Shaping agriculture's transition to a net zero future

BANK OF SCOTLAND

By the side of business

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Executive Summary

We recognise that climate change is one of the biggest challenges facing the UK today. Because of this, sustainability is 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's why we are committed to helping our clients' 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, in Scotland it is set at 2045. Broadly this implies that the sector is required to halve its carbon footprint by 2030. The National Farmers Union (NFU) has set the agriculture sector an even more ambitious goal of transitioning to net zero by 2040.

The scale of the NFU's ambition is matched by the scale of the challenge ahead. The agriculture sector contributes 19% of Scotland's total greenhouse gas emissions, and is unique in the type of emissions it contributes – 31% of emissions are nitrous oxide, 56% are methane, and 13% are carbon dioxide. This differs from other sectors which are mostly carbon dioxide intensive. The sector is also unique in its ownership and management of 80% of Scotland's land stock, providing an important 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.

During the release of our first agriculture report in July 2020 **Shaping Agriculture's Transition to net zero**, we were witnessing the implications of the coronavirus pandemic impact on the sector. Some of those challenges still remain, however additional challenges have been created by changes in both the economic and political outlook as well as the Russia-Ukraine war.

The purpose of this second edition of our agriculture report is to continue to support the sector by outlining practical tips, signposting and finance solutions 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.

We are committed to working together to understand and tackle the challenges posed by climate change, while also pursuing the many opportunities it presents.

This year, we are working with the Soil Association to pilot a new service that will help farmers accelerate their transition to net zero and identify financial and environmental advantages for their land.

Soil Association Exchange is designed to help farmers improve the ecological footprint and overall sustainability of their operations. The holistic approach will cover soil health, carbon emissions, water quality, biodiversity, animal health and safety and the social aspects of the farms' operation.

The transition to a greener, healthier planet will not always be easy, however we continue to look forward to working together on the transition to a sustainable, low-carbon future.

Lee Reeves

UK Head of Agriculture

Progress towards net zero in the UK

In 2019, the UK 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 2050[1], Scotland is committed to net zero by 2045. This commitment sought to align with the Paris Agreement, signed by 196 countries at the UN's 2015 COP21 conference in Paris, which agreed to limit the global temperature rise to well below 2°C, and preferably no more than 1.5°C[2]. These temperatures are seen as the upper limit to us avoiding the impacts of 'catastrophic, runaway climate change'.

Net zero is set to shape the coming decades within the agricultural sector, highlighted by the NFU target for the sector to transition to net zero by 2040[3]. This challenge comes at a time when the sector faces unprecedented turbulence as an outcome of the coronavirus pandemic and a shortage of workers, both of which have been deepened further by the implications of the Russian invasion of Ukraine affecting cost and availability of feed, fuel, and fertiliser.

Recent years have seen a series of historically significant global summits to address climate change and biodiversity loss. Global climate commitments resulting from the UK's COP26 Presidency, included ending deforestation and reducing methane emissions by 30% (both by 2030)[4,5], whilst COP27 in Sharm-el Sheik reaffirmed the vital role of agriculture in achieving global climate goals and established a reparations fund for communities facing the worst impacts of climate change. At COP15, the UN Biodiversity Conference in Montreal, sustainable farming practices were promoted to achieve its '30 by 30' target to protect at least 30% of the Earth's ecosystems by 2030. These developments will increase in influence in the UK agricultural sector as the decade goes on.

> "Agriculture is uniquely placed to contribute as a driving force behind the UK's net zero ambitions, as both an emissions source and a sink too."

Farmers are responsible for managing around 80% of Scotland's land area[6] and will play a vital role in implementing net zero plans by protecting and building carbon reserves in our soils and vegetation, as well as limiting emissions which currently amount to 7.4 million tonnes of carbon dioxide (CO_2) equivalent a year[7]. The sector's 19% contribution towards Scotland's total greenhouse gas emissions is unique in both the type and balance of emissions – 56% are methane, 31% are nitrous oxide and 13% are carbon dioxide[8]. Emissions from most other sectors are mostly carbon dioxide.

Progress towards net zero in the UK (continued)

What is net zero?

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 (Figure 1). A net zero emissions target is more realistic because it allows for some residual emissions.

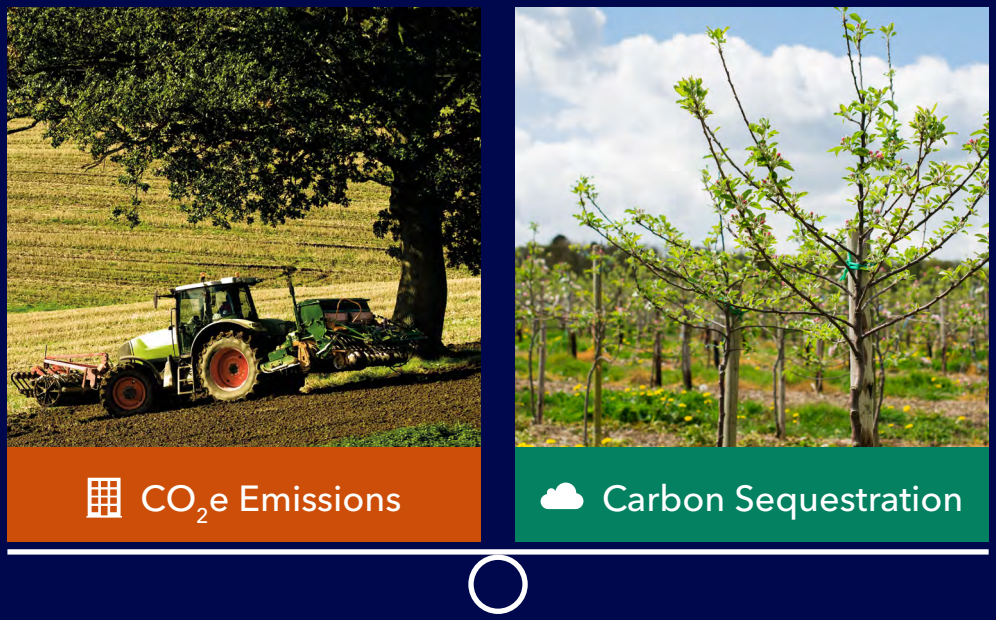


Figure 1. The net zero balance between greenhouse gas emissions produced and the amount removed from the atmosphere.

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 and improving soil health.

With the goals of net zero now widely recognised, the role of agriculture in decarbonisation must extend beyond low-carbon energy as the industry is expected to deliver a response to demonstrate to consumers and investors that agriculture and food is committed to a low carbon transition. At its heart, this means enhanced sequestration of carbon in our soils, trees and hedgerows, enhanced biodiversity and stewardship of our wider habitats and ecosystems. In order to progress along the pathway to net zero, agriculture must collaborate across the supply chain to collectively limit emissions, whilst adopting emerging technologies and practices to best maximise the resources available to us.

Progress towards net zero in the UK (continued)

Progress towards net zero

The UK's international leadership in climate commitments is not currently being matched with tangible progress on emission reduction, as highlighted by the independent Climate Change Committee (CCC) in its latest progress report to Parliament[9]. There remain significant steps to achieve a cut of 68% from our 1990 emissions by 2030 given emissions in 2021 were 47% below 1990 levels (Figure 2). The CCC outlines a particular lack of progress in agriculture and land use in the low-carbon farming and productivity measures needed to decarbonise the agriculture sector, i.e. tree planting and peatland protection.

