zneag CRC

Pathways to zero net emissions: a stocktake of emissions reduction technologies

Practical opportunities for farmers and producers

2025

What is this booklet about?

This booklet was created by Zero Net Emissions Agriculture Cooperative Research Centre (ZNE-Ag CRC) to help Australian farmers find practical, science-based ways to reduce on-farm emissions. It highlights the actions that can be taken right now, as well as new tools and technologies being developed to make low-emission farming easier in the future.

Inside, you'll find real examples of farms and supply chains that have already benefited from reducing emissions, leading to improved productivity, reduced costs, and access to premium markets. You'll also find clear checklists and strategies you can use to take the next steps on your own farm.

Where farm emissions come from

Farming and agriculture produce several greenhouse gases that trap heat in the atmosphere. On farms, most greenhouse gas emissions come from:

- **methane** released from livestock digestion (enteric methane)
- **nitrous oxide** released from fertilisers
- **carbon dioxide** from burning fuel, such as diesel, for on-farm electricity and transport.

Introduction

Australian farmers are already on the frontline of climate change. Seasons are shifting and becoming more variable, supply chain disruptions are increasing (for inputs and outputs), and market access is increasingly dependent on supplying lower-emission products. The good news is that some actions that cut emissions can also improve productivity. Reducing emissions isn't just good for the planet; it can be good for business.

More information is available through the full Stocktake of Pathways to Zero Net Emissions report, available from **www.zneagcrc.com.au/publications**.
This booklet will be updated annually to reflect new emissions reduction technologies.

Recognising the biogenic carbon cycle and methane as a short-lived gas

In sustainably managed grazing systems, carbon flows in a closed, repeating cycle – referred to as the biogenic cycle. Plants absorb carbon dioxide through photosynthesis and produce carbohydrates, which are consumed by the animal. In ruminants, enteric methane is then released back to the atmosphere. If total emissions are kept constant, there is a cycle of new emissions entering into the system and being drawn out of the system and, therefore, no additional warming. However, the atmosphere doesn't differentiate between sources of methane, which means reducing methane emissions has a positive impact on the climate.

Methane is a more potent greenhouse gas than carbon dioxide, trapping significantly more heat per molecule, but it has a much shorter lifespan in the atmosphere. If the amount of methane going into the atmosphere is reduced, even if that would normally be part of the biogenic cycle, the cooling impact is significant. Therefore, methane reduction or avoidance is important and prioritised by governments through specific methane targets.

Farm emissions are commonly categorised as Scope 1, 2 or 3 emissions:

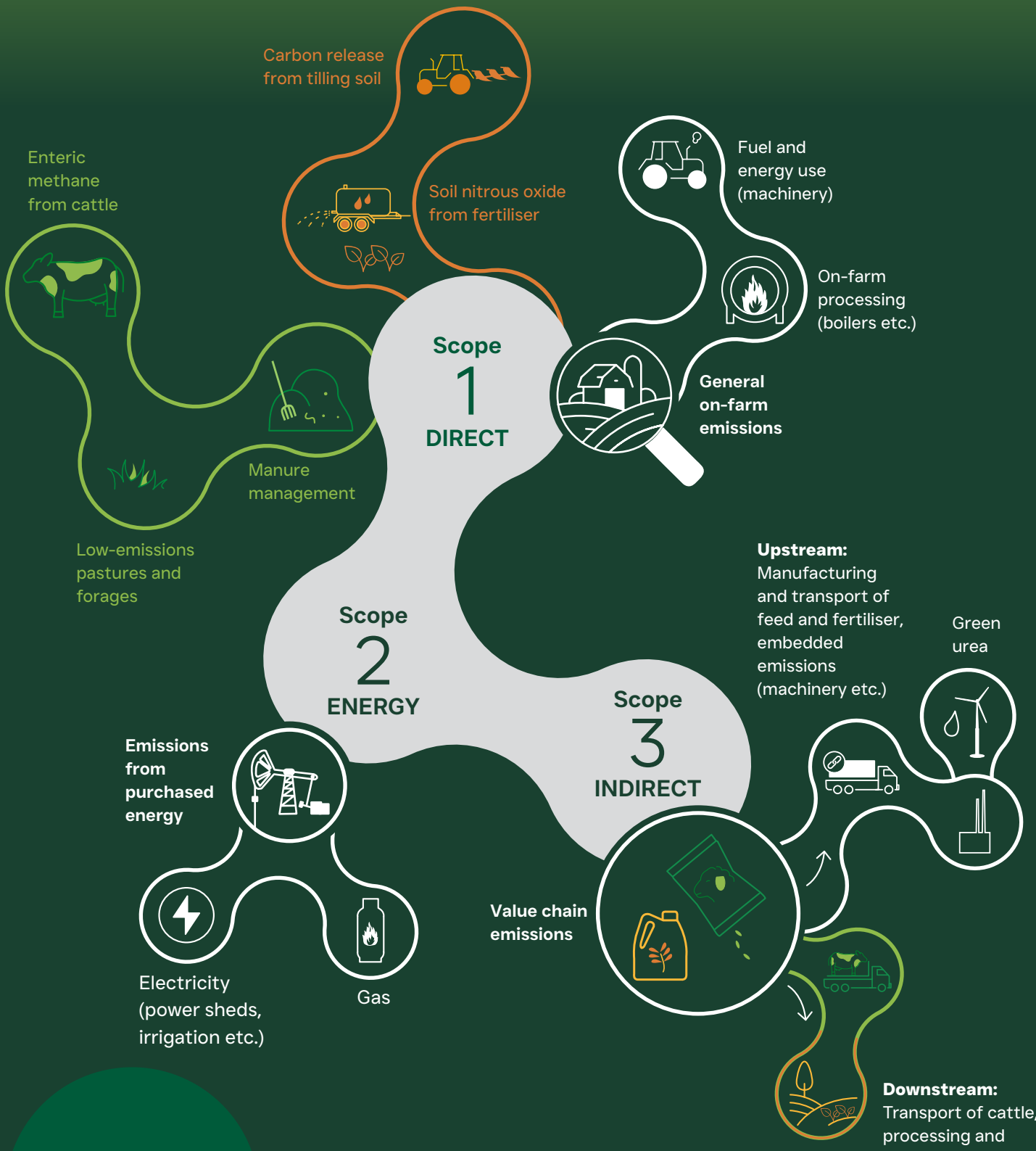
- Scope 1 emissions are from things directly under your control, such as emissions from livestock, fuel and fertiliser.
- Scope 2 emissions are those from the electricity and energy you buy that has been generated elsewhere.
- Scope 3 emissions include indirect emissions from the manufacture and transport of fertiliser, feed and chemicals, and the processing and transport of products after they leave the farm.

Tools to calculate your emissions

Name	Custodian
Greenhouse Accounting Frameworks (GAF)	Primary Industries Climate Challenges Centre (PICCC), University of Melbourne
MLA Carbon Calculator	Meat and Livestock Australia
Australian Dairy Carbon Calculator	Dairy Australia
Environmental Accounting Platform	Agricultural Innovation Australia
Ruminati | Agricultural Emissions Tracking	Ruminati
Carbon Footprint Calculator | Measure Water & Biodiversity – Cool Farm Tools	Cool Farm Alliance
SOCRATES Web (Soil Organic Carbon Reserves and Transformations in EcoSystems)	Queensland University of Technology
Full Carbon Accounting Model (FullCAM) - DCCEEW	Department of Climate Change, Energy, the Environment and Water

Overview of farm emissions profile

Livestock systems | Cropping | General



Reducing emissions improves farm efficiency, improves market access, and demonstrates sustainability.

Global emissions reduction and what it means for farmers

Countries around the world are setting targets to cut emissions and reach net zero by 2050. Australia, along with 195 other countries, signed the Paris Agreement to reduce emissions, aiming to limit global warming to well below 2°C. Many large retailers, processors, and food brands that buy Australian produce have followed suit, setting their own science-based targets through the Science Based Targets initiative (SBTi). These SBTi targets ensure companies' climate goals align with the latest science.

There are also new mandatory reporting rules in Australia that require many larger companies to report emissions in their supply chains. This creates a 'cascade effect', meaning suppliers, including farmers, will increasingly be asked for data on their farm emissions.

Why it's important for farmers to act now

Changing weather patterns, including more frequent droughts, floods and heatwaves, will continue to disrupt production, drive up input costs, and reduce yields. Over time, doing nothing could lead to higher expenses, fewer market opportunities, and greater exposure to climate and financial risks. However, Australian producers can play a key role in helping the country meet its climate targets and mitigate these risks.

Taking steps now to understand and reduce your farm's emissions can deliver real advantages to individual farm businesses while also addressing broader climate impact risks. For example, you can:

- stay ahead of the emerging reporting and certification environment
- maintain access to existing markets or gain access to premium markets that pay more for low-emission products
- improve efficiency, reduce input costs, and strengthen resilience to climate extremes
- participate in carbon markets to diversify income.

