



# OUR JOURNEY TO NET ZERO

## Farming's 2040 goal



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# INTRODUCTION

Two years ago, the NFU set the ambitious goal of reaching net zero greenhouse gas (GHG) emissions across the whole of agriculture in England and Wales by 2040. This is our contribution to the UK's ambition of net zero by 2050, a goal which we believe has stood the test of time. Across the British economy, sector upon sector has since stepped up to declare that each industry will reduce its emissions as far as possible and then offset the remainder.

We are proud that agriculture is almost uniquely placed to be part of the solution, as both an emissions source and a sink. As farmers, we can protect and enhance the carbon reserves already in our soils and vegetation, by modifying some of our farm practices and better managing our hedgerows and farmland trees. In addition to these 'nature-based' climate solutions, we can help to capture more carbon by growing the raw materials for bioenergy and the bioeconomy alongside our food production.

We believe we can only deliver net zero if we act across a range of GHG accounting inventories. Our net zero programme is steered by an advisory board of farmer representatives from all sectors and by a panel of independent scientific experts. Our leadership on this subject is recognised by numerous other organisations, including government departments and independent advisers such as the Climate Change Committee.

Assuming everyone listens to the scientists and agrees on action, then as the rest of the British economy decarbonises, the proportion of GHG emissions attributable to farming will start to go up. That is why we must address our own footprint, and why we are absolutely committed to our 2040 net zero goal for agriculture.

There is no single answer to this problem. To achieve our aim, we will need a range of measures that fall under three broad headings:

- Improving resource use efficiency of farming across all sectors;
- Increasing on-farm carbon storage in vegetation and soil;
- Boosting production of land-based renewable energy, including bioenergy for processes coupled to carbon capture, use and storage, to generate credits for GHG emissions avoided and GHG removal.

At the same time as reducing our impact on the climate, we should not reduce our capacity to feed UK consumers with high quality, affordable British food. The UK must not achieve its climate change ambitions by exporting UK production, or our greenhouse gas emissions, to other countries.

Our ambition for a net zero contribution to climate change across the whole of agricultural production by 2040 is a national aspiration, not an expectation that every farm can reach net zero. Every farm will start the journey to net zero from a different place and will need its own action plan.

The NFU believes that the agricultural sector is very much part of the solution to decarbonising the UK economy and achieving net zero. But we will need concerted support from government, industry and other key groups to help deliver this challenging, but achievable, ambition.



Minette Batters  
NFU President

# COP26 AND BEYOND: THE GLOBAL CHALLENGE ACCELERATES

Over the past two years, the worldwide impact of climate change has been relentless – fires, floods and unexpectedly strong storms have upped the stakes for extreme weather events in many countries. A stronger global consensus has emerged, with the Intergovernmental Panel on Climate Change calling the damaging human impact on the climate a “statement of fact” in its latest Sixth Assessment Report, which UN General Secretary Antonio Guterres described as nothing less than a **“code red for humanity”**.

Britain's Climate Change Act of 2008 introduced the world's first long-term national framework to tackle climate change, setting a legally binding target of an 80% reduction in GHG emissions by 2050, against a 1990 baseline. Seven years later, in 2015, the International Paris Agreement on climate change aimed to limit GHG emissions “as soon as possible” and keep global temperature increase “well below” 2C,

while recognising the importance of “safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change”.

Britain became the first major world economy to legislate for net zero emissions in 2019, aiming to end the contribution of UK economic production activities to climate change by 2050, and the government has now published its **Net Zero Strategy** which sets out how it will deliver on this commitment. By COP26 – the most important since the Paris Agreement – a further 17 countries will have net zero legislation in place, and 42 more have published net zero policy proposals, according to the **Energy & Climate Intelligence Unit's net zero tracker**.

## The current UK agricultural GHG inventory

Agricultural GHG emissions are very different from other sectors of the economy, such as electricity generation, transport and manufacturing. The principal GHG emitted by most industries is carbon dioxide (CO<sub>2</sub>) from fossil fuel combustion, while for agricultural systems methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are the main GHGs. Reducing these emissions is more difficult than cutting CO<sub>2</sub>, because they result from hard to control natural processes that are imperfectly understood, and a changing climate. There are also considerable limitations of measurement and data collection adding further complexity to accounting for emissions.

In every farming system, whether organic or conventional, a reliable supply of nitrogen is necessary for the growth of crops and pasture, and it is an unavoidable consequence of soil processes that a small amount of nitrogen in an agricultural system will be emitted as nitrous oxide. Likewise, methane is produced by bacteria as cattle and sheep break down the cellulose in their diet, producing milk and meat for human consumption from large areas of grassland that would be unsuitable for arable farming.