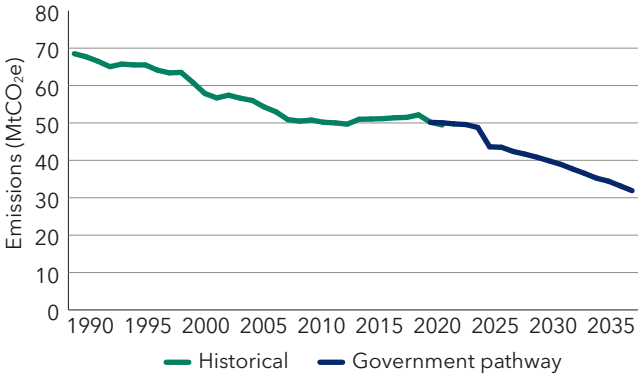


Figure 2. UK historical agriculture emissions compared to the Government's net zero pathway[9].

The challenge of keeping pace with the Government pathway goes beyond farmers and land owners. The UK Government's Food Strategy seeks to address this by unifying net zero strategies across the agri-food supply chain to create a 'more prosperous agri-food sector that delivers healthier, more home-grown and affordable diets'[10]. Dietary change has, however, been highlighted as a missing link within the strategy. The CCC has proposed a move to 'less but better meat and dairy' and plant-based alternatives, with a 20% reduction in meat and dairy by 2030 and 35% reduction in meat by 2050 required to keep pace with the net zero pathway[11]. Achieving these targets would release the 21% of agricultural land required for carbon sequestration measures, climate adaption and biodiversity, with the potential to drive down emissions at the scale and pace required to match the UK's net zero pathway.

Many of the top retailers have now set their own net zero targets in recognition of their responsibilities and contribution to limiting emissions within the agri-food supply chain. Some of these are highly ambitious and will require strong collaboration with farmers to achieve the scale of change required.

Retailers moving towards net zero

Morrisons – net zero across own operations by 2035 & directly supplied by 'net zero' carbon British farms by 2030

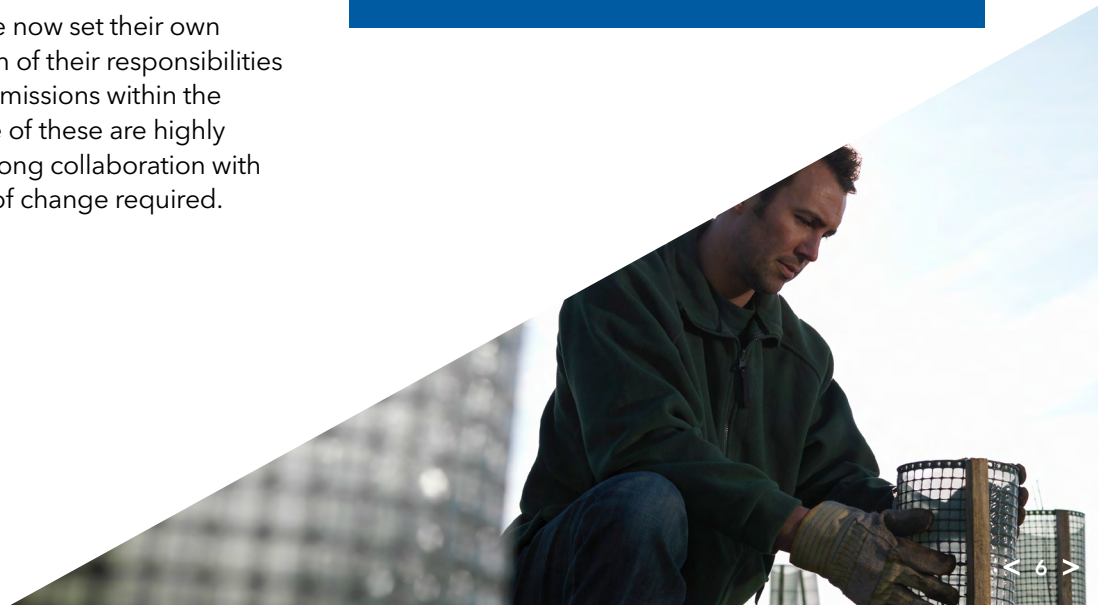
Sainsbury's – net zero across own operations by 2035

Tesco – net zero across own operations by 2035 & reduce absolute carbon emissions 100% by 2050

Asda – net zero business across its own operations by 2040

Aldi – carbon neutrality across own operations achieved in 2019

M&S – net zero business across its entire value chain by 2040



Why are agricultural emissions so important to net zero?

Agriculture has a vital place in economic and everyday life in Scotland. UK agriculture provides over half of the food we eat, employs almost 130,000 people annually and is a key part of the food and drink sector, which contributed £15 billion to the Scottish economy in 2021[6]. Farmers, estate, and land managers manage 80% of Scotland's land stock and therefore have the stewardship of safeguarding our habitats and wildlife whilst ensuring the highest standards of animal and plant health[7].

Key stakeholders in Scotland's agriculture sector face a difficult balancing act of reducing emissions through changes in practices and investments, whilst remaining under financial pressure to sustain yields and outputs to feed a growing population.

In 2020, emissions from agriculture accounted for 19% of Scotland's emissions (Figure 3). This comprises 3.8% of Scotland's total carbon dioxide emissions, 62% of total nitrous oxide emissions and just under half of total methane emissions. This contribution to Scotland's emissions is reflective of the difference in emission characteristics and profile versus other industries, which are often carbon intensive. In agriculture only 13% of emissions are carbon dioxide, 31% nitrous oxide and 56% methane[8]. 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[9].

2020 agricultural greenhouse gas emissions by source

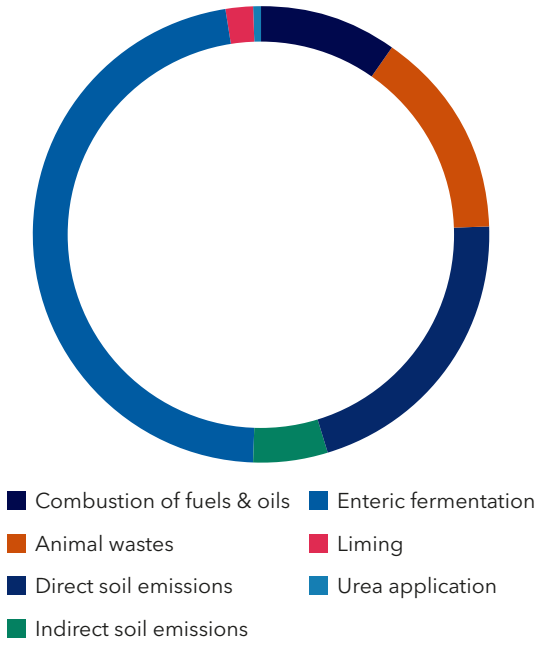


Figure 3. Total UK greenhouse gas emissions per sector in 2020 and by agricultural source[7].

Why are agricultural emissions so important to net zero? (continued)

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 amount[12].

The most emission intensive agricultural sectors per kilogramme output are beef and lamb production[13], with lamb production emissions cradle-to-farmgate at an average of 14.4 $kgCO_2e/kg$ bone-in carcass weight (Figure 4). In comparison, average emissions from arable and horticultural production are around 0.4 $kgCO_2e/kg$ output[14].

