

Shaping agriculture's transition to a net zero future



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Introduction

We recognise that climate change is one of the biggest challenges facing the UK today. Because of this, sustainability is now a key part of our business strategy, as it is for many of our clients. However, the transition to sustainable business practices can be challenging without support. That is why we are committed to supporting Britain's farmers to transition to sustainable business models and operations, and to pursue new clean growth opportunities.

The UK Government has set an ambition to be net zero by 2050, requiring a halving of the country's carbon footprint by 2030. The National Farmers Union (NFU) has set the agricultural sector an even more ambitious goal of transitioning to net zero by 2040. And while the sector, like the whole of the UK, is facing challenges caused by the coronavirus pandemic, our initial view is that the agriculture sector seems to have fared better than most. While undoubtedly income has been affected and financial support has been required by some, we are confident in the sector's resilience. To this extent the focus on net zero remains a priority.

The scale of the NFU's ambition is matched by the scale of the challenge ahead. The agriculture sector contributes 10% of the UK's total greenhouse gas emissions, and the sector is unique in the type of emissions it contributes – 31% of emissions are nitrous oxide, 56% are methane, and 13% are carbon dioxide¹. This differs from other sectors which are mostly carbon dioxide intensive. The sector is also unique in its ownership and management of 70% of the UK's land stock, providing a unique resource in the ability to tackle climate change. Adjustments in land use, woodland creation and soil restoration are wonderful, natural ways of sequestering carbon from the atmosphere, and therefore priorities over the decade ahead.

The purpose of this report is to outline practical tips, sign-posting and finance solutions to the agriculture sector as part of its transition to a net zero future. These have been drawn from a range of bodies, including the Committee on Climate Change, Promar International, the NFU and others. In the following pages we will cover:

- **What climate change is and why it matters**
- **Practical recommendations as to how you can transition to net zero**
- **How we can help**

As partners to this sector, we are committed to working together to understand and tackle the challenges posed by climate change, while also pursuing the many opportunities it presents too. The transition to a greener, healthier planet will not always be easy, however we look forward to embarking on the transition to a sustainable, low-carbon future together.

Executive summary

Climate change is a real and present threat within the UK and across the world and requires all industries to rapidly decarbonise in line with the UK's target to reduce CO₂ emissions by 50% by 2030. This report will examine the drivers behind the transition to net zero for agriculture, and what practical steps the sector can make to contribute to the low-carbon economy, mitigate risks and capitalise on the opportunities this transition presents.

A summary of our recommendations to support the agriculture sector's transition to net zero include:

1 Measure your farm's carbon footprint

Measuring your carbon footprint at farm-level is a critical first step. There are a number of carbon calculator tools on the market which can do this, and different tools will be appropriate for different farms. We offer an introduction to the three market leading tools to support you on this journey, see page 11 for full details.

2 Plant trees and hedgerows to sequester carbon

Tree planting and reforestation is key to decarbonising the UK's agriculture land and increasing the UK's woodland cover in line with the UK's transition to net zero. Our partnership with the Woodland Trust offers farms the opportunity to plant trees and hedges at heavily subsidised rates, see page 20 for full details.

3 Improve farm productivity and efficiency

There are a number of ways to improve agricultural productivity and efficiency while also reducing your carbon footprint. Reducing nitrous oxide and methane emissions are priorities, via activities such as the use of controlled release fertilisers and urease inhibitors and improving animal health and reducing livestock numbers overall.

4 Invest in low carbon agri-technology

The adoption of agri-tech solutions is a key enabler of the transition to net zero. From utilising livestock sensors, precision agriculture and hydroponic technology, the solutions support an increase in both yield and productivity.

5 Boost renewable energy generation

Boosting renewable energy and the bio-economy to displace greenhouse gas emissions from fossil fuels is a key part of the NFU's ambition for achieving net zero². Investment in renewable energy can provide additional income, support the production of organic fertiliser and improve waste management.

6 Improve soil health

Soils are the second largest carbon sink after our oceans, containing approximately 94% of the total carbon stored in the biosphere. Soil health is therefore hugely important both to preserving soil fertility, and the fight against climate change. Key solutions include maintaining cover crops, minimising tillage and tree planting.

7 Restore peatlands

Peatlands are a key part of the UK's landscape, covering 12% of the UK's land area³. Both upland and lowland peatlands are significant carbon sinks with 57% of the UK's soil carbon stored in peatland⁴. However, it is estimated that 80% of peatlands are significantly damaged, and so restoring and preserving peatlands is crucial.

How we can help

Our ambition is to be the sector's partner of choice on its transition to a low-carbon future. Climate change presents both risks and opportunities, and with over 90 years of working with the Agriculture sector, we're keen to help finance a greener future, together.

What is net zero and why agriculture?

In 2019, Britain became the first major world economy to legislate for net zero emissions, aiming to end the UK's contribution to global warming and climate change by 2050⁵. This commitment sought to align with the Paris Agreement, signed by 196 countries at the UN's 2015 COP-21 conference in Paris, which agreed to limit the global temperature rise to 2 degrees, and preferably no more than 1.5 degrees. These temperatures are seen as the upper limit to us avoiding the impacts of 'catastrophic, runaway climate change'.

Net zero refers to achieving an overall balance between the emissions produced and emissions taken out of the atmosphere. This is in contrast to a gross zero target, which would reduce emissions from all sources to zero. A net zero emissions target is more realistic because it allows for some residual emissions.