**British agricultural GHG emissions in 2019** were 46.3 million tonnes of CO<sub>2</sub> equivalent (roughly 10% of UK total GHG emissions), comprising methane (5.5% of UK total), nitrous oxide (3.3%) and CO<sub>2</sub> (1.3%). Agricultural emissions have decreased by 13% overall since 1990, but the quality of official government data gathering has made it difficult to demonstrate further progress since 2011, when the industry's GHG Action Plan was agreed. This report outlines details and examples of how we are addressing this.

**BRITAIN BECAME  
THE FIRST MAJOR  
WORLD ECONOMY TO  
LEGISLATE FOR NET ZERO  
EMISSIONS IN 2019**

# DELIVERING OUR VISION

Since 2019, our “three-pillar” approach to net zero has been reflected in the plans of many other industry sectors – reduce production emissions as far as reasonably possible through the more efficient use of resources, then use nature-based carbon storage and engineered greenhouse gas removals to offset the residual emissions.

Our approach is based on real-world experience and market intelligence, recognising that shifts in food consumption are more likely to be progressive than drastic, and acknowledging our opportunity to lead the way in climate-friendly meat and dairy production. We must not risk the export of our food production emissions through ‘carbon leakage’ from our highly trade-exposed sector. Instead, we should have the flexibility to respond to markets, including exporting our low-carbon produce and climate-friendly know-how.

With the support of our own Net Zero Steering Group and Science Advisory Panel and sector boards, we are now working on an interim 2030 target for GHG emissions reductions. The current process is to review technologies and techniques that are available for use on farm at the present time, to inform a realistic and achievable interim target on our path to net zero.

We are also involved in the relaunch of the Greenhouse Gas Action Plan as the Agriculture and Land Use Alliance which aims to provide a practical, evidence-based, and economically and socially just approach to maximise the contribution of agriculture to a net zero economy.

NFU teams are involved with many cross-industry initiatives essential to net zero policy and delivery. The Agricultural Productivity Task Force focuses on promoting resource use efficiency, and **The Institute of Agriculture and Horticulture** will provide a hub for skills and careers support. We are also integral in the development of the What Works for Farming initiative, which will provide farmers with best practice advice.

There are no ‘silver bullets’; we believe action to tackle climate change in UK agriculture requires a portfolio of different policies and practices focused on three key pillars:

- **Improving farming’s resource use efficiency to reduce our greenhouse gas emissions – enabling farming to produce the same quantity of food, or more, with fewer inputs in smarter ways;**
- **Farmland carbon storage in soils and vegetation – improving land management and changing land use to capture more carbon, through new and bigger hedgerows, more woodland management and creation, and especially more carbon-rich soil;**
- **Boosting renewable energy and the bioeconomy to displace GHG emissions from fossil fuels and to create GHG removal through photosynthesis and carbon capture.**

Many of our members are already carrying out net zero measures on farm, celebrated in our #Pledge2040 campaign where over 300 members have signed up to the **‘We’re in for net zero’ pledge** to tell us what they are doing to reduce emissions. Through our Net Zero Steering Group we have reviewed and provided guidance on GHG calculation tools to encourage take-up and help farmers make an informed decision on which tool might best suit their farm system.

Our evidence suggests that work under these three pillars could reduce, offset and counterbalance current agricultural emissions of 46.3 MtCO<sub>2</sub>e/year by 2040.

# A JUST RURAL TRANSITION

The UK Climate Change Committee recognises that the transition to net zero must spread the costs fairly across society. It is vital that the burden of decarbonising the economy does not disproportionately impact rural areas.

Our vision is for agriculture's transition to net zero to be economically and socially just to ensure the economic, environmental and social benefits of farming are protected. Our broad portfolio of measures to reduce our impact on the climate is designed to be adaptable to different farm sizes and types in all parts of the UK. While some farms will be able to go further than others on the journey to net zero, we believe all British farmers and growers can benefit from new technologies and green growth – assuming that appropriate policies and infrastructure are put in place for a thriving rural economy.

We have created **'Net zero and agriculture – a guide for local authorities'** to illustrate that farming is part of the solution to climate change, and to show how local authorities can work with farmers and growers, enabling new investments and new measures to be delivered by their local policy and funding strategies.