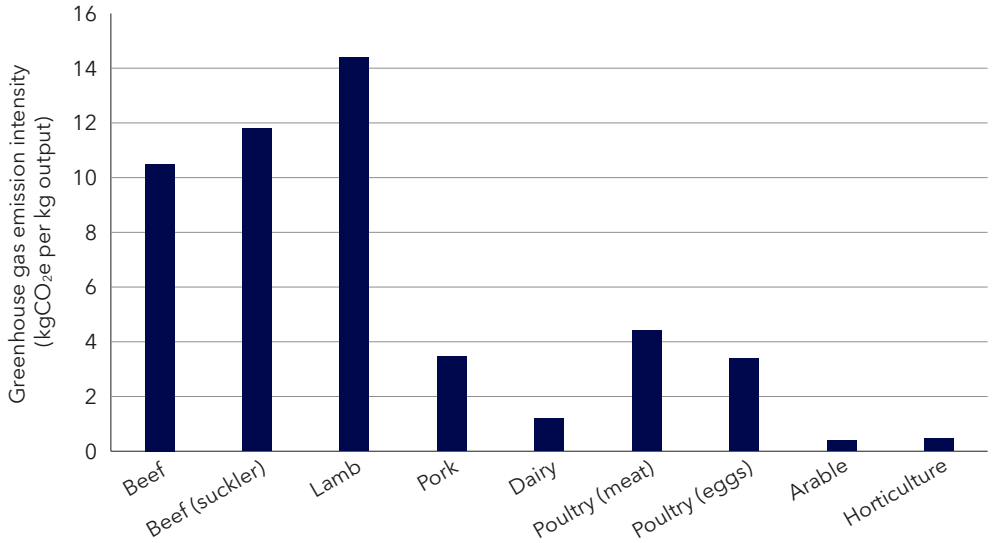


Figure 4. Greenhouse gas emissions intensity per kilogramme (kg) output from different agricultural sub-sector[12,13,14,15].

The emission intensity for each sector is drawn from various sources. The boundary set is cradle-to-farmgate, adopting functional units of 1kg bone-in carcass weight, 1kg eggs, 1kg milk, average 1kg arable and horticultural output, emissions are reported as kg CO_2e.

To date, most agricultural emission intensity studies have not accounted for the carbon taken down into the soils and trees of our farms due to the ongoing development of global metrics, models, and calculations for estimating carbon sequestration. Once the calculations for carbon sequestration have been formalised, sub-sectors covering vast land areas, such as livestock (beef and sheep), dairy and arable, have greater opportunities to evidence the additional carbon captured and offset this against emissions.

> "If emissions follow the trajectory, there is a less than 5 per cent chance of keeping temperatures well below 2°C relative to pre-industrial levels, and less than 1 per cent chance of reaching the 1.5°C Paris Agreement target."
>
> **Chatham House, 2021**

Recommendations to help your business transition to net zero

Bank of Scotland is 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. Throughout the net zero pathway it is essential farms take stock of their carbon footprint, this can then be used to guide changes in land management practices, as well as focusing actions to improve productive efficiency and inform opportunities for investment and innovation.

1. Measure your farm's carbon footprint
2. Improve farm productivity and efficiency
3. Invest in low carbon agri-technology
4. Boost renewable energy generation

Productivity, investment, and innovation

5. Improve soil health
6. Restore peatlands
7. Plant trees and hedgerows to sequester carbon

Land Management

Recommendations to help your business transition to net zero (continued)

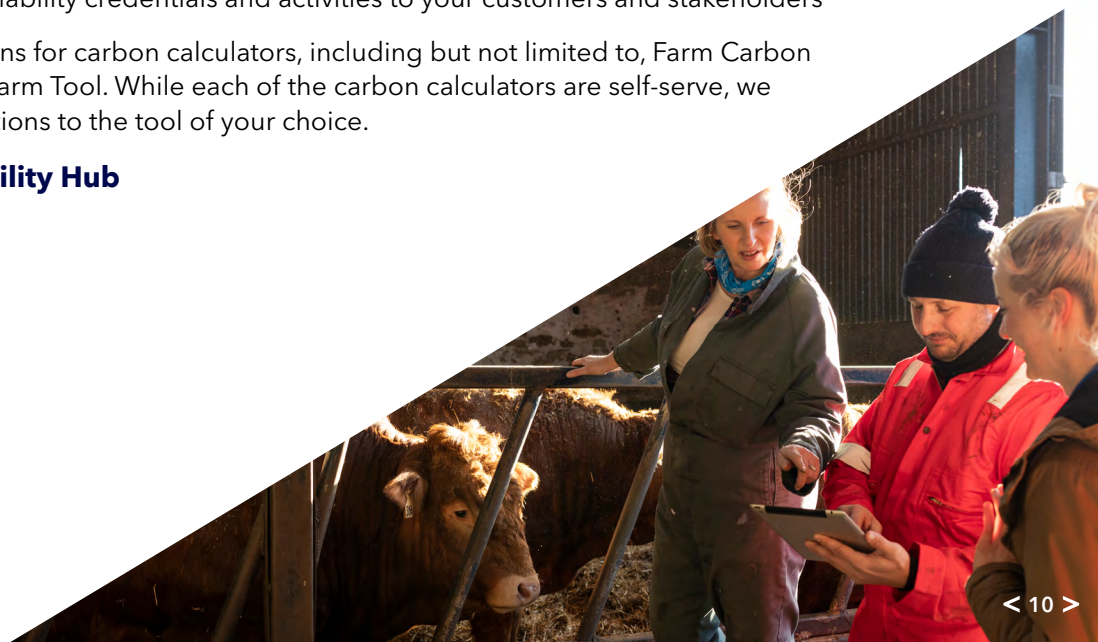
Measure your farm's carbon footprint

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, including but not limited to, Farm Carbon Toolkit, Agrecalc and Cool Farm Tool. While each of the carbon calculators are self-serve, we are happy to make introductions to the tool of your choice.

Agriculture Sustainability Hub



Recommendations to help your business transition to net zero (continued)

> 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 generations[20].

Improve farm productivity and efficiency

There are a number of ways to improve agricultural productivity and efficiency while also reducing your carbon footprint. The ambition of these 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.

62% of Scotland's total nitrous oxide emissions and 46% of total methane emissions come from agriculture[7].

Reducing emissions of these two greenhouse gases is key in order to decarbonise the sector and transition to net zero. Management practices and efficiency gains that reduce emissions whilst also boosting productivity are outlined below.

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 inputs[17]
- 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 years[18]
- Increased use of organic manures and better accounting of nutrients can reduce use of mineral fertilisers

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 seaweed can be mixed with rations and this is emerging as an option to reduce fermentation and the release of methane from digestion, whilst enhancing livestock immune systems[19]
- Gene editing and breeding the next generation of cows can assist reduce methane emissions by improving animal health and performance

Recommendations to help your business transition to net zero (continued)

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 people[21]. Sustainable intensification by investing in agri-tech aims to improve productivity with reduced inputs and lower environmental impact.

Agri-tech options for net zero

Precision agriculture
New technologies in the arable sector such as controlled traffic, variable rate application and crop sensors.

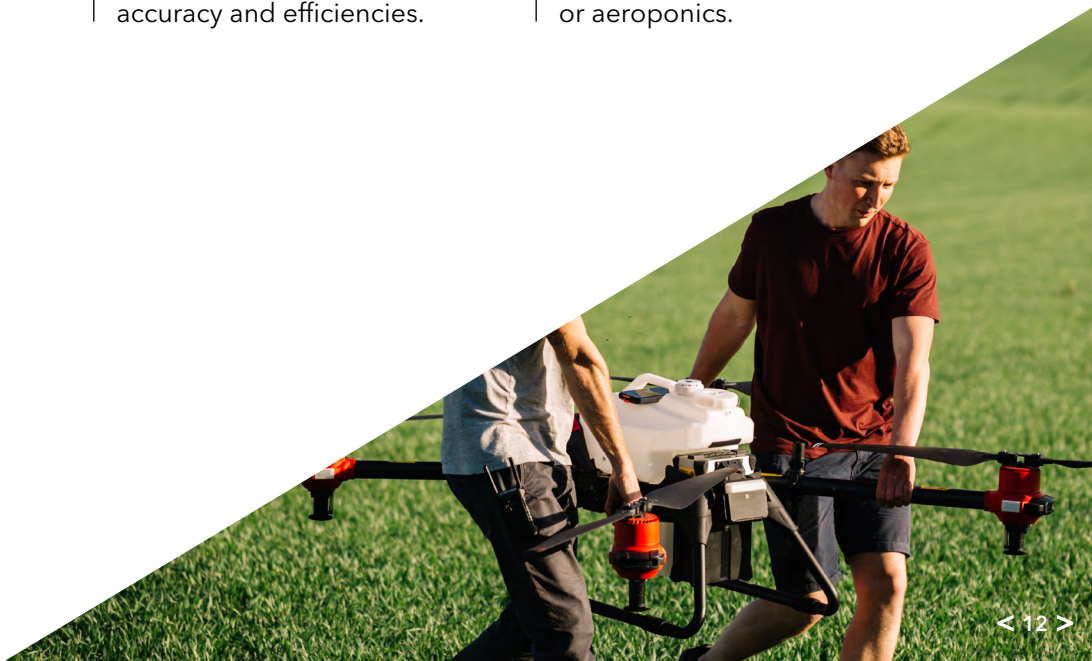
Improved crop genetics
New crop breeds made available through accelerated genetic discoveries.