Farms that can't show credible emissions reductions may lose access to key buyers or export markets as global supply chains tighten sustainability standards.

However, changes can take time and investment, and new technologies are sometimes costly or still in development. Different farming systems have different challenges, and what works for one may not suit another.

Recognising these barriers is an important part of the process, and ZNE-Ag CRC is helping to test tools and solutions and share knowledge to make emissions reduction practical, affordable and achievable for more farmers. Ultimately, this helps Australian farmers stay competitive, protect productivity, and build resilience for the future.

Definitions

Absolute reduction: a decrease in total emissions released (e.g. tonnes of methane avoided).

Carbon markets: a system for trading carbon credits, which represent a reduction or removal of one tonne of carbon dioxide equivalent.

ACCU: Australian Carbon Credit Unit, representing the equivalent of one tonne of carbon dioxide avoided or stored.

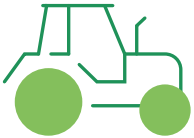
Carbon neutral: when remaining greenhouse gas emissions are offset by buying or generating carbon credits.

Zero net emissions: when the amount of greenhouse gases emitted is balanced by the amount removed. This term is commonly used at the industry or country level, while 'carbon neutral' is used for organisations, activities, or products.

Offsetting: compensating for your greenhouse gas emissions by investing in projects that reduce, avoid, or remove emissions outside your supply chain.

Insetting: interventions within a company's value chain that are designed to reduce its net greenhouse gas emissions.

Intensity reduction: reducing emissions per unit of product (e.g. less methane per kilogram of beef).



Reducing emissions from cropping

Where do cropping emissions come from?

Most greenhouse gas emissions from cropping come from fertiliser – both during fertiliser production off-farm (Scope 3) and the nitrous oxide released from soils after it's applied on-farm (Scope 1). For example, in Australian cereal crops, around 22% of emissions come from producing fertiliser and another 15% from using it on the farm.

Because fertiliser can be a significant expense, improving how fertiliser is used can save money, cut emissions, and keep nutrients where they're needed most: in your crops and soils. The amount of greenhouse gas emissions released from fertiliser application depends on soil type, rainfall and how fertiliser is managed. Factors such as soil type, rainfall and fertiliser management all affect the amount of emissions produced.

Other smaller sources of emissions in cropping systems include fuel use, machinery operation, stubble burning, and lime application.

Cropping solutions in practice: what can be done now?

The following options can help reduce emissions while also improving yield, maximising nutrient use efficiency, and enhancing soil health.

Fertiliser and nutrient management

Enhanced Efficiency Fertilisers

You can use Enhanced Efficiency Fertilisers to help cut nitrous oxide losses. These include urease and nitrification inhibitors, as well as controlled-release products with coatings or other features that slowly release nitrogen.

This could result in lower overall fertiliser-related emissions. Research trials have shown that Enhanced Efficiency Fertilisers can reduce nitrous oxide emissions by up to 60% in wheat crops and 56% in pastures.

You should consider that Enhanced Efficiency Fertilisers currently cost more than standard fertilisers and that they have not shown consistent improvements in plant growth.

Plant growth responses depend on a range of factors, including product formulation, soil type, weather conditions, and crop.

Emissions intensity versus total emissions

Total emissions are the overall amount of greenhouse gases a farm produces from across all activities.

Emissions intensity measures how much greenhouse gases are emitted for each unit of output, such as per kilo of milk or beef. Emissions intensity is often described as a carbon footprint. A farm can lower its emissions intensity by producing more efficiently, even if total emissions stay the same. This is often the most attractive way to reduce emissions in the short term, while improving profits.

Precision use of fertilisers

You can apply fertiliser at the right time, rate and depth to match crop needs and soil conditions. This helps plants take up more nutrients and reduces nitrogen loss.

This could result in increased plant yields for the same or less fertiliser, saving you money.

You should consider that precision approaches use technologies such as GPS, variable rate controllers, and in-season monitoring.

Green urea

You can replace conventional urea, which takes a lot of electricity to produce, with 'green urea', which is manufactured using renewable energy.

This could result in lower Scope 3 emissions for your farm and could help reduce total agricultural emissions.

You should consider that green urea currently costs more than standard urea, but those costs may decline as renewable energy becomes cheaper.

Crop and soil practices

Legumes

You can include legumes in crop rotations. Legumes naturally fix nitrogen, reducing reliance on synthetic fertilisers and improving soil fertility. Legume rotations can also suppress soil pathogens and increase gross margins.

