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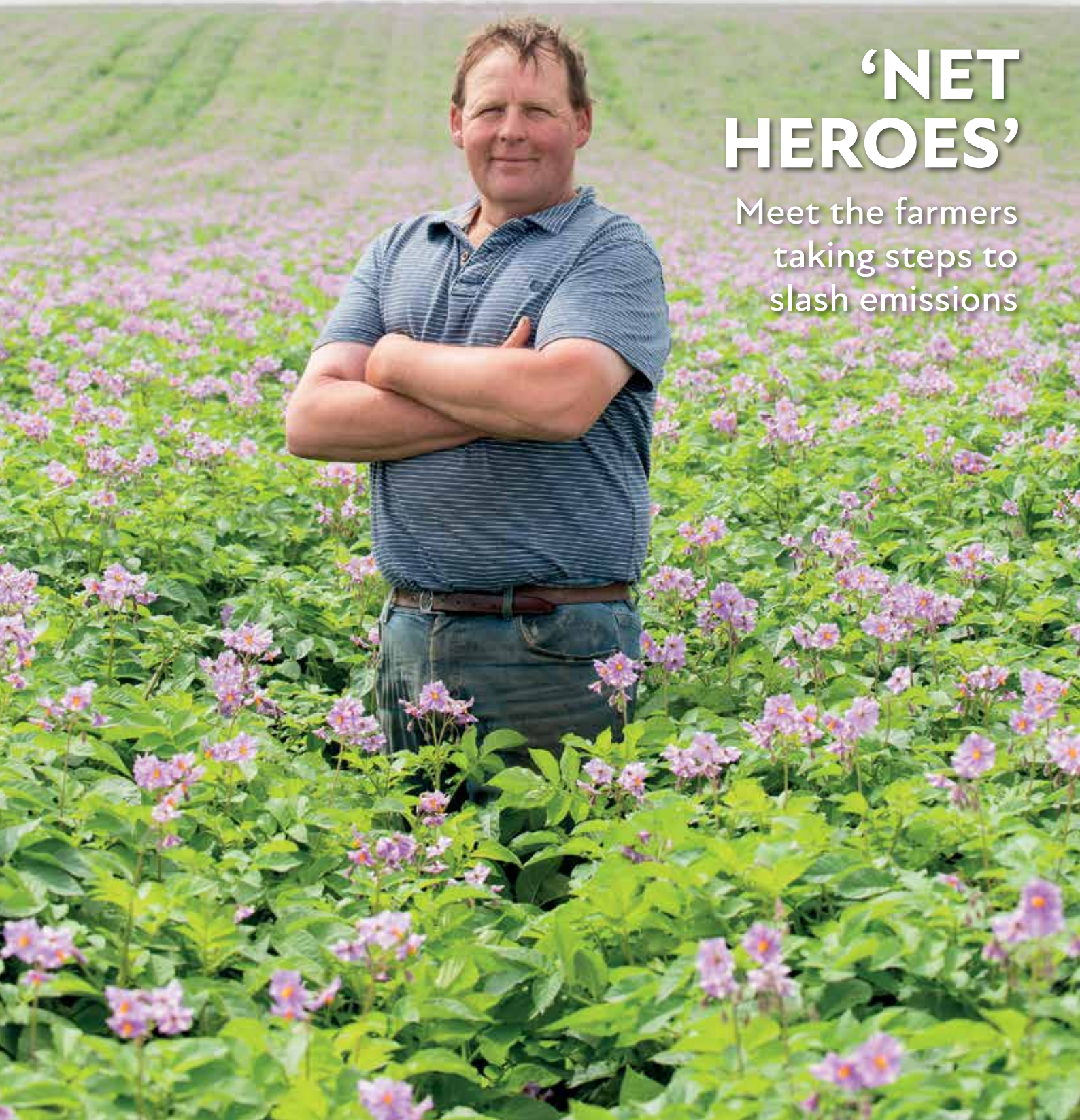
FARMERS WEEKLY

TRANSITION

Securing a sustainable future for your farm business



‘NET HEROES’

Meet the farmers taking steps to slash emissions

Lower emissions can be good for your farm

Welcome to *Transition* – the quarterly supplement from *Farmers Weekly* to help secure a sustainable future for your farm business.

This issue examines ways to cut greenhouse gas emissions – and ensuring that doing so stacks up financially as well as having an environmental benefit and helping to mitigate climate change. We start by looking at the need to reduce emissions with a special focus on government policies for agriculture, food production and the wider agri-food supply chain, including the incentives for carrying out the work.

Agricultural policy is changing across the UK, with an increasing focus on the environment. More schemes are being launched that reward farmers for lowering and avoiding pollution – encouraging producers to farm sustainably.

We explore the main sources of greenhouse gas emissions – including fossil fuels, fertiliser and livestock – and look at ways they can be reduced that are both viable in the short term and sustainable over the longer term.

Not all of these suggestions will be suitable for every farm. But we are sure that they will give you ideas to improve the sustainability of your business – helping to improve productivity and the environment.

As always, we are grateful to our Transition Farmers (see p5), who are sharing their stories as they strive to remain profitable, while cutting on-farm emissions. We are equally grateful to our Transition Partners, for sharing their expertise and advice along the way.

For more about our Transition initiative, visit our knowledge hub at **fwi.co.uk/transition**

Johann Tasker, *Transition* editor

OUR PARTNERS

The *Farmers Weekly* Transition Partner Network is a UK-wide community of farmers, industry stakeholders and influencers working together to secure a sustainable future for UK agriculture. If you are interested in joining the network and would like to find out more, please contact Anna Eccleston at **anna.eccleston@markallengroup.com**

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MAIN PHOTO: DAVID CHESHIRE/ALAMY STOCK PHOTO, SEAN EBSWORTH BARNES. INSET: MAJIVECKA/ADOBE STOCK, SES WATER COMPANY, BIB BILDER/ADOBE STOCK

CONTENT HIGHLIGHTS

Simple steps that can reduce emissions from fertiliser See p11

The alternative fuels aiming to cut agriculture's carbon impact See p21

What UK farmers can learn from Dutch 'nitrogen crisis' See p33

Harper Adams University's School of Sustainable Food and Farming supports a just transition to lower inputs

Harper Adams University (HAU) is a World Leading Specialist agricultural and agri-food university with its alumni accounting for 25% of graduates within the UK farming and food sectors. Impactful research-led education and innovation are the bedrock of HAU's mission and new University Strategy – to be launched this summer.

HAU's overall research focus is facilitating the just transition to 'Net Zero' in agriculture and food supply chains in concert with the wider requirements for 'sustainable agriculture' supporting the sector via our School of Sustainable Food and Farming. With the global integrated agri-food sector facing the challenge of achieving net zero within the wider sustainability framework (economic, social and environment), it is critical that we develop our education, research base and knowledge exchange to support the Farming and Agri-Food community.

HAU's research is focusing on the need to sustainably increase food production whilst decreasing environmental damage and valorising agricultural 'waste' as part of a circular agri-food system. The cumulative scientific evidence is unequivocal: we have exceeded our planetary boundaries in terms of climate change, biodiversity loss and natural nutrient cycles (e.g. N and P) and we have only a very short time in which to put it right. In the last couple of years, the UK has seen a plethora of inter-relating, sometimes overlapping, legislation and developments relating to global warming and environmental protection.

Biodiversity, water quality and emissions are areas where agriculture has been implicated through the use of potentially environmentally aggressive inputs and emissions. In 2021, the government launched its 'Net Zero' strategy: 'Build Back Greener', with the objective of reaching net zero emissions by 2050. The Skidmore Independent Review recently reported the economic, environmental and societal incentive of realising net zero, for which agri-food has great potential but is currently lagging other sectors, such as energy and transportation.

Professor Michael Lee, Deputy Vice-Chancellor, Harper Adams University

HAU through our research, education and knowledge exchange are focusing on forming solutions through circular agriculture to support the sector e.g:

- **Reducing Inorganic Fertiliser use** – developing novel valorisation pathways for the use of a range of agricultural residues and by-products, recovering novel products and eliminating the production of 'wastes' and their harmful contaminants. Valorisation of animal slurries, manure and anaerobic digestates will also reduce waterway eutrophication and farming's carbon footprint associated with artificial fertiliser use and through the development of renewable energy sources (e.g. liquified CH4).
- **Reducing Pesticide use** – our integrated pest and pathogen management (IPM) research aims to reduce synthetic pesticide use in crop production systems. Crop research is focussed on agronomy and production in a changing environment and the effects of stress on crop quality while working on optimising the agronomy of crops with an aim to minimise environmental impact of production.
- **Reduce Embedded Feed Carbon** – a current focus is on improving the utilisation of alternative feeds to soybean meal such as home-grown forage legumes, dietary means to reduce CH4 production by cattle, and improving the utilisation of alternative feeds such as insect protein and home-grown legumes such as lucerne.

School of **Sustainable Food and Farming**

Meet our Transition Farmers

These 15 farmers are sharing their journeys with us as they adapt their businesses

Karen Halton
Cheshire

Farm size 240ha

Enterprises
530-cow dairy herd

Transition goals
- Recruit/retain staff
- Maintain animal health and welfare
- Increase direct sales

James MacCartney
Rutland

Farm size 162ha

Enterprises
Beef and sheep

Transition goals
- Reduce disease in sheep
- Be better than net zero
- Establish herbal leys

Vaughan Hodgson
Cumbria

Farm size 244ha

Enterprises
Cereals, grassland, broilers

Transition goals
- Support the next generation
- Replace lost Basic Payment Scheme income
- Adapt to uncertain weather

Alan Steven
Fife

p11

Farm size 138ha

Enterprises
Potatoes, brussels sprouts, parsnips, malting barley

Transition goals
- Reduce cultivations
- Improve soil health
- More resilient rotations

Andrew McFadzean
Ayrshire

Farm size 285ha

Enterprises
350 beef cattle, wheat, beans, barley, fodder beet

Transition goals
- Slash finishing time
- Reduce dependence on inputs using solar energy
- Improve grassland

Rachel & Richard Risdon
Devon

Farm size 151ha

Enterprises
300-cow dairy herd

Transition goals
- Secure adequate labour
- Better understanding of Environmental Land Management
- Reduce carbon footprint

Kit Speakman
Essex

Farm size 275ha

Enterprises
Mixed arable, beef and sheep

Transition goals
- Bridge income gap
- Fully diversified business
- Widen the rotation

Eddie Andrew
Sheffield

Farm size 73ha

Enterprises
Dairy, milk delivery service, ice cream parlour and farm shop

Transition goals
- Co-operating to reduce costs
- Establish a new dairy
- Reduce carbon footprint

Irwel Jones
Camarthenshire

Farm size 375ha

Enterprises
1,500 ewes on owned and rented land, suckler cows and followers, root crops

Transition goals
- Manage natural woodland
- Plant hedgerows
- Rely less on volatile inputs

Andy Bason
Hampshire

p9

Farm size 800ha

Enterprises
Cereals, spring beans, oats, linseed and oilseed rape

Transition goals
- Cut carbon emissions by 30%
- Establish 10ha of agroforestry
- Establish 10ha of woodland

Duncan Blyth
Norfolk

Farm size 2,650ha

Enterprises
Cereals, oilseed rape, sugar beet, pulses, grassland, woodland, wetlands

Transition goals
- Improve soil health
- Develop natural capital revenues
- Achieve net zero by 2030

Fergal Watson
County Down

Farm size 285ha across three units

Enterprises
170-cow suckler herd, beans, wheat, spring barley, oats

Transition goals
- Recruit/retain farm staff
- Restructure suckler herd
- Improve business resilience

Philip Vickers
County Durham

Farm size 1,250ha

Enterprises
Winter wheat, oilseed rape, spring barley, spring beans, lupins, rotational grass; share-farming agreement with tenant sheep farmer

Transition goals
- Maintain margins while changing approach
- Improve soil health and resilience
- Enhance natural environment

Kate and Vicky Morgan
East Yorkshire

Farm size 1,700 breeding sows

Enterprises
Weaning 1,000 pigs a week – finished on-site and through B&B arrangements with local farmers, 140ha rented out

Transition goals
- Facilitate structural change in supply chain
- Establish more influence over own destiny
- Diversify

Ed Shuldham
Wiltshire

Farm size 1,800ha

Enterprises
Cereals, oilseed rape, oats, forage and grain maize, peas, solar, biomass, anaerobic digestion, events and property diversifications

Transition goals
- Help shape Sustainable Farming Incentive through participation in pilot
- Make more use of data
- Take natural capital

SECURING A SUSTAINABLE FUTURE FOR YOUR FARM

FARMERS WEEKLY TRANSITION

Follow our Transition Farmers as they take on the challenges and share their successes and failures, to help you tackle your own transition. Visit our Transition hub at **fwi.co.uk/transition-farmers**

PARTNER PERSPECTIVE

How Claydon Opti-Till® is helping farmers improve soil health

One of the major benefits of using Opti-Till® direct strip drilling to establish crops is the improvement in soil health.

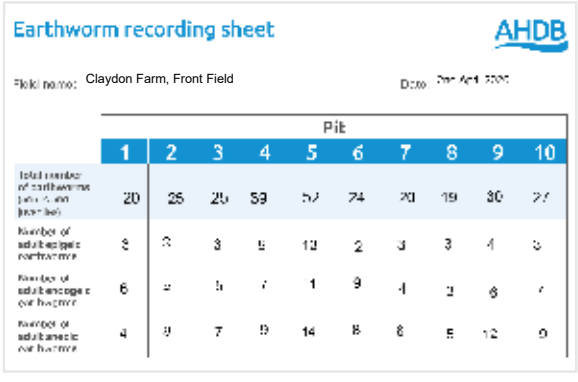
Surface of field covered with earthworm casts exhibiting a high level of activity.

In the first few years of using Claydon Opti-Till®, soil becomes easier to work (reducing horsepower and fuel consumption) and when conducting stubble management and weed control operations, tilth is noticeably more friable than for soil that has been conventionally cultivated.

Leaving residue on the soil's surface creates the ideal environment for earthworms to thrive. The worms process the crop residue which benefits the biological make-up of the soil, improves aeration and aids drainage.

Earthworms ingest soil and excrete it, leaving behind a myriad of nutrients that simple bacteria use as a food source; in turn, these bacteria interact with plant roots supplying them with important nutrients.

A 2014 meta-analysis study in the Netherlands by Jan Willem van Groenigen et al showed that on average earthworm presence in agro-ecosystems led to a 25% increase in crop yields and a 25% increase in above-ground biomass.


Earthworm recording sheet

AHDB

Field name: Claydon Farm, Front Field

Date: 2nd April 2020

	Pit									
	1	2	3	4	5	6	7	8	9	10
Total number of earthworms (adults and juveniles)	20	35	25	59	57	74	20	19	30	27
Number of adult endogeic earthworms	8	3	3	5	12	2	3	3	4	3
Number of adult epigeic earthworms	6	2	5	7	1	9	4	2	8	7
Number of adult anecic earthworms	4	9	7	9	14	8	8	5	12	9

An AHDB worm survey carried out on the Claydon farm in April 2020 across 10 pits (garden spade size) gave an average count of 28.1 worms, including adults and juveniles.