Cloud based tools
Online cloud hosted management tools and software platforms to measure and monitor inputs and outputs.

Livestock monitoring
Livestock sensors and tags to monitor animal behaviour for dairy, beef, pigs, and poultry.

Robotics & drones
Robotics, drones, and autonomous vehicles to lower labour costs and improve accuracy and efficiencies.

Controlled environment farming
Controlled environment farming includes systems such as: vertical farming, hydroponics or aeroponics.



Recommendations to help your business transition to net zero (continued)

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

Boost renewable energy generation

Boosting renewable energy to displace greenhouse gas emissions from fossil fuels is a key part of the NFU ambition for achieving net zero[3]. It is also an important strategy to improve the UK's energy security.

Renewable energy

Nearly 40% of UK farmers are using the sun, wind, farm by-products, ground source heating and energy crops to produce clean, low-carbon energy[22]. Renewable energy generation reduces reliance on fossil fuels, decouples the farm from energy price fluctuation, provides alternative revenue and lowers the farm's carbon footprint.

Circular waste streams such as anaerobic digestion

Anaerobic digestion (AD) converts animal manures, food waste, crops, and crop by-products into renewable energy. AD plants can help the agricultural sector transition to net zero by offering farmers additional income, producing renewable energy and organic fertiliser (digestate), and improving waste management.

Options for becoming involved in AD include building your own plant, lease land to a developer, grow and sell crops for AD, and join an AD co-operative. A small-scale AD plant (c.50kW) will achieve payback in 9–13 years.

Bioenergy crops

Bioenergy provides around 8% of the UK's primary energy demand[23]. The growth of the bioenergy sector provides two key benefits to deliver net zero by sequestering carbon dioxide for long periods in soils, trees, and other plants, as well as reducing fossil fuel emissions by directly displacing oil, coal, and natural gas.

In 2020, 121,000 hectares of agricultural land was used to produce maize, wheat, sugar beet, miscanthus and short rotation coppice for bioenergy[7].

Farms interested in bioenergy crops should: assess suitability of land parcels to energy crops, understand market demand factors, and establish fair contracts and share of risk within the supply chain.

Recommendations to help your business transition to net zero (continued)

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Intensive agriculture has caused arable soils to lose 40–60% of their organic carbon. 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, and increasing flooding[27].

Improve soil health

Soils are the second largest carbon sink after our oceans, storing three times more carbon than is found in the atmosphere[24]. UK soils contain approximately 94% of the total carbon stored in the biosphere[25].

Soil carbon comprises 47% of the mitigation potential for agricultural areas and grasslands by a mixture of protecting existing soil and restoring depleted stocks[26]. 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.

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 boosted by using a holistic approach to increase soil organic matter, such practices include:

Ameliorate soil compaction

- Careful timing of cultivation and grazing
- Reduced trafficking of soils using precision technologies

Prevent erosion

- Integrate trees into your system using agroforestry and shelter belts
- Establish crops in suitable conditions

Increase organic matter

Maintain cover

- Continuous cover from grass, crop residues and cover crops supports soil structure and soil organisms
- Deep rooted species can improve drainage and limit nutrient loss

Improve soil structure

- Implement reduced tillage and regenerative grazing to limit compaction and reduce mineral fertiliser inputs
- Incorporate organic manures and crop residues to sustain the soil biology

Recommendations to help your business transition to net zero (continued)

1 Measure your farm's carbon footprint

2 Improve farm productivity and efficiency

3 Invest in low carbon agri-technology

4 Boost renewable energy generation

5 Improve soil health

6 Restore peatlands

7 Plant trees and hedgerows to sequester carbon

Restoring 50% of upland peat and 25% of lowland peat would reduce agricultural emissions by 10%[30].

Restore peatlands

Peatlands are a key part of the UK's landscape, covering 12% of the UK's land area[28]. Both upland and lowland peatlands are significant carbon sinks with 57% of the UK's soil carbon stored in peatland[25]. It is estimated however, that only 20% of this peatland remains undamaged[27,29].

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 emissions[28]. The restoration of peatlands is therefore key to reducing emissions and enhancing the sequestration and long-term storage of carbon from the atmosphere.

Restoration of peatlands enhances climate regulation, carbon removed from the atmosphere and stored in the peat can remain for millennia. Healthy peatlands support other ecosystem services including provision of drinking water and flood defences, as well as being a unique habitat for rare and threatened species.

Actions to restore peatlands

- Use cover crops green manures within crop rotations to help maintain organic matter
- Adapt grazing regimes to suit sensitive habitats and avoid poaching and creation of bare ground
- Avoid burning of moorland as repeated burning can damage habitat and compromise grazing
- Consider grip blocking, drainage, and re-wetting of peat soils to restore natural functioning of peatland

Recommendations to help your business transition to net zero (continued)

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> 10% of farmland in agroforestry will support the UK to achieve net zero targets.
>
> **Woodland Trust, 2022[32].**

Plant trees and hedgerows to sequester carbon

Tree planting and reforestation is increasingly hailed as one of the most natural and powerful ways of fighting 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 Scottish Government has increased its yearly target from 12,000 to 18,000 hectares of new woodland by 2025 in order to support net zero ambitions[31].

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. Agroforestry – the growing of both trees and agricultural crops on the same land – taps into the symbiosis between trees and soil, bringing a host of environmental benefits alongside opportunities for improved productivity and diversification[32].

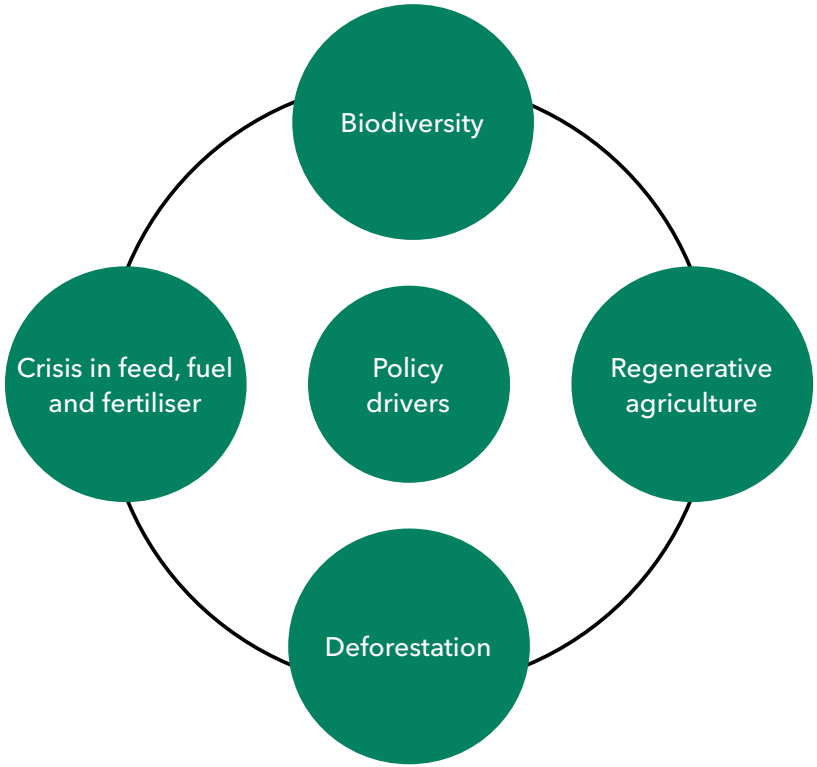
Given the importance of trees to a net zero future, we're delighted to have partnered with the UK's pre-eminent woodland conservation charity, the Woodland Trust, to plant millions of trees across the country by 2030. Our commitment to the reforestation agenda will see landowners in the agriculture sector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

The average cost of a tree will reduce from £3 to just 75p.