In a net zero scenario, the residual emissions are offset by actively removing the same quantity of emissions from the atmosphere. While agriculture is a significant contributor of greenhouse gas emissions, its management of land means that it is also uniquely placed to sequester carbon from the atmosphere through solutions such as tree planting, improving soil health and use of renewable energy. A number of companies, including many retailers, are also setting their own net zero ambitions.

Retailers moving towards net zero

2040 Sainsbury's

Net zero business across its own operations by 2040⁶

2050 Tesco

Reduce absolute carbon emissions 100% by 2050⁷

2040 Asda

Net zero business across its own operations by 2040⁸

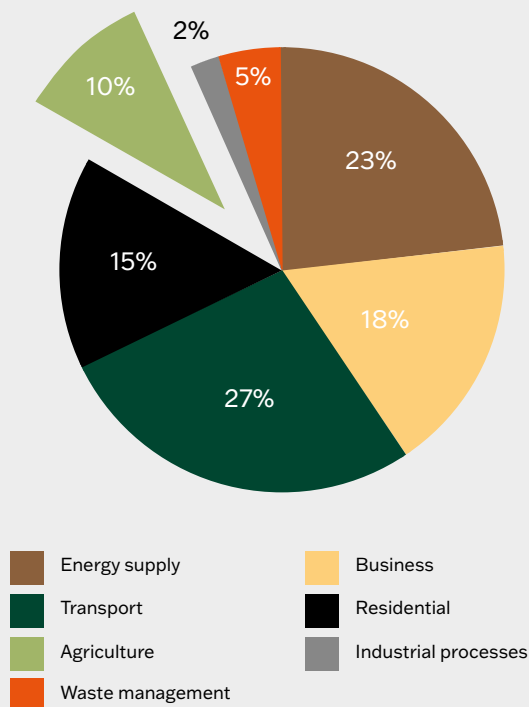
Why is the agricultural sector so important?

Farming is a hugely significant industry in the UK. Agriculture contributes up to 60% of the UK's food stock, employs nearly half a million people annually and delivers £24 billion of revenue to the UK economy⁹. Farmers, estate and land owners manage over 70% of the UK's land stock and are therefore responsible for the management and protection of vital habitats and wildlife⁶. And while the sector has made important strides in improving productivity while decreasing its environmental footprint over recent years, agriculture still contributed 10% of the UK's total greenhouse gas emissions in 2018¹⁰ (Figure 1). The sector is therefore expected to go on a steep decarbonisation journey in order to meet the NFU's goal of net zero by 2040.

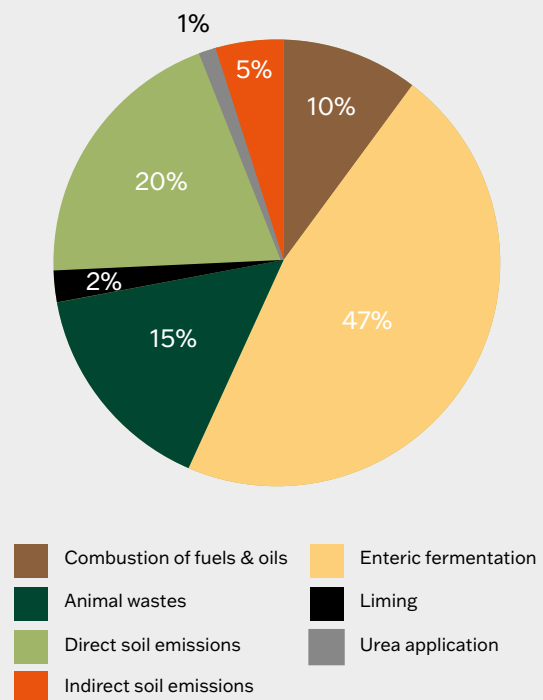
Figure 1

Total greenhouse gas emissions in the UK from agriculture in 2018 and by source¹⁰

2018 total greenhouse gas emissions per sector



2018 agricultural greenhouse gas emissions by source



The impact of climate change

The fact that the climate is changing and growing dangerously warmer is now embraced by scientists, economists and communities around the world. The average global temperature between 2015 and 2019 was the warmest of any equivalent period on record¹¹. The coldest place on earth is also warming at an unprecedented rate, with arctic sea ice melting by an average of 12% every decade between 1979 and 2018¹². Some predict that arctic summers may be entirely ice-free within the next 20 - 30 years¹⁰.

With such change comes major environmental and economic risks. Increased frequency and severity of extreme weather events such as floods, droughts, hurricanes and fires – jeopardises the safety and livelihoods of farming businesses, communities, nature and biodiversity, and the economic value of particular assets.

The impact of climate change is already being felt within the UK. The UK's ten hottest ever years have all occurred since 2002 and weather observations for 2018 showed that the summer was the warmest in the UK since 2006 and the driest since 2003¹⁴. 2019 also marked the end of the warmest decade on record since the mid-19th century.