As the Claydon Opti-Till® system has been adopted globally over the past 20 years, further benefits have come to light, helping growers cope with weather extremes. Moisture retention assists the establishment of the following crop in areas that experience low rainfall and high temperatures. In other areas where short, sharp rainfall events are becoming more frequent, Opti-Till® allows the soil to drain quicker, eliminating ponding, providing that drainage systems and soil structure are good to depth.

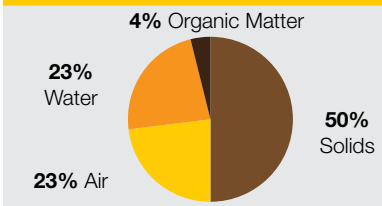
Increases in organic matter (OM) and soil organic carbon (SOC) are other benefits when soil is left undisturbed and not inverted. Soil organisms and roots are not desiccated and exposed to ultraviolet irradiation, earthworms and their burrows are left intact contributing to improvements in soil structure.

Following no cultivations for over 20 years the Claydon soils have OM scoring of 6.8% and SOC at 3.8% which is contributing to yields that are above the national average across the crop spectrum.

Cultivations can change soil density, affecting soil structure and inhibiting root development, capillary action and drainage. Different densities of soil can lead to sedimentation blocking the natural pores in the soil which can lead to erosion of the topsoil.

An open soil with good pore space ensures that soil has a good balance promoting drainage, moisture retention and maximising rooting to depth. A balanced soil will ensure that plant roots can utilise the soil, so harvesting nutrients and tapping into moisture, mitigating against weather extremes and maximising yield output in any given hectare.

Ideal Soil Structure



Well-structured soil ratio

Our experience and findings show that customers in many regions across an increasing number of countries are finding their soil health is improving with Claydon with the added benefits of better yields and an increased ability for their crops to cope with weather extremes.

To find out more:

+44 (0)1440 820327
info@claydondrill.com
https://claydondrill.com/

CLAYDON

Why emissions from farming must fall further

Growers and livestock producers have a key role to play in reducing greenhouse gas emissions. **Louise Impey** reports

Farming is responsible for 11% of total UK greenhouse gas (GHG) emissions and as much as 88% of UK ammonia emissions, according to Defra's latest *Agri-climate report*. Emissions matter for several reasons – the production of GHGs such as nitrous oxide, methane and carbon dioxide is linked to global warming and climate change, while ammonia is a damaging air pollutant with harmful effects on the environment.

Air pollution is also the leading threat to public health – harmful particulates cause up to 36,000 deaths a year and it is estimated that this will cost the NHS and social care £1.6bn between 2017 and 2025.

Downward trend

Behind these headlines, Defra's report confirms that the past 30 years has seen a downward trend for most emissions from farming, with total GHGs falling by 16% and ammonia emissions by 10%. Much of this fall has occurred in recent years and is the result of a drop in ruminant numbers and less use of synthetic fertilisers.

Emissions from producing 1 litre of milk have fallen by 22% since the 1990s, with 11% more milk being produced from 21% fewer cows. Likewise, the GHG emissions from producing 1kg of pork have fallen by 44%. And while nitrous oxide emissions from wheat production are unchanged, wheat yields have increased – suggesting that more wheat is being produced from the same amount of nitrogen. Given the current emphasis on net zero, it's not surprising that the Defra report also reveals that 64% of farmers considered it important to factor in GHGs when making farm business decisions, with 58% of them admitting to already taking action to reduce emissions.

Targets and legislation

The government has set a goal for the UK to be net zero by 2050, while the NFU has been more ambitious and committed to a date of 2040. Other government targets include a reduction of 16% in ammonia emissions by 2030, compared with 2005 levels.

The Clean Air Strategy 2019 aimed to reduce air pollution from agriculture, offering support for farmers to invest in infrastructure and equipment to reduce emissions, and bringing in regulations on low-emission-farming methods and fertiliser use. The Global Methane Pledge, which came from COP26 last year, saw the UK being one of the signatories to collectively cut methane emissions by 30% by 2030, on a 2020 baseline. In addition, the Environment Act 2021 makes air quality one of four priorities, and requires government to set legally binding targets for England, with an additional target on fine particulate matter.

When it comes to ammonia emissions, large intensive pig and poultry units already have to obtain and comply with permit conditions set by >

ACTIONS TO MAKE A DIFFERENCE

According to a guide produced by Innovation for Agriculture, in conjunction with WWF and Tesco, the following actions will help to reduce emissions. Taking a whole-farm approach, with multiple actions for specific enterprise types, will make the most progress:

- Grow cover/catch crops
- Integrate grass leys into arable rotations
- Include legumes in arable rotations
- Keep soil pH at optimum level
- Reduce cultivations
- Improve fertiliser applications and avoid excess nitrogen
- Use enhanced efficiency or protected fertilisers
- Consider slurry store design/management
- Investigate anaerobic digestion as a means of dealing with waste
- Look at feed additives, low cellulose diets and soya replacements in rations
- Consider livestock genetic improvement
- Focus on livestock health
- Grow grass-legume mixes for grazing
- Investigate what low-carbon farm machinery can offer
- Look at low-carbon heating/cooling systems.

PHOTOGRAPHY: ADOBE STOCK, LEAF, TIM SCRIVENER

< the Environment Agency – something that could be extended to big dairy and intensive beef units before too long.

Emissions types

There are three main GHGs produced from agriculture: nitrous oxide, methane and carbon dioxide. Of these, nitrous oxide from soils and methane from livestock are the two biggest sources. Carbon dioxide from energy use contributes much less.

GHGs are presented and measured in units of carbon dioxide equivalent (CO_2e), which allows comparisons to be made between them.

Carbon dioxide is the most abundant gas and is used as a benchmark. The others are converted into CO_2e by multiplying the quantity of gas emitted by the global warming potential (GWP) of that gas – its heat-absorbing ability compared to carbon dioxide. As such, carbon dioxide has a value of 1. For methane, the value is 28 and for nitrous oxide, the value is 298.

These figures are produced when a timeframe of 100 years is used to calculate emissions of GHGs. Some scientists believe that this method misrepresents the impact of shorter-lived GHGs, such as methane, and that a 20-year time horizon is more relevant. Others believe that GWP should be used, as it accounts for the different properties of the gases and their impact on the climate. It also allows for the fact that methane has a shorter lifespan than the others.

AMMONIA: WHAT'S THE PROBLEM AND WHAT CAN BE DONE?

Most of the ammonia produced by agriculture comes from urine and faeces from livestock, although the spreading of manures and fertiliser also plays a part.

A natural gas, ammonia is released when animal excrement comes into contact with air, before reacting with other gases in the atmosphere to form toxic particles known as particulate matter.

Emissions are already subject to legal reduction targets – with a 16% cut required by 2030 – and there are many steps farmers can take to lower emissions. This involves focusing on excretion from animals in buildings, as well as manure storage and at spreading – with particular emphasis given to the spreading stage, so that the field operation doesn't undo any good work already achieved.

"Remember that you are dealing with a gas," says John Morgan, of Creedy Associates. "You can't see it, so it's possible to save it in one part of the farm, only to lose it in another."

Diet is the first opportunity, as ammonia production is linked to the amount of protein fed to livestock. Wherever possible, diet protein should be matched to animal needs, which will vary with age, sex and production system. "Supply the feed ration as it was designed," he says. "This is important with forage, which can be variable. And avoid waste by concentrating on feed conversion efficiency." Extended grazing also helps, because it curtails emissions. "If you can avoid the use of yards and slurry storage, you have an advantage. Not housing livestock makes a big difference."

A systems approach – working from a back to front view – is how Mr Morgan suggests farmers can get to grips with ammonia emissions. He highlights spreading as a key action, as mistakes made at this stage mean other benefits are lost.

Manure/slurry spreading

The right amount, in the right place, at the right time is essential, which is why a nutrient plan and soil testing should be part of the procedure, with applications matched to crop need.

Rapid incorporation of manures and slurries is a good opportunity to reduce emissions, as left on the surface they can lose as much as 50-60% of ammonia in the first 12 hours, with farmyard manure typically losing 30% in that time. "It's all about reducing the surface area of the slurry exposed to the air," he explains. "This is why low-emissions spreading equipment for liquid manures can help."

Ammonia emissions are higher when it's warm and sunny, so the best conditions for spreading are when it's overcast and dank.

Storage

Farms with enough manure and slurry storage are in a good position to carry out spreading when crops can make the best use of nutrients. Covering stores reduces ammonia emissions – both permeable and impermeable covers can be used to good effect. "You are only losing ammonia when the muck is in contact with the air, so covers have a role," says Mr Morgan.

Slurry bags are another option and involve total containment, but they must be put in a bund. Covering solid manures with a sheet can also help, but is seldom a popular request. "As well as reducing ammonia losses, it helps to prevent the leaching of nutrients."

Housing

Absorbing faeces and urine with bedding cuts their exposure to air and helps to reduce emissions, as does regular scraping and cleaning of buildings. "Avoid standing urine pools on concrete wherever possible," says Mr Morgan. Vegetative buffers and breaks around buildings help to reduce wind blowing through them and limit exposure to air, while air scrubbers used in poultry buildings filter pollutants and retain ammonia.

Another technique used is acidification, which involves lowering the pH of manures to less than 6. This cuts ammonia emissions dramatically and the acid can be added at any stage to suit – either in-house, in-storage or in-field.

Environmental strategies include low emissions spreading, soil testing, slurry store covers and introducing livestock into rotations

Methane

Agriculture is responsible for 47% of the UK's methane emissions, most of which come from livestock production via enteric fermentation. Research has shown the most promising ways to reduce methane emissions from ruminants, as well as investigating their costs, are:

- Breeding for lower emissions animals
- Improved livestock health
- Feed additives that reduce methane production in gut bacteria
- Growing legumes in the rotation.

At the Roslin Institute, microbiome research has shown a direct correlation between the abundance of archaea in the rumen and the amount of methane produced by an animal. It also showed that a cow's genetics can directly affect the environment within the rumen, making it more or less hospitable for different species of micro-organism, including the methanogenic archaea.

According to Mick Watson of the University of Edinburgh's Roslin Institute, cattle breeders are now using microbiome data in their breeding programmes to select for lower emitting animals. "When farmers use this data in their breeding goals, together with feed additives that reduce methane emissions, there is an immediate fall in emissions."

Feed additives show great promise and there are several options that can help to reduce methane production. Of particular interest is Bovaer, which has been shown to give a 30% reduction in methane – or a 10-12% drop in GHG emissions for every kg of milk.

Animals lost to disease each year also have a climate and emissions impact, notes Prof Watson. "Resources are used and methane produced. By addressing animal health, along with genetics and nutrition, the sustainability of production is improved."

Nitrous oxide

Farming is responsible for 68% of the UK's nitrous oxide emissions. A very potent GHG, nitrous oxide mainly comes from fertiliser use, with 50% attributed to the manufacturing process and 50% to its use. The gas is released during spreading and when on the field, through processes such as volatilisation, leaching and direct loss.

There are several actions that farmers can adopt to reduce their reliance on nitrogen fertiliser, says Emma Adams of the Farm Carbon Toolkit. "Improving soil health, incorporating cover crops, widening the rotation and using organic sources of nitrogen are all helpful." Other actions that can help with nitrous oxide arising from fertiliser use includes the sourcing of fertiliser products – those coming from the UK or Europe usually have a lower emissions factor than product coming from China, for example.

Inhibitors, used to slow the conversion of ammonium to nitrate, have a role with urea products and help to improve nutrient use efficiency (NUE), which remains low with many granular fertiliser products.

"The standard figure for NUE from granular products is 60%," adds Ms Adams. "Some 40% is being lost at the outset and we need to consider how to minimise these losses." For most, it's about application. "Given their very high cost, it makes sense to apply fertilisers with accuracy, when the weather and plant growth is going to maximise uptake of the product."

Carbon dioxide

Farming is responsible for just 2% of the UK's carbon dioxide emissions, most of which come from combustion. That puts fuel use in the spotlight, whether it's for operating machinery, drying or heating. Simply minimising cultivations and tracking fuel use in real-time can help, as can minimising the time that tractors spend idling.

Further ahead, the development of autonomous machines and the use of robotics offer improvements, while the development of hydrogen technologies, biomethane combustion and battery-based electric vehicles will all help to reduce emissions. ■

TRANSITION FARMER: ANDY BASON

Emissions have already fallen at Newhouse Farm in Hampshire, as manager Andy Bason makes changes to the farming system in line with future requirements for delivering public goods.

In the past 10 years, fertiliser use has fallen by 18% and fuel use by 40%, thanks to reduced cultivations and a focus on soil health. "It wasn't deliberate at first – we were more intent on making adjustments that secured a sustainable future for the farm. But a carbon footprinting exercise carried out a few years ago helped with identifying areas that we needed to concentrate on," he says.

A goal of reducing greenhouse gas emissions by 30% was set when he joined the Leaf Resilient and Ready initiative, and soils have benefited from receiving chopped crop residues and growing cover crops. As a result, organic matter levels have risen, soil function has improved and the soils are starting to cycle nutrients. Ways of reducing total N fertiliser applications are also being investigated – although the farm doesn't use urea, with its associated ammonia emissions, Mr Bason would like to bring fertiliser costs down and be less reliant on the bag. "We are using tissue testing, Nmin measurements and refined application timings, so that we are only applying what the crop needs at the time that it needs it," he says.

● Follow Andy Bason and our other Transition Farmers as they adapt their business for the new environmental schemes and phase-out of the Basic Payment Scheme. Find out more on p5

WHAT ARE FARMERS DOING?

The three most common actions being taken by farmers to reduce emissions are:

- Recycling waste materials on-farm **82%**
- Improving energy efficiency **78%**
- Improving nitrogen fertiliser applications and efficiency **63%**

Feed efficiency key to a sustainable and profitable dairy industry

Pressure on dairy producer margins means a focus on high feed efficiency and high performance herds has never been more important, not just on the bottom line, but also on farm carbon footprints & sustainability requirements

"The essential ingredient to a high performance, healthy herd is accurate nutrition, and the ability to achieve the optimum balance is the key to driving feed efficiency," says KW Feeds ruminant technical manager Charlotte Ward.

"Feed selection and profitability go hand in hand – the correct feeding regime makes a significant difference to milk output, milk quality and of course the sustainability of your herd," she adds.

Nutritional and management strategies

Producers should review nutritional and management practices, using data available on farm to drive decision making.

An example is the use of hand held near infra-red spectrometers (HHNIR), enabling KW Feeds' specialists to predict forage nutrient content quickly and accurately.

"Understanding your forage base and supplementing protein/sugar/starch/additives accordingly, means you can focus on optimising forage digestibility and milk from that forage," says Ms Ward.

By looking to alternative product solutions, producers could extend or replace forage, or replace expensive compounds.

"The pre-treatment product Vista Pre-T for example, can enable better forage utilisation, resulting in reduced carbon emissions and reduced feed costs," she adds.

