 37–50)	
**	Helen Avery, Head of Nature Programmes, Green Finance Institute (QQ 65–73)	NSD0051
	Professor Ian Bateman, University of Exeter Business School	NSD0011
	Blue Marine Foundation	NSD0023
	Bright Blue	NSD0012
	The British Academy	NSD0024
	British Ecological Society (BES)	NSD0013
	Professor Harriet Bulkeley, Durham University	NSD0015
*	Annette Burden, Wetland Biogeochemist, UK Centre for Ecology and Hydrology (QQ 51–64)	
	Cairngorms Connect	NSD0038
	CCm Technologies	NSD0009
	Climate Solutions Exchange	NSD0035
*	Professor Chris Collins, Professor of Environmental Chemistry, University of Reading (QQ 9–21)	
*	Professor David Coomes, Director, University of Cambridge Conservation Research Institute (QQ 1–8)	
*	Country Land and Business Association (CLA) (QQ 74–84)	
	Ian Davis	NSD0007
**	Department for Environment, Food and Rural Affairs (Defra) (QQ 122–134) (QQ 135–152)	NSD0042 NSD0054
*	Dr Lynn Dicks, University Lecturer in Animal Ecology, University of Cambridge (QQ 9–21)	
*	Environment Agency (QQ 85–93)	
*	Professor Chris Evans, Biogeochemist, UK Centre for Ecology and Hydrology (QQ 22–36)	
	Farming Forum Grassroots Group	NSD0003 NSD0047
*	James Mansfield, Finance Earth (QQ 65–73)	
	Food, Farming and Countryside Commission	NSD0010

	Forest Canopy Foundation	NSD0026
*	Forestry Commission (QQ 85–93)	
	Euan Nicholas Furness	NSD0001
	Game and Wildlife Conservation Trust	NSD0046
	Inga Foundation	NSD0008
	Institute for Global Prosperity	NSD0025
*	IUCN UK Peatland Programme (QQ 51–64)	
*	Professor Hilary Kennedy, Emeritus Professor, School of Ocean Sciences, Bangor University (QQ 37–50)	
	Landscape Decisions Programme Network	NSD0014
	Professor David J Large, University of Nottingham	NSD0002
*	Richard Lindsay, Head of Environmental and Conservation Research, Sustainability Research Institute, University of East London (QQ 22–36)	
**	Marine Management Organisation (MMO) (QQ 94–105)	NSD0053
	MyOcean Resources Limited	NSD0018
	National Association for Areas of Outstanding Natural Beauty (NAAONB)	NSD0021
**	National Farmers Union (NFU) (QQ 94–105)	NSD0017
**	National Trust (QQ 74–84)	NSD0049
**	Natural England (QQ 85–93)	NSD0030
*	NatureScot (QQ 106–121)	
**	Dr Lisa Norton, Agroecology researcher, UK Centre for Ecology and Hydrology (QQ 9–21)	NSD0045
	Plantlife	NSD0039
	Dr Ana Queiros, Plymouth Marine Laboratory, Professor Nathalie Seddon, University of Oxford and Alison Smith, University of Oxford	NSD0020
**	Royal Society for the Protection of Birds (RSPB) (QQ 94–105)	NSD0029
	The Royal Society	NSD0050
**	Scotland's Rural College (SRUC) Thriving Natural Capital Challenge Centre (QQ 74–84)	NSD0040
**	Scottish Forestry (QQ 51–64) (QQ 106–121)	NSD0052
	Professor Nathalie Seddon, University of Oxford, Alison Smith, University of Oxford and Dr Ana Queiros, Plymouth Marine Laboratory	NSD0020
	Alison Smith, University of Oxford, Dr Ana Queiros, Plymouth Marine Laboratory and Professor Nathalie Seddon, University of Oxford	NSD0020

	Society for Applied Microbiology (SfAM)	NSD0016
	Soil Association	NSD0044
	Professor Chris J Spray MBE	NSD0004
*	Professor Rick Stafford, Marine Biologist, Bournemouth University (QQ 37–50)	
*	Sir Harry Studholme, Former Chair, Forestry Commission (QQ 1–8)	
	Sustainable Soils Alliance	NSD0033
	Dr Francesca Vantaggiato, King's College London	NSD0031
	Dr Jonathan Walker, Swansea University	NSD0034
	Dr Alexander Waller	NSD0005
*	Dr Bonnie Waring, Senior Lecturer, Grantham Institute on Climate and Environment, Imperial College London (QQ 1–8)	
	Professor Robert Wilby, Professor of Hydroclimatic Modelling, Loughborough University	NSD0032
	Wilder Carbon Ltd	NSD0043
	Wildfowl and Wetlands Trust	NSD0041
	The Wildlife Trusts	NSD0036
	WWF	NSD0022
*	David Young, Lawyer and Partner, Wheatley Young Partners (QQ 65–73)	

Private seminar

Seminar held remotely at the House of Lords on 29 June 2021

Members of the Committee present were Lord Patel (Chair), Baroness Blackwood of North Oxford, Viscount Hanworth, Lord Holmes of Richmond, Lord Kakkar, Lord Krebs, Baroness Manningham-Buller, Lord Mitchell, Baroness Rock, Lord Sarfraz, Baroness Sheehan, Baroness Walmsley, Baroness Warwick of Undercliffe and Lord Winston.