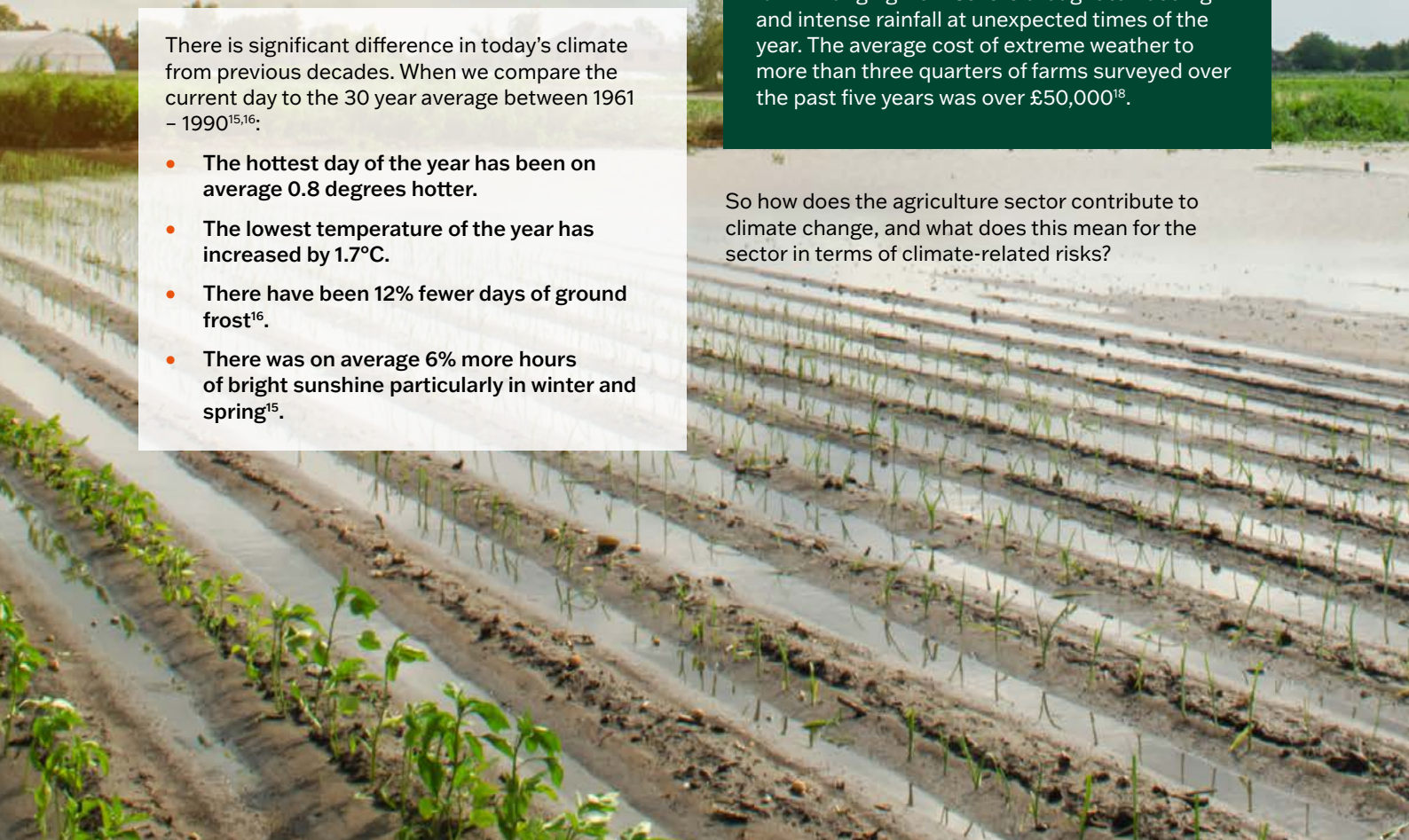
The impacts of extreme weather events are also being experienced in the UK. The heatwave in July 2019 set the country's all-time highest temperatures (as it also did for Belgium, Germany, Luxembourg and the Netherlands) and three named-storms in a row made February 2020 the wettest February on record, costing an estimated £363 million in damage¹⁴. The average British farmer is also experiencing the physical and economic impact of a warming climate.

There is significant difference in today's climate from previous decades. When we compare the current day to the 30 year average between 1961 – 1990^{15,16}:

- The hottest day of the year has been on average 0.8 degrees hotter.
- The lowest temperature of the year has increased by 1.7°C.
- There have been 12% fewer days of ground frost¹⁶.
- There was on average 6% more hours of bright sunshine particularly in winter and spring¹⁵.

When surveyed by Farmers Weekly, more than four out of five farmers say they are experiencing more frequent extreme weather events on their farm – ranging from severe drought to flooding and intense rainfall at unexpected times of the year. The average cost of extreme weather to more than three quarters of farms surveyed over the past five years was over £50,000¹⁸.

So how does the agriculture sector contribute to climate change, and what does this mean for the sector in terms of climate-related risks?



