

REWILDING AND CLIMATE BREAKDOWN

How restoring nature can help decarbonise the UK

**REWILDING
BRITAIN**



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FOREWORD



We are at a crossroads. The breakdown of our climate is no longer a fringe concern, but is increasingly recognised by the public as an urgent existential threat to both nature and human society.

The gap between our awareness of that threat and the inadequacy of our current response has become clear. This report is a contribution to bridging that gap. New thinking and practical action is urgently needed if the UK Government is to meet its legally-binding commitments to combat the catastrophic effects of climate change.

Taking a different approach to the way land is managed is as important as high-tech solutions to address climate breakdown. The UK has an opportunity to become a world leader in natural climate solutions. This report outlines how we can support land use change to reduce carbon emissions and remove carbon from the atmosphere as well as stop the ongoing loss of the UK's biodiversity. In doing so we could also meet the Prime Minister's pledge to protect 30% of the UK's land and sea for nature's recovery by 2030.

Those who manage our land play a pivotal role and should be supported to come together to deliver major carbon reductions. We offer a costed proposal for how current agricultural subsidies can be replaced with additional dedicated funds raised using a polluter-pays levy. This would mean diversifying land uses in response to the climate emergency in a way that also sustains a vibrant, resilient future for rural communities. This future should be tailored to each context and guided by local leadership, using credible and non-bureaucratic ways to measure the outcomes for communities and the environment.

Our proposals build on existing indications of a change of approach – for example the increasingly accepted 'public money for public goods' principle for recognising good stewardship of the land and sea, and the National Farmers' Union (NFU) commitment to reach net zero

emissions by 2040. We show that they can be achieved without the significant loss of high quality, productive farmland. Meanwhile we are learning at amazing speed about the role that living systems play in our shared prosperity, and how nature can bounce back, if we let it.

Rewilding cannot solve the climate crisis on its own but it could play a pivotal role. What we are calling for is more public debate around how our countryside is managed into the future and how we balance sustainable farming with ensuring local people can make a viable living.

Rebecca Wrigley,
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**THE UK CAN
BE A
WORLD
LEADER
IN NATURAL
CLIMATE
SOLUTIONS**

SUMMARY

- We must radically change the way we manage our land, sea and other natural assets if the UK is to meet its legally-binding climate targets and stop the ongoing loss of our biodiversity.
- Reducing carbon emissions alone will not be enough to keep the heating of the planet below 1.5°C. Large amounts of carbon also need to be removed from the atmosphere.
- Rewilding and other natural climate solutions can draw millions of tonnes of carbon from the atmosphere by restoring and protecting our living systems. Evidence suggests they could provide over a third of the greenhouse gas mitigation required globally between now and 2030¹. Yet so far they have attracted only 2.5% of funding for mitigation², and far too little political attention.
- The rewilding of peatlands, heathland, native woodlands, saltmarshes, wetlands and coastal waters in the UK can all make a significant contribution to carbon sequestration. Additional benefits include flood mitigation, water quality improvement, increased health and wellbeing, enhancement of biodiversity and landscape amenity value.
- With the UK's departure from the EU and its Common Agricultural Policy, we have a once-in-a-generation opportunity to transform the way land is used. The Agriculture Act (2020) has laid the foundations for a new system of farm payments – in England, these are to be called the Environmental Land Management scheme (ELMs), with similar schemes under consideration in Wales and Scotland. But many of the details of these new schemes have yet to be worked out, and it's vital that land managers are incentivised to rewild, not just carry on business-as-usual.
- Those who work and manage the land play a pivotal role. They should be rewarded for delivering carbon reductions and biodiversity benefits as part of a mosaic of land uses that sustains thriving rural communities.
- This report outlines how a new payments system could, through a rewilding-based approach, financially support farmers and other landowners to increase carbon sequestration on their land and restore damaged and degraded ecosystems.
- This new system could make a substantial contribution to achieving the UK's commitments under the Climate Change Act, as well as supporting the land use sector to meet the commitment set out by the NFU of net zero emissions by 2040. Rewilding must also be a central component of the Prime Minister's pledge to protect 30% of the UK's land and sea for nature's recovery by 2030 (the '30x30' commitment)³.
- If £2.1 billion of the £3.1 billion currently spent annually on farm payments were allocated to supporting native woodland re-establishment, the restoration and protection of peatbogs, heaths, and species-rich grasslands over a total of 7.2 million hectares (i.e. 30% of the UK) this could sequester 53 million tonnes of CO₂/year. This is more than 12% of current UK greenhouse gas emissions. This compares to the UK Government's current commitment of £50 million to help plant new woodlands through the Woodland Carbon Guarantee, £640 million for the Nature for Climate Fund and only £10 million towards peatland restoration⁴.

THE REWILDING OF PEATLANDS, HEATHLAND, NATIVE WOODLANDS, SALTMARSHES, WETLANDS AND COASTAL WATERS IN THE UK CAN ALL MAKE A SIGNIFICANT CONTRIBUTION TO CARBON SEQUESTRATION.

SUMMARY

Rewilding Britain is calling for the UK and devolved governments to make a bolder financial and political commitment to nature's recovery. We are asking them to:

1 Integrate carbon sequestration into any new 'public money for public goods' mechanisms for land managers to incentivise large-scale natural climate solutions.

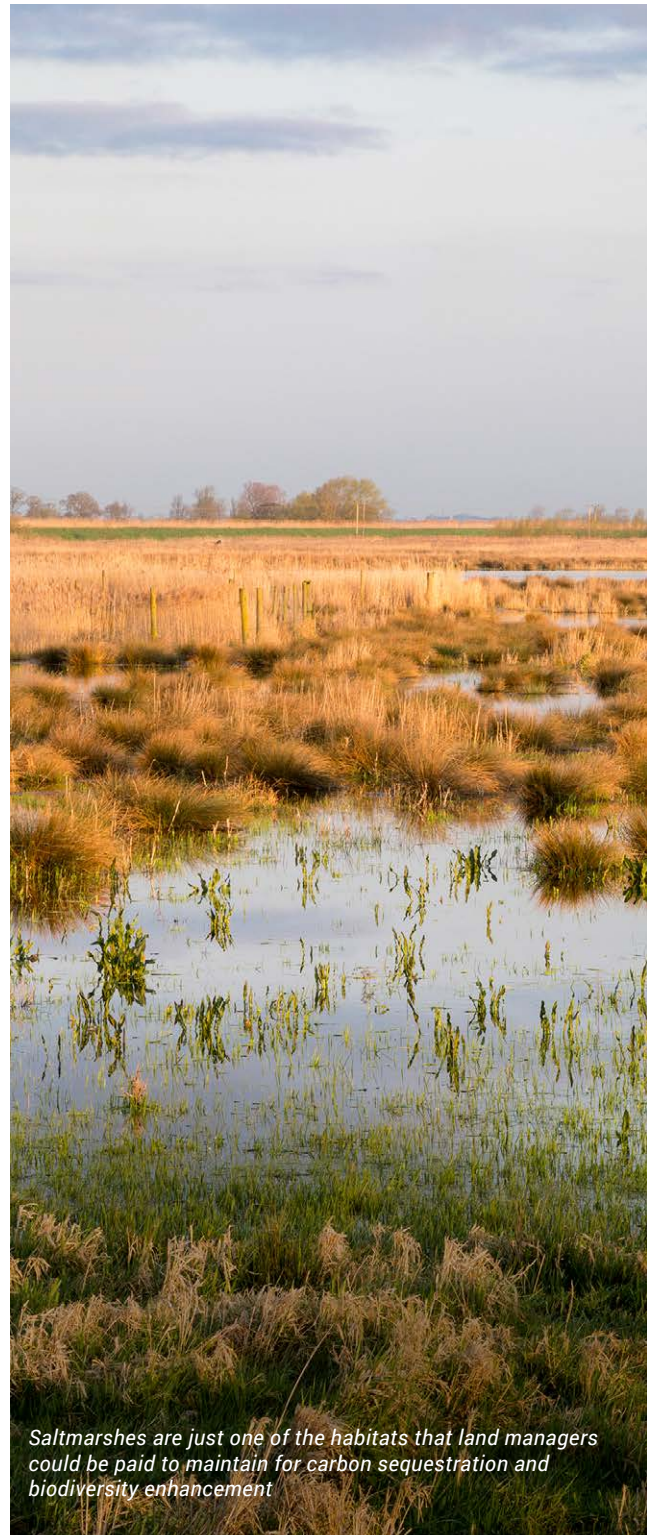
We propose a model of payments that values carbon sequestration and biodiversity enhancement in different restored ecosystems, particularly focused on less productive and marginal landscapes to minimise the impact on opportunity costs for food production. Our indicative annual standard payments would support restored peat bogs and heathland at £292/ha, woodland at £413/ha, species-rich grassland at £144/ha, saltmarsh at £322/ha, ponds and lakes at £204/ha, and offshore ecosystems at £161/ha per year.

2 Establish a mandatory economy-wide carbon pricing mechanism linked to carbon emissions to raise dedicated revenue to help fund natural climate solutions.

This should incentivise emissions reductions whilst providing additional funds to support carbon sequestration activities in the agricultural and land use sectors. The UK's emissions are 435 million tonnes of CO₂ equivalent per year, so if a carbon price was applied across the economy at £40 per tonne this yields a theoretical upper limit of £17.4 billion, although in reality not every tonne of carbon is accounted for, so the real figure will be much lower.

3 These local partnerships would support locally-led partnerships to coordinate action across landholdings.

To ensure natural climate solutions are designed and brokered locally within each ecological, economic and cultural context.



Saltmarshes are just one of the habitats that land managers could be paid to maintain for carbon sequestration and biodiversity enhancement

SETTING THE SCENE

GLOBAL CLIMATE CONTEXT

Global warming of 1°C has already taken place since the pre-industrial period, almost entirely due to human emissions of greenhouse gases. We are now seeing the devastating consequences of this increase, including disappearing coral reefs, heavier and more extreme rainfall, prolonged droughts, intensified wildfires and a dramatic decline in Arctic sea ice extent.