Remarks were heard from:

- Professor Nathalie Seddon, Director of Nature-based Solutions Initiative, Department of Zoology and Wadham College, University of Oxford;
- Professor Pete Smith, Chair in Plant and Soil Science, University of Aberdeen; and
- Professor Rick Stafford, Professor of Marine Biology and Conservation, Bournemouth University.

Private seminar

Seminar held remotely at the House of Lords on 12 October 2021

Members of the Committee present were Lord Patel (Chair), Baroness Blackwood of North Oxford, Baroness Brown of Cambridge (co-opted), Lord Holmes of Richmond, Lord Kakkar, Lord Krebs, Baroness Manningham-Buller, Baroness

Rock, Lord Sarfraz, Baroness Sheehan, Baroness Walmsley, Baroness Warwick of Undercliffe and Lord Winston.

Remarks were heard from:

- Professor Sir Charles Godfray, Head of the Oxford Martin School;
- Professor Nathalie Seddon, Founder, Nature-based Solutions Initiative;
- Stewart Maginnis, Global Director, Nature-based Solutions Group, IUCN;
- Professor Richard Bardgett, Former head of the British Ecological Society 2017–19; and
- Professor Pete Smith, Chair in Plant and Soil Science, University of Aberdeen.

APPENDIX 3: CALL FOR EVIDENCE

The House of Lords Science and Technology Committee, Chaired by Lord Patel, is conducting an inquiry into Nature-based Solutions for Climate Change to assist in achieving the UK's target of net zero greenhouse gas emissions by 2050. The deadline for receiving written evidence submissions is Thursday 30 September 2021.

Background

In recent years, there has been a renewed focus on nature-based solutions (NbS) to help address societal challenges, including climate change. These solutions are based on protecting, managing, restoring, or creating natural or modified ecosystems, on land or in marine environments. These techniques can mitigate climate change by absorbing greenhouse gases or reducing emissions from the land-use sector. They also aim to provide co-benefits, such as enhanced protection for biodiversity, improved health, water security, increased resilience to extreme weather events, and broader adaptation to climate change.

The UK is host to many natural ecosystems such as peatlands, seagrasses, and woodlands that have historically been degraded or lost. Following a recent methodology change, land use in the UK has now been identified as a net source of greenhouse gas emissions (Defra, 2019 UK Greenhouse Gas Emissions, Final Figures, 2 February 2021). This issue could worsen with additional climate change, although it may be possible to address land use emissions using nature-based solutions.

Successful implementation of nature-based solutions requires careful, site-specific planning, stakeholder engagement, financing and regulation. Systems must be created for accurately measuring, modelling, reporting and verifying the effects of interventions on ecosystems and carbon emissions. Nationally and internationally, concerns around financing, governance, and delivery of ambitious pledges must be addressed. The size of the potential mitigation contribution from nature-based solutions remains unclear.

The Committee seeks to understand the potential of nature-based solutions to contribute to Net Zero emissions in the UK; how nature-based solutions can fit into the UK's broader land use, forestry and agricultural planning; and how policy can support the implementation of best-practice techniques to deliver nature-based solutions at scale.

The Committee is seeking evidence on the following questions (there is no requirement to answer all questions in your submission):

Questions

1. What is the potential scale of the contribution that nature-based solutions can make to decarbonisation in the UK?

   - Which ecosystems are most relevant to the UK for nature-based solutions, and which have the largest potential to sequester carbon or reduce emissions?
   - How much of the UK's 'hard-to-mitigate' emissions can be offset by nature-based solutions? How much of the UK's land and exclusive economic zone (EEZ) coastal areas would need to be managed to achieve this, and what level of investment would be required?

- How do the costs and benefits (including co-benefits), of implementing nature-based solutions compare to other techniques for offsetting 'hard-to-decarbonise' sectors?

2. What major scientific uncertainties persist in understanding the effects of nature-based solutions and affect their inclusion in carbon accounting, and how can these uncertainties be addressed?