Agricultural Greenhouse Gas emissions

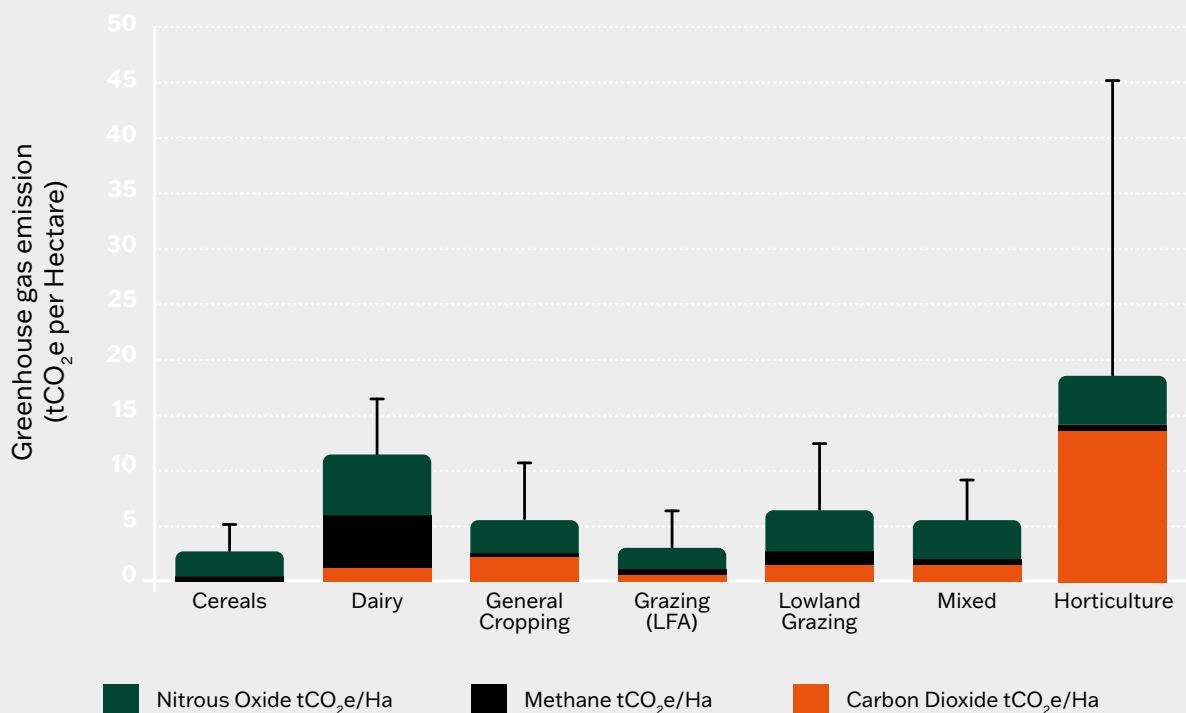
Emissions from the agriculture sector accounted for 10% of the UK's total emissions in 2018 which is the highest share since 1990¹⁰. The UK's agriculture sector faces the challenging task of continuing to feed a growing population and meet changing consumer preferences whilst reducing emissions which are much harder to reduce than other sectors.

The emission sources of agriculture are in stark contrast to the rest of the economy, where the majority of emissions are from carbon dioxide. In agriculture only 13% of emissions are carbon dioxide, 31% are nitrous oxide and 56% are methane^{1,2,10}. The most emission intensive agricultural sectors per hectare are horticulture, dairy and lowland grazing (Figure 2).

There has already been great progress made in reducing emissions from agriculture. Between 1990 and 2017 emissions of nitrous oxide decreased by 17% and methane emissions decreased by 15%¹⁴. But more needs to be done.

Unlike carbon dioxide and nitrous oxide, methane is a short-lived greenhouse gas and does not accumulate in the atmosphere. Methane does however have a global warming potential 28 times that of carbon dioxide. Methane emitted into the atmosphere is removed by chemical reactions, known as "sink" processes through the natural carbon cycle, so that only about half will remain after a decade. The warming from methane emissions largely depends on the sustained rate of emissions rather than the overall amount²⁰.

Figure 2
Emissions per hectare from agricultural sectors and contribution of each greenhouse gas¹⁹



Managing climate related risks

Climate related risks to your business can include both physical and transitional risks. Physical climate risks include both the impacts from specific events like floods, and from longer-term changes such as changes in temperature and precipitation leading to drought and heat stress. Transitional risks result from the policy, legal, technology and market resulting from the shift to a low carbon economy.

Climate related impacts are already occurring through gradual change and as a result of more rapid changes triggered by extreme weather events^{16,21}.

Physical risks

Flooding

Increased risk of flooding – up to 50,000 ha flooded once every three years in low lying flood prone areas is likely²².

Drought

Periods of summer drought are becoming more frequent, especially in the south of the UK as summer temperatures are rising and rainfall decreasing.

Water demand

Water scarcity is increasing as water demand from the country's rising population surpasses the falling supply during periods of low rainfall.

The Environment Agency warns that catchments with irrigated agriculture are already over-abstracted with limited availability of more water for irrigation²³.

Heat stress

Risk of increased occurrence of heat stress within the livestock sector, especially in the pig, poultry and dairy sector. High humidity and temperatures can result in 5-15% decline in milk production and can lower conception rates²⁴.

Depleted soil

Soil health is being depleted as climate impacts soil moisture and organic matter. It is estimated 2.9 million tonnes of topsoil is lost each year in the UK²⁵.

Transitional risks

Policy change

Changing policy frameworks could pose material challenges for the sector, as they may impact the transition to a low-carbon economy. Such changes include:

- New legislation (e.g. Environment Bill and Agriculture Bill)
- New regulation (Clean Air Strategy)
- Transition away from CAP subsidies

Consumer pressure

Shifting diets and consumer demand for alternative protein is growing. 21% of consumers are looking to reduce red meat consumption, whilst plant based meals have grown 23% since 2015^{26,27}. Vegan meals are now the fastest growing dietary category on menus within the restaurant sector²⁶.

Supply chain pressure

Increasing demands from retailers for climate friendly, low carbon food is evident. This reflects data that shows 59% of consumers are interested in the environmental credentials of food products²⁶. All major supermarket retailers now have net zero targets.