We have little time to address the crisis. The 2018 report from the UN's Intergovernmental Panel on Climate Change (IPCC) stated that restricting global warming to 1.5°C above pre-industrial levels would require a 45% reduction in net human-caused emissions of CO₂ by 2030, global carbon net neutrality by mid-century, and then the removal of billions of

Aiming below 1.5 or 2°C?

Climate science and policy has looked at a number of potential pathways for lower levels of global temperature change. Some have focused on keeping within 1.5°C of warming and some 2°C. We support efforts and policies aimed at keeping global warming below 1.5°C, but in this document we sometimes refer to evidence that focuses on a 2°C target.

tonnes of atmospheric carbon dioxide for the rest of the century. The IPCC⁵ also stated that we have less than 12 years to make the necessary changes. We want to see the heating of the planet kept below 1.5°C. For this to happen it is clear that reducing emissions alone will not be enough. Carbon needs to be removed from the atmosphere too.



**WE WANT TO SEE
THE HEATING OF THE
PLANET
KEPT BELOW
1.5°C**



We now need to build on the progress made in greening energy production and take urgent action to decarbonise agriculture

UK CONTEXT

The UK has long-term, legally-binding targets for reducing its emissions. The Climate Change Act 2008, amended in 2019, requires that the UK reaches 'net zero' greenhouse gas emissions by 2050, and sets a series of five-year carbon budgets as milestones along the way⁶.

Thanks largely to the rapid decline of coal in the power sector, the first budget's requirements were exceeded, and the UK is on track to meet its commitments on the second and third. But from 2023 the numbers look far more challenging, and the Climate Change Committee (CCC) has stated in its recent progress reports to Parliament that the UK is not yet on course to meet the legally-binding fourth and fifth carbon budgets, let alone the more challenging sixth carbon budget.

The agricultural sector is itself a large contributor to greenhouse gas emissions. In 2018 agricultural emissions were 45.4 million tonnes of CO₂ equivalent (the impact of different greenhouse gases expressed in terms of the amount of CO₂ that would create the same amount of warming), accounting for 10% of UK total emissions⁷. Without urgent action to decarbonise, agriculture will be one of the largest-emitting sectors by 2050⁸.

Much of the early reduction has been made with relatively straightforward steps, such as switching from the most carbon-intensive forms of energy production like coal towards gas and renewables. Further reductions will require more profound measures across the whole economy.

**AGRICULTURE
ACCOUNTS FOR
10% OF UK CO₂
EMISSIONS**

REWILDING AS A 'NATURAL CLIMATE SOLUTION'

OVERVIEW

In 2017 an international team of conservationists and climate experts published a paper in the journal PNAS that proposed a new approach to reducing greenhouse gases in the atmosphere by the use of what they called 'natural climate solutions'. These were 20 conservation, ecological restoration and improved land management strategies that increase carbon sequestration (removal) or avoid emissions across forests, wetlands, grasslands and farmland worldwide. These natural climate solutions could provide over a third of the CO₂ mitigation required by 2030 to keep to a likely 2°C pathway, the experts suggested⁹, and could be a powerful and effective supplement to decarbonisation of the economy. A separate study by the Crowther Lab published in July 2019 mapped global tree restoration potential, finding that restoring trees to 0.9bn hectares

of suitable land worldwide could sequester 200 gigatonnes of additional carbon at maturity¹⁰.

These proposals have now been taken up by a global campaign asking governments to support natural climate solutions with an urgent programme of research, funding and political commitment¹¹. Currently it is estimated that only 2.5% of the money spent on climate mitigation is directed towards approaches that work to improve natural ecosystems¹². Natural climate solutions, such as rewilding, can achieve negative emissions in a way that works with nature and benefits human societies rather than threatening the wellbeing of both through the diversion of large areas of land to forestry-based 'Bio-Energy with Carbon Capture and Storage' (BECCS, see box on the next page).

Beavers are one of nature's ecosystem engineers, reducing flooding, improving water quality and maintaining habitats which boost carbon sequestration



**ONLY 2.5% OF THE MONEY SPENT ON
CLIMATE MITIGATION IS DIRECTED
TOWARDS APPROACHES THAT WORK
TO IMPROVE NATURAL ECOSYSTEMS**

BECCS: The dark side of carbon reduction

Reducing carbon emissions alone will no longer be enough to address climate change. Billions of tonnes of carbon need to be removed from the atmosphere in order to avoid dangerous levels of warming. However, some forms of carbon reduction risk disastrous side-effects for human wellbeing and biodiversity.

Bio-Energy with Carbon Capture and Storage (BECCS) means growing biomass (organic matter used as a fuel) in plantations, burning it in power stations to produce electricity, capturing carbon dioxide from the exhaust gases and burying this liquified stream of waste gas underground in rock formations.

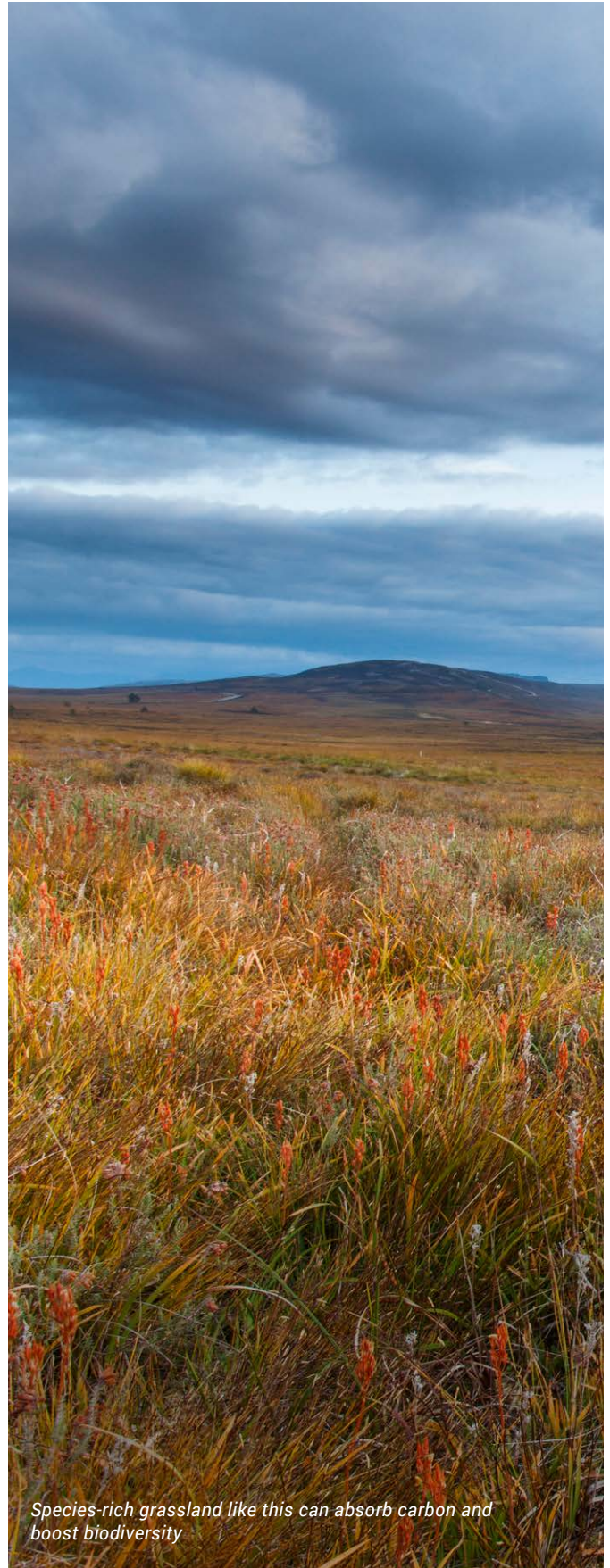
According to scientific analysis, deployment of BECCS on even a moderate scale could take up over a billion hectares (three times the land area of India) of the world's most productive agricultural land, or imply the removal of over half the world's natural forests¹⁴.

The natural climate solutions approach is particularly important given the May 2019 report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which found that 1 million species “already face extinction, many within decades, unless action is taken to reduce the intensity of the drivers of biodiversity loss”¹³. It is vital therefore that climate mitigation does not add to the pressure on global biodiversity, and that it instead promotes ecosystem restoration together with carbon sequestration.

WHAT REWILDING CAN OFFER

Rewilding is the large-scale restoration of ecosystems and the reinstatement of natural processes. It enables nature to take care of itself and encourages a balance between people and the rest of nature where each can thrive. Rewilding is fast emerging as one of the most powerful, cost-effective and life-affirming ways to rise to the challenge of climate breakdown and loss of wildlife.

Rewilding creates a dynamic mosaic of areas where nature is left to take care of itself interconnected with areas which can sustain a range of high-nature value productive activities, such as low impact silviculture (the process of tending, harvesting and regenerating a forest), harvesting of natural products, nature-based enterprises and extensive (as opposed to intensive) meat production.



Species-rich grassland like this can absorb carbon and boost biodiversity

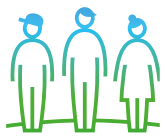
The potential benefits of rewilding are exciting and varied. They include:



Restoring higher levels of biodiversity



Creating more opportunities for human wellbeing in nature



Protecting communities at risk of flooding



Economic revival of rural areas through new, nature-based enterprises

Any of these benefits alone might be reason enough to support more rewilding of our land and seas. But another feature of rewilding could be of pivotal importance in the next few years – the sequestering of carbon from the atmosphere.

These restoration efforts pull carbon out of the atmosphere and store that carbon in forests, vegetation and in the soil. On the land and sea, rewilding's ability to restore soils and seabeds, native plant communities and living reefs, trees and seagrass beds can create valuable carbon sinks.