NovaPro Vs imported soya

NovaPro's carbon footprint is only around 1/7th of the carbon footprint of soya*

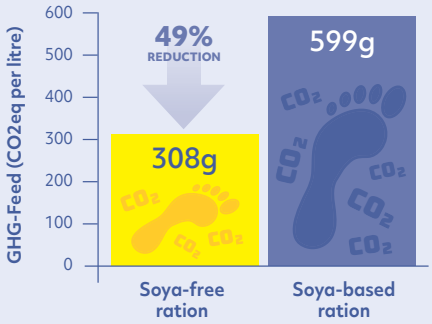
Home-grown alternatives and co-products

If the driver of the dairy industry is the cost per litre of milk, the challenge is to mitigate the carbon footprint of each litre, while understanding that economic performance and viability is key.

"A stronger focus on sustainably sourced feeds, for example zero deforestation certified soya, also gives rise to potential for both more home-grown alternatives and co-products," says Ms Ward. "Developments, such as the high-energy rumen-protected protein NovaPro, is a good example."

Sample customer ration

Reduction of 291g CO_2e per litre and made more cost effective by removing soya and feeding UK sourced co-products



NovaPro is made from UK rapeseed and brings performance benefits, including improving intakes and yields, while removing soya from dairy cow diets. Its carbon footprint is only around 1/7th of the carbon footprint of soya*.

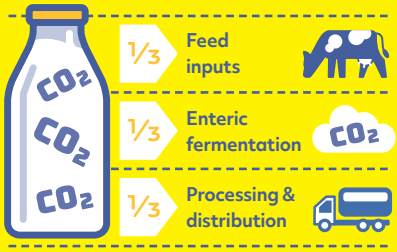
"Fed alongside moist ingredients, such as C★Traffordgold or brewers grains, or liquid feeds such as distillery syrups, NovaPro also supplies a cost-effective source of rumen degradable protein," adds Ms Ward.

Trials

Trials run by Professor Phil Garnsworthy at the University of Nottingham found rations containing NovaPro produced an additional 1.7 litres of milk per cow per day compared to a soya and rape ration, with no significant effect on milk constituents.

"This was coupled with a significant reduction in milk urea, suggesting an improvement in nitrogen efficiency and less direct and indirect emissions from manure," says Ms Ward. Professor Garnsworthy has also published a paper showing UK wheat distillers can achieve a similar reduction in soya. Vivergo wheat distillers, sourced from the bio-refinery in Yorkshire, is a palatable, high energy and protein feed, rich in digestible fibre, low in starch and providing a good source of bypass protein. It provides a further sustainable alternative to soya.

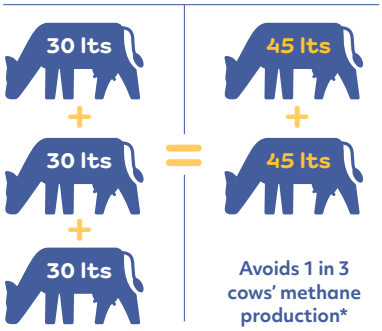
Carbon footprint of a litre of milk on a supermarket shelf*



* Approximate calculations

The link between efficiency and greenhouse gas (GHG) per litre of milk produced

Maximise efficiencies to boost performance



*Based on the logic that you can produce the same amount of milk from 2 cows as 3 if you boost production efficiencies and therefore lose the maintenance methane emissions from one cow.

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* GFLI figure for soya coming into the UK including Land Use Change, NovaPro figure submitted for review into GFLI branded data

How to get the most from nitrogen fertiliser

Simple steps can help reduce emissions from fertiliser. **Johann Tasker** and **Louise Impey** take a closer look and explore the benefits

High prices, supply chain issues and environmental concerns are prompting more farmers to reassess their fertiliser strategy.

Nitrogen fertiliser is the biggest source of greenhouse gas (GHG) emissions from agriculture, making it an increasingly high-profile environmental and political topic – and an issue farmers have been tasked with addressing.

Most emissions arise when nitrogen fertiliser is applied. The biological processes of nitrification and denitrification in the soil after application cause the emission of nitrous oxide – a long-lived gas with high global-warming potential.

While keen to reduce nitrogen emissions, growers such as Transition Farmer Alan Steven (see p13) are also demanding better value for money from fertiliser – including more accurate and efficient nutrient applications. Mr Steven farms 138ha of premium land with his brother John and cousins at Kingsbarns, near St Andrews, Fife. He grows premium crops – a mix of potatoes, field-scale vegetables and cereals – on a seven-year rotation for local markets.

"We moved to liquid fertiliser from solid for better compound placement on our potatoes," says Mr Steven. "It's made it easier for us to deliver the right amount of nutrients where they are needed more accurately."

Price spikes

Omex Agriculture commercial director Rob Burton says the company is receiving similar enquiries from other farmers looking to make the switch to liquid fertiliser – especially since last year's nitrogen price spikes. "More growers are wanting to get the best out of their fertiliser and improve their nitrogen use efficiency," he says. "They want to apply nutrients to the crop exactly where needed – and not beyond."

There are other reasons growers consider switching, says Mr Burton. Liquid fertiliser is popular with cost-conscious growers because it is applied by sprayer – making good use of existing farm machinery rather than having to buy a spreader. "You know every square metre on the field is getting exactly the right amount of nitrogen, particularly round the field-edge. And nitrogen use efficiency is improved too because being in the solution form it goes straight into the soil."

Farmers who want to reduce nitrous oxide emissions from fertiliser need to understand and baseline their nitrogen use efficiency (NUE), which shows how much nitrogen is being used by their farming system. In its simplest form, NUE is a measure of the amount of nitrogen taken up by a crop compared to the amount of available nitrogen. Armed with this information, growers can reduce any wastage and move closer to achieving net-zero targets. Average NUE levels are approximately 65% in the UK, >

Transition Farmer Alan Steven

UREA FERTILISER RULES UPDATE

The introduction of new rules on urea fertiliser use will come into force later this year. Defra farm minister Mark Spencer has warned farm leaders that, should they fail to meet this timescale, the government will intervene.

The original plan to only allow the use of untreated or unprotected urea products between 15 January and 31 March each year, with treated products used for the rest of the year, was due to be implemented by 2023. That would have seen only protected fertilisers used at times of the year when the risks of ammonia emissions are at their highest. The aim is to reduce the ammonia emissions associated with the use of urea and help the industry reach air quality targets. However, unprecedented market conditions and product supply difficulties following the Ukraine invasion prompted Defra to delay the new regulations.

Mr Spencer has now made it clear that he wants sanctions in place from autumn 2023, with the industry scheme involving Red Tractor auditing. With fertiliser prices reducing and availability issues easing, he stressed that he is not in favour of further delays.

Once under threat from a total ban, the use of urea fertiliser is still allowed under a self-regulation approach by the farming industry, although Defra will monitor progress and implement action if necessary. Although the new scheme will be in place this autumn, inhibited urea will not be used in most situations until next spring.

Nitrogen is responsible for about 50% of the yield for most crops. Left: CF Fertilisers is trialling the production of green and blue ammonia

< giving plenty of scope for improvement, according to the findings from a recent trial undertaken on behalf of Kellogg's.

In-season monitoring – using soil nitrogen supply analysis, tissue testing and handheld chlorophyll meters – showed a marked improvement in NUE to at least 72%. Using the growing plant as a sensor worked well, improving NUE and reducing demand for fertiliser. This is good for farm productivity, as well as for the environment – especially at a time when high levels of ag-inflation mean crop nutrition is expensive and commodity prices have eased back from last year's highs.

Energy intensive

"Fertiliser is an essential component of crop production," says Mr Burton. "Nitrogen is probably responsible for 50% of the yield in most crops. So it is important to get the best out of it – whatever form you use – and make sure you know exactly what you're doing and where it is going."

As well as emissions arising from application and usage, some 50% of the GHGs associated with nitrogen fertiliser come from the production process itself, which is extremely energy intensive. While manufacturing plants have significantly reduced any leakage from their facilities, the Haber-Bosch process used in nitrogen fertiliser production has seen little change over the past 100 years and comes with a large carbon footprint. This process fixes atmospheric nitrogen with hydrogen to produce ammonia – the building block for all nitrogen products. Under scrutiny, manufacturers and distributors are rising to the challenge of decarbonising their products.

Hutchinsons nutrition expert Tim Kerr says: "Prices may have fallen from 2022's highs, but there is still a drive to optimise nitrogen rates linked to the broader recognition that nitrogen fertilisers are the largest contributors to the carbon footprint of crops. We've invested in extensive trials across our regional technology centres and Helix farms, looking at possible solutions and ways to address nitrogen use by optimising soil health and the use of organic manures, cover cropping, and other alternatives."

Foliar applications of nitrogen in the form of methylated ureas can reduce nitrogen rates by about 30kg/ha, with no detrimental impact on yield, says Mr Kerr. "This is all useful and shows that new technologies can help reduce our reliance on bagged nitrogen."

Hutchinsons is currently evaluating a new product called R-leaf. It uses photocatalysis to

MAKE THE MOST OF NITROGEN

1 **Match nitrogen to crop requirements**
Start by estimating soil nitrogen supply. This will give an indication of the soil's capacity to supply nitrogen to a crop, based on previous cropping and fertiliser use, as well as soil type and winter rainfall.

2 **Improve fertiliser timing**
The timing of fertiliser applications is important for two reasons – maximising crop uptake and avoiding extreme weather events. Apply nutrients as close to the time that the plants need them by splitting applications and keep an eye on the weather forecast.

3 **Monitor the temperature**
Avoid applications made in conditions that increase emissions. Nitrogen uptake is restricted in cold temperatures, and soil needs to be above 10C for it to work well. Urea is more prone to losses in windy weather.

4 **Tailor applications**
Knowing the yield potential of the site allows fertiliser applications to be tailored according to crop potential. In addition, precision farming techniques can help target fertilisers according to need, preventing over-application while maintaining productivity.

5 **Incorporate manures**
The form that the nutrients are applied to a crop has a big impact on emissions. For example, rapid incorporation of manures and organic materials prior to crop establishment will help reduce emissions levels.

6 **Improve soil health**
Soil acidity, organic matter content and structure will influence what happens to the nitrogen in the fertiliser once it is applied. Waterlogged soils produce higher emissions.

capture air pollution and turn it into nitrogen fertiliser. It works by using daylight to enable the breakdown of nitrous oxides to nitrate that plants can take up as feed.

"R-leaf could offer a step forward in helping farmers reduce synthetic nitrogen use and increase profitability – a win-win," says Mr Kerr. "There are also 'softer' benefits to consider such as to the soils, as less synthetic nitrogen is applied."

Fewer inputs

Crop nutrition expert ICL says reducing GHG emissions while producing more food with fewer inputs is the major challenge faced by UK farmers. It specialises in controlled release, foliar and fertigation fertilisers. The company also supplies phosphate, potash and polysulphate-based fertiliser – a product that can boost autumn establishment and root development, leading to higher yields at harvest.

"Understanding your soil is critical for optimising nutrient uptake," says ICL agronomist Scott Garnett. "Sulphur is essential for NUE, along with potassium and phosphate. If your soil is deficient, inevitably there will be a limiting factor and impact on yield."

A 100kg/ha application of polysulphate resulted in a 28% increase in nitrogen uptake and a 41% increase in phosphate during winter barley trials in 2020-21. This was a significant increase in the efficiency for all key elements during the autumn period. Results were observed in the crop as stronger, healthier plants with a significantly enhanced biomass. Plants that entered the dormant winter period in a healthy state then emerged faster and stronger when spring growth commenced.

Meanwhile, manufacturers such as Yara are investigating new techniques to produce "green" fertilisers that the company claims have a carbon footprint that is 80-90% lower than fertilisers >

TRANSITION FARMER: ALAN STEVEN

Alan Steven switched to liquid fertiliser seven years ago, and says the advantages far outweigh any downsides. He farms a seven-year rotation of potatoes, field-scale vegetables and cereals with his brother John and cousins on a mix of loam soils across 138ha at Kingsbarns, near St Andrews, Fife.

"At the time, we happened to buy a second-hand planter," explains Mr Steven, who says his main motivation was being able to adjust fertiliser application rates more easily on the potato crop. "It came with a liquid fertiliser kit, which made it easier for us to make the change. Our intention was that we could link applications to soil maps, so we could deliver the right amount of nutrients where they were needed, more accurately.

"Our old granular fertiliser spreader was chain-driven. Upgrading it would have meant buying a new hopper for about £10,000 to do the same job. We looked at it and felt liquid fertiliser would work better on our variable soils – and would be more accurate, too."

Operator safety was also a factor. "Liquid fertiliser is much easier to handle than granular. There are no heavy bags and it's stored outside in tanks, so you don't need so much indoor shed storage. You just pull up to the tank and fill up."

Mr Steven finds liquid fertiliser more efficient and productive. One simple bowser is enough to keep planting potatoes throughout the day, and it does other jobs as well. But there are one or two downsides. "Liquid fertiliser is a heavy product, so you need to be careful with soil compaction when you're applying it. It's a bit heavier on the sprayer, too. You get about 800 litres of fertiliser to the tonne compared to 1,000 litres of water, so it is slightly heavier."

There are also different storage guidelines. Storage tanks are bunded for environmental protection in the event of a leak and to ensure the highest level of safety and security for the farmer. Tanks need to be regularly inspected and maintained. But it is worth the effort, says Mr Steven. "The big advantage is the accuracy of application – you're never going to get better. It is easier to apply accurately to the crop while keeping it away from field boundaries and watercourses."

● Follow Alan Steven and our other Transition Farmers as they adapt their business for the new environmental schemes and phase-out of the Basic Payment Scheme. Find out more on p5

The amount of nitrogen, phosphorus and potassium captured by cover crops is influenced by factors such as soil type, previous cropping and the species in the mix

Liquid fertiliser is easier to apply accurately to the crop while keeping it away from field boundaries and watercourses. Top right: About 50% of the GHG associated with N fertiliser comes from the production process itself

August-sown crops are best placed for early rapid growth

< produced with natural gas. These fertilisers are still nitrate-based and have the same chemical and physical composition as their current product range; the difference is that the ammonia used in their manufacture is produced using hydrogen from water. They will be produced in Norway, where the company's first production plant is based, says Yara's vice-president of green and low carbon fertiliser solutions, Birgitte Holter. "Production of fertilisers without the use of fossil fuels will start in the second half of 2023," she says.

CF Fertilisers has also made steps to reduce the emissions associated with its products and help farmers on their net-zero journey. Abatement technology on the nitric acid plants, at its Billingham facility, has reduced emissions associated with Nitram by 40%. To decarbonise its manufacturing process, CF Fertilisers is pursuing green and blue ammonia production. Produced conventionally, but with the carbon dioxide captured and sequestered, it expects blue ammonia to be the more cost effective of the two.

CCm Technologies is also assessing ways its fertiliser products – made with captured carbon dioxide and biological waste materials – can meet the crop's nutrient demands while reducing the farm's carbon footprint. By taking the stabilising nutrients contained in already available resources, such as straw, woodchip and vegetable waste, CCm says the resulting fertiliser is then delivered to the crop in a readily available form. ■

MANY BENEFITS OFFERED BY COVER CROPS

Cover crops offer benefits for soils, water quality, biodiversity and the farm business. When it comes to reducing the need to apply nitrogen to following crops, two of the most common queries are how much N do they take up and what happens to it.