It is widely accepted that the move to a low carbon economy needs to be fair and equitable so that no areas of the country, or sectors of the economy, are either singled out or disadvantaged. It is vital that rural

areas can preserve our distinctive cultural landscapes, and the skills that help to manage biodiversity and protect our natural resources, while at the same time being able to reduce our environmental impact and continue to produce climate-friendly food.

Our net zero vision is based on land sharing, not land sparing – demonstrating multi-functional land use through improved farm practice and farming systems. We will always favour the productive use of land over the creation of unproductive 'land banks' and believe that measures like rewilding and large-scale afforestation should only be deployed on the most marginal land.

## Measurement, reporting and verification

Significant progress has been made over the past two years in developing systems for farmers and growers to track and be rewarded for reducing or offsetting GHG emissions. The NFU has engaged with government on developing a framework for rewarding greenhouse gas removals – whether nature-based (Pillar 2) or engineered (Pillar 3) – as well as with other trade associations and new cross-industry groups such as the Coalition for Negative Emissions.

We have contributed to a government Task and Finish Group on monitoring, reporting and verification of greenhouse gas removals, and we have given evidence to independent bodies like the Zero Carbon Commission. We have also endorsed the Oxford Offsetting Principles which support our 'portfolio' approach to the possibility of failure or under-delivery of individual measures.

Our net zero ambition is based on the near-unique ability of farming as a sector to remove carbon dioxide from the atmosphere – but this process must be verifiable, additional and permanent.

Measurement may need to be based on both physical audits (actually measuring and recording changes in farm practice) as well as expected results predicted by modelling. It is quite likely that monitoring and verification of certain measures, like enlarged or extended hedgerows, will be easier than others, such as soil carbon. However, "proxy indicators" of changed management practices which are likely to increase carbon storage could be coupled to models that are supported by actual field testing.

**WE BELIEVE ALL BRITISH FARMERS AND GROWERS CAN BENEFIT FROM NEW TECHNOLOGIES AND GREEN GROWTH – ASSUMING THAT APPROPRIATE POLICIES AND INFRASTRUCTURE ARE PUT IN PLACE FOR A THRIVING RURAL ECONOMY.**



# WHAT DO WE NEED TO ACHIEVE NET ZERO?

We cannot do this alone. We are looking to government and other stakeholders to act with us and help us deliver this ambition. This will need concerted and robust action, upholding the principles of a fair and just low carbon transition for the rural economy.

## PILLAR 1: Boosting productivity and reducing emissions

Improving farming's productive efficiency will enable farmers to produce the same quantity of food, or more, with fewer inputs, in smarter ways. This, in turn, will enable the sector to reduce its greenhouse gas emissions.



## AN AMBITIOUS PRODUCTIVITY PROGRAMME

Resource use efficiency is all about productivity improvements – producing the same or more with fewer inputs. This not only saves money but also reduces the GHG footprint of the product and farm system. We estimate that wholesale take-up of productivity improvements across farmers and growers could see a 25% reduction in GHG emissions.

**An ambitious and long-lasting productivity programme is needed which will provide targeted investment, supporting research and development, knowledge exchange, training, advice, collaboration and incentivising the adoption of technical advances to deliver GHG reduction and resilience.**

We would also like further development phases of the Sustainable Farming Initiative (SFI) to specifically target net zero. Farmers and growers should be incentivised to scrutinise every part of their systems to seek the most climate-friendly methods of producing our food. Net zero is not included explicitly in the detail of the first draft SFI standards, and yet the government's own Net Zero Strategy flags the future Environmental Land Management schemes, of which the SFI is a key part, as a "powerful vehicle for achieving net zero".

### Pushing for productivity improvements

"We have a firm agenda to improve efficiency on the farm and reduce our greenhouse gas footprint to ensure the farm is financially strong and sustainable for the future.

"To help reduce our energy consumption, and lessen our environmental impact, we are in the process of replacing our milk storage equipment with a more energy efficient system which will help us heat our water while cooling our milk. We're also trialling a seaweed food supplement to reduce methane emissions from the herd. This is part of a project I'm working on at the University of Nottingham called Project Ecologeco.

"Grassland management is at the heart of our plans. Allowing species of deeper rooting rye grass and clover to flourish helps improve soil health and increases nutrient cycling, fixing nitrogen in the soil and reducing the need for artificial fertiliser use. This will also help improve the health and productivity of the herd by reducing the worm burden.