Woodland Trust

What are the key drivers of net zero in agriculture?

As the agricultural sector shifts to embrace a net zero future, several key drivers have emerged that form the foundation of low-emission farming. These key areas are united by a focus upon profit, sustainability and benefits for carbon efficiency and performance. Farm businesses with a good understanding of the key challenges and opportunities within each area are better placed to address both physical climate risks i.e., flooding and drought, as well as the transitional risks that result from the policy, legal, technology and market changes.



Changing policy frameworks continue to pose new challenges for the sector. Agriculture is a devolved issue, yet policy mechanisms to encourage transition across all four nations of the UK are collectively targeting low emission farming. Changes to the policy landscape will impact all aspects of the drivers identified, these include:

International commitments – The Glasgow Climate Pact 2021 at COP26 strengthened the Paris Agreement's goal to limit the rise in global temperatures to 1.5°C. World leaders, including the UK, also committed to halt and reverse forest loss and degradation by 2030[2,4,5].

New legislation – The Scottish Agriculture Bill and Natural Environment Bill are in the process of being passed, holding a wide environmental focus, designed to lead transition away from EU legislation. Resulting agricultural policy will focus on 'public money for public goods' such as clean air, nature conservation, and water management.

New regulation – **Cleaner Air for Scotland 2** sets out strategies to improve air quality by reducing pollution[33].

For a more detailed, technical report exploring policy drivers impacting agriculture within the climate and net zero policy arena, please visit:

Agriculture Sustainability Hub

What are the key drivers of net zero in agriculture? (continued)

Biodiversity loss and climate change should be addressed together

Farmers and land managers play a critical role in managing and protecting our most precious protected habitats. The importance of enhancing this offering is clear, with biodiversity on UK farms having fallen to around 30% of 1970 levels, driven largely by intensive farming practices[34].

These practices initially drove productivity, however a decrease in traditional mixed farming, increases in farm size, and loss of on-farm wildlife habitats, including hedgerows, ponds, and meadows, has led to the fragmentation and loss of connectivity between habitats, so much so that the UK sits at the bottom of the biodiversity intactness index, the lowest of any G7 nation[35].

Overuse of artificial fertilisers and pesticides have unbalanced the complex web of life that both above and below-ground natural ecosystem services, such as nutrient cycling, pollination, and carbon storage, further impacting long-term agricultural productivity.

Biodiversity net gain

The importance of implementing urgent and effective actions to protect and enhance biodiversity is being recognised across the UK's devolved nations. The underlying principles of biodiversity net gain (BNG) are to halt the decline in native species by the end of the decade, requiring new developments to create and improve local habitats. A framework for this is being developed at a different pace across each nation. Scotland have proposed an approach to 'secure positive effects for biodiversity' through the National Planning Framework (NPF4), which will detail this further but is not expected to be approved until early 2025.

Once BNG becomes a mandatory requirement in England in 2023 it will require the developers to create a 10% biodiversity uplift on all their developments, either through on-site or off-site biodiversity provision, or by purchasing statutory credits[36]. Crucially, for rural land managers, the creation of an off-site biodiversity market offers an opportunity to monetise habitat creation, with the market in England estimated to be £135–£274 million per year[37].

Source: Mathias Tschumi

> "Agriculture has been identified as the most important driver of biodiversity change over the past 45 years, with most effects being negative."
>
> **State of Nature report 2019**[27]

What are the key drivers of net zero in agriculture? (continued)

Enhancing on-farm biodiversity

Agroecological practices that boost on-farm biodiversity will play an essential role in increasing climate resilience. Biodiversity is important in delivering healthy, functioning ecosystem services which can enhance productivity potential. Yields of wheat, beans and oil seed rape can be maintained in fields with up to 8% of land set aside due to the benefits derived from wildlife-friendly approaches[38].

> "Climate change is a primary driver of biodiversity loss. And climate change depends on biodiversity as part of the solution. So clearly the two are linked and cannot be separated."
>
> **Elizabeth Mrema, Exec. Secretary, UN Convention on Biological Diversity**
> https://www.un.org/en/climatechange/thought-leaders-elizabeth-mrema

By targeting habitat creation on the least productive land parcels, biodiversity can be boosted without reducing agricultural yields, whilst creating stacked income opportunities from subsidies, BNG credits and carbon credit markets. Beginning to quantify biodiversity on the farm will help measure and track improvements over time and improve access to these markets. Strategies to enhance biodiversity include:

- Introducing multi-species ley mixes to increase pollinator populations and improve soil health
- Agroforestry, woodland creation and improving hedgerow condition to support birds and invertebrates. The farmland bird index has fallen by more than half between 1970 and 2018 in the UK[39]
- Regenerative practices, such as reduced tillage, to enhance above and below-ground biodiversity
- Careful nutrient management planning and precision application to protect sensitive species and the wider environment, whilst saving money and increasing business efficiency

For a more detailed, technical report around nature-based solutions to address climate change and biodiversity loss and its impacts, please visit:

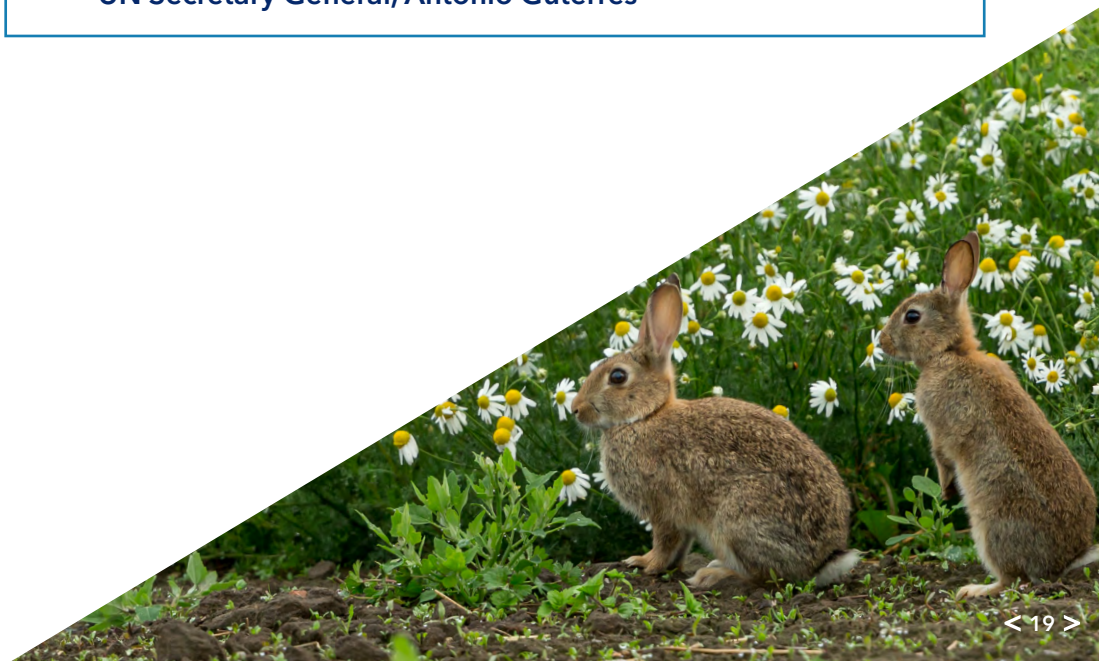
Agriculture Sustainability Hub

COP15

The agreement to halt and reverse biodiversity loss by the end of the decade at the COP15 UN Biodiversity Conference matches the urgency declared towards climate change within COP21's Paris Agreement. The UK, alongside nearly 200 other countries, signed the Kunming-Montreal Global Biodiversity Framework (also known as the '30 by 30' deal) to protect at least 30% of Earth's ecosystems by 2030.