For example, globally peatlands store more carbon than the world's rainforests. The UK has about 13% of the world's blanket peat bog, classified by the International Union for Conservation of Nature (IUCN) as one of the world's rarest habitats. These peatlands represent the single most important terrestrial carbon store in the UK¹⁵, and yet some 80% of them have been damaged by drainage, extraction, burning and overgrazing (see box).

In Britain we can choose to protect and restore our internationally-rare peat bogs, which form a crucial store of the Earth's carbon. Re-wetted peatland can stop emitting carbon and transition toward becoming a net carbon sink, once peat-forming plant species are re-established.

For peat's sake



Peatland is formed by an accumulation of mosses and other plants, and is one of the greatest stores of carbon in the landscape. Globally, peatlands store more carbon than the world's rainforests. Peatland goes on drawing down carbon over centuries and millennia as layers of peat accumulate.

In total, peat bogs of both the blanket and raised (generally lowland) types cover around 10% of Britain's land area, with half of that being in Scotland. Peat has an important function in providing freshwater: the UK and Republic of Ireland account for 85% of global consumption of peat-sourced water¹⁶.

However, much of our peatland is subject to draining, burning, afforestation with plantations, overgrazing, wind farms and other developments that disrupt ecology and hydrology and strip peat of its ability to draw down carbon from the atmosphere.

Although not currently included as part of the UK's carbon accounts, damaged UK peatlands are likely releasing almost 23 million tonnes of CO₂e per year, considerably more than all UK oil refineries¹⁷. In England, about half of this comes from lowland fens which have been drained and converted to agricultural use: studies show as much as 30 tonnes of CO₂ equivalent per hectare per year in emissions from drained lowland fens¹⁸.

Rewilding our damaged upland bogs and mires – by blocking drainage ditches, reducing grazing pressure and helping native plants thrive there again – could make a major 'win-win' contribution to the UK's part in tackling climate breakdown. Not only would it stop the harmful effects of their current use, but it would begin to sequester significant amounts of carbon from the atmosphere in restored upland blanket bogs. When healthy peatland's contribution to the production of clean water and flooding reduction is taken into account too, the case for their restoration becomes stronger still.

Other precious habitats such as heathland, native woodlands, saltmarshes and wetlands can also make a significant contribution to removing carbon. Lowland fens – of which only a fraction of the original area remains in eastern England – can be strong carbon sinks, while dwarf shrub-dominated upland heath – which covers 2-3 million ha in the UK – can sequester twice as much carbon as grasslands¹⁹.

The potential for forest regrowth is even greater. The UK has large areas of grassland which lie naturally within the broadleaved forest biome and yet are mostly devoted to extensive livestock grazing – supported largely or even entirely by agricultural subsidies – while producing little food, supporting few wildlife species and leading to soil erosion and downstream flooding.

Although there are substantial uncertainties, scientists suggest that naturally regenerated forests can sequester around 10 tonnes of CO₂ per ha from the atmosphere per year on average after they become fully established²⁰. The re-introduction of ecosystem engineer species (organisms that profoundly shape habitats, such as beaver) – a key objective of rewilding – can also contribute to carbon absorption through the creation of new wetlands, as well as increase species richness and biodiversity in general²¹.

Around our coasts, rewilding also offers the prospect of restoring balance to marine ecosystems, allowing marine life to flourish and helping to regulate carbon levels in the seas. In contrast, repeated trawling disturbs sediments and reduces carbon storage as well as devastating sea floor ecosystems²². Protecting shelf seas (seas close to the coastline) from trawling and dredging could therefore make a significant contribution to carbon sequestration.



OPPORTUNITY FOR CHANGE: A FUTURE FOR BOTH PEOPLE AND NATURE

The critical need to prevent climate breakdown makes change an immediate imperative. We must urgently consider how to deploy natural climate solutions across the UK as part of the broader need to deliver on our legal commitments to drastically reduce carbon emissions, and to sequester additional carbon from the atmosphere in decades to come.

Natural climate solutions require major changes to the way the UK manages both its land and seas. On land – the focus of this report – in the past agricultural subsidies have led to much of our farmland being ecologically impoverished, with hedgerows destroyed, accelerated losses of topsoil, overgrazing of our uplands and ongoing reductions in wildlife from birds to amphibians to insects. Our peat bogs, which should be a global treasure, have been drained, burned, ploughed and otherwise degraded and as a result are emitting millions of tonnes of CO₂ per year into the atmosphere instead of sequestering it.

The UK's exit from the European Union has led to changes to our agricultural subsidy regime – offering a rare and significant opportunity to design a system that improves on the EU Common Agricultural Policy (CAP) in delivering a more sustainable approach to food production on British farms, as well as better outcomes for wildlife and broader landscape ecology. Rewilding is a major part of this opportunity.

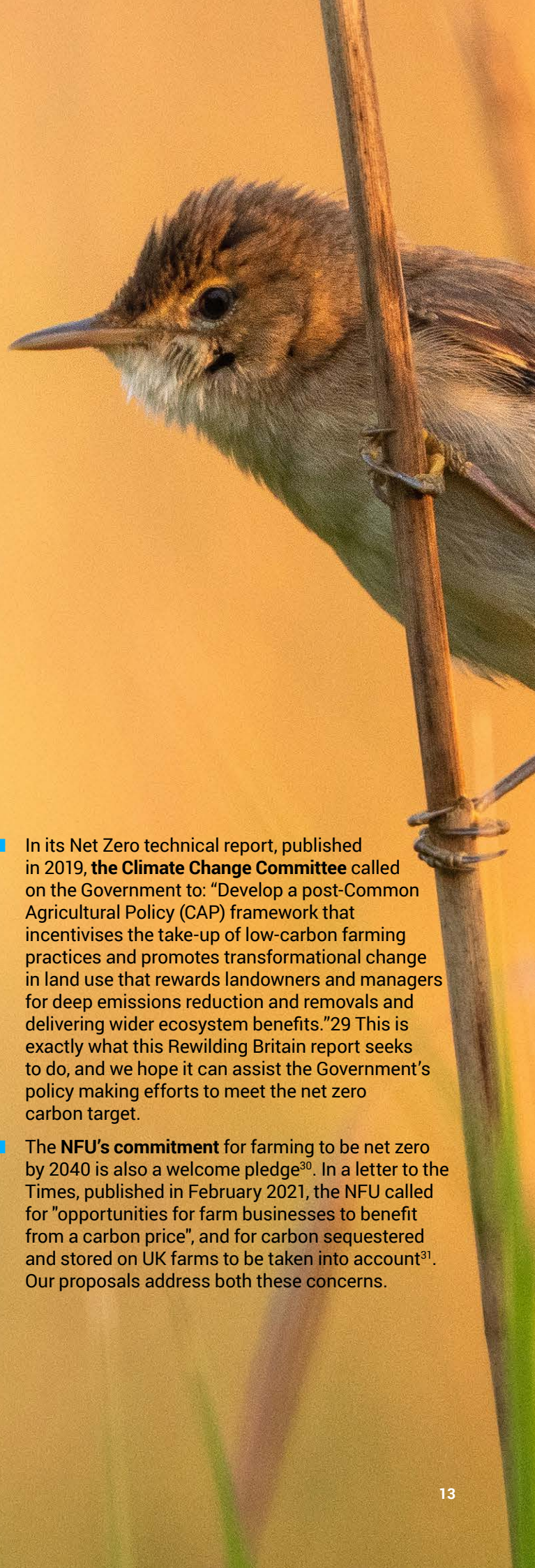
- **The Agriculture Act 2020** mandates a phase-out of the area-based 'Basic Payments Scheme' subsidies received by farmers under CAP, and their replacement with an improved system based on the principle of 'public money for public goods'. These new payments, called (in England) Environmental Land Management schemes (ELMs), will begin in 2024 and take over entirely from old-style payments in 2027. We see this post-Brexit restructuring of the UK's land use sector as a once-in-a-generation opportunity to design a new system that works in the interests of land managers and wider society.
- The precise design of the new **Environmental Land Management** schemes (ELMs) payments is still being worked out, but encouragingly, UK Government policy is already pushing in the right

direction. The Government's consultation paper 'Health and Harmony: The future for food, farming and the environment in a Green Brexit' stated: "We will incentivise methods of farming that create new habitats for wildlife, increase biodiversity, reduce flood risk, better mitigate climate change and improve air quality by reducing agricultural emissions...We will achieve this by ensuring that public money is spent on public goods, such as restoring peat bog and measures which sequester carbon from the atmosphere". The Agriculture Act gives the Environment Secretary powers to set up future land use payments schemes for England to incentivise, amongst other things, "managing land or water in a way that protects or improves the environment" and "managing land, water or livestock in a way that mitigates or adapts to climate change".



The new Environmental Land Management payments system offers a fantastic opportunity for land managers to be paid for large-scale rewilding schemes

- DEFRA has set out that there will be **three levels of ELMs** payments in future. Sustainable Farming Incentives would encourage farmers to adopt environmentally sustainable farming and forestry practices. Local Nature Recovery would support farmers, foresters and other land managers on delivery of locally-targeted environmental outcomes. Landscape Recovery would pay for larger-scale, transformational projects. Landscape Recovery payments offer most potential for rewilding whole landscapes. A series of ELM scheme ‘tests and trials’ are currently being run by the Government, working with farmers and land managers, to refine details of the payments schemes to be offered by 2024.
- In the meantime, as ELMs is being set up and Basic Payments phased out, DEFRA has issued guidance to land managers on the ‘**agricultural transition**’ taking place between now and 2024. Its official guidance states that future ELMs payments for Landscape Recovery will include incentivising land managers for “rewilding in places where that’s appropriate”²⁷.
- The UK Government has also set up a £640m **Nature for Climate Fund**, designed to provide additional funding for natural climate solutions like woodland creation and peat restoration during this Parliament, before ELMs kicks in. The forthcoming England Tree Strategy and England Peat Strategy, and Treasury-led Spending Review, are expected to include further details of how this pot of money will be distributed.
- Although the **Scottish Government** has not yet made substantive policy proposals, the **Welsh Government** has now consulted on their Agriculture (Wales) White Paper. It contains the clear stated intent “to enable and support the decarbonisation of the Welsh Government’s net zero by 2050 ambition”. The Welsh Government’s ambition, which led to this White Paper, is to adopt a land management scheme that “will enable farmers, foresters and other land managers to be paid for the production of goods for which there is currently no functioning market. The scheme will be outcome-based and we will often use proxy outputs to calculate payments to land managers.”²⁸ The Welsh Government states that one outcome is “improved mitigation of climate change risk. The output proxy could be numbers of tonnes of carbon dioxide sequestered in new woodland on a farm (estimated based on land area and type of woodland).” In essence what we propose in Section 5 of this report shows how the Welsh Government’s suggested system could work in practice.
- In its Net Zero technical report, published in 2019, the **Climate Change Committee** called on the Government to: “Develop a post-Common Agricultural Policy (CAP) framework that incentivises the take-up of low-carbon farming practices and promotes transformational change in land use that rewards landowners and managers for deep emissions reduction and removals and delivering wider ecosystem benefits.”²⁹ This is exactly what this Rewilding Britain report seeks to do, and we hope it can assist the Government’s policy making efforts to meet the net zero carbon target.
- The **NFU’s commitment** for farming to be net zero by 2040 is also a welcome pledge³⁰. In a letter to the Times, published in February 2021, the NFU called for “opportunities for farm businesses to benefit from a carbon price”, and for carbon sequestered and stored on UK farms to be taken into account³¹. Our proposals address both these concerns.