"We're increasing our soil testing from every four years to annually, so we can fine tune the inputs we apply. This will save us money, reduce our environmental impact, and hopefully give us increased grass growth and plant diversity, leading to better silage yields and quality. The cost of testing is tiny compared to the savings on fertiliser and the increase in grass growth.

"We're also creating a reseed policy which will help improve nitrogen fixation, increase grass growth levels and improve the quality of the silage we produce which will boost our grass to milk conversion rates.

"In certain fields no fertiliser or herbicides are applied. These fields aren't mown to allow natural grasses to flourish and, in turn, increase biodiversity on farm. We also have fields that have restricted grazing (only one cow per acre until 1 June) to allow nesting birds to flourish, in particular lapwings."

**Jessica Langton, dairy farmer, Derbyshire**

## UPGRADED INFRASTRUCTURE IN RURAL AREAS

Adequate investment in infrastructure is vital to enable the use of new technologies which support a net zero transition. This includes mobile and broadband access, electric vehicle charging points, fast tracking of electric grid network connections to enable decentralised renewable energy generation and battery storage.



### Working for self-sufficiency in resources

"Our family farm runs arable, dairy and poultry and our aim is to become resource self-sufficient as far as we can.

"Energy efficiency is so important with two poultry layer sites for 78,000 hens and two pullet rearing sites for 26,000 pullets, so we have invested in renewables.

"We are fortunate that our location on the banks of the river Ouse, and being right opposite an old hydro electric installation, gave us the idea of using hydro power. We worked with external companies to install two Archimedes screws, one in 2012 which produces 100kW and then a larger one in 2018, producing 250kW.

"Now that power is used for both the poultry sheds and our family home, with the rest exported to the grid. We pump water from our bore holes and generate a further 94kW of electricity from solar panels on the top of the poultry sheds which covers about 10% to 15% of the farm's electricity needs.

"We also have a biomass boiler which heats the pullet rearing sheds. Almost all our feed for the dairy cows and hens is now grown on farm, and our mill and mix operation reduces cost and the transport footprint.

"To complete the circular economy, we use the poultry litter and farmyard manure across the arable area, and use cover crops to improve soil condition."

**David Throup, arable, dairy and poultry farmer, Yorkshire**



**ADEQUATE INVESTMENT IN INFRASTRUCTURE  
IS VITAL TO ENABLE THE USE OF NEW  
TECHNOLOGIES WHICH SUPPORT A  
NET ZERO TRANSITION.**

# AN ACCOMMODATING PLANNING SYSTEM

The planning system needs to facilitate the upgrading and modernisation of existing agricultural buildings, as well as the construction of new buildings, for better energy efficiency, emissions reductions, and resilience.

Local plans should include agricultural improvement projects to take place as permitted development, subject to prior approval, and local planners require the resources to understand and support the evolving needs of the agricultural sector.



## Investing in productivity and resilience

"I have invested heavily in new infrastructure. The old farmyard was struggling to function as the size and sophistication of machinery has increased over the years, so we recently completed the construction of a new farmyard to a new safer, more accessible area.

"The new machinery is making the business fit for a net zero future through improving the efficiency of our farming operations. I made sure the roof of the new yard is ready to take solar panels and it was orientated in the right way, so I would like to invest as soon as we can.

"Some of the infrastructure needs are not as visible as the new farmyard. Poor broadband is another real issue for many farmers as in some areas it's really slow. A lot of the technology coming down the track to improve productivity on farm will rely on good connectivity, like robotics, more targeted pest control, herd health monitoring and data collection.

"We have very variable soils around the farm – some are poorer quality and were never successful for arable cropping. So, I have converted some fields to permanent pasture, sequestering carbon in the soil and locking it up for the long term. Introducing sheep has led to a 34% increase in yield. I also trialled older varieties of wheat which are better adapted to our system. I'm keen to do more work on finding the best blend of livestock and technology from soil testing to better livestock genetics.

"We're also harvesting all the rainwater from the new shed and collecting it in storage tanks. My hope is that we'll be self-sufficient in water, not having to use any mains water in our agricultural operations. We need serious investment in better infrastructure to make sure the industry can meet the range of climate challenges in the future."

**Stuart Roberts, mixed arable and sheep farmer, Hertfordshire**



**LOCAL PLANS SHOULD INCLUDE AGRICULTURAL IMPROVEMENT PROJECTS TO TAKE PLACE AS PERMITTED DEVELOPMENT, SUBJECT TO PRIOR APPROVAL, AND LOCAL PLANNERS REQUIRE THE RESOURCES TO UNDERSTAND AND SUPPORT THE EVOLVING NEEDS OF THE AGRICULTURAL SECTOR.**

# GHG FOOTPRINTING

Many farmers are taking a keen interest in understanding their GHG footprint and where they should be focusing their effort to reduce emissions further. However, many are reporting a lack of confidence in using GHG calculators. This is due to confusion over the number of calculators that are available, the time taken to input data, the suitability to their farm system and a lack of clarity in the results.