Recommendations to help your business transition to net zero

We are committed to supporting farmers and the wider agriculture sector reduce their emissions and transition to a net zero future. The following recommendations from leading agricultural industry bodies and the scientific community are the most impactful activities you can undertake at farm level to begin your net zero journey.

- 1 **Measure your farm's carbon footprint**
- 2 **Plant trees and hedgerows to sequester carbon**
- 3 **Improve farm productivity and efficiency**
- 4 **Invest in low carbon agri-technology**
- 5 **Boost renewable energy generation**
- 6 **Improve soil health**
- 7 **Restore peatlands**

"Climate change is a huge threat to farming in the UK. Agriculture must play its part in getting to net zero emissions, and that will involve tough choices. But, we must do it in a way that maintains food production in the UK."

Neil Parish MP

Chair of the Environment,
Food and Rural Affairs Committee²⁸

1

Measure your carbon footprint

Every farm will start the journey to net zero from a different place and will need a unique action plan to achieve emission reductions. As a starting point, we recommend that farms take stock of their carbon footprint by completing an assessment using a carbon calculator. Calculating your farm's carbon footprint will allow you to:

- Identify sources of emissions on the farm.
- Create a baseline of emissions to monitor progress.
- Benchmark emissions against similar food product categories (e.g. milk or wheat).
- Identify potential cost savings.
- Investigate the impact of making changes on the farm by testing scenarios.
- Build an evidence base to report emissions to key industry bodies.
- Gain a better understanding of low carbon farming practices.
- Respond to growing consumer demand for lower carbon farming produce.
- Demonstrate your sustainability credentials and activities to your customers and stakeholders.

There are a number of options for carbon calculators. In order to get your started with your choice we have highlighted three market-leading offerings below. While each of the carbon calculators are self-serve, we are happy to make introductions to the tool of your choice if that would be helpful.

Carbon footprint calculator	What does it cost?
Farm Carbon Calculator The Farm Carbon Calculator gives a numerical and visual estimate of the greenhouse gas emissions across all farming enterprises (using current internationally agreed emission factors) and shows how they might improve with any proposed changes to that farming system. It also uniquely provides an estimate of the amount of carbon sequestration that a farm is achieving. e: info@farmcarbontoolkit.org.uk w: www.farmcarbontoolkit.org.uk	Free for farmers
Agrecalc Agrecalc is a carbon footprint tool designed to identify the level and sources of greenhouse gas emissions by farm, enterprise and product. It allows improvements to be monitored and can help benchmark key performance indicators using an extensive farm database. e: info@agrecalc.com w: www.agrecalc.com	Free for measurement of your annual footprint; more detailed benchmarking and scenarios start at £59 a year
Cool Farm Tool The Cool Farm Tool is an online calculator that enables farmers to measure their greenhouse gas emissions and understand mitigation options for agricultural production. The Cool Farm Tool is a product footprint tool, not a whole farm tool. It is used by many food companies to measure emissions, such as Unilever. e: info@coolfarmtool.org w: www.coolfarmtool.org	Free for farmers

2

Plant trees and hedgerows to sequester carbon

Tree planting and reforestation is increasingly hailed as one of the most natural and powerful ways to fight climate change. With trees and hedgerows' natural ability to absorb carbon dioxide from the atmosphere, they act as one of the world's largest 'carbon sinks'. It is for this reason that the Committee on Climate Change (CCC) has recommended that the UK increase its woodland cover from 13% to 19% in order to meet the UK's net zero goal by 2050²⁹.

Increasing woodland cover from 13% to 19% by 2050 is the equivalent of planting 90 million trees or 30,000 hectares each year²⁹.

Trees and hedgerows also play a critical role in a farm setting, improving soil health, providing shade and shelter from extreme weather conditions, and enhancing biodiversity and wildlife.

Given the importance of trees to a net zero future, we're delighted to have partnered with the UK's pre-eminent woodland conservation charity, the Woodland Trust, to plant millions of trees across the country by 2030. Our commitment to the reforestation agenda will see landowners in the agriculture sector receive significant subsidies for the purchase of trees and hedgerows via the Woodland Trust.

The cost of planting trees could be subsidised by up to 75% via our partnership with the Woodland Trust.

AMC has committed to plant millions of trees by 2030 to support the agriculture sector transition to net zero by 2040.

To find out more about this partnership and the offer to you, please see the appendix on page 20.

Why are trees and hedgerows so vital to tackling climate change?

Trees act as a carbon sink: Trees capture carbon from the atmosphere and transform it into biomass during the process of photosynthesis. Planting trees is one of the most effective ways for landowners to tackle climate change and decarbonise their land.

Trees protect the soil: Nearly 2.9 million tonnes of topsoil are eroded in the UK every year²⁵. By strategically planting trees, farmers can build natural barriers to protect soil and crops from the full impacts of strong winds and intense rainfall.

Trees provide protection against drought and floods: When it's hot, trees provide shelter and shade to reduce heat stress, for soil, crops and livestock. Shelterbelts help to modify the crop microclimate by reducing wind speeds and evapotranspiration losses, preventing crops from becoming water stressed. Shelterbelts, riparian planting and buffer strips across catchment-wide areas can improve water infiltration and control flood peaks.

Trees are crucial to preserving biodiversity: Woodland species continue to decline with 25% of woodland bird indicator species declining between 1970 - 2017³⁰. Woodland planting is a critical way to create ecosystems which support biodiversity and the protection of different woodland habitats.