Achieving ambitious targets such as halving excess nutrients, pesticide risk and food waste by 2030 will undoubtedly shape the direction of UK agricultural strategy and funding over the course of the decade. Nature-based solutions that address both biodiversity loss and climate change through 'sustainable management of agriculture' offer a key strategy for farmers and land managers to maintain, enhance and restore ecosystems across the 71% of the UK's land stock covered by agriculture.

> "We are finally starting to forge a peace pact with nature."
>
> **UN Secretary General, Antonio Guterres**



What are the key drivers of net zero in agriculture? (continued)

The rise of regenerative agriculture

The term 'regenerative agriculture' has experienced a sharp rise from niche practice to widespread concept, gaining popularity as a common solution to address net zero and long-term farm productivity.

Placing soil health at the centre of the system, regenerative agriculture blurs the once distinct lines between conventional and organic agriculture with a group of principles that balance between food production and restoring, preserving, and protecting the land and soils. It is a holistic approach to farming which encourages resilience and innovation, with potential to reverse the 40–60% organic carbon loss from UK arable soils[27].

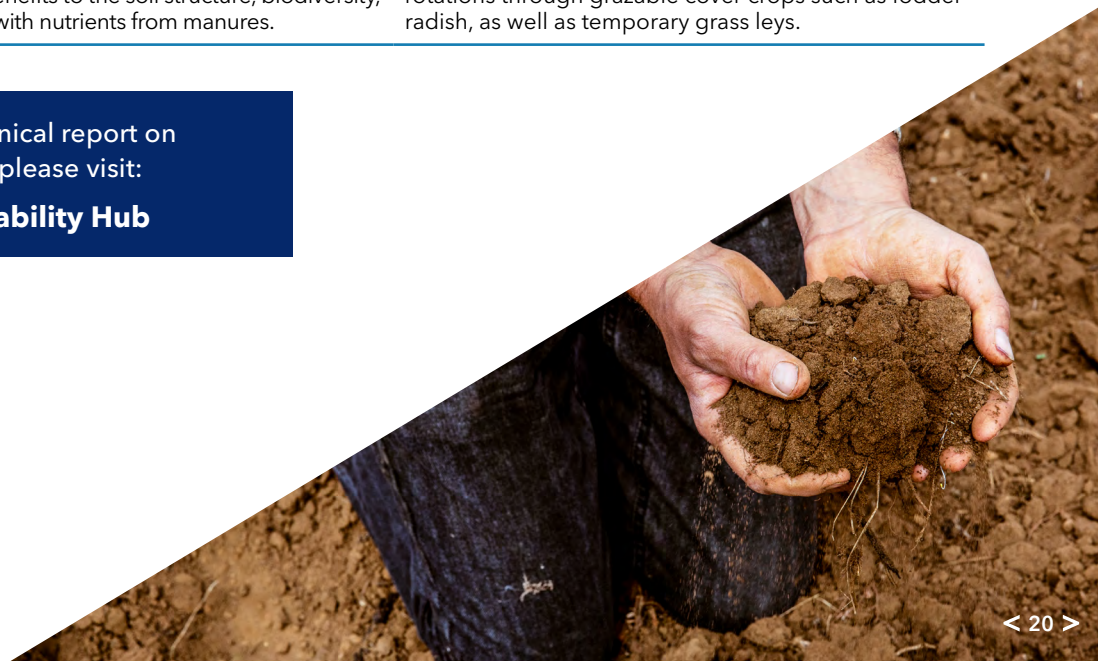
> "With the inflationary environment and widespread supply chain disruption, it would be easy to reduce focus on the longer-term challenge of scaling regenerative farming. But we believe it's vital we maintain a sense of urgency. We must take action now to avoid more acute crises in the future."
>
> **Agribusiness Task Force, 2022**[40]

Despite the recent rise to popularity of regenerative agriculture in the UK, its roots are in a set of management principles that most farms are familiar with. There is no conclusive definition of regenerative agriculture; the focus is on adopting principles rather than practices, therefore opening it for interpretation for individual systems. Implementing a combination of the five core principles, outlined right, can offer benefits to land and farm management whilst not compromising the long-term future of the environment.

Core principle	Why	How
Minimise soil disturbance	Soil disturbance leads to breakdown of the habitats of the soil organisms that create soil fertility.	Assess your land field-by-field to understand where tillage and use of chemicals can be limited.
Maximise crop diversity	Adding diversity can decrease pest and disease pressures while supporting biodiversity and improving soil health.	Increase crop or plant diversity on your farm by diversifying main-rotation crops, adding companion crops or intercropping. Mixed species leys and perennial pasture can help diversify grassland.
Keep soil covered	By keeping soil covered it is protected from wind and water erosion, while preventing moisture evaporation and weed seeds germinating.	Plan your rotation to include cover crops, catch crops and overwinter growth. Cover crops and crop residues acting as 'green manures' can be broken down and converted into organic matter residue.
Maintain living root year-round	Ensuring live roots are infiltrating the soil all year round supports good soil health with continuous food sources for soil organisms, allowing mycorrhizal fungi to be carried between crops.	Explore opportunities for arable reversion. Limit fallow periods by planning for continuous cover within crop rotations.
Integrate livestock	Integrating livestock brings many benefits to the soil which include benefits to the soil structure, biodiversity, and fertilisation with nutrients from manures.	Review opportunities to include livestock in arable rotations through grazable cover crops such as fodder radish, as well as temporary grass leys.

For a more detailed, technical report on regenerative agriculture, please visit:

Agriculture Sustainability Hub



What are the key drivers of net zero in agriculture? (continued)

Tackling deforestation

Forests are some of the most biologically diverse areas on the planet and their health is a core pillar of addressing the climate crisis. Forests function as incredibly important carbon sinks, regulate global water and climate systems and buffer both natural and human disasters such as pandemics.

The global agricultural industry is a main driver of tropical deforestation, accounting for 70–80% of tropical forest loss[42]. A significant contributor to this has been the dependence of the livestock industry upon soybean and palm oil which has catalysed large-scale production on converted land.

Soybean is largely produced in South America and is almost ubiquitous in animal feed due to its function as an excellent source of protein with high digestibility.

Palm oil production is centred around Indonesia and Malaysia, with the crop unrivalled for its yield capacity and versatile properties, highlighted by its presence in over 50% of food and non-food products in UK supermarkets[43].

Forests remove and store one-quarter of all CO_2 released into the atmosphere from human activities, 1.5 times more carbon than the United States emits annually[41].