Not only can restored wetlands make a significant contribution to carbon sequestration; they provide a habitat for species like the reed warbler

WHAT REWILDING BRITAIN IS PROPOSING

We need to radically change the way we manage our land, sea and other natural assets if we are to meet our net zero climate target, reverse the ongoing decline in the UK’s biodiversity, and deliver on the Government’s promise to protect 30% of the UK’s land and sea for nature by 2030.

This can be achieved without the loss of high quality, productive farmland or a net reduction in agricultural output. It is the least productive marginal lands, where the opportunity cost for food production is comparatively small, that provide the best options for carbon sequestration, rewilding and other ecosystem services.

To put this in context of the scale of other land uses in Britain:

- Grouse moor estates cover around 1.3 million ha in England, Scotland and Wales³²
- Deer stalking estates account for around 1.8 million ha in Scotland³³
- Blanket and raised bog peatlands cover nearly 3 million ha across the UK³⁴
- Cereal crops are grown on 3.2 million ha of the UK and oilseed crops on 590,000 ha, out of a ‘total croppable area’ of 6.1 million ha³⁵

We propose a system that would adequately recognise the potential for rewilding to increase carbon sequestration and contribute to meeting UK carbon targets and that could transform the level of funding available. The benefits could be significant and wide-ranging.

This is an opportunity for the UK to become a world leader in the delivery of natural climate solutions in response to the climate emergency we are facing.

We are calling for the UK and devolved governments to:

1

Integrate carbon sequestration into any new ‘public money for public goods’ mechanisms to incentivise large-scale natural climate solutions.

We support the ‘public money for public goods’ principle and believe that this should be largely centred around a model of payments that values carbon sequestration in different restored ecosystems to deliver long-term mitigation of climate change.

Future subsidies should be used to support farmers and others managing the least agriculturally productive areas to stay on the land whilst delivering carbon reductions and transitioning towards more diverse, resilient nature-based economies.

ECOSYSTEM TYPE		STANDARD PAYMENT HA/YR
	Peat bogs and heathland	£292
	Woodland	£413
	Species-rich grassland	£144
	Saltmarsh	£322
	Ponds and lakes	£204
	Offshore	£161

These subsidies could be layered to reflect where there are also additional contributions to public goods such as biodiversity enhancement, flood mitigation, water quality improvement, water table stabilisation and so on.

In essence, farmers and land managers would be paid a per-hectare amount based on the type of land in question and the restored natural ecosystem that it would be supporting. The specific figures proposed are outlined in Section 5 and in the table here, but in brief a specified carbon price would be multiplied by the quantified tonnage of carbon that could potentially be sequestered in the restored natural ecosystem type. This means that the payments system has a quantitative basis in science rather than being arbitrary.

Simplicity is key: bureaucracy and over-complication is one of the main reasons the EU CAP Pillar II (environmental) schemes were poorly utilised and unpopular among farmers. There would be a cap of around 1,000 ha for any individual landholding to avoid inadvertently benefiting the largest landowners but we propose that enhanced incentives should be given for landholdings to come together to form contiguous zones of recovering, protected and restored ecosystems.

It is obviously important to strike a balance in UK farming between food production and carbon sequestration, biodiversity, flood mitigation and other land use objectives. Therefore it is necessary that subsidy levels are not set so high as to outstrip financial returns from crop production in more productive lowland and arable

systems and perversely incentivise the wide-scale abandonment of food production in UK farming.

To give an idea of cost effectiveness we estimate that if £2.1 billion of the £3.1 billion spent on pre-Brexit CAP payments were allocated towards supporting native woodland re-establishment on rough grassland, and restoration and protection of peatbogs and heaths over 7.2 million ha (30% of the UK), this could sequester 53 million tonnes of CO₂ per year, about 12% of current UK greenhouse gas emissions³⁶.

While existing carbon offset projects tend to have a heavy burden of monitoring and verification, it is impractical to do this over millions of hectares. Therefore it is suggested that simplified Peatland and Woodland Carbon Codes could provide the carbon accounting methodologies – with the addition of biodiversity and rewilding elements – and would be accountable to the funder in delivering the required ecological improvements. These monitoring and verification arrangements would be no more burdensome than at present. This proposal needs to be supported by a regulatory framework which should be enforced through law.

It is important to note that we do not propose that this system comprises the entirety of UK agricultural subsidies. There will no doubt be other objectives that the Government wishes to support, and 'public payments for public goods' may be augmented by other financial support paid to farmers. For this reason we propose below a source of funding that could be additional to continued agricultural subsidies in other areas.

Those who manage the land should be rewarded for delivering carbon reductions and biodiversity benefits



2

Establish a mandatory economy-wide carbon pricing mechanism linked to carbon emissions to raise additional dedicated revenue to fund natural climate solutions.

The UK Government has stated its intention to move towards a 'polluter pays' model to fund carbon mitigation after Brexit and the UK's consequent withdrawal from the EU Emissions Trading Scheme (ETS). A UK Emissions Trading Scheme is understood to be under development. Determining how this mechanism would work in a detailed sense is beyond the scope of this report, but it is clearly an opportunity to close the loop in terms of carbon mitigation if the proceeds increase the revenue available to incentivise carbon sequestration activities in the agricultural and land use sectors.

It would make sense to have a single economy-wide price on carbon, established by the Government as part of a mandatory emissions pricing system which removes the grandfathering element of the existing EU ETS (whereby emissions permits are perversely handed out free to existing polluters). This price per tonne would be paid by emitters from all sectors of the economy from transport (including aviation and shipping) to industry to power generation. It would incentivise emissions reduction and also raise funds for carbon sequestration in restored ecosystems at a basic rate of the same price per tonne for carbon sequestered as for carbon emitted.

The current EU ETS prices are around 20-30 euros per tonne. To generate a more reliable income stream, and to reflect the real social cost of carbon, we propose adopting the revised BEIS (Department for Business, Energy and Industrial Strategy) carbon values used for UK public policy appraisal. We believe this is also a reasonable starting level for a carbon tax because if it is set too low there is insufficient incentive to drive decarbonisation of the economy.

According to BEIS: "These long-term carbon values reflect the costs required to limit global temperature increases to 2 degrees centigrade above pre-industrial levels."³⁷ In this report, we conservatively use the 2030 'low' value of about £40 per tonne of CO₂ equivalent, though this can be replaced with the higher values if certain requirements are met. This should not be taken to mean that we consider £40 a tonne to be an appropriate carbon price indefinitely – to avoid climate

breakdown much higher prices will be needed to drive urgent economy-wide decarbonisation. Our proposal is to then offer a higher level of payments – double or triple basic payments – to larger contiguous land areas which can be entered into the scheme jointly as outlined in Section 5.

What levels of revenue might this yield? The UK's emissions are 435 million tonnes of CO₂ equivalent per year³⁸, so if a carbon price was applied across the economy at £40 per tonne this yields a theoretical upper limit of £17.4 billion, although in reality not every tonne of carbon is accounted for so the real figure will be much lower. Even so, there would be sufficient revenue to cover the entire scale of our proposal, even with higher-level payments.

As it would take time for these benefits to be realised, they could be funded by an escalating economy-wide carbon price which fully reflects the higher social costs of carbon in future decades. Over the very long term, the aim of a carbon price is to incentivise the transition towards a fully net-zero carbon economy. At this point it stands to reason that yields from carbon emissions would also fall to zero, removing this source of revenue.

However we envisage that by this point, many decades hence, rural communities would be transitioning to a more diversified economic model that could ultimately operate without general support from public funds. This model is therefore proposed as a short to medium-term transition scheme rather than a permanent settlement.



A carbon tax on activities like power generation could raise funds for restored ecosystems in our land and seas

3 Support locally-led partnerships to coordinate action across landholdings for the delivery of natural climate solutions.

The best use of land to support climate change mitigation will vary across Britain depending on the local economic, ecological and cultural context. Local decision making will be needed to determine the best approach and to coordinate actions across multiple landholdings. Achieving sufficient scale also requires decision-making at a scale larger than that of any single landholding or individual marine user. It relies on people coming together across multiple holdings and sectoral interests to collectively explore alternative ways of managing the land linked to contiguous zones of recovering, protected and restored ecosystems.

We therefore propose the creation of locally-led entities or partnerships to coordinate cohesive action across multiple landholdings/marine areas linked to integrated land use strategies. These legally constituted entities, usually a combination of private landowners, communities and private sector businesses, will be able to collectively deliver greater benefits at a landscape scale in terms of carbon reduction, wildlife populations, water quality, soil etc. In addition, they will bring collective bargaining power to broker public payments, provide a marketing/trading platform for local products and ecosystem services, offer a means of monitoring carbon reductions and ensure that benefits accrue to local communities.