Expand and widen hedgerows and boundaries: Hedgerows provide a large range of carbon and environmental benefits, such as cover for pollinating insects, plus shelter and containment for livestock. They also act as windbreaks, reducing soil erosion and improving efficiency of water use by crops.

"Through tree and hedge planting, land managers have an opportunity to exploit a simple and affordable way to future proof landscapes against shifts in weather and climate"

William Stiles
Aberystwyth University³¹

3

Improve productivity and efficiency

There are a number of ways to improve agricultural productivity and efficiency while also reducing your carbon footprint – and in fact many new farming practices have sustainability at their heart. The ambition of these new practices is to support you to produce the same quantity of food, or more, with fewer inputs, in smarter and more carbon-efficient ways.

Unlike other sectors where emissions are mainly carbon dioxide, agriculture is unique as the major greenhouse gases emitted from the sector are nitrous oxide and methane.

70% of the UK's total nitrous oxide emissions and 49% of total methane emissions come from agriculture¹⁰.

Reducing emissions of these two greenhouse gases is key to decarbonise the sector and transition to net zero. This section focuses on management practices and efficiency gains that can be made on farm that will help reduce emissions of these two greenhouse gases whilst also boosting productivity.

Reducing nitrous oxide emissions

- The use of controlled release fertilisers and urease inhibitors can increase nitrogen use efficiency and reduce nitrous oxide emissions by 15 – 25% whilst reducing costs associated with fertiliser inputs³².
- Precision farming can deliver nutrients and crop protection products more efficiently with variable rate spreaders and sprayers now having a payback period of between 2 – 8 years³³.
- Increased use of organic manures and better accounting of nutrients can reduce use of mineral fertilisers.

An arable farmer in Yorkshire was able to reduce mineral nitrogen application rate by 20-25 kg/ha by making better use of organic manures and digestate³⁴.

- Loosening compacted soils and improving soil health through regenerative agriculture and minimum till will help minimise nitrous oxide emissions from soil.
- Precision agronomy practices, planning crop rotations and variety selection will all assist in lowering emissions of nitrous oxide whilst also improving crop yields.

Reducing methane emissions

- Improved animal health in livestock and dairy systems can reduce methane emissions by improving feed conversion rates, raising fertility, reducing mortality, and increasing growth rates and milk yields.
- Feed additives such as tannins that can be mixed with rations are emerging as an option to reduce fermentation and the release of methane from digestion³⁵.
- Gene editing and breeding the next generation of cows can assist reduce methane emissions by improving animal health and performance.
- Altering fat and crude protein content of animal diets can help reduce emissions and improve conversion of protein more efficiently into milk and meat products.
- Increasing stocking density accompanied by a sustainable grazing management plan can help maximise grassland utilisation rates, improve forage quality and lower emissions through efficiency gains³⁵.

New Zealand researchers found that the trait for emitting methane is 20% heritable for sheep so by breeding lower emitters, it was possible to reduce the amount they produced after a few generations³⁶.

4

Invest in low carbon agri-technology

Adopting agri-tech solutions on farm is increasingly seen as a critical path to improving productivity and efficiencies on farm, whilst also reducing emissions. A rapidly growing market, the UK's agri-tech sector is worth more than £14 billion to the UK economy and employs over 500,000 people⁹. Sustainable intensification by investing in agri-tech aims to improve productivity with reduced inputs and lower environmental impact. Vertical farming, as an example can provide 4-6 times more growth surface area whilst lowering overall carbon dioxide emissions by 67-92% when compared with greenhouses or polytunnels³⁷.

Agri-tech options for net zero

Precision agriculture <p>Precision agriculture technology in the arable sector such as controlled traffic, variable rate application and crop sensors.</p> <p>Precision agriculture in potatoes can increase profit by up to 21% or 420 €/ha³⁹.</p>	Improved crop genetics <p>New crop breeds made available through accelerated genetic discoveries.</p> <p>Average growth in yield has been between 0.6% to 2.0% per annum since 1984 thanks to breeding improvements⁴⁰.</p>	Cloud-based tools <p>Online cloud hosted management tools and software platforms to measure and monitor inputs and outputs.</p> <p>Estimated that an average farm can increase yield by 1.75% using cloud-based tools⁴¹.</p>
Livestock monitoring <p>Livestock sensors and tags to monitor animal behaviour for dairy, beef, pigs and poultry.</p> <p>Livestock sensors can increase milk yield by up to 10%⁴².</p>	Robotics & drones <p>Robotics, drones and autonomous vehicles to lower labour costs and improve accuracy and efficiencies.</p> <p>Robotic milking systems are gaining popularity with a 6 – 15 year payback period for return of investment⁴³.</p>	Controlled environment farming: <p>Controlled environment farming includes systems such as: vertical farming, hydroponics or aeroponics.</p> <p>Controlled environment farming can increase yields by up to 2.5 times, but many systems require significant upfront investments and have high running costs⁴⁴.</p>

Investing in agri-tech case study

The Netherlands is a small, densely populated country, with more than 1,300 inhabitants per square mile⁴⁵. Despite not having large amounts of agricultural land, it is the globe's number two exporter of food as measured by value. The Netherlands is the world's top exporter of potatoes and onions and the second largest exporter of vegetables overall in terms of value⁴⁵. How have Dutch farmers been able to achieve this level of productivity with limited land? The answer lies in investment in agri-tech.