We support the development of GHG footprinting to better reflect the diversity of UK farming systems, capture on-farm sources and sinks, and enable product and farm business calculations. Greater transparency would allow better comparison between different GHG calculators and instil more confidence in users.



## Measuring success in reducing emissions

"I trialled three freely available GHG calculator tools to see how they work for a poultry business and, while each had its own benefits, none of them worked particularly well for broiler chicken production.

"Feed use is always likely to be the biggest single factor in poultry's carbon footprint and it's important that calculator tools better reflect this. We're making as many productivity improvements as we can, but our greenhouse gas footprint will always be affected by our high welfare standards.

"I intend to revisit the GHG calculation to track progress on the number of measures we've introduced on farm to help reduce emissions and minimise our climate footprint. We're currently putting the finishing touches to a new larger poultry shed which will be heated entirely by biomass so we won't have to rely on any fossil fuels. The shed is also fitted with better insulation and includes LED lighting which will further improve our energy efficiency.

"We already have 50kW solar panels on the roof of our poultry sheds. These produce more power than we need during the day so we export some of the surplus back to the national grid. We're also keeping a watchful eye on battery storage as a possibility to store any excess power produced for future use.

"The next project on the farm will be to lay some more hedges to complement the trees we have previously planted. This will help capture more carbon from the atmosphere and further reduce our impact on the environment."

**Simon Barton, poultry farmer, Somerset**



**WE SUPPORT THE DEVELOPMENT OF GHG FOOTPRINTING TO BETTER REFLECT THE DIVERSITY OF UK FARMING SYSTEMS, CAPTURE ON-FARM SOURCES AND SINKS, AND ENABLE PRODUCT AND FARM BUSINESS CALCULATIONS.**

## PILLAR 2:

### Carbon storage/ nature-based solutions

Farming is responsible for a critically important carbon resource in soils, wooded landscape and semi-natural habitats. To achieve net zero, we need to actively incentivise the conservation of this carbon resource as well as its enhancement.



## MAINTENANCE OF EXISTING CARBON STORES MUST BE REWARDED

Farmers and growers are becoming more knowledgeable about their ability to sequester carbon on farm. But existing stocks of carbon in grasslands, woods and hedgerows must be protected to prevent releasing more carbon into the atmosphere. Maintenance and conservation of existing carbon stocks has a cost and without any recognition or reward there is a risk they are seen as having no value.

### Working hand in hand with the environment

"A key part of our journey in regenerative farming is to look after the environment while producing high quality food, and for us that starts with the soil.

"Traditionally, we have always used chemical inputs sparingly and when you take them out of a system it takes time for biology to make up the difference. We began with putting in red clover which works well as it is deeper rooting and fixes in nitrogen. Using herbal leys such as chicory and plantain for grazing reduces the incidence of worms in our lambs. The wormers can damage soil biology and affect dung beetles and nematodes. But herbal leys need planting again every few years which has a cost implication.

"I realised I needed to make the most of older pasture. I knew someone nearby with a reasonably species diverse meadow and I was able to take the seed by cutting and putting the hay over my fields.

"My dad and I have planted 500m of hedgerows over the past couple of years and will be doing the same next year. Our project with the Woodland Trust to plant a few hundred trees has the go-ahead. We are planting a good pasture field with rows of trees with 15-metre spacing so that machinery will fit if we want to go back to arable.

"With a rotational grazing regime, the cattle graze a small area for a short period of time and then move on to allow the grass a chance to replenish and put sufficient energy back into the roots. This can improve the soil organic matter and biodiversity. We are taught to be tidy as farmers and we need a real shift in thinking. We need to ask: 'Why is that thistle there?' It's most likely doing a job – maybe taking some compaction out or bringing minerals up in the soil. That's fine because it's covering the soil from the sun. It's only anecdotal at the moment, but I've noticed more skylarks and pollinators."