Support should also be provided to these partnerships to help land managers transition to alternative uses. This includes help with skills, training and information to implement new uses of land, financial support for high up-front costs and long-term pay-backs for investing in alternative uses linked to rewilding. It should also include action to address barriers to the take-up of new nature-based enterprises and forms of production.

WE PROPOSE THE CREATION OF LOCALLY-LED ENTITIES OR PARTNERSHIPS TO COORDINATE ACTION ACROSS LANDHOLDINGS AND MARINE AREAS

HOW WILL THIS WORK IN PRACTICE?

Rewilding Britain is already working to model in the real world how these payment systems could work at scale. The Rewilding Network we established in 2020 now provides a central meeting point for landowners, land and project managers, and local groups wanting to rewild. Within the first few months of forming it has already brought together 28 rewilding projects and 12 local rewilding groups across 100,000+ ha of England, Scotland and Wales and is growing fast. All members are collaborating, connecting and sharing learning and could offer an opportunity to test how payments for public goods might work in practice across a diverse range of landholdings.

What we are proposing for these landholdings, and other similar areas across the UK, is a system of both standard payments and enhanced or premium payments where landowners come together to form contiguous zones of recovering, protected and restored ecosystems. A starting proposal for both standard payments and enhanced payments is outlined below. This is based on existing evidence but also highlights where further research is needed.

STANDARD PAYMENTS - A STARTING PROPOSAL



£292

Suggested standard payment for carbon benefits (ha/yr)

PEAT BOGS AND HEATHLAND

The carbon dynamics of peatlands are complicated. Currently UK peatlands are, overall, thought to be emitting carbon due to drainage and poor management, with the CCC estimating “net emissions from all peatlands sources of around 18.5MtCO₂e currently.”³⁹ Therefore the carbon-related payments for peatland restoration and recovery need to average out avoided emissions as well as sequestration on healthy peat-forming boglands.

Estimates of carbon accumulation in peatlands also vary widely. A 2018 literature review reported 0.24 tonnes/ha/year as a long-term average for northern peatlands, with other UK estimates varying from 0.18 to 2 tonnes/ha/year⁴⁰. Estimates of the carbon sequestration potential of heather-dominated heathlands in the literature vary from 0.6 tonnes/ha/year⁴¹ for a restored ecosystem to 3.45 tonnes/ha/year for existing upland areas in Scotland⁴². The latter paper concludes that heather moorland sequesters double the carbon of grasslands, and states that “the potential rate of [carbon] sequestration by upland heath is comparable to that of woodland”.

Accordingly we select a mid-level estimate of 2 tonnes of carbon/ha/year. To convert to CO₂ equivalent we multiply by 3.66, giving an estimated CO₂ sequestration rate of **7.32t/ha/yr**. Multiplied by a £40/tonne carbon price, this gives a figure of **£292/ha/yr** for heathlands and peatlands.

To qualify for payments, land managers would have to invest capital and ongoing management costs in blocking drains, to maintain a sufficiently high water table for peat formation to resume. Vegetation might also need to be restored, especially with the major peat-forming sphagnum moss species, and grazing would need to be absent or strictly limited to native herbivores. Studies have shown that the exclusion of large herbivores from upland heathland can increase carbon storage potential, although this is complicated by nitrogen dynamics⁴³.

To avoid any perverse incentives (i.e. to degrade and then restore) we propose that intact areas of bog should attract the same support. Peatland hydrology must not be disturbed by access roads for grouse shoots or windfarms, and no peat must be removed from the landscape.



£413

Suggested standard payment for carbon benefits (ha/yr)

WOODLANDS

There is a pressing need for large-scale native woodland regeneration in the UK in order to draw down more carbon and create good quality new habitat for woodland species, particularly on rough grassland that does not have organic (peat) soils. Although natural regeneration is slower to accumulate carbon in tree biomass than dense, fast-growing conifer plantations, we believe the carbon price payable per ha should be the same across the board to account for the ecological benefits of natural regeneration.

The most recently-published scientific literature review, by Susan Cook-Patton and colleagues in *Nature* in September 2020, gives updated figures for the carbon captured in biomass of naturally-regenerating woodlands worldwide. For UK woodlands, with an addition to account for carbon captured in woodland soils, this gives an estimated CO₂ sequestration rate of **10.32 t/ha/yr**⁴⁴. Multiplied by our carbon price of £40 per tonne, this yields an overall figure of **£413/ha/year**.

As with peatlands, we propose that this should be payable to owners and managers of old-growth native forests in order to remove any perverse incentive to deforest and restore. Commercial conifer plantations should not be eligible (because they do comparatively little for biodiversity, and are already incentivised via the market for timber), except where they are removed and replaced with native woodland. In addition, scrub and bracken should not be seen as a negative presence on the landscape, but as a useful succession phase to more established woodland.



£144

Suggested standard payment for carbon benefits (ha/yr)

SPECIES-RICH GRASSLAND

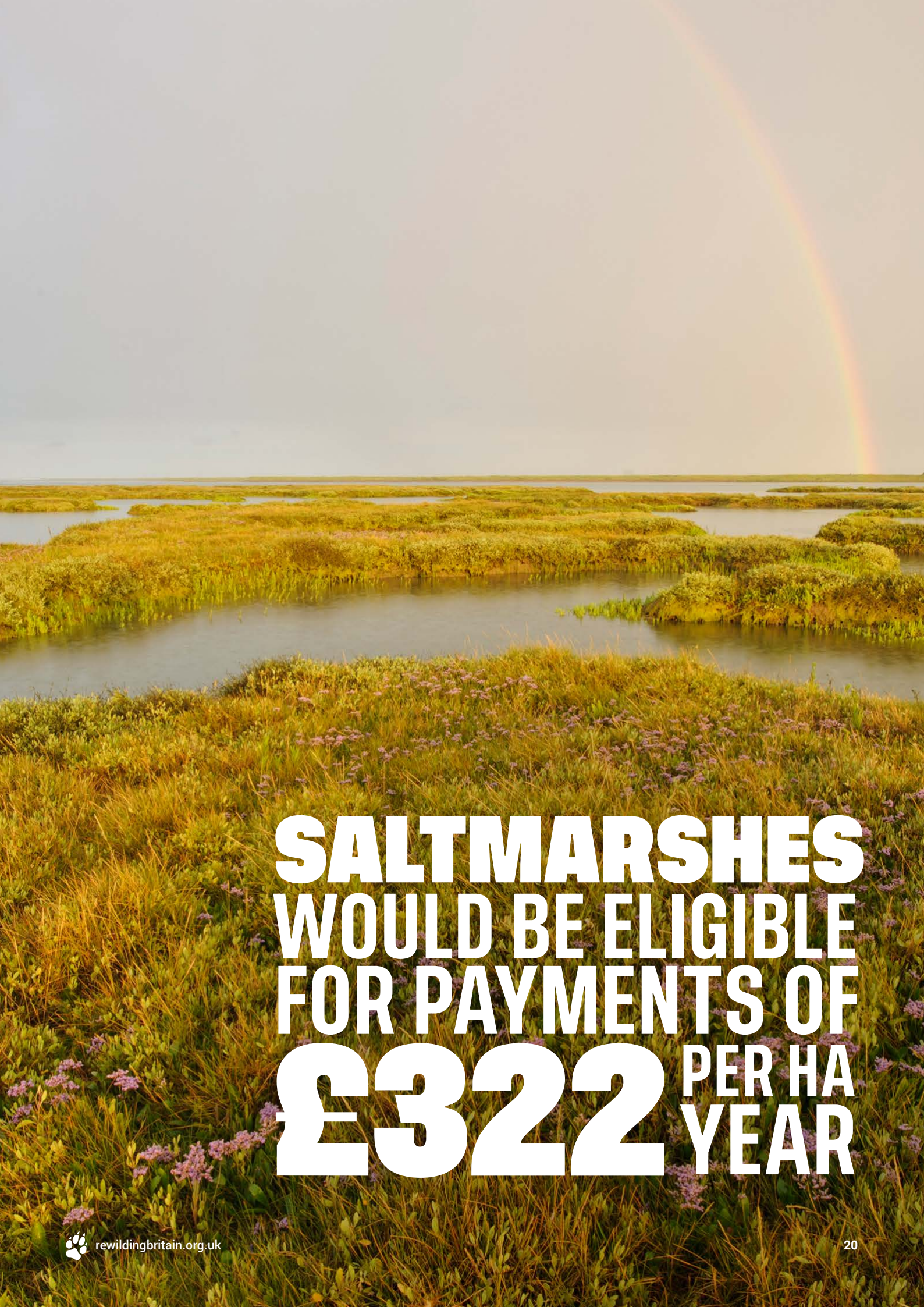
A recent paper found that UK grasslands hold as much as 2 billion tonnes of carbon, a substantial store, and that less intensive management (in terms of fertiliser added and grazing/cutting regime) results in more carbon being stored⁴⁵.

On average European grasslands are thought to be a small sink of carbon, of about 0.15 tonnes of carbon/ha/yr⁴⁶. However, estimates vary by an order of magnitude or more⁴⁷. Even though they may hold substantial carbon in soils and leaf litter, grasslands do not accumulate carbon in perpetuity as do peatlands and some forests. Therefore unless a change of management regime encourages more carbon sequestration, annual carbon payments are not merited⁴⁸.

A beneficial change of management regime might be reducing grazing, or switching from sheep to cattle or other native-equivalent herbivores. For example, a 2014 study on Glen Fingas estate in Scotland concluded that “no sheep and low-intensity sheep grazing are better upland management practices for enhancing plant and soil C sequestration than commercial sheep grazing” and that ungrazed grassland vegetation holds double the carbon of grazed⁴⁹.