- How reliable are the estimates of the quantity of greenhouse gas emissions reduction or sequestration by nature-based solutions, as well as the duration and reliability of storage?
- Which bodies should be involved in establishing an agreed evidence base to inform best-practice techniques for restoring peatlands?
- To what extent do we understand the capacity of the oceans and coastal ecosystems to sequester greenhouse gases through nature-based solutions?

3. What frameworks already exist for the regulation and financing of nature-based solutions?

- What can be learned from the implementation of the Woodland and Peatland Codes for the regulation and financing of nature-based solutions?
- Are there good examples of nature-based solutions already being undertaken in the UK or elsewhere, and what can we learn from them?
- How should a hybrid public-private financing model be regulated? How should any carbon offsetting markets be regulated to ensure that they prioritise and support well-designed and effective nature-based solutions?
- How can we ensure that the carbon accountancy is science-based, robust, and consistent across nature-based solutions?

4. Who are the key stakeholders for the implementation of nature-based solutions in the UK? How can stakeholders' expertise and concerns inform the incentives and requirements for implementing nature-based solutions?

- How can farmers (including tenant farmers) and land managers be supported in their deployment of nature-based solutions by policy and legislative frameworks?
- Are there examples of projects which have engaged with stakeholders and local communities to implement nature-based solutions successfully, and what can we learn from them?

5. How should implementation of nature-based solutions be integrated with other government policies for landscapes and seascapes, for example, agricultural, forestry, and land-use planning policies?

- How could nature-based solutions implementation contribute to the UK's goals surrounding biodiversity, the preservation of nature, and adaptation to climate change?
- Which ongoing governmental plans, policies, and strategies are relevant to nature-based solutions, and can they be better coordinated? For example, are the Nature for Climate Fund and associated targets for peatland and forestry restoration designed so as to support nature-based solutions?
- Should incentives for nature-based solutions be included in future agri-environment schemes, and if so, how?

6. How should nature-based solutions be planned and monitored at the national level?

   - What measuring, reporting, and verification requirements should be put in place to determine the degree of success of nature-based solutions? Which techniques and technologies are best suited to accomplishing robust monitoring?

21 July 2021

APPENDIX 4: TECHNICAL TERMS AND ORGANISATIONS

Blue Carbon	Carbon stored in marine or coastal ecosystems, including marine sediments.
CO_2-equivalent	CO_2-equivalent is the metric used by the UK Government to aggregate greenhouse gas emissions across the Kyoto "basket" of seven greenhouse gases. It does so by adding together the greenhouse gas emissions multiplied by conversion factors, called Global Warming Potential, to account for the fact that some greenhouse gases are more powerful at warming per unit mass than others. (Carbon dioxide (CO_2), methane (CH4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF6) and nitrogen trifluoride (NF3)).[336]
Natural Capital	Natural capital is an attempt to quantify the value of natural assets to humanity—including geology, soil, air, water, and all living things. Natural capital metrics are therefore an attempt establish a consistent methodology to quantify the value of the natural world, often in monetary terms.[337]
Ecosystem Services	From stocks of natural capital, humans derive 'ecosystem services', which include food, water, plant and animal materials used for fuel, medicines, building materials, and so on. Ecosystem services include natural flood defences, carbon storage, crop pollination, and 'cultural ecosystem services' such as the recreational value of the natural environment.
Hectare	A unit of area equal to 10,000 square metres (or around 2.47 acres)
Marine Management Organisation	The Marine Management Organisation is a non-departmental public body set up in 2009 in England. Its responsibilities include marine planning, fisheries management, and, alongside Natural England and the Joint Nature Conservation Committee, to protect and manage England's Marine Conservation Zones.

336 Department for Business, Energy and Industrial Strategy, '2019 UK Greenhouse Gas Emissions, Final Figures' (2 February 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957887/2019_Final_greenhouse_gas_emissions_statistical_release.pdf [accessed 13 January 2022]

337 Whether natural capital or other forms of valuing nature and the benefits it provides are the correct approach, not only methodologically but also philosophically and morally, is an ongoing debate. Some argue that the process of extending the logic of the marketplace into how we treat nature may give licence to destroy it, or falsely assume that the benefits it provides are both reliably quantifiable comparable to other things measurable in monetary terms. Others argue that if no natural capital accountancy is undertaken, then the marketplace will ignore the benefits of nature and the losses when it is destroyed as an "externality". While natural capital is often measured in monetary terms, as in the Office for National Statistics accounting of Britain's natural capital, it is not clear that actual financial flows around these ecosystems will match this valuation: it is closer to a metric for trying to compare the value provided by different ecosystems.

Crown Estate	The Crown Estate is an independent commercial business with a diverse portfolio of UK buildings, shoreline, seabed, forestry, agriculture and common land. It is relevant to nature-based solutions due to its role in managing the sea floor.