In a potato field near the Netherlands' border with Belgium, Dutch farmer Jacob van den Borne prepares for harvest. He utilises two drones, a driverless tractor roaming the fields and a quadcopter in the air⁴⁵. This technology provides detailed readings on soil chemistry, water content, nutrients, and growth, measuring the progress of every plant down to the individual potato. Van den Borne's production numbers testify to the power of this investment in precision farming technology. The global average yield of potatoes per acre is about nine tonnes. Van den Borne's fields reliably produce more than 20 tonnes per acre demonstrating significant advances in productivity⁴⁵.

"With the technological revolution that is happening, the skills of the farming workforce need to keep pace. New technologies require new abilities and today's modern British farmer is a Swiss-Army-Knife of skills. An engineer, an environmentalist, a data scientist a biochemist, an energy producer, a tourism entrepreneur, and an investor too"

Greg Clarke
Business Secretary, 2018³⁸

5

Boosting renewable energy

Boosting renewable energy and the bio-economy to displace greenhouse gas emissions from fossil fuels is a key part of the NFU ambition for achieving net zero².

Renewable energy

Nearly 40% of farmers in the UK are using the sun, wind, farm by-products and energy crops to produce clean, low-carbon energy⁴⁶. Renewable energy on the farm reduces reliance on fossil fuels, ensures energy security, decouples the farm from global energy price fluctuation, provides alternative revenue and lowers the farm's carbon footprint. Renewable energy on farm can include:

- Wind
- Solar
- Biomass boilers
- Heat recovery and exchange systems
- Ground source heating

A 100kW solar scheme will payback in approximately 9-15 years whilst a biomass boiler system will payback in approximately 5 - 7 years.

Circular waste streams such as anaerobic digestion

Anaerobic digestion (AD) converts animal manures, food waste, crops and crop by-products into renewable energy. In 2019 there were almost 500 AD plants in operation in the UK, with a further 343 under development⁴⁷. AD plants can help the agricultural sector transition to net zero by offering farmers additional income, produce renewable energy and organic fertiliser (digestate), and improve waste management.

There are a number of different options available for becoming involved in AD. You can build your own plant, lease land to an AD developer, grow and sell crops for AD, join an AD co-operative, or go with a combination of these options. A small-scale AD plant (c. 45-50kW) is likely to payback between 9-13 years.

Bioenergy crops

Bioenergy provides around 7% of the UK's primary energy demand⁴⁸. The growth of the bioenergy sector, and associated crop expansion can provide two key benefits to deliver net zero:

1. Its growth removes carbon dioxide from the atmosphere and stores it for long periods of time in soils, trees and other plants.
2. When managed and harvested in a sustainable way, bioenergy crops can also be used to reduce fossil fuels emissions by directly displacing oil, coal and natural gas.

In 2018, agricultural land provided 94,000 hectares of land for bioenergy crops¹⁴. Of which, 84,000 hectares were arable crops – wheat sugar beet and maize. Biomass crops (miscanthus and short rotation coppice (SRC)) comprised 10,000 hectares of land.

Farms interested in this alternative land use should focus on:

- Assessing land parcels which would be better prioritised to energy crops.
- Understanding market demand factors to build confidence at farm level.
- Establishing a fair contract with end users and protocols of equitable distribution of risk.
- Investing in technology and local bioenergy markets.

6

Improve soil health

Soils are the second largest carbon sink after our oceans, storing three times more carbon than is found in the atmosphere⁴⁹. UK soils contain approximately 94% of the total carbon stored in the biosphere with vegetation containing 6% of the total⁴.

Soil carbon comprises 47% of the mitigation potential for agricultural areas and grasslands by a mixture of protecting existing soil and restoring depleted stocks⁵⁰. This issue is particularly acute in the UK as an estimated 84% of fertile topsoil has been lost since 1850⁵¹. Improved farming practices and alternative land uses are needed to rebuild the soil's carbon stores and prevent the loss of greenhouse gases from soil.

- **UK soil is a hugely important carbon store** containing the equivalent to 80 years of the country's annual emissions⁵².
- **Intensive agriculture has caused arable soils to lose 40 - 60% of their organic carbon** and some parts of the country such as fenland could be only 30 - 60 years away from eradication of soil fertility⁵².
- **The economic impact of soil degradation in England and Wales is estimated to cost £1.2 billion a year**, impacting greenhouse gas emissions, reducing agricultural production, increasing flooding and poorer water quality⁵².



Maximising soil health

Building overall soil health, and particularly soil organic matter to help store carbon is vital if agriculture is to reach net zero whilst maintaining food production. Soil health can be improved through a holistic approach to soil management including:

Ameliorate soil compaction: Careful management and timing of cultivation and grazing pressure will assist to reduce soil compaction. Reduce trafficking of soils and use of precision agriculture and agri-tech can reduce compaction from heavy machinery and high risk cultivation practices. Compacted arable soils can need up to twice as much fertiliser to maintain crop yields⁵³.

Prevent erosion: Integrating trees into arable crops using shelterbelts and along the field boundaries has been shown to increase crop yields and potentially reduce soil erosion by at least 3%⁵⁴.

Maintain cover: Protect soils from erosion by ensuring complete ground cover in grasslands, retain crop residues, use cover crops and manage grazing pressures. Using deep rooted cover crops in the rotation can also assist in improving drainage and reducing sediment and nutrient loss by up to 80%²⁵.