Various studies suggest that 10-50% of the nitrogen taken up by a cover crop will be available to the subsequent crop – with the rest having a crucial role in helping to build soil organic matter and improve soil function. Adas trials indicate that many cover crops provide about 50kg of N/ha in the spring – which is worth good money in the current volatile fertiliser market.

According to work by Frontier Agriculture, cover crops are responsible for an average 60% reduction in nitrate leaching, and even better results can be achieved when they are established early. Their ability to capture nutrients means they create plant material that is then returned to the soils following their destruction, and the nutrients are returned to the soil as organic matter.

Frontier's specialist Rob Nightingale says the main driver of the amount of nitrogen taken up is the cover crop sowing date. Crops sown in August have the opportunity for early rapid growth and the chance to develop a well-established rooting system. "The longer they are in the ground, the more nutrient they will capture," he adds. "In dry conditions, they will be less effective, as the nitrate doesn't move as much."

A freshweight cut down will help to understand how much nitrogen, phosphorus and potassium has been captured. He advises collecting a 1sq m sample of biomass from a representative area of the field and sending it away for analysis. "This year, the results have shown a wide variation in nutrients, ranging between 30kg N/ha and 200kg N/ha. This is influenced by factors such as soil type and previous cropping, as well as the species contained in the mix."

AVOIDING LOSSES TO THE ATMOSPHERE

Nitrogen in liquid fertiliser solutions of urea and ammonium nitrate is quickly available for crop uptake.

Solutions based on urea alone will contain no more than 18% nitrogen because at low ambient temperatures, urea crystallises out of solution, according to the *RB209* guide published by the Agriculture and Horticulture Development Board.

Nitrogen content of applied urea lost to the atmosphere as ammonia varies, depending on soil and weather conditions, and is typically 10-30%. Losses may be minimised if urea is applied shortly before rain is expected and/or is shallowly cultivated into the soil.

Recommended nitrogen rates are based on the main nitrogen source being ammonium nitrate, ammonium sulphate or calcium ammonium nitrate. Urea can be treated with urease inhibitors to reduce losses through volatilisation.

If untreated urea is to be used, recommended rates may need to be adjusted to allow for losses as ammonia. It is unlikely that this adjustment will be necessary if urea is treated with a urease inhibitor.

Nitrification inhibitors can delay the release of nitrate following fertiliser application, which can reduce leaching and nitrous oxide emissions. They can be added to liquid fertilisers prior to application or sprayed onto soil prior to spreading solid fertilisers.

For complete agronomic advice on product choice and guidelines for use, consult a Facts-qualified adviser.

PHOTOGRAPHY: ANGUS FINDLAY, GARY NAYLOR, TIM SCRIVENER, PA IMAGES/ALAMY STOCK PHOTO

Kellogg's Origins™ – Advancing Sustainable Agriculture

10 years on, and Kellogg's Origins programme goes from strength to strength – helping farmers make better decisions by bringing the best of industry knowledge and support to bear.

This year marks the 10th anniversary of the Kellogg's Origins programme within the UK. A programme that was created to build partnerships with farmers across the globe to support their climate, social, and economic resiliency. From small beginnings, but with a hearty ambition, our goal is to reach 1 million farmers worldwide by the end of 2030.

Our aim is to work with suppliers, research institutions, and non-profit organisations across each region and country to provide farmers with training and technical assistance to improve farm productivity, regenerate soil health, protect species and habitats, reduce greenhouse gas emissions, and improve their livelihoods in ways that protect and respect human rights.

In the UK the programme works with a group of farmers, who predominately supply their wheat through Heygates mill in Northamptonshire, where it is processed for delivery to the Kellogg's factories in Manchester and Wrexham.

Over the last 10 years we have worked alongside organisations such as EFFP, the Allerton Project, NIAB, Innovation for Agriculture, and Map of Ag to name but a few, to arrange visits, speakers, technical support, and most importantly a series of farm-based trials.

A key facet underpinning the programme is listening to what the farmers want and what works for them. Our farmers are all pushing the boundaries of sustainable farming in their own right – our role is to work alongside them to enhance what they are doing and to partner with those who can provide the scientific rigour behind the projects we get involved with.

Back in 2014 we started a three-year project working with NIAB to explore the implications and benefits of growing cover crops. Working with 9 farmers across 17 fields, we compared over 70 different cover crop mixes. Covering an area in excess of 500ha it was the biggest cover crop trial in the UK. The output was a detailed report of field activity and findings, and a Cover Crop guide which is available to anyone who would like a copy.

In 2017 we embarked on a two-year project with Innovation for Agriculture to evaluate the efficacy of organic soil amendments to improve crop production and soil health. The aims were to determine the effects of application on crop performance and the soils' chemical, physical and biological health, and how this differs depending on the choice of frequency of the organic amendment applied. The results over the long-term highlighted that compost positively improved soil fungal populations, structure, aggregation, infiltration, and biological activity.

More recently, we have been working with Map of Ag alongside eight Origins farmers on a project to improve nitrogen use efficiency (NUE). Using a hand-held Nitrogen tester we are using the plant itself to tell us when and how much nitrogen it requires and adapting applications accordingly. Results to date are encouraging with average nitrogen applications falling from 212kg/ha to 171kg/ha in 2021, with a yield reduction of only 0.14t/ha. At prevailing nitrogen prices, this resulted in a net cost benefit of £51/ha.

The minimum NUE was raised to 74%, saving the equivalent of 5.4 tonnes of fertiliser which equates to a 13-tonne reduction in carbon emissions over the trial sites.

For Kellogg's it all starts out in the fields. We're proud to work closely with our farmers in the UK to help them meet the challenges ahead. Combining the best of farming practices to improve economic, social, and environmental performance.

To find out more
Email Mairead.Comerford@kellogg.com

Kellogg's ORIGINS PROGRAMME

PARTNER PERSPECTIVE

Farmplan

3 ways you can prepare for uncertainty with smart tools by your side

With unpredictable input costs, volatile markets, and future uncertainty, UK farmers face extraordinary challenges. The drive towards net zero may feel like an added pressure to many, however could this be an opportunity to look at where farms can be more efficient and resilient?

Farmplan Business Cloud, a leading farm management solution from Proagrica, enables growers and livestock producers to remain profitable and mitigate risks by putting the right farm management information in their hands when they need it most. Piers Costley, Farmplan Director, says that smart tools like Farmplan Business Cloud (FBC) can help farmers stay flexible and plan for the future in uncertain times.

"In fact, our range of solutions including Gatekeeper and FBC are built around the ability for users to record, track, and understand data," says Piers. "Only by doing that will you be able to remain agile, forecast accurately, and plan accordingly for whatever tomorrow may bring."

So how can these tools help farmers navigate volatile markets?

Make informed decisions

Where is a farm performing well? What needs to happen so the business can grow sustainably? By having the right tools in place farmers can analyse their business in as much detail as they need, so they can answer these questions, continuously improve and stay resilient.

"Only with the right information at your fingertips can you make the right decisions at the right time, on everything from inputs and machinery to selling and compliance," says Piers.

"Decisions on farm aren't often made alone, so because FBC is a cloud-based product, you can easily share your data with your accountant or you can connect with your agronomist through Gatekeeper, helping you share and receive information more easily" adds Piers.

Manage diversification

For farmers looking to diversify to improve revenue opportunities, our tools make it easy to assess your business and choose diverse projects that will work for you. Our tools can handle data for all types of enterprise from traditional farms to farm diversification projects, helping them grow.

"Our solutions are up to date with UK farming regulations, so are agile enough to accommodate diversification or expansion," says Piers. "these tools are designed to help your business thrive."

Pivot more readily

Against a backdrop of huge change and risk, farmers must stay agile. One way they can do this, is by harnessing the right tools.

"As farmers know only too well, the agricultural industry never stands still, "says Piers. "We have a range of intuitive cloud-based solutions on the horizon, which are easier to use for farmers, are more flexible on-farm, and allow data to be shared more easily with advisors and other required stakeholders, at the right time. Farmers face a challenging future environment but with the right tools they will be better equipped to efficiently manage their farms and be agile and ready to take advantage of the opportunities to come."

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Proagrica

How science is adding value to livestock manure

Transforming slurry and manure into energy is at the heart of a study that seeks to help NI livestock farmers achieve net zero. **Charlotte Cunningham** reports

Researchers in Northern Ireland are exploring how manures can be more than just a waste product by helping reduce overall carbon footprints and associated emissions.

The work, carried out by the Agri-Food and Biosciences Institute (Afbi), forms part of the NI government's plans to reach net zero.

Agriculture is the country's biggest greenhouse gas emitter – responsible for 27% of all emissions in 2020, according to the Statistics and Research Agency. These emissions are made up of methane, carbon dioxide and nitrous oxide – all three of which are often associated with livestock production and, in particular, the management and handling of manure and slurry.

"Agriculture is such an important sector to Northern Ireland. Livestock production is what we do," says Chris Johnston from Afbi's agri-environment branch. "We've got more animals than people, so [what we're focusing on] is [reducing] emissions to air and emissions to water. Our soils are also filling up with nutrients, which isn't particularly useful for soil or water quality either." Financially, it is uneconomic too, he adds: "If you think about it, we're just filling up [soils] with more and more valuable nutrients.

"What we want is a situation where livestock manures are managed in a way that we can produce energy from them, recycle the nutrients by extracting nitrogen and phosphorus and potentially recirculate those products back into agriculture or elsewhere.

"Phosphorus, for example, is one nutrient we have far too much of. We import a lot – in feed more than fertiliser – and we export less than we import. So, the question is: what can we do to try to make livestock agriculture sustainable into the future?"


Chris Johnston


John McIlroy

Nitrogen losses

Afbi's John McIlroy adds that the nitrogen cycle and losses associated with it have also been fundamental drivers behind the research. "A lot of our research is on emissions into the air, and in particular we've focused on ammonia emissions in recent years because it's a very significant pathway for nitrogen loss – it's one of the greatest losses within our nitrogen cycle.

"So essentially, we're bringing nitrogen fertiliser onto farms and paying a lot of money for it – particularly in light of recent political events and the cost of nitrogen fertiliser – but we're losing a significant proportion of that as ammonia." Not only is that an environmental hazard, but it also results in financial losses for farmers. "That [lost] nitrogen is nitrogen that, had it been stabilised and retained within the fertiliser, would have made its way into the soil [to be] used by the crop."

With those challenges in mind, the system in place at Afbi's Hillsborough research centre is based around using anaerobic digestion (AD) and slurry separation technology to make better use of slurry. While the technology itself is nothing new, Dr McIlroy says it is how this technology – and the subsequent manure and by-products >

Agriculture is Northern Ireland's biggest greenhouse gas emitter, responsible for 27% of all emissions in 2020

PHOTOGRAPHY: TIM SCRIVENER, AFBI

Tactics such as using low-emission spreading methods and covering slurry stores can help prevent losses to the air

< – can be used that makes it interesting from an emissions reduction perspective. "It's a holistic system that we've been developing at our platform at Afbi Hillsborough, where we have control of the emissions through treatment of the manures."

So how does it work and how could the system be beneficial for Northern Ireland's farmers in the long term?

Anaerobic digestion

The first stage of the process is using the slurry from Afbi's own farm, which is "recycled" via the on-site anaerobic digester. Animals extract the nutrients they need from feed and grass during digestion. But there is still a residual energy source in the organic matter carbon in the resulting slurry, Mr Johnston explains.

"So what we're doing is forcing more methane out under an anaerobic environment – anaerobically digesting it and pushing more methane and carbon dioxide out. We're adding extra material to it as well, to up the amount of methane, because it's the methane that is the energy molecule we are after."

This enables the reuse of as much material as possible in terms of the carbon, recovering the maximum amount of energy in a final digestate product, which can then be used as a fertiliser, he explains. "It's really the same thing as the [unprocessed] slurry, but it will have changed chemically to a degree because the carbon will have reduced slightly due to us converting some to carbon dioxide and taking the methane out. "There will [also] be higher available nitrogen because of the different bacterial processes that go on within the AD plant. All the phosphorous, potassium and nitrogen is still there – really all we've done is take out some carbon, oxygen and hydrogen."

Feeding slurry to AD plants enables the creation of gas from the residual energy in the carbon matter

Though the composition may be similar, Dr McIlroy warns that, to keep emissions as low as possible, further processing is needed after AD. "If you compare digestate to slurry, there's higher available nitrogen – the nitrogen has changed from organic nitrogen to an inorganic form called ammoniacal nitrogen. That ammoniacal nitrogen is more predisposed to ammonia loss. The pH of the digestate is also increased slightly when compared with the slurry, so both of those things make digestate more predisposed to ammonia loss than slurry, which is why we really need to have nutrient management technology after AD."

This could be covering slurry stores or applying the materials to land using low-emission spreading methods. This technique is something that has been in place at Afbi Hillsborough since 2019 and has been proven to reduce ammonia emissions, adds Dr McIlroy. Issues such as phosphorous loading on to agricultural fields, and the problems associated with that, also strengthen the argument for this post-digestion management.

Separation

The next step is separation. "This is a physical process whereby solids and liquids will be split to the greatest degree possible – and there are lots of different technologies that can be implemented [to do that]," says Mr Johnston. Afbi is using a screw-press separator, which is the most common type used in agriculture and works like a pressurised sieve to separate materials. "The idea is to have as much of the phosphorous in the solid fraction and as much of the nitrogen in the liquid fraction – that's the general goal of the separation process," explains Dr McIlroy.

"The reasoning for this," explains Mr Johnston, "is that we want to remove some of the phosphorus from the land base, but we want to leave the [nitrogen] that's expensive to buy – there's no point removing all the fertiliser and having to buy it in through a very greenhouse gas-hungry process."

It is estimated that this technology has the potential to reduce total phosphorus content from slurry or digestate by 20-40%.

GAS POTENTIAL

The use of biomethane captured from slurry is a huge area that offers potential to farmers, wider agriculture and associated industries, says the Agri-Food and Biosciences Institute's (Afbi's) Chris Johnston.

A recent paper co-authored by Afbi examined the potential for Northern Ireland livestock and agriculture contributing to displacing the import of fossil gas. Though much of Northern Ireland's fuel is still based on oil sources, there is a new gas network that is currently distributing 6,500GWh (gigawatt-hour) of gas, explains Mr Johnston. About 80% of this could be displaced directly from biogas produced through anaerobic digestion, according to economic modelling based on the research findings.

Underused grass and other energy crops could all be co-digested with the slurry, highlighting the huge potential for agriculture to be a big part of the solution for decarbonising energy in Northern Ireland, believes Mr Johnston. "There's the opportunity to decarbonise domestic properties and industry transport, and then there's methane tractors, too – we've had one at Afbi to try – so it does seem to be a real opportunity and a way forward to try to make better use of biomethane."


Slurry from Afbi's own farm is recycled via its AD plant

Future applications

What happens next with these solids and liquids is an area still being investigated by Afbi. "This is the bit where we're now trying to find out what the best route for Northern Ireland agriculture is," explains Mr Johnston.

With regards to the liquid fraction, management can be as simple as spreading it onto land via a trailing hose or a trailing shoe, says Dr McIlroy. "You'd reduce a lot of the emissions from [doing] that, but you would still have some."

There are a number of nitrogen separation technologies that can reduce emissions further, but these are currently only available on a large scale and require further investigation.