This could result in emissions reductions of up to 55% and fertiliser savings of up to 80%.

You should consider that strategies such as leaving legume residue on the soil surface as long as possible and applying fertiliser at a rate that accounts for the legume can significantly reduce nitrous oxide emissions compared to standard practice, without reducing yield.

Future solutions

ZNE-Ag CRC is developing practical farm-ready tools to help growers reduce emissions from cropping systems.

One project is designing a way to evaluate, test, and rank new Enhanced Efficiency Fertilisers (inhibitors or controlled-release fertilisers) based on how well they reduce emissions and support plant growth, and on their cost-effectiveness. The results will shape national calculators and standards to help farmers make informed choices.

The CRC will also investigate other options to reduce emissions, including the use of microbial fertilisers, biofertilisers, and organo-mineral blends that enhance soil health and reduce synthetic nitrogen demand. Other CRC research will explore how mixing different approaches, such as using legumes in rotation, inhibitors and precision fertiliser placement, can cut emissions while boosting productivity.

Australian canola farmers join the European biodiesel market

Canola growers in Western Australia and South Australia have gained access to the European Union's biodiesel market, which pays a premium for low-carbon oilseed.

In 2015, CSIRO assessed Australian canola and found that carbon emissions from crops in WA and SA were substantially below the EU threshold. The credible carbon footprint measurements led to formal EU market access. Since then, due to the $20 to $40 price premium for canola entering this high-value biodiesel market, WA's canola exports have earned an estimated $432 million in extra returns. This demonstrates how achieving low emissions from farming can unlock premium markets and enhance farm profitability.

Cover crops and reduced fallows

You can use cover crops and reduce fallow periods to help maintain soil cover and capture leftover nitrogen. Keeping soils covered improves soil health, reduces erosion, and limits the amount of nitrous oxide released from bare soils.

This could result in yield gains of 5–15% in winter cereal crops following summer cover crops, depending on soil type and rainfall.

You should consider that while grass cover crops are effective at soaking up residual nitrogen in the soil, and when combined with legumes, help reduce emissions while also boosting productivity, the benefits of cover crops depend on the region. In areas with high rainfall, they tend to be helpful. But in low-rainfall zones, they can sometimes harm soil health and reduce the yield of the next crop.

Soil carbon capture

You can capture carbon in soil by building organic matter through practices such as stubble retention, minimal tillage and maintaining groundcover. These actions increase soil carbon, benefit crop and pasture growth and productivity, and improve water retention.

This could result in higher soil moisture. For every 1% increase in soil organic carbon, soil can store around an extra 150,000 litres of water per hectare. This helps to sustain pastures during dry periods, increasing plant biomass by up to 30%.

You should consider that achieving and maintaining permanent, stable soil carbon gains can be difficult, as numerous factors influence soil carbon accumulation and loss, including climate, land management, nitrogen content, vegetation cover, and soil properties.

Solutions to reduce fertiliser and emissions

Emissions from cropping: Australian cereals

15.1%
nitrous oxide emissions from fertiliser use on farm

22.5%
emissions from fertiliser production off farm

Switch to Enhanced Efficiency Fertilisers (EEFs)

Reduces fertiliser-related emissions (up to 60% in wheat crops and 56% in pasture)

→ yield (same)

Green urea

Reduces Scope 3 emissions

Precision use of fertilisers

Increases plant yield for the same or less fertiliser

Soil carbon capture

Improves soil moisture, increasing plant biomass by up to 30%

Sow legumes as crop-rotation

Reduces emissions by up to 55%

↗ yield (increase)

Legumes and cover crops store nitrogen and carbon in the soil, prevent erosion and lower the need for fertilisers.

Sow cover crops and reduce fallows

↗ Increases yield by 5–15% in winter crops

Reducing emissions from livestock

Where do livestock emissions come from?

Most greenhouse gas emissions from grazing cattle and sheep come from methane produced during digestion (known as enteric fermentation in the rumen). Methane makes up around 70–80% of total emissions from livestock operations. The balance is made up of other greenhouse gas emissions, including nitrous oxide from soils and fertilisers, and carbon dioxide from energy use. Methane is a relatively short-lived greenhouse gas with a strong global warming effect. This means that reducing methane emissions can quickly reduce the impact of warming. As a result, tackling your methane emissions could offer you the best short-term win for reducing emissions and aligning with market and government targets.

Livestock solutions in practice: what can be done now?

The following options can reduce methane and nitrous oxide emissions while improving animal productivity.