Improve soil structure: Implementing minimum till cultivation and regenerative grazing practices to improve soil structure and reduce compaction will help to reduce emissions from the soil and reduce amount of mineral fertiliser needed.

Increase organic matter: Over half of the soil carbon is contained within the top 30cm of the soil⁵². Incorporating organic manures and crop residues with reduce cultivation all help to reduce losses of organic matter.

Soil health is the biggest environmental issue facing us. It is vital that a bright spotlight is shone on the need to restore soils, not only for the benefit of the environment that we all depend upon, but for our food security too."

Tony Juniper

Chairman of Natural England⁵⁵

7

Restore peatlands

Peatlands are a key part of the UK's landscape, covering 12% of the UK's land area³. Both upland and lowland peatlands are significant carbon sinks with 57% of the UK's soil carbon stored in peatland⁴. It is estimated however, that only 20% of this peatland remains undamaged^{52,56}.

As a result of modification, drainage and damage, UK peatlands have switched from a carbon sink to a source of emissions now contributing approximately 4% of the UK's total greenhouse gas emissions³. The restoration of peatlands is therefore key to reducing emissions and enhancing the sequestration and long term storage of carbon from the atmosphere.

Restoring at least 50% of upland peat and 25% of lowland peat would reduce agricultural emissions by 10%²⁹.

Lowland peat has been particularly damaged in the UK by draining the soil to make it suitable for crop production, especially areas such as the East Anglian Fens and the Somerset Levels where over a third of the UK's fresh vegetables are grown⁵⁷. There is a high risk that more peatlands will be lost due to hotter and drier conditions in the changing climate unless they are restored²⁹.

Actions to restore peatlands

To prevent erosion and loss of carbon emissions from peat soils:

- Use cover crops within crop rotations to help maintain organic matter.
- Invest in agri-tech and precision agriculture to implement zero and minimum till cultivation techniques.
- Adapt grazing regimes to suit sensitive habitats and avoid poaching and creation of bare ground.
- Consider whether repeated burning of moorland is necessary as this can damage habitat and compromise grazing.
- Consider grip blocking, drainage and re-wetting of peat soils to restore natural functioning of peatland.

There is a recognised need for financial incentives and support to be made available for farmers who experience income foregone from the loss of agricultural productivity following peatland restoration. Such incentives may include public funding from Government, private funding from water companies or use of carbon market mechanisms.

Benefits of peatland restoration



Climate regulation

Carbon removed from the atmosphere is stored in the peat and can remain there for millennia provided the habitat remains wet⁵⁸



Water quality

Peatlands are extremely important for ecosystem services such as provision of drinking water, providing flood defences and regulating flows⁵⁶.



Biodiversity values

Provide distinct high value habitat for many rare and threatened species.



How we can help

While the transition to net zero will not necessarily be easy, and will require change, we are committed to working closely with the sector on its transition to a low-carbon economy. Our Regional Agricultural Managers have received sustainability training from the world-leading University of Cambridge Institute of Sustainability Leadership. Alongside our extensive network of Land Agents they can work with you to understand and develop your plans and to arrange suitable funding to assist you to manage both the opportunities and risks presented by climate change.

Support we can offer:



Our Regional Agricultural Managers and network of AMC land Agents can help support you.

Contact us to find out more.

Appendix:

Partnering with the

Woodland Trust

Given the importance of trees to a net zero future, we are working with the Woodland Trust, the UK's pre-eminent woodland conservation charity, to plant millions of trees across the UK by 2030. Our commitment to the reforestation agenda will see a significant proportion of those trees planted on agricultural land, where trees will be heavily subsidised for landowners, to support their achievement of net zero by 2040.

The planting of trees and hedgerows on agricultural land is critical to decarbonising the agriculture sector. Planting of trees and hedgerows is also key to expanding the UK's tree numbers to align with the national strategy to become net zero by 2050.

In addition to working with farmers and landowners, this partnership will plant 10 new areas of woodland across the UK, and support up to 3000 schools and community groups to plant trees in their local communities.

The offer to you

Subsidised tree and hedgerow planting: If you have over half a hectare, or 100 - 250m of space to plant a new hedgerow, you could unlock a significant discount of up to 75% to plant trees or hedgerows on your land.

Woodland creation advice: The Woodland Trust Creation Team offer tailored advice on woodland design, ensuring the most appropriate spacing and species mix.

Woodland Trust specialist support throughout: You will have access to a dedicated Woodland Trust project officer who'll help guide your application from start to finish. Either plant the trees yourself, or the Woodland Trust can arrange planting for you at a significantly subsidised rate.

How to apply

1. Register your interest in this programme by applying through www.woodlandtrust.org.uk/amc. The Woodland Trust will then arrange a call with you to discuss your requirements, and your Regional Agricultural Manager can also join if you wish.
2. In general, if your project is under 0.75ha (around 1,000 trees) the planting plan and arrangements can be agreed over the phone. For larger sites and those over 0.75ha a site visit will be arranged with a Woodland Creation Advisor.
3. Once you have approved the design of your woodland you will be asked to sign the Woodland Trust landowner agreement. Smaller woods and hedgerows will not require a landowner agreement.
4. Your trees will be delivered on an agreed date between November and March, to coincide with the tree planting season, and if your wood is being planted by the Woodland Trust, a contractor will plant your trees within a week of their arrival.



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