"By doing that [nitrogen separation], we're able to create a nitrogen fertiliser that can be reused and redistributed. But we're also removing the environmental impact of that nitrogen as we're capturing, managing and saving it," says Mr Johnston.

Acidification of the liquid fraction could also help stabilise the nitrogen, which would again reduce emissions when it's spread on the land, says Dr McIlroy. "Another example is an acid-stripping system, where you use a sulphuric acid to scrub the ammonia from that liquid fraction, and what you end up with is a liquid ammonium sulphate solution – like a liquid fertiliser – which reduces nitrogen losses."


Slurry is split into solids and liquids for further processing

There are fewer available options for the solid fraction. "People often forget that when you separate, you have a big pile of solids to deal with as well as the liquid fraction," he adds. "On farms in Northern Ireland, particularly big farms, it's likely that those solids would be destined either for further processing or for export off that farm, as the phosphorous balance might already be exceeded."

Through further processing, there is the possibility that these solids could be used to make a compost-like substance for horticulture, for example, but Mr Johnston says this is where there are more questions than answers at the moment. "The question is: what are the most suitable markets? We hear lots about removing peat from horticultural products, so it may be that this is a good alternative," he says.

However, before this becomes an option for livestock farmers, more needs to be understood about the biosecurity, regulations, nutrition, and value as a fertiliser. ■

Six key measures identified for livestock emissions reduction


Jayne Brookman

A new report gives priority recommendations to focus the ruminant livestock sector in its bid to achieve net zero.

At the top of the list is a call for the standardisation of greenhouse gas (GHG) data to establish baselines and enable benchmarking for carbon footprint audits. Such an "evidence-based" approach would allow for a better assessment of the success of GHG reduction strategies.

"The ruminant livestock industry has a critical role to play in achieving the ambition of net-zero emissions by 2050," says Jayne Brookman of the European Institute of Innovation and Technology Food (EIT Food), which published the report.

Called *Achieving net zero targets in the ruminant livestock industry in the UK and Ireland*, the study brought together experts from government and non-government organisations. Key stakeholders from the wider agri-food industry included the AHDB, Teagasc, and the Agri-Food and Biosciences Institute.

"For the ruminant livestock industry to transition to net zero, input and support will be required from all players along the supply chain, as well as adoption by farmers," says Ms Brookman. "We hope that the recommendations will help a wide range of stakeholders, from farmers to investors and policymakers, to take meaningful action that will support the ruminant livestock industry to achieve net zero."

PRIORITY RECOMMENDATIONS

- Urgent standardisation of GHG data for benchmarks and baselines
- Optimising the age of ruminant livestock slaughter to cut methane emissions
- Introducing policies that reward farmers to support the transition to net zero
- Expanding the network of demonstrator farms to enable research, knowledge transfer and training around new technologies to accelerate the transition to net zero
- Promoting land management strategies (including agroecological and regenerative practices) for net zero
- Improving understanding of the complexity of carbon sequestration to ensure a holistic response

Source: EIT Food

PHOTOGRAPHY: EIT FOOD, SMSPSY/ADOBE STOCK

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PARTNER PERSPECTIVE

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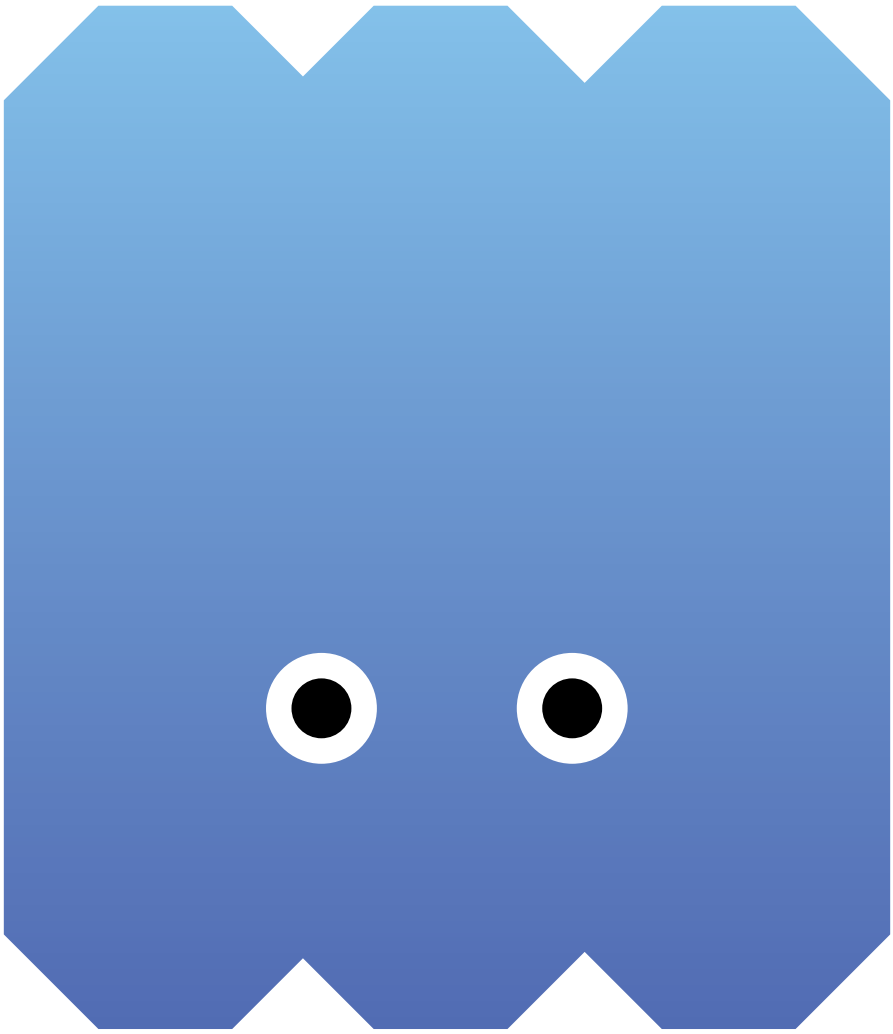

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NEW HOLLAND

How alternative fuels are helping to reduce emissions

Farmers in Essex have been putting a methane tractor through its paces to help develop the prototype. **Charlotte Cunningham** finds out more

Diesel-powered transport and machinery have been under scrutiny globally for some time because of their large environmental impact in the form of hefty carbon dioxide emissions.

Recent years have seen the debut of all kinds of prototype farm machines – using everything from solar electricity to hydrogen as a power source – in a bid to reduce the sector's carbon impact.

Although some alternative fuels are still a few years away from commercial viability, there are opportunities to reduce on-farm kit emissions now. Biomethane-powered tractors are being rolled out on farm, using an eco-friendly alternative to natural gas, which can be collected and captured from slurry stores and anaerobic digester (AD) plants.

New Holland has been leading the way, with the first prototype of its methane-powered tractor concept launched in 2013. It is based around the idea of using methane-filled gas cylinders in place of diesel tanks. In 2019 the T6.180 Methane Power was debuted at Agritechnica, ahead of the start of production. The manufacturer claims carbon dioxide emissions are 11% less than those of a diesel equivalent, and overall emissions are reduced by 80%.

Today a number of these methane-powered beasts are being used on UK farms, including at Essex-based Sell Farming. Ben Sell runs a mixed beef, sheep and arable operation with his brother Alex near the New Holland factory at Basildon. The fifth-generation farmers also operate a busy contracting business. On top of this, the farm grows energy crops such as maize to feed the on-site AD plant.

Emissions concerns

Conscious of the emissions coming from both his livestock and arable enterprises, Mr Sell says understanding what they can do as a business to reduce this is an area they are just starting to look into. "Something that is being talked about a lot is using direct drills and not releasing carbon from the soil. I feel at the minute we're not particularly doing the right thing – we're still a predominantly plough-based farm and have a lot of problems with blackgrass and ryegrass in the area. "One thing I am starting to look into doing is strip tillage. At the minute we're not in a position to go down that route in terms of a cereal rotation, but we could be enhancing the use of cover crops and using strip tillage for maize."

However, they are already making considerable environmental savings using a New Holland T6.180 Methane Power, which has replaced a diesel-fuelled alternative. The Sells were among the first to test a pre-production model, after being approached by New Holland to become a "field test" farm for the new methane tractor.

The purpose of this was to allow the tractor to be put through its paces in a real-life situation, >

with any feedback filtering into what would become the final commercial launch, explains Mr Sell. "At the time, apart from seeing Corporal Jones's van on *Dad's Army* running on methane, I didn't really know anything about methane power," he says. Keen to explore the potential of this biofuel, they received the first prototype in February 2021. "It was something very different and very new, and we went into it with an open mind," says Mr Sell.

That said, with a busy business he was apprehensive as to whether the methane tractor would be able to keep up with the high hours required of kit on the farm. This was something New Holland wanted to test rigorously, across various operations to see exactly what the tractor could or could not do, and so he put it straight to work with a straw spreader used for bedding up. "It was on for all of about 10 minutes and the torque just wasn't there – you'd hit a firmer lump in the bale of straw, and it just didn't have the torque to push it through. I remember thinking then it had an awfully long way to go."

Feedback like this went back to the manufacturer for improvements to be made, and today Mr Sell is on his sixth test unit – the version that is now available commercially to farmers in the UK. "What we tend to do is get a unit come out, we test it and do different bits and pieces with it and then [New Holland] takes it away after several months [to make improvements]." Compared with that initial prototype, the current commercial version has come on leaps and bounds, says Mr Sell. "If you had the two beside each other, the characteristics of this one now are totally different – it really is amazing how far they have come."

The farm's AD plant is not gas-to-grid but generates electricity, so the methane to power the tractor is supplied by New Holland

On-farm performance

Today, the methane tractor has secured its place in the fleet, says Mr Sell, and is used for a range of jobs around the farm. "At this time of year on the feed wagon we've got a Teagle straw spreader that we do the feeding with as well, as we're just feeding suckler cows, so we're using the tractor with that. We're getting a good seven to 10 hours out of it doing that. We also find that it's fantastic for doing jobs like the spraying and the fertilising – it's a nice little light tractor and very nimble." It is perfect for amenity work such as hedgecutting and flail-topping, too. "We also use it for rolling behind the cereal drill and, again, it's fantastic for that," says Mr Sell.


Ben Sell

To optimise fuel economy, Mr Sell says he tries to avoid using the tractor for jobs that require high rpms. "It's perfectly capable of doing those tasks, but once you get above 1,500-1,600rpm, you start guzzling the fuel an awful lot quicker than you would be doing the lesser tasks." When it comes to the job of refuelling, the process is as quick and easy as with a diesel tractor, but with the added benefits of being cleaner to handle, and odourless. "I've actually [refuelled] in a smart shirt before," he says.

Methane supply

Although the farm does have an AD plant, this is a gas-to-electricity digester, rather than gas-to-grid, so at the moment the methane to power the tractor is being supplied by New Holland.

In the future, Mr Sell says he is keen to look at being able to produce his own biomethane on farm to make use of the slurry from the livestock enterprises. He is particularly interested in the Bennamann system (see "The Bennamann system – How it works"), which facilitates on-farm capture and conversion of methane to biomethane fuel.

The system is based on a layered lagoon cover. As well as stopping rainwater getting into slurry, this traps the methane emitted which can then be converted into fuel-grade methane. "This would essentially couple on to what we've already got," he says. "Though the infrastructure would initially be expensive, given the tasks that we'd be doing [with the tractor] it would pay for itself." By capturing and collecting methane produced on-farm, there is also potential to sell excess gas in the future – making it an even more attractive opportunity.

In terms of the cost to supply compared with diesel, Mr Sell says it is complex to quantify as it involves converting bars of pressure into the equivalent litres an hour. But he has identified working the tractor at 1,500-1,600rpm to be the sweet spot for savings when running methane over diesel.

Long term, Mr Sell reckons this kind of technology will offer a significant cost benefit to farmers, as well as the environmental advantages. But he believes a government incentive will be required to get wide-scale rollout of alternative fuels on farms. "[There is] a lot of pressure on us as farmers to try to achieve

net zero by 2050, but in order to reach that goal, I really do believe that the government will need to provide some kind of incentive." He says grant funding to subsidise the cost of processing equipment or infrastructure – like the Bennamann system – would be really helpful.

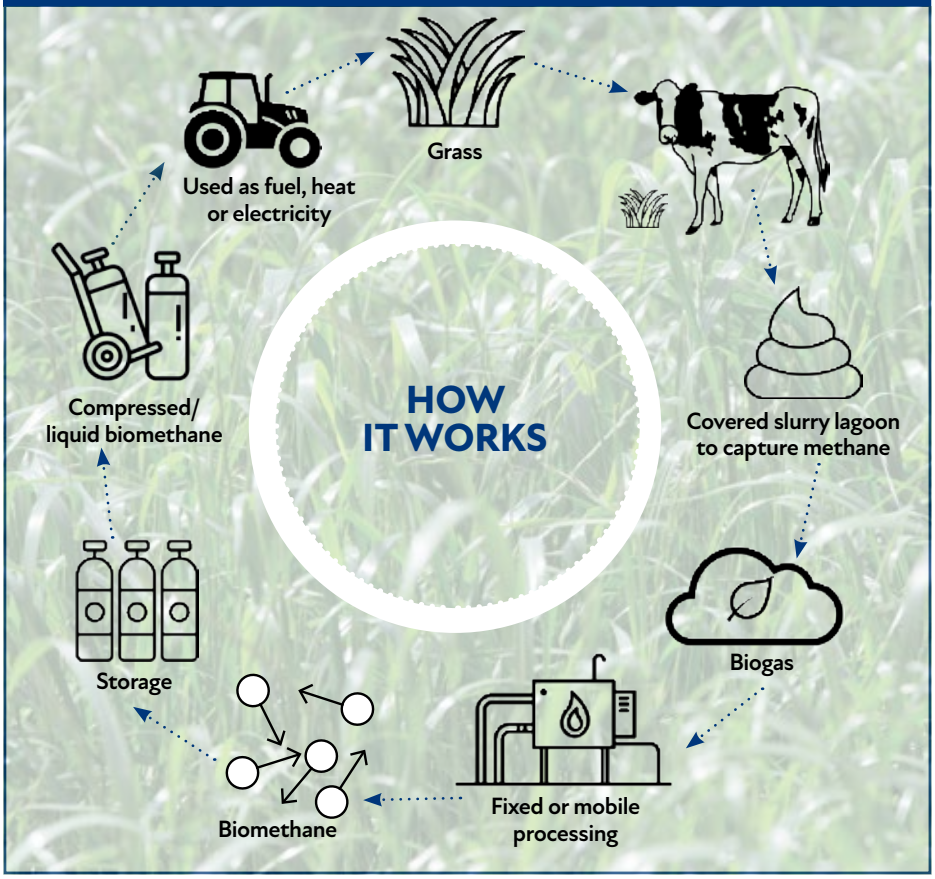
Fuel of the future?

Mr Sell says that while he doesn't believe alternative fuels can fully replace diesel power just yet, these tractors do have a valuable and important place within machinery line-ups – particularly if powered by farm-produced methane. "Ultimately, [the methane tractor] isn't going to be a tractor to replace all tractors, particularly with our contracting. It has a place on-farm, but I don't think it could annihilate its diesel counterparts.