Although there is again a notable paucity of scientific data, it also seems likely that species-rich grasslands sequester more carbon than monocultures⁵⁰. One recent study found that “high diversity mixtures of perennial grassland plant species stored 500% and 600% more soil C and N than, on average, did monoculture plots of the same species”⁵¹. Similarly, a study in northern England found a species-rich hay meadow (with clover added in seed) sequestered as much as 3 tonnes of carbon/ha/yr, while other plots which were fertilised and had lower diversity even lost carbon⁵².

We assume an annual carbon sequestration/avoided emissions rate of 1 tonne of carbon/ha/year for grasslands. This is **3.6 tonnes/ha/yr** in CO₂ equivalent terms, meaning that with a £40 carbon price, managers of restored grasslands could be paid **£144/ha/year**. We propose that this would only be payable where a reduction/cessation in grazing and/or

A landscape of saltmarshes with a rainbow in the sky. The foreground is filled with green and yellow grasses and purple flowers. The middle ground shows a winding waterway through marshy areas. The background is a flat horizon under a cloudy sky with a prominent rainbow on the right side.

**SALTMARSHES
WOULD BE ELIGIBLE
FOR PAYMENTS OF
£322 PER HA
YEAR**

an increase in biodiversity in cut meadows can be clearly demonstrated or expected.

This lower carbon price (as compared to woodlands and peat bogs for example) reflects not only the science but the fact that an economic return from livestock and vegetation removal (hay) can still be earned, perhaps to support premium value extensive meat production in a dynamic mosaic of natural/grazed/cut areas.



£322

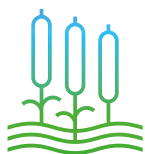
Suggested standard payment for carbon benefits (ha/yr)

SALTMARSH

Saltmarshes and other coastal ecosystems can sequester very large amounts of carbon in sediments, as well as being important for fisheries, biodiversity and coastal protection. In addition, in order to adapt to rising sea levels, we need to incentivise managed coastal retreat and allow transformation of existing agricultural land that is no longer viable into saltmarsh.

Recent estimates in the scientific literature yield a figure of 2.2 tonnes/ha/year⁵³. Multiplied by 3.66 to convert to CO₂ equivalent and with a carbon price of £40/tonne this means saltmarshes would be eligible for payments of **£322/ha/year**.

It has been shown that grazing dramatically reduces carbon accumulation in saltmarshes, so removal of grazing pressure is vital under this scheme⁵⁴.



£204

Suggested standard payment for carbon benefits (ha/yr)

PONDS AND LAKES

There is a less extensive literature on the carbon accumulation rates of lakes and ponds. One recent study suggested average rates of 1.4 tonnes/ha/year⁵⁵. Multiplied by 3.66 to convert to CO₂ equivalent and with a carbon price of £40/tonne this means ponds and lakes would be eligible for payments of **£204/ha/year**.

Land managers would need to provide detailed maps of their holdings in order to qualify, but this already applies with the current subsidy system of Basic Payments and any additional 'greening' payments. It is worth noting that under the current system ponds and lakes are classed as 'permanent ineligible features', so farmers are given an incentive to destroy rather than safeguard them⁵⁶. We would also include wetlands in this category.



£161

Suggested standard payment for carbon benefits (ha/yr)

OFFSHORE ECOSYSTEMS

Offshore habitats, particularly seagrass meadows, are also large carbon stores and sinks. However, carbon can be rapidly released when they are damaged by trawling or other human activities. We would propose that payments incentivise the restoration and protection of coastal shelf ecosystems against the damage inflicted by trawling fisheries, particularly where community-led.

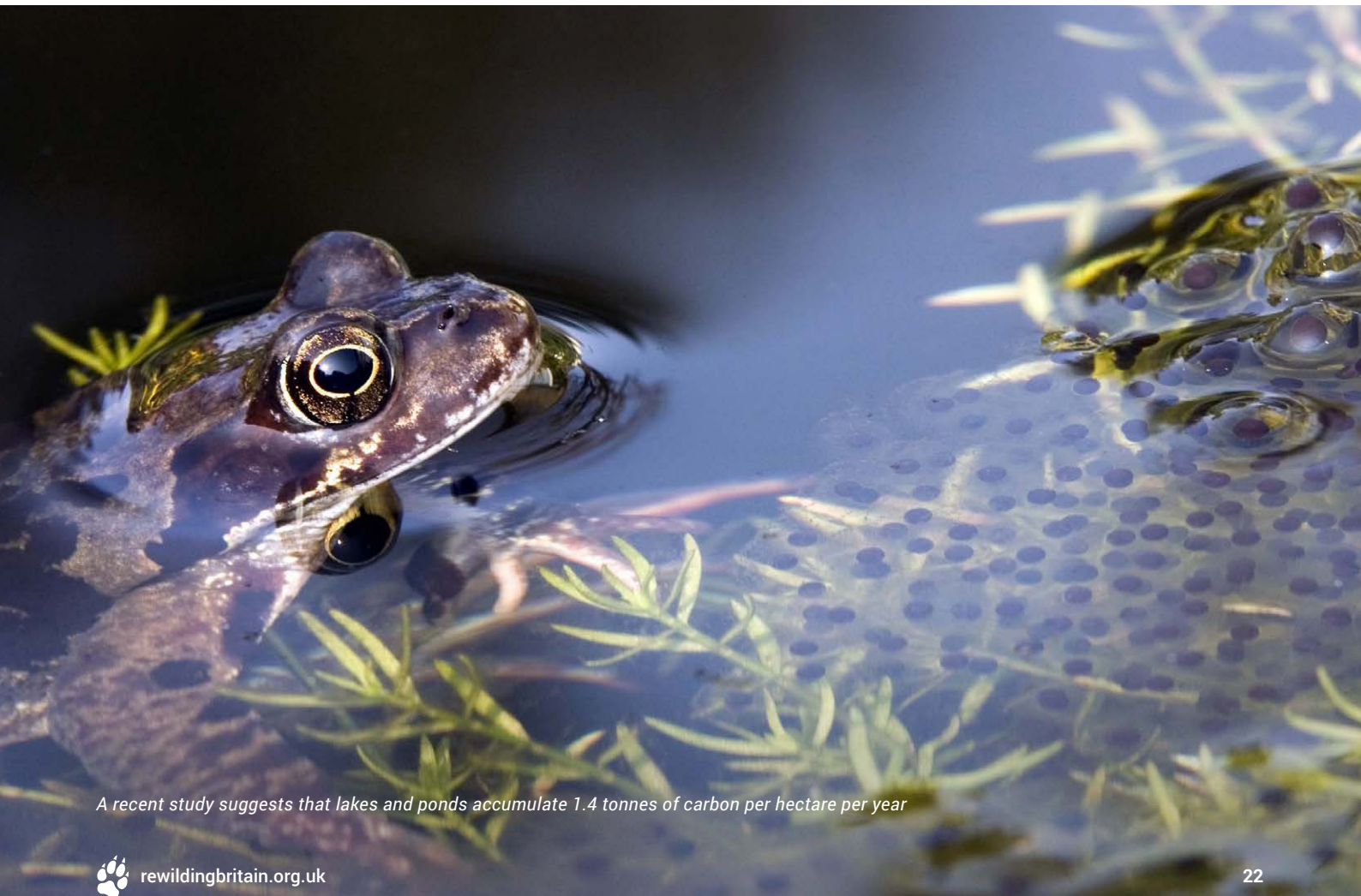
However, the carbon sequestration potential is too uncertain to set a clear price at present, and it is worth noting the potentially vast aggregate area under consideration here. One recent estimate is that seagrass ecosystems accumulate about half as much carbon as saltmarsh⁵⁷, giving an indicative price of **£161/ha/year**. This may well be more than the value of these ecosystems realised by repeated trawling, and could thereby incentivise their full protection as no-take marine conservation zones.

Enhanced payments for greater benefits

We propose that the BEIS mid-level carbon price of £80 be payable for land areas which can achieve a minimum cluster of 5,000 ha in total area (known as Nature Recovery Networks). We do not propose this for offshore shelf as the area is too large to be

financeable. An even higher incentive, such as the top level BEIS carbon price of £120 per tonne, should be payable once highly valued and ecologically crucial native species are shown to be permanently present in the Nature Recovery Network zones, creating highly rewilded ecosystems. These species might include beaver, lynx, osprey, pine marten and so on.

ECOSYSTEM TYPE	NATURE RECOVERY NETWORK PAYMENT AT £80/YEAR CARBON PRICE <small>Suggested enhanced payment for carbon benefits (ha/yr)</small>	HIGHLY REWILDED ECOSYSTEMS AT £120/YEAR CARBON PRICE <small>Suggested full payment for carbon benefits (ha/yr)</small>
Peat bogs and heathlands	£584	£876
Woodlands	£826	£1,238
Species-rich grassland	£288	£432
Saltmarsh	£644	£966
Ponds and lakes	£408	£612



A recent study suggests that lakes and ponds accumulate 1.4 tonnes of carbon per hectare per year

COSTINGS AND FEASIBILITY

How do these figures compare with the current subsidy regime? In the UK, £3.1 billion was spent in the last year of agricultural subsidies under the CAP, with only £400 million of that being for agri-environment schemes. Most of the remainder was 'basic payments' paid by hectare, benefiting the largest landholders and contributing little to environmental protection. Estimates for the national average of basic payments were around £230 per ha in 2017, well below most of the enhanced figures above.

Since this includes arable land, perhaps the best comparator is with non-moorland upland SDA ('Severely Disadvantaged Areas' – this is a land productivity rather than a social/economic designation) which received 178 euros (£155) in 2017 and upland SDA moorland which received 50 euros (£43) with small 'greening' supplements payable for both⁵⁸.

However, if our proposed 'public money for public good' system seems unduly generous compared with old-style CAP subsidies, consider that some of the 'Countryside Stewardship' payments available from public funds under the previous system were very much comparable: for example, £640 per ha was payable for planting winter food for seed-eating birds, £511 for a nectar flower mix for pollinators and £524 for nesting plots for curlew and lapwing⁵⁹.