**Richard Thomas, mixed arable and livestock farmer, West Midlands**

**MAINTENANCE AND CONSERVATION OF EXISTING CARBON STOCKS HAS A COST AND WITHOUT ANY RECOGNITION OR REWARD THERE IS A RISK THEY ARE SEEN AS HAVING NO VALUE.**

## ACCESS TO BOTH PUBLIC AND PRIVATE SECTOR FUNDING

Access to both public and private finance is essential to pump prime the market for payments for carbon storage. Nature-based solutions have huge multiple benefits for the public good, from sequestering carbon to improving habitats and biodiversity. But they come at a cost. We recognise the opportunity coming down the line from the private sector in buying carbon offset from farmers and growers. However, the market is not yet established and there needs to be robust measurement, reporting and verification. Similarly, the issue of scale required in contracts may overlook the benefits of smaller changes on farm, such as hedgerow planting and maintenance. To incentivise widespread action at any scale, public finance is required.



**NATURE-BASED SOLUTIONS HAVE HUGE MULTIPLE BENEFITS FOR THE PUBLIC GOOD, FROM SEQUESTERING CARBON TO IMPROVING HABITATS AND BIODIVERSITY.**

### Managing land for food and carbon

"Increasing the quality of the soil is the most important thing we can do on farm, not only for yields and food security but also to absorb emissions through the plants that we grow – be that grass in pastures or crops or cover crops grown in between crops to protect the soil.

"Selling that potential is a great prospect for a farm business which needs to be profitable. We must not feel guilty in pushing that message. Managing land and improving soil has a cost and you need the investment to make it better.

"I use cover cropping of multiple species, catch cropping and chopped straw – all of which are capturing carbon, drawing it down and locking it into the soil at the same time as improving soil nutrients and biodiversity. This all comes at a cost. There are huge public benefits, so we need to find a way to get funding on to farm to undertake all that work. It needs to come from multiple sources and this is where stacking of funding comes in. You must not be precluded from access to funding from one area when you are delivering so many benefits. This is so important.

"I am involved in an initiative in my area to monitor soil and nutrient capture, but there are real challenges in accurate measurement. We need a standardised audit procedure and we need to keep the value on farm.

"Catch cropping – planting a fast-growing crop like radish between rows of the main crop, or after harvest – is a new initiative I have tried and will look at more in the future as I'm really pleased with the results in improving the soil. The following milling wheat crop was high yielding – 11.5 tonnes per hectare. Over the years I have planted and maintained hedgerows, trees and buffer strips around water courses, and it would be good to see government support for that."

**Richard Bramley, arable and root crops, Yorkshire**



# PILLAR 3:

## Renewables and the bioeconomy

The UK needs to develop a strong domestic bioenergy market in the short term, alongside expansion of other land-based renewables. At the same time as displacing greenhouse gas emissions from fossil fuels, we must build the longer-term potential for national greenhouse gas removal through a variety of bioenergy pathways as well as the wider bioeconomy.



## BIOENERGY, CARBON CAPTURE AND STORAGE (BECCS) MARKET CREATION

The government's forthcoming Bioenergy Strategy must build on the industry-led strategy of 2019 alongside a clear carbon price trajectory. It is essential that investment is made in multiple demonstration projects to prove greenhouse gas removals at different scales.

### Diversified income from marginal land

"We identified some surplus land totalling about 80 acres, roughly 10% of our farm, and the decision was what to do with it to diversify for the long term sustainability of the business. We wanted a cash crop which wouldn't need a lot of work but had a predictable yield for many years.

"Since 2015, we've been planting perennial energy crops – a mixture of short rotation coppice (SRC) willow varieties. Our land receives a lot of rainfall, being just outside the Lake District, so the willow is well suited to the conditions.

"We have also installed our own biomass boiler for crop and grass drying, and a small wind turbine as well as solar panels. We are always open to new ways to bring in additional income, so short rotation coppice willow fits our way of thinking.

"We are very keen on reducing carbon emissions. We've planted loads of hedges on the farm and we try to be very environmentally based – we were even organic for a while.

"Inputs are a big cost factor as well as adding to our carbon footprint so we try to reduce them as much as we can. The fast-growing SRC willow crop ticks a lot of boxes in terms of other benefits; I reckon that our biodiversity value has increased by at least 50% at the farm, and the abundance of wildlife we have seen since planting has been much more than we expected.

"As soon as I heard that perennial energy crops could produce profits of £230 to £260 per acre, per year, which equates to £570 to £640 per hectare per year, my ears pricked up. And since we've planted it on land that wasn't really producing anything, I think it could do even more."