"[On the contracting side] the longevity we're finding just isn't as great on some of the higher engine load tasks. In the summer, we do put an 18t silage trailer behind it and will use that to bring in grass. The beauty of using it for those jobs is that you're always using it for return journeys back to the farm, so it's easier to refuel.

"If you're a livestock farmer or you have AD you are creating methane. It's a waste product, and if you're not capturing it, it's only going to go back into the atmosphere. In the long term, with the right infrastructure and the right advice, I feel like farmers could produce their own fuel, on their own farms, which will create a more circular process." ■

THE BENNAMANN SYSTEM – HOW IT WORKS



Electric advantages on Norfolk dairy unit

Clockwise from top left: Stephen Temple has trialled a Faresin electric telehandler; the anaerobic digester plant produces 170kW of electricity; an electric JD Gator helps bring in the cows for milking

A loader, telehander and ATV are part of the electric-powered fleet at Stephen Temple's farm in Norfolk.

Together with his wife, Catherine, he runs a 130-head dairy herd at Copys Green Farm and grows a variety of crops such as lucerne and winter beans (grown as a co-crop with oats) for feed, as well as winter and spring barley for seed. This is on top of the on-site cheesemaking business which is supplied with the milk from the Brown Swiss herd.

Over the past 15 years, the Temples have been making a conscious effort to improve the sustainability of their business, which has largely focused on energy and fuel efficiency due to Mr Temple's background in engineering. "As an engineer, I've always been interested in energy," he says. "When I was working overseas in Malawi for many years, I was working on reducing energy consumption on tractors. It's something I've been involved in for a lot of years."

This desire to be more energy efficient has seen the Temples install an anaerobic digester plant which produces 170kW of electricity – fed via the slurry from the dairy herd and maize silage – and supplies the farm, the cheesemaking and the farm cottages, with excess exported to the National Grid.

They have also moved to a strip tillage system, having previously been plough-based. As well as the benefits to the soil and soil carbon, the move to strip tillage has reduced passes in the field and therefore diesel consumption.

To further reduce fuel consumption and make use of the on-farm electricity generation, Mr Temple has incorporated a number of electric-powered vehicles into his machinery fleet over recent years, including an electric John Deere Gator – which he uses for bringing cows in for milking – as well as an electric forklift used for moving the milk around for cheesemaking.

He trialled a Faresin electric telehandler but did not feel it was a suitable electric alternative for his farm. "The design isn't really ready for farm use as far as I can see," he says. "The cooling air intake was right behind the wheel, so as soon as you drove into the straw yard it got covered up with straw and wouldn't work, so the oil overheated. In construction, it would be fine, but not in agriculture.

"We've also got a little electric articulated steer handler which I want to convert," he explains. "At the moment, when bedding our cubicles we've got to walk behind a petrol-powered straw blower, which works extremely well, but the problem is that it's got a petrol engine, with a very hot exhaust, and is very close to straw – so we go through a fire extinguisher or two a year. My idea is to put [the straw blower] on the forks of the [electric] handler, and power it from its battery. That's a project for the future."

Leaning on his engineering skills, Mr Temple is currently working on building a machine based on the Tow and Fert sprayers – which are designed to maximise the efficiency of fertiliser. "These are only petrol or pto-powered, so if we want an electric one, we've got to build it ourselves," he says. "We've got the chassis made and we've tested the pump and nozzle. We now just need to finish welding and get it painted up and ready for use."

All cars on-farm are electric too, including a recently bought electric pickup to replace an old Land Rover Defender.

While there is an obvious cost-saving benefit from being more efficient with energy, Mr Temple says the environmental advantages and emissions savings are hugely important to him. "Global warming and climate change is the biggest threat to mankind – the planet will survive, but not in a format that's kind to humans. The more I can reduce waste, the happier I am. If we can avoid buying fuel in, that's all for the good of the environment.

"People are concerned with the cost of dealing with climate change, renewable energy and being environmentally conscious, but we've found that pretty much everything we've done has saved us money or made us profit."

While Mr Temple has the setup on farm to make electric-powered kit work, he believes that wider adoption of alternative fuels is likely to be limited by the significant investment required. It is this cost that is currently preventing him from looking at other fuel options such as methane.

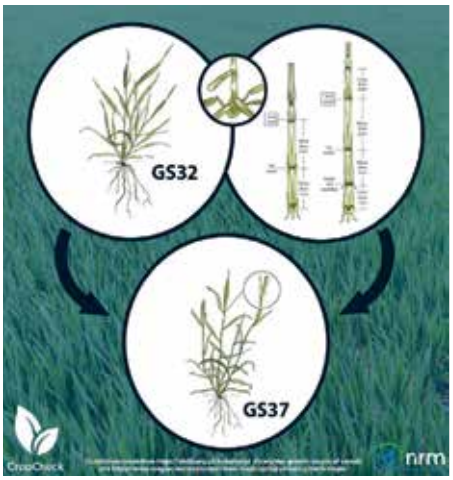
"I looked at methane a few years ago, when diesel prices were lower, and the cost of putting the kit in to clean up the biogas to make biomethane, and then to compress it into a tank to fuel a tractor, was not competitive with red diesel.

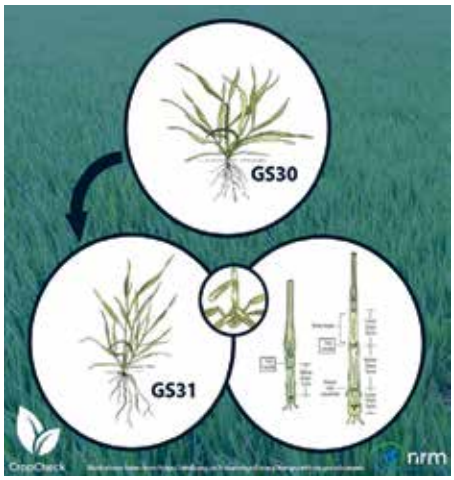
"The methane tractors also don't really have enough range for a day's work [for us], when you're working five miles from home."

Hydrogen power is also something he does not envisage being part of the plan anytime soon. "It'd be better to wait for battery technology to evolve – which it's doing incredibly rapidly at the moment. If you're going use hydrogen, it has got to be made renewably from electricity otherwise you might as well just use diesel." ■

Linking plant tissue analysis to key growth stages for more accurate results

Rapidly changing weather conditions an be a real challenge for growers if they don't keep a close watch on their crops to ensure they are receiving everything they need to thrive.





Wheat crop at GS30, GS31, GS32 and GS37 (AHDB Wheat Growth Guide)

We have seen the driest February for 30 years, and the fifth mildest since records began in 1884. However, Spring has started off chillier, with many places in the UK seeing rain, sleet, and snow.

Dr Sajjad Awan, NRM's Soil and Crop Nutrition Agronomist, says that making sure you're extra observant and adjusting management plans throughout the season will help you combat unpredictable weather conditions. This will make all the difference to determine the final outcome.

'Extreme weather conditions can affect crop development,' says Sajjad. 'However, when the soil and air temperatures do begin to climb, rapid growth quickly follows. It's crucial this year that farmers take plant tissue samples at the optimal time for the best results and maximum benefit. This is made even easier with NRM's innovative plant tissue analysis service, CropCheck, which not only tells you what's in your cereal crops, but how that relates to what you should expect at a particular growth stage.'

CropCheck is the next step in plant tissue analysis. NRM's expert agronomists have identified specific nutrient adequacy ranges for cereal crops at key growth stages coinciding with fertiliser application timings. This means fertiliser plans can be adjusted if necessary to rectify any deficiency issues, helping farmers save money on expensive applications.

'Our plant tissue results for the 2022 season revealed that most nutrients were lower than in the previous season,' continues Sajjad. 'For example, wheat crops only took up around three-quarters of phosphorus, sulphur and boron than they did during spring 2021. This was primarily due to the drier-than-average spring. CropCheck would have helped the affected growers decide what to do to improve nutrient uptake for optimal yield.'

With the risk of more unpredictable weather patterns in the future, Sajjad asserts that it's important that we incorporate resilience strategies into our crop management plans.

'Protecting the soil and its health, as well as monitoring crop growth, can guide how we react to the effects of a changing climate on crop productivity,' says Sajjad. 'Robust laboratory analysis identifies deficiencies in the crop, allowing farmers to rapidly mitigate issues and improve nutrient use efficiency. This not only bolsters profit, but it helps protect our planet by reducing nitrate and phosphate losses to the environment. Ultimately, using soil, crop measurements, and innovative analyses to guide management decisions helps build resilience, sustainability, and ongoing productivity in our growing systems.'

Identifying growth stages accurately is important when sending samples into the lab for analysis. This is because the critical values that the results are benchmarked against are specific to that point in the crop's development. CropCheck provides specific nutrient adequacy levels for cereal crops between GS30, when the ear is at 1cm, and between GS32, when the second node is detectable, and GS37, when the flag leaf is just becoming visible.

CropCheck gives growers and advisers confidence that their cereals crop is on track to reach its full yield potential, helps to pinpoint the nutrients the crop needs, and prevents unnecessary applications of those it doesn't require. With unpredictable conditions and stubbornly high input prices, this peace of mind is invaluable.

Set yourself up for success with NRM.

NRM is the UK's largest provider of agronomic analysis for the land-based industries for improved farm productivity. We provide a sample kit which contains everything needed to place an order for CropCheck analysis. Interpretation is also provided to guide why nutrients might be high or low.

You can order your kit through your agronomist, at **cawood.co.uk/order-sample-kits**, or by contacting customer services at NRM on **01344 886 338.**

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The vital role of soil in emissions reduction

Reaching net zero will be challenging for farmers. But it can be done, says **Joe Stanley**

The decarbonisation of food production will be one of the defining undertakings of our industry this century, as farmers play their part to reach the UK's target of net-zero emissions by 2050.

The NFU's aspiration is for agriculture to reach that target a decade earlier. Certainly, no other industry is in as advantageous a position, with farmers managing more than 70% of our land – and with all the possibilities for carbon sequestration that brings – alongside the rapid development of strategies to reduce direct emissions via managerial, technological and biological processes. Careful management of our soils is key to these aspirations, and the growing use of "regenerative" farming techniques will help to drive a burgeoning interest in building soil health and carbon.

At the GWCT Allerton Project, a 320ha research and demonstration farm in Loddington, Leicestershire, we are lucky to have soil scientist Jenny Bussell as a full-time member of the team. Over recent years, Dr Bussell has been undertaking a comprehensive range of soil research at our heavy-land site, much of it using our Gasmet portable greenhouse gas analyser, which allows us to measure a range of soil emissions in real time.

Compaction research

One trial conducted as part of the EU-wide SoilCare project was to assess the effects of compaction on soil productivity and emissions.

It's well known that moving from inversion tillage to a reduced- or zero-tillage system can have beneficial outcomes for soil organic matter retention and a drop in soil carbon dioxide emissions. But what is not as widely appreciated is the effect compaction can have on associated emissions of nitrous oxide, a greenhouse gas 300 times more warming than carbon dioxide. Although levels of nitrous oxide – both in the atmosphere and as a percentage of national emissions – are low, the potency of the gas gives cause for concern, and agriculture is responsible for some 75% of UK emissions. Much of this derives from soil management, primarily during the microbial process of denitrification, in which inorganic nitrate is converted to nitrous oxide. This occurs in wet, anaerobic soil conditions and in heavier soils.

The SoilCare trial saw us intentionally compact an arable field by driving over it repeatedly before running a series of split plots, including ploughed, direct-drilled and direct-drilled following a pass with a low-disturbance subsoiler.

Joe Stanley

In wet winter soils we recorded nitrous oxide emissions 10-15 times higher in the compacted direct-drilled plot versus the ploughed and subsoiled plots, respectively. In dry summer conditions, with the soil no longer providing the (un)favourable anaerobic conditions, comparative nitrous oxide emissions were similar between the treatments. But we also found that carbon dioxide losses from the two "disturbed" plots (subsoiled and ploughed) were significantly higher in winter than in the direct-drilled plot.

When we added the two sets of emissions together and adjusted for the global warming potential of nitrous oxide v carbon dioxide, we found the total soil GHG emissions from compacted direct-drilling were the same as those from the cultivated plots. Thus, on soils liable to anaerobic winter conditions, simply moving to a direct-drilled system may not offer benefits from a carbon accounting and climate point of view – although the fuel savings (about 50% between direct-drilled and ploughed) would factor in favour of the compacted direct-drilled area.

In this trial we were dealing with intentionally compacted ground. Across the wider Allerton Project, we can demonstrate that well-managed soils do not have the same nitrous oxide issues in a direct-drilled system. But mechanical intervention may sometimes be necessary to avoid such an outcome, and can be important for long-term soil health, as well as offering an agronomic reset in situations with high weed burdens.

Also being investigated by Dr Bussell is gas flux data indicating that our long-term direct-drilled soils have higher average carbon dioxide emissions than those which have been continually ploughed. This is linked to the greater diversity and mass of respiring biology in the soil, but needs to be squared with the concurrent increase in soil organic matter in those direct-drilled soils.

There are few "silver bullets" or simple answers to the question of how we reduce emissions from our soils while building soil health and sequestering carbon. But we hope to be providing part of the answer here at the Allerton Project in the coming years. ■

● *Joe Stanley is head of training and partnerships at the Allerton Project. For details, visit allertontrust.org.uk*

PARTNER PERSPECTIVE

Digital revolution allows designer breeding

Plant breeding is evolving substantially to keep pace with the sheer rate of change in farming practices, the environment and growers' needs these days, reveals a leading UK breeder.

Speaking at the latest in the series of Farmers Weekly Transition seminars this month, Bayer senior oilseed rape development scientist, Matthew Clarke stressed the importance of moving on from approaches that take 10 years or more to bring varieties to the market.

"Hybrid breeding has cut the varietal development timescale down significantly in OSR and maize breeding," he pointed out. "And gene-editing should allow hybrid breeders to make even more rapid progress on broader fronts by making it much quicker to move desirable traits with increasing precision within the species in parent lines.

"While the greater breeding progress the Precision Breeding Act should allow the industry to make is particularly welcome in helping it rise to the challenge of doing things faster as well as better, I see the digital revolution being as least as much of a game-changer, if not more so.

"The power of genetic mapping, data mining and artificial intelligence gives us the ability to turn plant breeding on its head to meet changing commercial needs far more precisely, individually and rapidly."

Mr Clarke stresses that the traditional process of identifying beneficial traits, incorporating them into high output lines and selecting varieties from them has enabled considerable genetic progress; especially so when aided by genetic markers. But the time it takes effectively means it is applying the solutions of the past decade to the problems of the current one. Which, he believes, is no longer sufficient with the speed at which modern growing needs are changing.

This is particularly the case with complex characters like tolerance to climatic stresses and durable resistance to pests and diseases that tend to be governed by many genes in different locations, each with relatively small and quite different effects; characters which are far less amenable to marker-assisted breeding.

"Today's technologies are enabling us to genetically profile our best-performing varieties in a wide range of different environments and under an array of different regimes to identify whole blocks of their genomes that are distinctively associated with the best and most reliable performance within each," he explained.

"Knowing what we are looking for, we are then actively seeking these blocks of genes in our parent lines, using sophisticated models that estimate with considerable accuracy the breeding value of parents for the particular outcomes we want.