Deforestation policy

UK policy has recently grown to attempt to address the rate and extent of global deforestation as a key consideration in achieving net zero. Historic programmes attempting to curb forest loss from soybean and palm oil production have had mixed success i.e., the Amazon Soy Moratorium and REDD+, however there is greater promise stemming from the COP26 pledge to end deforestation by 2030 as an integral part of the global path to net zero. UK industry is also taking collective action to ensure all physical shipments of soy to the UK are deforestation and conversion free as part of the UK Soy Manifesto[44].

Farm actions to limit deforestation

Livestock farmers can minimise their contribution to deforestation with a range of actions, which include:

Source soy and palm oil from sustainable certification programmes – Roundtable on Responsible Soy (RTRS) and Roundtable on Sustainable Palm Oil (RSPO) certification sets standards for deforestation-free production.

Prioritise country of origin – Danube soy production promotes sustainability, is non-GMO and of European origin. It has an associated carbon footprint that is 10 times lower than soy sourced from Brazil due to the reduced emissions from being deforestation free and having a shorter transport distance[45].

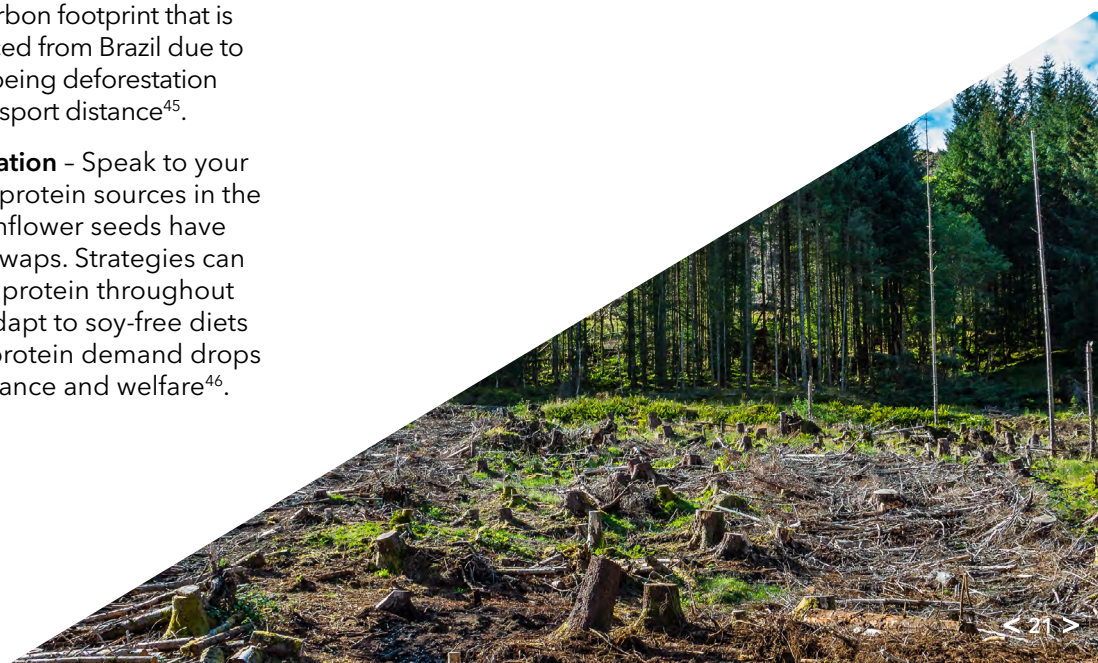
Reducing quantities in the ration – Speak to your nutritionist about balancing protein sources in the diet. Rapeseed meal and sunflower seeds have the best potential as direct swaps. Strategies can also be applied to decrease protein throughout the animals' life. Hens can adapt to soy-free diets from 50-weeks onwards as protein demand drops without risk to flock performance and welfare[46].

Explore alternatives to soy – Processed animal proteins (PAPs), algae and insect proteins, such as black soldier fly larvae, are all expected to increase in availability with research, development, and new regulations.

Explore alternatives to palm oil – Substituting palm-based fat supplements in dairy diets for a palm-free supplement composed of vegetable oil and fish oil reduced the carbon footprint of the feed and improved feed efficiency in addition to milk yield and quality[47].

For a more detailed, technical report on deforestation and how it impacts UK agriculture, please visit:

Agriculture Sustainability Hub



What are the key drivers of net zero in agriculture? (continued)

The crisis in feed, fuel and fertiliser can offer new business opportunities

UK agriculture has faced unprecedented challenges in recent years, with pressure placed on farm businesses from worker shortages and covid-19 after-effects compounded by disruption to cost and availability of feed, fuel, and fertiliser due to the Russian invasion of Ukraine.

This turbulence may feel exacerbated by the drive to address climate change through net zero targets; however, these challenges bring opportunities for farm businesses to develop innovative strategies to enhance efficiencies and lead to greater resilience.

Costs of fuel, feed and fertiliser have reached unprecedented levels as a result of the Russian invasion into Ukraine. Russia, a large exporter of these three commodities, has seen the UK place a 35% tariff on Russian fertiliser along with additional sanctions. As a result, ammonium nitrate imported into the UK increased 120% between September 2021 and September 2022[48].

UK farmers are also being affected by rising costs in animal feed. This is in part due to rising fertiliser prices, with concentrate prices increasing by 60% in the last year[49]. Sunflower meal, soybean and wheat prices have increased significantly. In 2019 exports from Ukraine made up 42% global sunflower oil exports, with Russia prominent as the world's largest wheat exporter[50] (Figure 5).

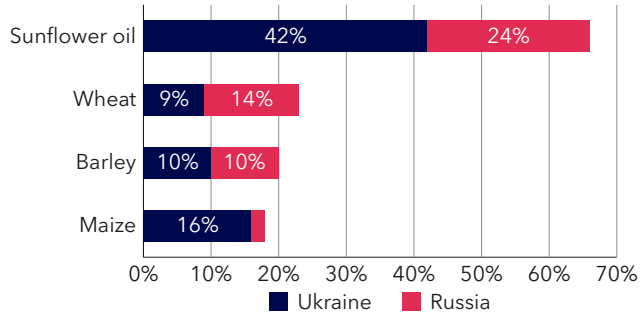


Figure 5. Global food exports from Ukraine & Russia[50].

The UK's low reliance on Russian gas, only 3%, made a complete transition away from imports easier than other EU countries. The impact of sanctions on global energy markets has not, however, shielded UK farm businesses from soaring energy costs.

Practical actions to limit the rising cost of feed, fuel, and fertiliser

Farm businesses can achieve sustainability and resilience by reducing reliance on imported feed, fuel, and fertilisers, while making the most of resources available to them. A few simple actions farms can take include:

- **Energy efficiency:** Using energy audits to assess how much demand the business has during key consumption periods and where reductions can be made.
- **Renewable energy:** Scoping for new sources of renewable energy can offer enhanced business diversification and reduced reliance upon fossil fuels.
- **Utilising fertilisers:** To minimise costs, farmers should make the most out of both manufactured and organic fertilisers. Organic manures are crucial to reducing reliance on manufactured fertilisers and contain all the relevant nutrients required. Precision nutrient application using soil testing and crop sensors can improve the effectiveness of timing and spatial targeting, thus reducing over application.
- **Feed efficiency:** Minimising protein inputs while maintaining efficient and profitable outputs may be key for dairy and beef production to minimise costs and ammonia losses. This can include the use of feed additives and feed alternatives.

For a more detailed, technical report on how the feed, fuel and fertiliser issues can be overcome, please visit:

Agriculture Sustainability Hub

What simple actions can your sub-sector start to prioritise?

Achieving an overall balance between reducing greenhouse gas emissions and increasing the carbon dioxide removed from the atmosphere through sequestration will provide a different challenge for each agricultural sub-sector. Each farm will begin their net zero journey at a different place and will need a unique action plan.

We have developed a range of factsheets to help farmers and growers to develop their climate reduction plans. Below is a summary of the key headlines and practical steps for each sector.