To compare this with the financial returns from more productive arable systems, the gross margin for feed wheat was reported at £744 per hectare in 2018, and for winter oilseed rape it was £662.⁶⁰ Unlike our proposed payments for rewilding, these take costs into account, and are significantly higher than most basic ecosystem restoration payments. Even so, as stated earlier this report advances suggestions for only one part of a new agricultural support system, while the government is proposing to support food production in other ways, such as incentivising productivity growth.

Another test of viability might be an overall costing. Allowing natural forest regeneration on 2.8 million ha of land currently used for low species-diversity grassland would, under the lowest tier of our proposed payment system, cost about £1.16 billion per year, about half of previous CAP spending. Adding the majority of the UK's peatlands and heaths, covering about another 2.2 million ha, would raise the cost by another £640 million. Adding also 2.2 million ha of species-rich grassland, would add another £315 million to the annual cost. **This totals £2.1 billion, substantially less than the previous CAP system.**

It is important to note that this would be for a drastically improved environmental outcome: all three land types in this example are frequently degraded and losing both carbon and biodiversity. And the public subsidies paid in the past often incentivised further damage rather than restoration. This £2.1 billion would support the sequestration of 28.9 million tonnes of CO₂ equivalent per year in new native woodlands, 7.9 million tonnes of CO₂ equivalent per year in species-rich grasslands and 16.1 million tonnes of CO₂ equivalent per year in peatlands and heaths. (See endnotes for calculations⁶¹.) Together these represent 53 million tonnes of CO₂ equivalent per year of carbon sequestration potential – 12% current UK emissions – all for substantially less than the price of the former CAP system.

Moreover, the proposed carbon pricing system would provide a new dedicated source of additional funding that would be more than sufficient to cover the entire scale of our proposal, even with higher-level payments. In contrast, CAP payments came out of general taxation and so had to compete with other social and political objectives.

How do our proposals compare in geographical scale to both the UK Government and the CCC in terms of ambition? The Government has proposed 500,000 hectares for the Nature Recovery Networks it plans to develop⁶². It also proposes 260,000 hectares of new woodland in England⁶³ (and 775,000 hectares across the UK)⁶⁴ by 2050, and the restoration of only 5,851⁶⁵ hectares of peatland. However, so far it has only committed £50 million to help plant new woodlands through the Woodland Carbon Guarantee and £10 million towards peatland restoration⁶⁶. The CCC's latest report on meeting the 6th carbon budget includes a 'Widespread Engagement' scenario which would see over 1.7m hectares of new woodland created by mid-century (taking UK woodland cover from 13% to 20%), and the restoration of all upland peat⁶⁷.

There is ongoing consideration of how the scheme might apply to commons, which exist across Britain and are subject to differing access and grazing regimes. Many commons have different owners and graziers, where the latter exercise grazing rights under law. Any reduction in grazing or change in management to benefit carbon storage and biodiversity needs to be incentivised by financially rewarding current graziers, and we propose any payments are proportional to current grazing rights where these are exercised. This is a complex area, however, and proposals require refinement and consultation. We also propose that in tenanted systems the payments should go to tenants rather than landowners as is currently the case.

GLOSSARY OF TERMS

Amenity value	The idea that something has worth because of the pleasant feelings it generates to those who use or view it. This value is often used in cost-benefit analysis to determine the worth of natural resources that will not be harvested for economic gain.
BECCS	Bioenergy with Carbon Capture and Storage
BEIS	Department for Business, Energy and Industrial Strategy
BPS	Basic Payments Scheme
CAP	Common Agricultural Policy
Carbon sequestration	The long-term storage of carbon in plants, soils, geologic formations and the ocean
CCC	The Committee on Climate Change is an independent, statutory body established under the Climate Change Act 2008 to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.
CO₂ equivalent	Carbon dioxide equivalent or CO ₂ e is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO ₂ e signifies the amount of CO ₂ which would have the equivalent global warming impact.
ELMS	Environmental Land Management System
ETS	Emissions Trading Scheme
IPBES	The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services is an independent intergovernmental body, established by member states in 2012. The objective of IPBES is to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human wellbeing and sustainable development.
IPCC	The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.
IUCN	International Union for Conservation of Nature
Natural climate solutions	Conservation, ecological restoration and improved land management strategies that increase carbon sequestration or avoid emissions across forests, wetlands, grasslands and farmland.
NFU	National Farmers' Union
Paris Agreement	An agreement signed in 2016 at the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse gas emissions mitigation, adaptation and finance. It is a landmark environmental accord that was adopted by nearly every nation to address climate change and its negative impacts. The deal aims to substantially reduce global greenhouse gas emissions in an effort to limit the global temperature increase in this century to 2°C above pre-industrial levels, while pursuing efforts to limit the increase to 1.5°C.
Rewilding	Large-scale restoration of ecosystems and the reinstatement of natural processes which allow nature to take care of itself and encourage a balance between people and the rest of nature, where each can thrive.
Shelf seas	Shallow sea close to the coastline.
Siviculture	The process of tending, harvesting and regenerating a forest.

REFERENCES

- ¹ Griscom, B. et al, 2017: 'Natural Climate Solutions', PNAS 114 (44) 11645-11650. <https://www.pnas.org/content/114/44/11645>
- ² Buchner, B. et al, 2015: 'Global Landscape of Climate Finance 2015', Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2015/>
- ³ 10 Downing Street press release, '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>. See also earlier UK Government calls to protect 30% of global oceans: DEFRA press release, 'UK creates global alliance to help protect the world's ocean', 24 September 2019, <https://www.gov.uk/government/news/uk-creates-global-alliance-to-help-protect-the-worlds-ocean>
- ⁴ See Government response to a Rewilding Britain parliamentary petition: <https://petition.parliament.uk/petitions/254607>
- ⁵ 'IPCC Special Report: Global Warming of 1.5°C', October 2018. <https://www.ipcc.ch/sr15/>
- ⁶ For more on the Climate Change Act, the Climate Change Committee and the UK's carbon budgets, see <https://www.theccc.org.uk/uk-action-on-climate-change/>
- ⁷ DEFRA, 'Agricultural Statistics and Climate Change', 10th Edition, September 2020, p.13-14, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941991/agriclimate-10edition-08dec20.pdf
- ⁸ 'Land use: Reducing emissions and preparing for climate change', Committee on Climate Change, November 2018. <https://www.theccc.org.uk/publication/land-use-reducing-emissions-and-preparing-for-climate-change/>
- ⁹ Griscom, B. et al, 2017: 'Natural Climate Solutions', PNAS 114 (44) 11645-11650. <https://www.pnas.org/content/114/44/11645>
- ¹⁰ J.-F. Bastin et al., 'The global tree restoration potential', Science 05 Jul 2019: Vol. 365, Issue 6448, pp. 76-79, DOI: 10.1126/science.aax0848, <https://science.sciencemag.org/content/365/6448/76/tab-pdf>.
- ¹¹ See <https://www.naturalclimate.solutions/>
- ¹² Buchner, B. et al, 2015: 'Global Landscape of Climate Finance 2015', Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2015/>
- ¹³ 'Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services', IPBES, May 2019. <https://www.ipbes.net/>
- ¹⁴ Boysen, L. et al, 2017: 'The limits to global-warming mitigation by terrestrial carbon removal', Earth's Future, 5 (5) 463-474 <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016EF000469>
- ¹⁵ Bain, C. et al, 2011: 'IUCN UK Commission of Inquiry on Peatlands', IUCN UK Peatland Programme, Edinburgh. p10 and p38
- ¹⁶ Xu, J. et al, 2018: 'Hotspots of peatland-derived potable water use identified by global analysis', Nature Sustainability, 1, 246-253. <https://www.nature.com/articles/s41893-018-0064-6>
- ¹⁷ Centre for Ecology and Hydrology (CEH), 'Implementation of an Emissions Inventory for UK Peatlands', report to BEIS, December 2017, https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1904111135_UK_peatland_GHG_emissions.pdf. For comparison to UK oil refinery emissions, see DECC & BIS, 'Industrial decarbonisation and energy efficiency roadmaps to 2050: Oil refining', March 2015. "In 2012, oil refining emitted 16.3 million tonnes of CO₂".
- ¹⁸ Evans, C. et al, 2016: 'Lowland peatland systems in England and Wales – evaluating greenhouse gas fluxes and carbon balances. Final report to Defra on Project SP1210', Centre for Ecology and Hydrology, Bangor
- ¹⁹ Quin, S. et al, 2015: 'Calluna vulgaris-dominated upland heathland sequesters more CO₂ annually than grass-dominated upland heathland', Science of the Total Environment, 505, 740-747 <https://www.sciencedirect.com/science/article/pii/S0048969714014752>
- ²⁰ Cook-Patton, S., et al, 2020: 'Mapping carbon accumulation potential from global natural forest regrowth', Nature, 585, 545-550. See endnote 54 for our calculations.
- ²¹ Law, A. et al, 2017: 'Using ecosystem engineers as tools in habitat restoration and rewilding: beaver and wetlands', Science of the Total Environment, 605-606, 1021-1030. <https://www.sciencedirect.com/science/article/pii/S0048969717315929>