"This whole genome approach moves us from selecting the best from breeding decisions made some time ago to designing the best to work with the specific regimes, conditions and pressures of today. And, through the power of hybrid breeding, doing this within a timespan of less than five years.

"Of course, the whole business of introducing new traits from relatives and near-relatives into high performance backgrounds continues behind the scenes as part of our longer-term improvement efforts. And gene-editing should allow us to much more accurately introduce traits we know to be beneficial under certain conditions into genetic backgrounds originally designed for others to address changing environmental and pest pressures or market needs.

"But, by using the vast amounts of linked genetic and performance data we have at our fingertips today in increasingly sophisticated ways, we are well on our way to purpose-building varieties to meet different growing needs on a much more individualised basis than ever before. And, most importantly, to doing this far more rapidly."

To find out more
Visit http://www.cropscience.bayer.co.uk

BAYER

How pig producers can strive towards net zero

Simple changes to production systems are improving the viability and sustainability of British pork. **Charlotte Cunningham** reports

Livestock are often seen as key contributors to greenhouse gas emissions (GHGs) – including methane from ruminants and the carbon footprint of animal feed based on imported products such as palm oil or soya.

As well as GHGs associated with animal feed, emissions challenges in the pig sector are largely centred on nitrogen and phosphorus from manure management. But an increasing number of producers are seeking to reduce emissions in viable ways while helping to secure a sustainable future for British pork.

They include Yorkshire farmers Andrew and Stuart Wood, who are making use of soya alternatives and renewable energy to bring down the emissions associated with their 300-sow farrow-to-finish unit near Goole.

Andrew (left) and Stuart Wood

The herd is based on Genesus F1 types (a cross between Landrace and Yorkshire), using the criss-cross system to produce replacement gilts, and Genesus Duroc genetics for everything else, farrowing into individual slatted farrowing rooms.

Weaning takes place at five weeks with a target weight of 10kg. Daily liveweight gain, averaging 840g from weaning to finish, is monitored throughout the production life cycle. Finished weights average 120kg at 23 weeks, with stock sold on contract through Beadle Marketing to Cranswick at Preston.

Soya alternatives

As well as the pig enterprise, the farm has 121ha of arable ground. This provides key dietary components for the pigs such as cereals and maize, as well as home-grown beans for protein. All rations are milled and mixed on farm, giving the brothers greater control over what they feed to the pigs at all times.

This setup has also allowed them to gradually move away from reliance on emissions-heavy soya – without affecting pig performance. Although soya is still fed, its use is marginal, and the majority of protein is sourced from alternative products. The brothers work closely with nutritionist Faye Murch from Kingsgate Nutrition to meet both dietary and environmental targets.

However, soya usage has never been particularly high, as the farm has historically relied on whey as a key protein source. Stuart says: "In the mid-1980s we started using whey, and we've always been liquid fed for the latter stages [of the diet]."

Today, the herd receives a liquid feed at most stages of production which includes co-products such as whey, potato puree and a wheat distillers' syrup alongside the farm's home-grown ingredients. "We have also been using crushed crisps until recently, but they're a bit priced out of the ration at the moment," says Stuart.

The management of the pigs is split into four stages, taking them through from weaning to finishing. At each stage, pigs are fed a different, bespoke diet tailored to their needs.

Andrew explains: "At the first stage, they are weaned into eight pens of 18 and fed a bought-in feed from ForFarmers, consisting of cooked cereals and whey powder, which is helping to achieve a daily liveweight gain of 500g over four weeks."

From this stage, pigs are moved into bigger groups – about 70 – and wet fed a diet based on whey, potato puree and the farm's own wheat and barley, as well as minerals and a small amount of soya. "Over the coming weeks we're also aiming to [start to] include brewers' yeast as a liquid, which we hope will reduce our soya usage even more," says Stuart.

Keeping wet feed consistent through the production cycle really helps with the transition at this stage, says Andrew. "The piglets see their >

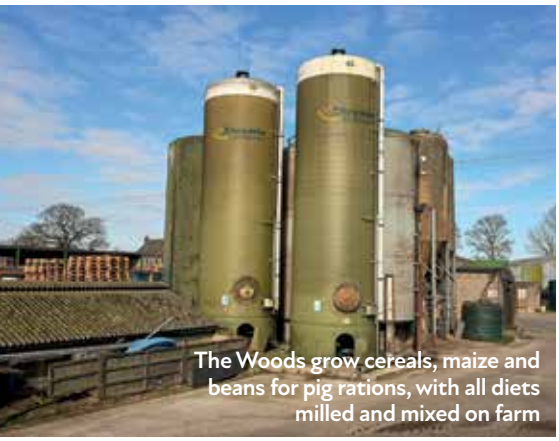
FARM FACTS

SD and AJ Wood, Goole, Yorkshire

- 300 sow farrow-to-finish unit
- All feed milled and mixed on farm
- 120ha of arable ground, growing cereals, maize and beans
- Finished weights: 120kg at 23 weeks
- Daily liveweight gain (wean to finish): 840g
- No zinc used for the past 10 years

A 250kW solar panel array on the farm powers the pig housing

PHOTOGRAPHY: COLIN WALLWORK



The Woods grow cereals, maize and beans for pig rations, with all diets milled and mixed on farm

A liquid feeding system is implemented across most of the production cycle

BARRIERS TO NET ZERO

Although some producers are making significant progress towards net zero, instability in the pig sector could be a barrier to further improvements, says National Pig Association chief executive Lizzie Wilson.

Lizzie Wilson

"I guess what we need first and foremost is for the whole supply chain to be able to sustain a profit to enable reinvestment in infrastructure such as buildings and equipment, and animal health and welfare, to improve productivity and efficiency and mitigate our environmental impact as much as possible," she says.

"We've already got a good story to tell as an efficient and proactive sector, but producers need whole supply chain support and investment when trying to deliver solutions like sustainable soya, as they can't do it on their own – either practically or financially. Retailers are all being driven by their Scope 3 obligations but after two years of financial loss, producers are in no position to be solely accountable in delivering their commitments."

Government intervention is needed, she says, with regard to planning in particular. "Currently the Slurry Infrastructure Grant scheme could well run into trouble if planning applications for slurry stores aren't approved by local planning authorities. Hold-ups are due to the Habitats Directive, associated nutrient neutrality issues – whereby local planning authorities may only sanction new development if it will not result in any more nutrients impacting a protected site than previously – and the lack of recognition of betterment.

"Even if producers can financially reinvest in their business and buildings, this issue threatens to halt any progress on achieving our net-zero ambitions."

< mothers being wet fed in the farrowing house and they seem to go straight to it at this stage." Four weeks later, pigs move to a straw yard and stay on a liquid feed consisting of the same ingredients as before, but in different proportions.

The final weeks are spent in the fully slatted finishing house, where pigs are split into groups of 18 based on weight. The same base wet ration is fed but formulated slightly differently to accommodate finishing requirements, says Stuart.

From weaning to finishing, the farm is using a total of 5-7% soya in the diets, and he says that once they move on to the brewers' yeast this will come down to less than 5%. Processing and transport also contribute to feed emissions, but Stuart says this is resolved by sourcing almost all co-products from within a 50-mile radius.

Investing in technology

To strengthen links between the pig enterprise and the arable business, the Woods have invested in slurry technology. This has reduced their reliance on bought-in fertiliser for the arable crops and lowered the associated emissions. "We put in a slurry separator about three years ago to improve consistency of the slurry," says Stuart. "We get that analysed, so we know what the nutrient content is, and then we know how much we need to put on to grow a decent crop of wheat or barley.

"Last year on one field of wheat, we did 10t/ha and didn't use any artificial nitrogen at all – we just put the slurry and some compost on." Stuart says they are going to replicate this in the coming season on a larger scale, with the aim of growing 40ha of wheat without any nitrogen. There is an economic benefit too, adds Andrew: "You're not applying it [the slurry] for nothing, but we've got it here already so we don't have to buy it in – we only have to hire a contractor to apply it."

The farm also makes use of renewable energy sources to reduce its overall environmental impact, and has a 250kW solar panel plant. This was installed in December 2015 and powers the pig housing as well as the main farmhouse.

"We toyed originally with wind turbines and a biomass boiler, but solar panels seemed a better fit for us," says Stuart. "We're using as much as we can from that. On a nice bright day [in winter] we use a lot of solar power and not as much from the National Grid, and as we get into the summer we're actually able to export it to the National Grid too."

UK PIG EMISSIONS: AT A GLANCE

A snapshot of GHG emissions associated with the UK pig sector is included in a recent report by the Centre for Innovation Excellence in Livestock (Ciel).

- Pigmeat production valued at £1.4bn in 2020
- Key challenges include the sector's contribution to acidification and eutrophication due to emissions of nitrogen and phosphorus from manure
- Pigmeat is one of the sectors where the differences in carbon footprinting at farm level versus the National Inventory approach are relevant
- GHG emissions, as determined through life cycle assessment (using a carbon calculator), are mainly attributed to feed production (75-80%)
- Direct emissions from UK pig systems, as accounted for under inventory accounting, are mainly aligned with methane from manure and enteric fermentation (digestion), and nitrous oxide as a result of manure application

Left: Pigs farrow into slatted farrowing rooms, with weaning at five weeks

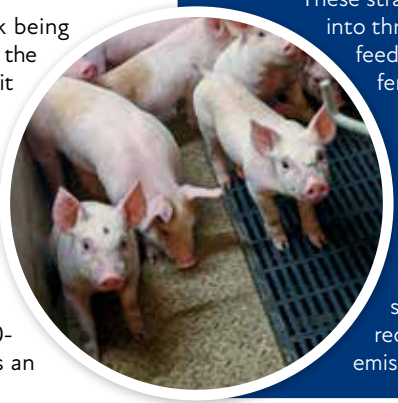
Tweaking the system

Their approach recently saw the Woods crowned Finisher of the Year at the National Pig Awards, But the brothers remain humble, saying this is the way they have inherently wanted to run their business for the past 10 years. "It was an accident," laughs Andrew. "But ultimately, it is more cost effective for us to have a lower carbon footprint."

An official carbon audit has yet to be carried out. Until then, the Woods say the focus is making small tweaks where possible to ensure overall business efficiency. In turn, they believe this will help reduce their environmental impact. "Though there isn't [carbon emissions] pressure from [our processors] yet, supermarkets are now starting to put pressure on processors to get carbon footprints down, so it's inevitable," says Andrew.

The brothers say there's not a lot more they can do at the moment to reduce their carbon footprint without spending a lot of money. However, something they are interested in is making more from their muck, which could be beneficial to agricultural emissions in general, as well as offering a financial opportunity for the farm.

"There's quite a lot of work being done at the moment looking at the gases in slurry. There's quite a bit of hydrogen that can be harvested from slurry," says Stuart. "It'd be nice to be able – if there's something there – to capitalise on that. I understand that there is the equivalent of £20 worth of hydrogen produced by a bacon pig in its lifetime. Well, if we're selling 8,000-9,000 pigs a year, then there's an opportunity there." ■



WAYS TO REDUCE GHG EMISSIONS IN PIG PRODUCTION

Research into a range of mitigation strategies for reducing livestock emissions was carried out recently by a group of scientists for the Centre of Innovation and Excellence in Livestock (Ciel), headed by Elizabeth Magowan from the Agri-Food and Biosciences Institute

For the pig sector, the aim was to look at the impact on GHGs of strategies such as removing soya from the diet and genetically improving pigs to emit less, as well as how easy and cost-effective this might be.

These strategies were split into three areas: animal, feed and manure/fertiliser.

The table below highlights some of the measures pig producers can consider – and how effective they might be when it comes to setting strategies to reduce overall on-farm emissions.

EFFECT OF FARM MANAGEMENT CHANGES ON EMISSIONS AND OUTPUT

Strategy	Cost	Ease of implementation	State of readiness to implement	Potential GHG mitigating effect	Impact on carbon footprint	Other impacts	Accounted for in National Inventory
Animal							
Genetic improvement	Low	High	Now	Methane and nitrous oxide reductions	Low	Phosphorus and ammonia reductions	Yes
General health improvement	Low	High	Now	Methane and nitrous oxide reductions	Low	Phosphorus and ammonia reductions	Yes
Feed							
Precision feeding and management to improve feed use efficiency	High	Medium	Later	Methane and nitrous oxide reductions	Low	Phosphorus and ammonia reductions	Yes
Specialist ingredients to improve feed utilisation	Low	High	Now	Methane and nitrous oxide reductions	Low	Phosphorus and ammonia reductions	Yes
Higher co-product inclusion level	Low	Medium	Now	Product dependent	Medium		No
Use of alternatives to soya bean meal	Medium	Medium	Now	Product dependent	High		Yes
Lower crude protein diet	Low	High	Now	Nitrous oxide reductions	Low	Ammonia reductions	Yes
Manure/fertiliser							
Anaerobic digestion	High	Medium	Now	Methane reductions	Medium	Odour and ammonia reductions	Yes
Acidification	High	Low	Now	Methane reductions	Low	Odour and ammonia reductions	No
Covered stores	High	High	Now	Depends on what cover is made of	Low	Odour and ammonia reductions	Yes
Low-emissions spreading and precision application of manure	High	High	Now	Nitrous oxide reductions	Medium	Ammonia reductions	Yes

Source: Ciel. Notes: Impact on carbon footprint was assessed via a carbon calculator. National Inventory and inventory accounting are used by the government to measure carbon emissions and carbon capture at a sectoral and national level. Soya bean emissions are often attributed to the country of production, so they will reduce overall pork emissions but have a lesser effect on "local" emissions. Low ease of implementation = more difficult to implement. May require infrastructure or full system changes.

PARTNER PERSPECTIVE

Livestock hold key to tackling methane emissions by 2030

At COP26 the UK signed the Global Methane Pledge, committing to cutting methane emissions by 30% by 2030.

Methane emissions are accelerating global warming faster than carbon dioxide, increasing focus on cutting methane rapidly to tackle the climate crisis in the short term. Achieving this is impossible without the livestock industry contributing to reductions.

Ruminant livestock – cows and sheep - are the leading cause of farm greenhouse gas (GHG) emissions. Livestock is the source of around half the UK's total methane emissions, with methane accounting for 55% of the emissions from agriculture. Methane is produced naturally as a by-product of ruminant digestion and decomposition of manure; therefore livestock farming will always be associated with some level of methane output. It is limiting the intensity of these methane emissions that is important.

For dairy, beef and sheep systems, the toolkit of short, medium and long-term actions to mitigate methane emissions is growing rapidly, driven by investment in research and innovation. Many of these strategies and investments have co-benefits to limit other forms of pollution and protect air and water quality.

Feed strategy: As almost 40% of methane is produced from the rumen, methane emissions relate directly to feed intake and quality.

- Improving the quality of cattle diets and selecting homegrown forage such as multi-species swards, can optimise rumen performance and lower protein requirements.
- Several methane-inhibiting feed additives, such as seaweed and nitrates, are emerging as promising supplements to reduce methane produced from ruminants digesting feed by over 30%.

Manure management: The storage of liquid slurry in uncovered lagoons produces significantly higher quantities of methane than solid manure.