**Terry Dixon, mixed dairy and arable farmer, Egremont, Cumbria**

**IT IS ESSENTIAL THAT INVESTMENT IS MADE IN MULTIPLE DEMONSTRATION PROJECTS TO PROVE GREENHOUSE GAS REMOVALS AT DIFFERENT SCALES.**



# ACCELERATE THE USE OF BIO-BASED MATERIALS IN CONSTRUCTION AND INDUSTRY

The government's 2018 Bioeconomy Strategy needs to be implemented and there needs to be visible support from the Home Office and Department for Levelling Up, Housing and Communities for novel building and insulation materials like hemp fibre and sheep's wool. There also needs to be support for the increased production and use of bio-based packaging material, which can be created from the by-products of food production and can replace single-use, non-recyclable packaging products.



## Innovation in bio-based packaging

"We are the biggest tomato producer in the UK, supplying about 30% of all the tomatoes grown in the UK which amounts to many hundreds of millions of tomatoes grown in our glasshouses each year.

"We worked with industry expert Steve Price, as well as a number of universities, to develop our anaerobic digestion (AD) plant. It breaks down all our tomato crop's leaf waste and converts it to produce valuable by-products that can be used in our growing operation: heat, electricity, transport fuel, irrigation water, fertiliser and CO<sub>2</sub>, which can be fed back on to the crop.

"It's important for us as a business to be constantly looking at ways we can improve our environmental credentials as well as producing healthy food. Our AD plant also helps us turn the hundreds of tonnes of crop leaf waste produced into a range of biodegradable by-products, including cellulose fibre and liquid cellulose which can be used to manufacture home-compostable packaging film and punnets for our tomatoes.

"Using the leaf waste to produce environmentally friendly packaging is another way in which we can reduce our environmental footprint, ensure we don't waste anything produced during the growing process, and reduce the demand for non-recyclable packaging products.

"Like all glasshouse growers, energy efficiency is key. Technology is very important to us to create the right growing conditions, like automatic screens that close just before nightfall to trap the sun's warmth in the glasshouses.

"We have Combined Heat and Power (CHP) plants on all our sites, with the waste heat and CO<sub>2</sub> used to grow the crop. Thermal storage tanks allow us to store hot water from the CHP systems which operate in the day when the crop doesn't require heat. When the sun goes down, the hot water is then pumped back into the glasshouses to warm the crop without the need to run the boiler.

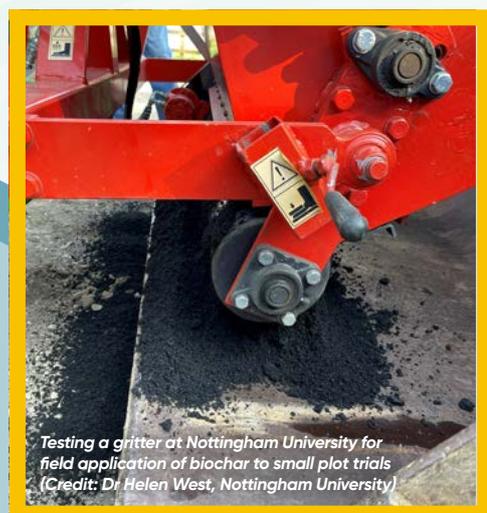
"This is the circular bioeconomy in action – harnessing biology to generate energy and packaging products. We plan to liaise further with other business sectors to use the CO<sub>2</sub> produced from biomass power generation and also to re-purpose ideas and innovation from other sectors."

**Phil Pearson, tomato producer, various locations**

**THERE NEEDS TO BE VISIBLE SUPPORT FROM THE HOME OFFICE AND DEPARTMENT FOR LEVELLING UP, HOUSING AND COMMUNITIES FOR NOVEL BUILDING AND INSULATION MATERIALS LIKE HEMP FIBRE AND SHEEP'S WOOL.**

# FAST-TRACK RESEARCH AND DEVELOPMENT OF NEW GREENHOUSE GAS REMOVAL METHODS

Rapid demonstration projects are needed to qualify promising new greenhouse gas removal methods for widespread deployment, such as land spreading of biochar and enhanced weathering minerals.



*Testing a gritter at Nottingham University for field application of biochar to small plot trials (Credit: Dr Helen West, Nottingham University)*

## Research on land spreading biochar for soil carbon capture

Under the UK Research and Innovation (UKRI) greenhouse gas removals demonstration programme, the NFU is supporting a consortium led by Nottingham University to conduct field trials of biochar (ground-up charcoal) application on at least ten different farm and soil types across the Midlands and North Wales. The NFU sits on an Expert Advisory Group to oversee the project and review progress.