Dairy

Key emission challenges are reducing methane from digestion. This is produced as fibre broken down by bacteria in the rumen.

Practical steps to focus on:

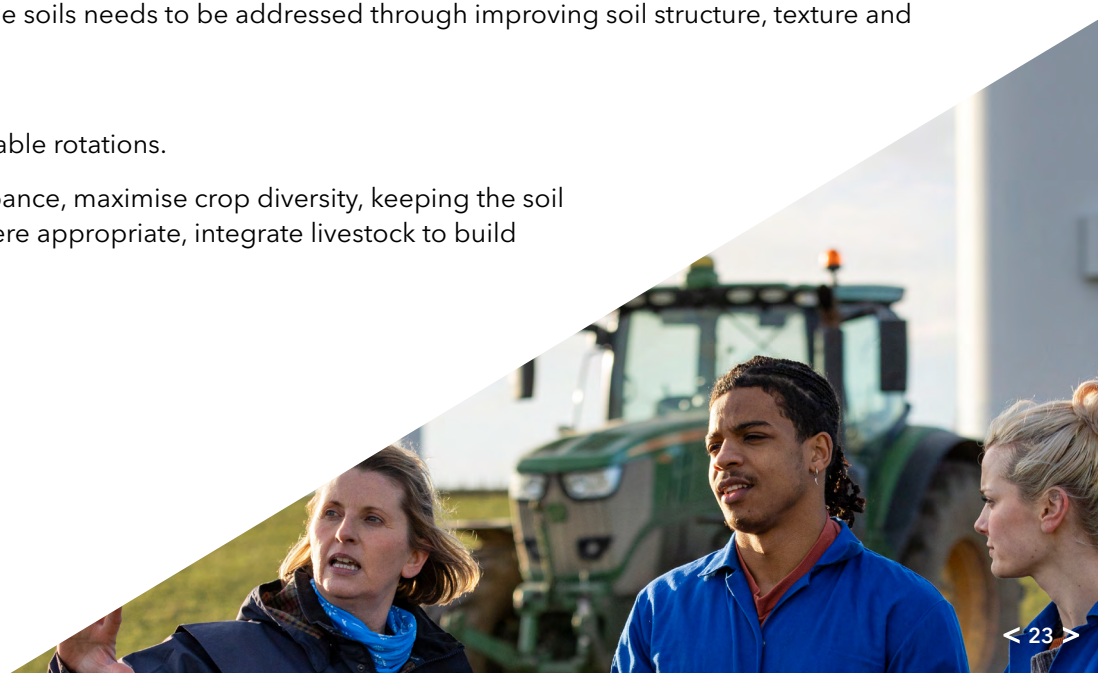
1. Target improvement in feed efficiency by producing higher quality, homegrown feeds and increasing levels of carbohydrates in the diet.
2. Optimise replacement numbers by maximising the genetic potential within the herd; this can achieve emission reduction through enhanced health traits, increased longevity, lower nitrogen excretion rates, and improved fertility.

Arable

Key emission challenges are reducing impacts from nitrous oxide which are generated from the cultivation of soils and the production and application of mineral nitrogen. The degradation of arable soils needs to be addressed through improving soil structure, texture and increasing levels of organic matter.

Practical steps to focus on:

1. Maintain ground cover using cover / catch crops in arable rotations.
2. Adopt regenerative principles to minimise soil disturbance, maximise crop diversity, keeping the soil covered, maintaining a living root year-round and where appropriate, integrate livestock to build organic matter levels.



What simple actions can your sub-sector start to prioritise? (continued)

Horticulture

Priority areas include reducing energy and fuel use, reducing nitrogen use from field grown crops, tackling water scarcity and improving soils as 40% of UK vegetables are grown in areas of lowland peat[51].

Practical steps to focus on:

1. Optimise nutrient availability to allow targeted application of organic and inorganic fertilisers.
2. Reduce water demand by using precision irrigation and adopt drip irrigation which has a water use efficiency above 95%[52].

Livestock (beef and sheep)

The key challenge for beef and sheep farms is to reduce methane levels by focusing on breed, feed, genetics, and management of manures.

Practical steps to focus on:

1. Improving feed quality and selecting types of homegrown forage to optimise rumen performance and lower protein requirements.
2. Adapting grazing strategies to rotational, high density grazing for short durations with longer grass recovery (i.e. mob grazing) has been shown to sequester and store carbon.

Poultry

The key challenges are addressing feed production, use and management which are responsible for 78% of total emissions within broiler units and 69% within layer production farms[53]. These emissions are largely due to land use change associated with sourcing certain proteins, particularly soya.

Practical steps to focus on:

1. Reducing crude protein levels relevant to growth rate and age of the bird is an essential step. Reducing dietary protein by 2–5% can lead to a reduction of 60% in total nitrogen excretion[54].
2. Identifying alternative methods of treatment for poultry litter can reduce ammonia emissions by 25%[55].

What simple actions can your sub-sector start to prioritise? (continued)

Pigs

Feed and feed production are the main challenges and contribute up to 80% of emissions from pork[56]. Improving feed conversion efficiency, reducing direct emissions from slurry and manure management, and lowering energy requirement in equipment are all important focus areas.

Practical steps to focus on:

1. Sourcing alternative feeds and reducing reliance on soyabean meal which is connected to deforestation is a critical action.
2. Genetic planning can support reducing maintenance (feed) requirements as well as targeting improved growth rates.

Renewable Energy

Agriculture and horticultural businesses are energy and fuel intensive. Many farm businesses are considering investing in renewable energy, but capital expenditure can be cost prohibitive and/or the farm has not properly quantified its energy consumption demands and requirements.

Practical steps to focus on:

1. Review the energy, fuel and heat requirements of the farm and identify what the most intensive energy/fuel activities are and how they can be operated more efficiently.
2. Consider incorporating solar photovoltaics into grazing systems or mounted onto buildings alongside battery storage technology.

Download the full factsheets for these sub-sectors by visiting:
bankofscotland.co.uk/sustainable-agriculture

How can we help?

Funding support

Through our Clean Growth Finance Initiative, we offer discounted lending for a broad range of investments in sustainable agriculture, from renewable energy generation such as solar and wind, to green agri-tech solutions. The eligibility criteria to access this funding includes:

- Farm productivity and efficiency
- Investment in low-carbon agri-technology
- Soil health
- Restoring peatlands
- Boosting renewable energy generation

Support with tree and hedge planting

Our partnership with the Woodland Trust, the UK's pre-eminent woodland conservation charity, guarantees heavily subsidised rates for tree and hedge planting for those in the agriculture sector, reducing the average cost of planting by up to 75%. For further details, see page 27.

Trained experts

Our Relationship Managers have received training from the Cambridge Institute for Sustainability Leadership and have a good understanding of the specific challenges and opportunities presented by climate change to the agriculture sector. We're here to help you on your journey to net zero.

Net zero resources

We have worked with Promar International to develop a range of sub-sector factsheets and technical notes to help farmers and growers with their climate impact reduction plans. These resources provide context to the key drivers of net zero in agriculture and identify practical steps that can be taken along the pathway to net zero.

If you would like more information on any of the above, please contact your Bank of Scotland Relationship Manager.

Partnering with the Woodland Trust

BANK OF SCOTLAND

WOODLAND TRUST SCOTLAND

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 country 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 2045.

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 Scotland's tree numbers to align with the national strategy to become net zero by 2045.

In addition to working with farmers and landowners, this partnership will plant 10 new areas of woodland across the UK and support up to 3,000 schools and community groups to plant trees in their local communities.

Our 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 can 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/bankofscotland** The Woodland Trust will then arrange a call with you to discuss your requirements, and your Relationship 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 Adviser.
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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