- Addition of an impermeable slurry storage cover can prevent methane release to the atmosphere, whilst limiting air pollution, enhancing the potential nitrogen content of slurry and reducing reliance on purchased artificial fertilisers.
- Anaerobic digesters (AD) use bacteria to ferment slurry to produce methane and digestate, the methane can be used to produce electricity and heat or extracted for use as biomethane fuel.
- Slurry additives can mitigate methane emissions by up to 80% through chemical, biological and physical modes of action.

Herd management and genetic improvements: Promoting animal health and welfare by aiming for better longevity to limit heifer numbers in dairy, whilst focussing on higher growth/conversion rates in beef and sheep systems, has been proven to aid in reducing methane emissions.

- Improving production efficiency through health and genetic gain, as well as improved fertility can offer farms the ability to reduce the number of animals required to produce the same equivalent output, therefore decreasing methane emissions.
- Genomics can be utilised to build methane traits into livestock breeding indexes and help identify top performing animals.

Utilisation of methane: Innovative technologies to capture and convert methane into a profitable asset encourage more circular farming and will become more commercially viable as the decade progresses.

- Novel slurry treatment units utilise plasma arc technology to enrich slurry by fixing nitrogen from the atmosphere and as a result almost entirely eliminating methane.
- Biomethane captured from AD can be reused to power low-carbon farm machinery.
- Technologies are emerging to capture methane emissions directly from housed cattle.

Limiting methane emissions correlates strongly with improved financial performance. In order to track and quantify changes in methane emissions over time, farmers should complete annual carbon footprints.

To achieve the challenging target of reducing methane emissions by 30% by 2030, livestock farmers will require support and funding streams to work collectively to rapidly integrate both existing mitigations and new technological innovations.

For further support and guidance go to lloydsbank.com/sustainable-agriculture

What UK farmers can learn from Dutch 'nitrogen crisis'

Research could help dairy farmers cut emissions. **Johann Tasker** reports

Scientists in the Netherlands are developing ways dairy farmers can reduce greenhouse gas emissions using methods that could also benefit UK milk producers. It follows calls by the Hague government for a 50% cut in nitrogen emissions by 2030 – a target that Dutch farmers say threatens to drive them out of business, destroying their livelihoods and breaking up rural communities.

Dairy farmer Herman Miedema milks 175 cows across some 100ha of grass and maize silage just outside the small village of Vyns, in the heart of Friesland province – the dairy capital of the Netherlands. Mr Miedema is already reducing emissions. He installed a curved slatted floor system in 2009, so slurry and urine are stored immediately rather than left exposed to the elements, where they would volatilise. He is also grazing cows outside for 180 days annually, reducing the amount of crude protein in feed rations and diluting manure with water before spreading it on the fields. But it is not enough. "We are being asked to do more – much more."

One of the world's most densely populated countries, the Netherlands is home to about 16,000 dairy farmers milking some 1.57 million cows. Dutch agriculture is responsible for about half the country's greenhouse gas emissions. The Dutch government requires farmers to have a permit to farm. Mr Miedema is one of the lucky ones; he still has his permit. But the Dutch Supreme Court has declared the permits of 3,000 livestock farmers invalid, throwing their future into doubt.

Dutch farmers took to the streets to protest against the government's plans to limit nitrogen emissions

Herman Miedema

Permit predicament

Those 3,000 farmers find themselves in a nitrogen crisis. They are unable to invest in their businesses because the banks won't lend them money. But they can't sell-up either because few people want to buy a farm with an invalid permit. To help farmers, the government has earmarked €25bn (£22bn) to halve nitrogen emissions from agriculture by the 2030 target. Proposals include paying dairy farmers to quit the industry.

Trinke Elshof, of the Dutch farmers union (LTO), says a 40% reduction in nitrogen emissions is possible. But a 50% reduction is a step too far, she argues – an impossible goal for the dairy sector. "The government is focusing purely on nitrogen emissions. But we think they should look more broadly. We need a total package – reductions, yes, but also solutions such as innovation and other on-farm measures."

Scientists at the Dairy Campus research centre – part of Wageningen University – agree that innovation has a big role to play in reducing emissions in a way that could benefit farmers, consumers and the environment. Founded in 2011, the centre is undertaking an increasing amount of research into emissions reduction, including innovative nutrition and grazing techniques, manure and slurry management, housing, and animal health and welfare. The centre at Leeuwarden includes 500 dairy cows across 350ha of land. Wageningen livestock scientists conduct high-tech, applied research and groundbreaking experiments across the entire dairy chain. >

TASFOTONL/ADOBE STOCK, ROB ENGELAAR/EPA-EFE/SHUTTERSTOCK, JÜRG VOLLMER, MAG/JOHANN TASKER, ADOBE STOCK

Reducing crude protein can cut emissions without reducing milk yield

< Data first

"This is not a farm – milk is a by-product of what we do," says Dairy Campus managing director Kees de Koning. "Our core business is research – our cows produce data – lots and lots of data and information. We need cows to do that to help shape a future for Dutch dairying while reducing greenhouse gas emissions."

When it comes to cow diets, Dairy Campus researchers have already shown that a 1g reduction in crude protein content can reduce ammonia emissions by 1% without a corresponding drop in milk yield, so long as cow management is high. They have already reduced dietary crude protein content from 165g to 150g/kg dry matter, cutting ammonia emissions by 15% without any detrimental effect on cows with a 10,000-litre lactation. Their aim is to see how low they can go. "We have a saying: what doesn't come in, doesn't come out," says scientist Harmen van Laar. "It is about adjusting the ration to reduce emissions without affecting milk output, cow health and welfare or fertility."

Dairy Campus scientist Bert Philipsen has been investigating the effect of grazed grass and silage on emissions. Silage contains more crude fibre, but fresh grass can help reduce emissions of enteric methane, he says (see "Ways to cut dairy emissions"). Feeding fresh grass is a cost-effective way of reducing emissions, says Dr Philipsen. "You don't have to invest in any additional machinery or technical equipment, and some processors will pay a 1-2cent/litre premium on the milk produced.

Feed suppliers and other farm input suppliers are using this knowledge to help farmers improve cow management out in the field. They include Judith Mensink, a nutritionist with the feed company Royal Agrifirm Group. "We are delivering feeding advice – encouraging farmers to graze more efficiently, add supplements to their rations where appropriate and reduce crude protein content to cow diets where they can. But it's not just about the ration, it's also about feed management. It's about cow comfort and health. You want your cows to give as much milk as possible, and that means ensuring they are healthy, whether they are feeding indoors or grazing outside."

Sieta van Keimpema

People and planet

Despite some success, farming campaigners argue that the government is continuing to prioritise the environment at the expense of people. And they warn that putting farmers out of business will decimate rural communities. "There is a lot of pressure on farmers to just go away," says Sieta van Keimpema, of the Dutch Farmers Defence Force. "Our government wants to buy out farmers, and if you do not do it voluntarily, they will push you out. It's going too far."

Like the farmers she represents, Ms van Keimpema believes innovation is the answer. "It's the reason that we are not milking cows by hand anymore. And we shouldn't forget, that every year there are more people on this planet. Everyone is a consumer, and that is part of the problem. If there was no innovation, no one would have a bicycle or a car or would fly. It's unfair to ask farmers to turn the clock back 200 years while letting everyone else consume whatever they want."

It is an argument that has gone beyond farming. The Farmer-Citizen Movement (BBB) political party has surged in popularity – winning some 20% of the vote in last month's provincial elections. BBB politician Femka Wiersma says the shock result shows that the government needs to listen to the people. "Trust in the government is at an all-time low," she says. "We need a party that can regain that trust, and a long-term policy for Dutch farmers." ■

WAYS TO CUT DAIRY EMISSIONS

Graze grass

Grass and grazing have the potential to reduce both ammonia and methane emissions. Methane emissions are lowest with full grazing, compared to grass silage and zero-grazing systems. A further study is investigating whether grass silage from first, second and third cuts lead to a different quantity of methane emissions. Weekly milk samples are being taken to determine milk fat and protein content, with feed samples collected from silage pits of grass cut at different times.

Better floors

Emissions-reducing floor systems enable rapid drainage of urine as well as sealing of the floor. Using this system, slurry pit emissions have been as low as 6kg of ammonia an animal a year.

Dairy Campus researchers are testing a new system they believe could reduce ammonia emissions to just 3kg an animal, without gas forming in the slurry pit below and with separate manure flows for further valorisation.

Feed additives

Methane inhibitors have significantly cut dairy cow emissions in the Netherlands. The reduction varies from 27-40% a cow, depending on the animal's ration and the amount of inhibitor administered. A quarter of a teaspoon of the inhibitor Bovaer daily per cow has reduced emissions by an average of 30%. Tests were conducted across three different configurations of grass silage and maize silage diets. There are also indications that certain types of seaweed can inhibit the formation of methane during the digestion of feed.

Urine and manure

By encouraging cows to urinate in a special "toilet" while eating concentrate, the urine does not end up in the solid manure, and considerably less ammonia is formed. The toilet is actually a walk-through concentrate feed box that stimulates the cow to discharge urine. It detects urination and then collects, drains and stores it away from the manure. Cows voluntarily enter and leave the box.

Scientists say there is no indication that the welfare of the cows is compromised during this process. They say there is another major advantage, too – the pure cow urine is rich in potassium and nitrogen and can be used as a fertiliser substitute.

PARTNER PERSPECTIVE

How the UK Agri-Tech Centres are a catalyst for change

The UK Agri-Tech Centres are a unique collaboration between Government, academia and industry. Together, they drive greater efficiency, resilience and profitability across the agri-food sector.

The UK Agri-Tech Centres were established to join up existing research excellence, invest in innovative resources, address challenges that no one part of the agri-food sector can tackle alone and position the UK as a global leader in sustainable food production.

With core funding from Innovate UK, the UK's national innovation agency, the Agri-Tech Centres serve the needs of everyone involved in the UK agri-food sector, including farmers, agricultural advisors, scientists, suppliers, processors and retailers. Our reach extends across all key industry players, trade associations and government.

We are a shared voice to inform and influence industry priorities, and ensure important industry issues are addressed.

Why work with us? The Centres are essential catalysts for change. We provide a gateway for companies and individuals seeking access to the very best science, expertise and technologies - stimulating new research, practice and technology for the agri-food sector.

Each Centre has a unique focus, offering capabilities that are leading the world in delivering sustainable food and farming solutions.

Agri-EPI Centre

Agri-EPI supports and delivers research, development, demonstration and training on precision agriculture and engineering to maximise the agri-tech sector's contribution to sustainable food production and supply. Agri-EPI's vision is to support the development and growth of innovation with scientifically robust and commercially viable solutions to help farmers and agri-food business become more sustainable and profitable.

CHAP Crop Health & Protection

CHAP brings together researchers, industry and government to accelerate the identification, development and adoption of innovative agri-tech crop solutions to transform UK and global farming systems sustainably. CHAP achieves this by building multi-disciplinary collaborations that collectively design interventions, investing in open-access facilities for translational research and engaging in demonstration and knowledge-exchange.

Agrimetrics

Agrimetrics have created the first agri-food data marketplace: a place to find and manage food and farming data. They provide a safe and equitable place to share and monetise data as well. Agrimetrics' cutting edge, data-linked technologies make managing and connecting data simpler and more affordable. They are ISO27001-accredited and a Microsoft Partner.

CIEL Centre for Innovation Excellence in Livestock

CIEL is the UK's livestock innovation centre and the sector's point of access to some of the best livestock research capability in the world, covering all the core livestock species. CIEL is at the heart of a collaborative network of industry members that span the livestock supply chain. CIEL brings industry together with research excellence, helping everyone involved in producing food do so sustainably and profitably.

To find out more about the UK Agri-Tech Centres
Call Sarah Anderson on 07507 758 198
Email sarah.anderson@agritechcentres.com
Visit www.agritechcentres.com

AGRI-TECH CENTRES

UKRI Innovate UK

Animal health and fertility are key components of efficiency

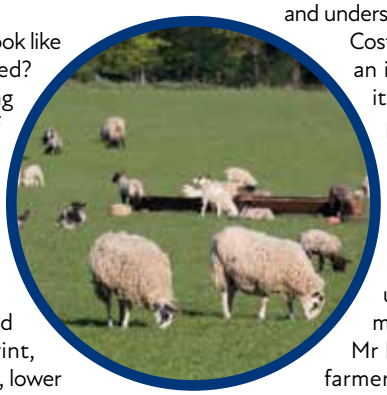
How to build resilience into a livestock system

Resilience is vital for farm businesses to withstand challenges and capitalise on opportunities. A recent *Transition* webinar looked at the focus areas for farmers

The UK's focus on sustainable food production has seen farmers putting emphasis on efficiency and environmental impact. As new schemes and funding become available, it's about balancing productivity with the delivery of "public goods" to achieve a good return.

So what does this balance look like and how is resilience achieved? No one size fits all, according to Jude Capper, professor of sustainable beef and sheep systems at Harper Adams University (HAU).

"No matter your system, if you make incremental improvements through the whole system, you should have a lower carbon footprint, better economic performance, lower resource use, and lower overall environmental impact," she explained.



Match system to resources

"If you can meet and/or exceed key performance indicators such as age at slaughter, average daily liveweight gain, and percentage of ewes weaning live lambs, then big gains can be made."

It's also not about creating a monoculture across UK farms. "It's about matching the system to the resources, and the breed to that system," she said.

Across the industry, efficiencies need to significantly increase, but that doesn't necessarily mean scale, said AHDB economics and analysis director David Eudall. "Farmers have to decide what is best for them. A key thing is understanding every aspect of your business, to breed in that resilience and understand where you are."

Cost of production is, of course, an important baseline. "Break it down and focus on small parts where you can make improvements; even small gains can go a long way in improving the finances and wider sustainability."

Benchmarking is a valuable tool, but businesses must compare like for like, said Mr Eudall, and pressure for all farmers to reach "perfection" is unhelpful.

Animal health and fertility are key components of efficiency, said farm vet and TB Advisory Board director Sarah Tomlinson. "It's getting the basics right and tackling biosecurity and endemic disease.

"If we can have more healthy and productive animals, we can have fewer adult animals, which reduces the environmental impact. To start, make sure your bulls are fertile; that's a simple thing all livestock businesses can do. And look at where losses are happening."

Getting daily management procedures right has a huge positive effect on the health, welfare and productivity of the next generation of stock, and farmers should take advantage of the government-funded animal health and welfare pathway visits, she added.

A large element of sustainability – and therefore resilience – is measuring and reducing emissions, as well as sequestering carbon, which may unlock future income streams for farmers.

Get soils in shape

Since grassland is a major component of the livestock business, it should be a focus. "If you want to grow a crop of grass that is going to be resilient and maintain supply to the farm for grazing or silage, the soil needs to be right. Test your soils and don't forget pH," said David Linton, commercial manager UK at Barenbrug.

"Yield, quality, sward density and disease resistance are all improvements farmers might be looking for. But we're also seeing more interest in deeper rooting varieties to combat drought conditions or to bring up more nutrients from the soil." ■

WATCH THE WEBINAR

Watch the discussion in full at **fwi.co.uk/transition**, where you'll also find all the other webinars in the Transition series

PHOTOGRAPHY: TIM SCRIVENER

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