Over 200 tonnes of biochar will be prepared from virgin and recycled wood, together with the investigation of alternative feedstocks and processes. Project results will include workshops for the farming community, including professional farm advisers. By early next decade, the NFU believes that land spreading of biochar could be capturing 2.5 million tonnes/year of CO<sub>2</sub> across the UK.

## Research on Enhanced Mineral Weathering to capture carbon in soils

Another project under the UKRI greenhouse gas removals demonstration programme involves a team of scientists led by Professor David Beerling at the University of Sheffield, who are conducting a large multi-partner research project looking at the scientific, economic and social acceptability of using crushed rock in agriculture to capture greenhouse gases. The NFU is a member of the project's Expert Advisory Group.

The work is investigating novel soil amendments of crushed silicate rocks to accelerate natural CO<sub>2</sub> capture processes, while improving and sustaining soil fertility. It will provide the first integrated assessment of the science, societal, and scalability opportunities and challenges of applying this technology to UK agriculture. The NFU estimates that land spreading of enhanced weathering minerals in Britain has the potential to deliver at least one million tonnes/year of CO<sub>2</sub> capture by the early 2030s.



*Spreading crushed rock in previous field trials conducted in Norfolk (Credit: Dr Dimitar Epihov, Sheffield University)*

**RAPID DEMONSTRATION PROJECTS ARE NEEDED TO QUALIFY PROMISING NEW GREENHOUSE GAS REMOVAL METHODS FOR WIDESPREAD DEPLOYMENT, SUCH AS LAND SPREADING OF BIOCHAR AND ENHANCED WEATHERING MINERALS.**

# ACROSS ALL PILLARS

## RECOGNISING THE FULL BREADTH OF FARMER AND GROWER CONTRIBUTION TO REDUCING EMISSIONS ACROSS INVENTORIES

The Land Use, Land Use Change and Forestry inventory should be significantly upgraded to recognise the full breadth of the contribution that farmers and growers make to reducing emissions. As it stands, the inventory does not reflect the current situation or capture the progress being made in terms of our pillar 2 measures, such as trees on farm, or pillar 3, such as renewables and bioenergy.



**THE LAND USE, LAND USE CHANGE AND FORESTRY INVENTORY SHOULD BE SIGNIFICANTLY UPGRADED TO RECOGNISE THE FULL BREADTH OF THE CONTRIBUTION THAT FARMERS AND GROWERS MAKE TO REDUCING EMISSIONS.**

### Working towards net zero across all three pillars

"Here in Wales we are so lucky with our environment. We have 1,600 acres of varied terrain which has allowed us to diversify in a number of areas.

"Alongside the sheep and cattle, we now have egg production, green energy and tourism. We also co-own Blodyn Aur – the rapeseed oil company selling over 6,000 bottles a month of Welsh rapeseed oil to Asda, Morrisons and Sainsbury's in Wales.

"We try to do lots of little things that we hope will help the bigger picture. Ahead of expanding the poultry units, I visited sites across Europe to learn how to improve productivity and limit the environmental impact. We invested in ammonia scrubbers to reduce ammonia emissions by an estimated 90%. We'll double egg production, but ammonia emissions will reduce. And the poultry business doesn't use any mains water – it all comes from our borehole.

"We started rotational grazing the cattle which improves soil health as well as decreasing the worm burden for the stock. We test the soils every three years. I also manage 1,000 acres of heather moorland, seven acres of ancient woodland and I preserve 30 acres of peatland which stores thousands of tonnes of carbon per hectare. We have four miles of hedgerow and 2.5 miles of streamside corridors, plus I've planted over 4,500 trees over the last three years for carbon sequestration.

"It gives me great pride that we produce green energy here at Derwydd. We have a huge amount of rainfall and big hills here, which are great for producing hydro-electricity. We installed a 30kW hydro-electric system in 2012, with 24kW photovoltaic panels as back-up when warm weather reduces the flow of water.

"For the poultry units we have 80kW ground and air source heat pumps warming the air. Because the hens use less energy keeping warm they eat less food, so I reckon we've saved around three lorry loads of feed per year. There are also solar panels on the hen sheds which power our Polaris Electric utility vehicle and the family car. Any energy not used on farm is exported back to the grid.

"Being environmentally friendly has actually benefited the farm. When I retire I want to give this farm to my children in a far better condition than I inherited it."

**Llyr Jones, mixed farmer, Denbighshire, Wales**

# OUR JOURNEY TO NET ZERO

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