- 22 Puseddu, A. et al, 2014: 'Chronic and intensive bottom trawling impairs deep-sea biodiversity and ecosystem functioning', PNAS, 111 (24), 8861-8866. <https://www.pnas.org/content/111/24/8861>
- 23 'Health and Harmony: The future for food, farming and the environment in a Green Brexit', Department for Environment, Food and Rural Affairs, 27 February 2018 <https://www.gov.uk/government/consultations/the-future-for-food-farming-and-the-environment>
- 24 Agriculture Act 2020, <https://www.legislation.gov.uk/ukpga/2020/21/contents/enacted>
- 25 DEFRA blog, 'New details of the flagship Environmental Land Management scheme unveiled by Environment Secretary', 25 February 2020, <https://deframedia.blog.gov.uk/2020/02/25/new-details-of-the-flagship-environmental-land-management-scheme-unveiled-by-environment-secretary/>
- 26 DEFRA website, 'Environmental Land Management: tests and trials', first published October 2020, <https://www.gov.uk/government/publications/environmental-land-management-tests-and-trials>
- 27 DEFRA, 'The Agricultural Transition Period 2021 to 2024: Adviser Pack – information and resources about the upcoming changes to English agricultural policy', November 2020, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/940434/atp-adviser-pack.pdf
- 28 'Brexit and our land: Securing the future of Welsh farming', Welsh Government Consultation document, 2018, p.42 https://gov.wales/sites/default/files/consultations/2018-07/brexit-and-our-land-consultation-document_0.pdf
- 29 'Net Zero Technical report', Committee on Climate Change, May 2019. <https://www.theccc.org.uk/publication/net-zero-technical-report/>
- 30 NFU, 'Achieving Net Zero: Farming's 2040 Goal', September 2019, <https://www.nfuonline.com/nfu-online/business/regulation/achieving-net-zero-farmings-2040-goal/>
- 31 NFU, 2021: 'The Times publishes NFU letter on carbon tax'. <https://www.nfuonline.com/news/media-centre/press-releases/the-times-publishes-nfu-letter-on-carbon-tax/>
- 32 BASC, 2015: 'Grouse shooting and management in the United Kingdom: its value and role in the provision of ecosystem services', BASC. <https://basc.org.uk/research-projects/>
- 33 PACEC, 2016: 'The Contribution of Deer Management to the Scottish Economy – Final Report'. <http://www.deer-management.co.uk/wp-content/uploads/2016/02/Final-25FEB.pdf>
- 34 Artz, R. et al, 2019: 'The State of UK Peatlands: an update'. https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2020-01/IUCN_S~1.PDF
- 35 DEFRA, 2018: 'Agriculture in the United Kingdom', https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/741062/AUK-2017-18sep18.pdf
- 36 BEIS, '2019 UK Provisional Greenhouse Gas Emissions', <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2019>
- 37 BEIS, 2018: 'Updated short-term carbon traded values, used for UK Public Policy Appraisal', https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/671194/Updated-short-term-traded-carbon-values-for-appraisal-purposes.pdf
- 38 BEIS, '2019 UK Provisional Greenhouse Gas Emissions', <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2019>
- 39 'Land use: Reducing emissions and preparing for climate change', Committee on Climate Change, November 2018. <https://www.theccc.org.uk/publication/land-use-reducing-emissions-and-preparing-for-climate-change/>
- 40 Marrs, R. et al, 2019: 'Experimental evidence for sustained carbon sequestration in fire-managed peat moorlands', Nature Geoscience, 12, 108-112. <https://www.nature.com/articles/s41561-018-0266-6>
- 41 Quin, S. et al, 2014: 'Restoration of upland heath from a graminoid- to a Calluna vulgaris-dominated community provides a carbon benefit', Agriculture, Ecosystems & Environment, 185, 133-143. <https://www.sciencedirect.com/science/article/pii/S0167880913004441>
- 42 Quin, S. et al, 2015: 'Calluna vulgaris-dominated upland heathland sequesters more CO₂ annually than grass-dominated upland heathland', Science of the Total Environment, 505, 740-747. <https://www.sciencedirect.com/science/article/pii/S0048969714014752>
- 43 Smith, S. et al, 2015: 'Combination of herbivore removal and nitrogen deposition increases upland carbon storage', Global Change Biology, 21 (8), 3036-3048. <https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.12902>

- ⁴⁴ Cook-Patton, S., et al, 2020: 'Mapping carbon accumulation potential from global natural forest regrowth', *Nature*, 585, 545-550. Our calculations are as follows. From Cook-Patton et al, Supplementary Data, UK mean aboveground carbon sequestration rate is 1.93 tC/ha/yr. Belowground carbon sequestration rate is 0.89 tC/ha/yr. Combined this totals 2.82 tC/ha/yr. Multiplied by 3.66 to convert from carbon to CO₂, this yields a figure of 10.32 tCO₂/ha/yr.
- ⁴⁵ Ward, S. et al, 2016: 'Legacy effects of grassland management on soil carbon to depth', *Global Change Biology*, 22 (8), 2929-2938 <https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.13246>
- ⁴⁶ Chang, J. et al, 2015: 'The greenhouse gas balance of European grasslands', *Global Change Biology*, 21 (10), 3748-3761
- ⁴⁷ Soussana, J. et al, 2007: 'Full accounting of the greenhouse gas (CO₂, N₂O, CH₄) budget of nine European grassland sites', *Agriculture, Ecosystems & Environment*, 121 (1-2), 121-134
- ⁴⁸ Smith, P., 2014: 'Do grasslands act as a perpetual sink for carbon?', *Global Change Biology*, 20, 2708-2711
- ⁴⁹ Smith, S. et al, 2014: 'Optimizing Carbon Storage Within a Spatially Heterogeneous Upland Grassland Through Sheep Grazing Management', *Ecosystems*, 17, 418-429
- ⁵⁰ Natural England, 2012: Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources. <http://publications.naturalengland.org.uk/publication/1412347>
- ⁵¹ Fornara, D. and Tilman, D., 2008: 'Plant functional composition influences rates of soil carbon and nitrogen accumulation', *Journal of Ecology*, 96 (2), 314-322
- ⁵² De Deyn, G. et al, 2011: 'Additional carbon sequestration benefits of grassland diversity restoration', *Journal of Applied Ecology*, 48, 600-608
- ⁵³ Mcleod, E. et al, 2011: 'A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO₂', *Frontiers in Ecology and the Environment*, 9 (10), 552-560. Table 1, <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/110004>
- ⁵⁴ Morris, J. & Jensen, A., 2003: 'The carbon balance of grazed and non-grazed *Spartina anglica* saltmarshes at Skallingen, Denmark', *Journal of Ecology*, 86 (2), 229-242. <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2745.1998.00251>
- ⁵⁵ Taylor, S. et al, 2019: 'High carbon burial rates by small ponds in the landscape', *Frontiers in Ecology and the Environment*, 17 (1), 25-31. <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fee.1988>
- ⁵⁶ Rural Payments Agency, 'Basic Payments Scheme, rules for 2018'. p22 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/705756/BPS_2018_scheme_rules_v5.0.pdf
- ⁵⁷ Mcleod, E. et al, 2011: 'A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO₂', *Frontiers in Ecology and the Environment*, 9 (10), 552-560. Table 1, <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/110004>
- ⁵⁸ DEFRA & Rural Payments Agency, 2017: 'Farmers set for increased payments as the Rural Payments Agency confirms BPS 2017 entitlement and greening rates'. <https://www.gov.uk/government/news/farmers-set-for-increased-payments-as-the-rural-payments-agency-confirms-bps-2017-entitlement-and-greening-rates>
- ⁵⁹ Gov.uk, 2019: 'Mixed Farming Offer: Countryside Stewardship'. <https://www.gov.uk/government/publications/mixed-farming-offer-countryside-stewardship>
- ⁶⁰ FarmBusiness, 2017: 'Greater Farming Profits Expected in 2018'. <http://www.farmbusiness.co.uk/business/greater-farming-profits-expected-in-2018.html>
- ⁶¹ 2.2 million hectares of bog/heath: Total CO₂ absorbed per year at 7.32 t/co2/yr = 16.10 million t/CO₂/yr
2.2 million hectares of grassland: Total CO₂ absorbed per year at 3.6 t/co2/yr = 7.92 million t/CO₂/yr
2.8 million hectares woodland: Total CO₂ absorbed per year at 10.32 t/co2/yr = 28.9 million t/CO₂/yr
- Latest 2019 BEIS figures (see endnote 36) put UK CO₂e GHG emissions at 435.2MtCO₂e. Total from above is 52.92. Percentage of UK emissions: 52.92/435.2 *100 = 12.2% of UK emissions. It is worth restating however the wide degree of uncertainty regarding the carbon accumulation potential of highly variable ecosystems and situations so this figure should be taken as indicative rather than definitive.
- ⁶² 'A Green Future: Our 25 Year Plan to Improve the Environment', Department for Environment, Food and Rural Affairs, 11 January 2018 <https://www.gov.uk/government/publications/25-year-environment-plan>

- ⁶³ The Government states in its response to our petition (see footnote below) an ambition to increase the wooded area of England from 10% to 12% by 2060, which we calculate as adding another 260,000 ha, given an England land area of 13 million hectares, with current woodland area of 1.3m hectares. <https://www.ons.gov.uk/economy/environmentalaccounts/articles/uknaturalcapitalandcoverintheuk/2015-03-17> Currently there are 1.4 million ha of broadleaved and 1.4 million ha of coniferous woodland in the UK.
- ⁶⁴ According to the CCC, “England and the DAs have an ambition to increase woodland creation, which if achieved, would deliver annual planting of 20,000 hectares by 2020 and 27,000 hectares from 2025”. This delivers roughly 775,000 hectares by 2050 of new woodland. See ‘Net Zero Technical report’, Committee on Climate Change, May 2019. <https://www.theccc.org.uk/publication/net-zero-technical-report/> p.211
- ⁶⁵ This figure is for restoration of degraded peatlands and does not include current natural state peat bogs. DEFRA, Government response to a Rewilding Britain parliamentary petition: <https://petition.parliament.uk/petitions/254607> This states: “We have committed to publishing an England Peatland Strategy. The strategy will set out our vision to reverse decline in peatlands and restore them, which is in line with the Government’s commitment to be the first generation to leave the natural environment of England in a better state than we found it. Work is underway on four large-scale peatland restoration projects across England, to which we have allocated £10 million, and will restore 5,851 ha of degraded peatlands.”
- ⁶⁶ See Government response to a Rewilding Britain parliamentary petition: <https://petition.parliament.uk/petitions/254607>
- ⁶⁷ CCC, Sixth Carbon Budget report, December 2020, <https://www.theccc.org.uk/publication/sixth-carbon-budget/#downloads> - see pages 171-174 for details of the ‘Widespread Engagement’ scenario for land use (including trees and peat).

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