Improving herd productivity

Improved weaning rates

You can increase herd productivity and reduce methane emissions intensity by improving weaning rates. Higher weaning rates mean more beef or lamb produced per breeding animal, spreading each animal's methane output over more kilograms of product. This can be achieved through better nutrition, especially for heifers, and by selecting animals with strong estimated breeding values (EBVs) or genomic breeding values (GBVs) for traits such as days to calving, heifer puberty, pregnancy within 4 months after calving in cattle, and weaning rate in sheep.

This could result in a 20% reduction in emissions intensity per kilogram of liveweight.

You should consider that some of these measures can come at an increased input cost and higher total emissions across the herd.

Reducing time to market weight

You can ensure animals reach market weight faster to reduce the amount of emissions animals produce over their lifetime. Earlier turn-off times can be achieved by feeding higher-quality forages, better grazing management, and genetic selection for growth rates (e.g. higher 400-day or 600-day weight EBVs).

This could result in more than a 25% reduction in emissions per kilogram of liveweight.

You should consider that some of these measures will come at an increased input cost.

Moderate mature cow weight

You can monitor cow weight as it has a distinct influence on emission intensity and the total enteric fermentation emissions of the enterprise. Moderate sized cows are recommended, as they are more efficient (less energy for maintenance than very large cows) and less prone to dystocia than small cows.

This can result in a 6% reduction in emissions intensity.

You should consider that moderate sized cows are a good target, rather than small cows, to avoid dystocia, and that smaller cows will fetch a lower cull price.

Low-emissions pastures and forages

You can plant pastures and forages that reduce emissions, such as Leucaena, Brassicas, Biserrula, and Desmanthus. These plants contain compounds that reduce livestock methane production and increase livestock productivity.

This could result in a 20–40% reduction in emissions, depending on the species grazed.

For example, Leucaena, a widely used legume in northern grazing systems, can reduce emissions by 20% and some Brassicas can reduce emissions by up to 40%.

You should consider that most of these species are legumes with high nutritive value, so they will increase the rate of animal weight gain, leading to faster turnoff.

Feed and nutrition management

Feed additives

You can use proven feed additives, such as Bovaer® 3-NOP (3-nitrooxypropanol) or red seaweed (Asparagopsis spp.), to suppress methane production in the rumen. You can also use other feed additives to reduce methane emissions, such as tannins, saponins, Agolin™ or Mootral™ (essential oils), and Polygain (sugar cane extract). High-fat or oil supplements reduce hydrogen availability, which restricts methane formation.

This could result in a 10–90% reduction in emissions, depending on the feed additive and the system in which it is being used (grazing vs feedlot).

You should consider that some feed additives are expensive and may not significantly boost productivity, so widespread use will likely need shared-benefit funding through insetting for large-scale adoption. In addition, while products like Bovaer® and red seaweed can deliver large emission cuts, practical delivery methods for grazing livestock are still being developed.

CASE STUDY

Reducing emissions through moderate cow size

An Elder's study examined how altering cow size can help reduce methane emissions in a southern mixed-farming beef herd of 270 British-bred cows. The herd, which turns off weaners at five to six months without supplementary feeding, had an average cow weight of 650 kilograms and produced about 1,232 tonnes of carbon dioxide equivalent per year, with an emissions intensity of 12.4 kilograms of carbon dioxide equivalent per kilogram of live weight.

Reducing the average cow weight to 600 kilograms lowered total emissions to 1,140 tonnes of carbon dioxide equivalent and emissions intensity to 11.7 kilograms of carbon dioxide equivalent per kilogram of liveweight – a 6% reduction. This could be achieved by selecting moderate-framed cows or crossbreeding with smaller-framed breeds. Moderate-sized cows are more efficient, needing less feed for maintenance, and this case study shows they can help lower emissions without affecting herd performance.

Feed digestibility

You can improve feed digestibility by using higher-quality forage, which reduces methane emissions per kilogram of output produced.

This could result in a 5–50% reduction in emissions intensity.

You should consider that improving feed quality may require changes to pasture species, grazing management, or supplementary feeding, which can increase costs or labour.

Manure and waste management

You can reduce methane emissions and recycle nutrients through composting. You can also capture methane emissions from manure and lagoons.

This could result in a 60–90% reduction in baseline methane through anaerobic digestion with gas capture and use. Composting or windrow treatment of separated solids can reduce methane emissions by 10–40%.

You should consider that installing systems to capture or manage methane from manure can involve upfront costs and maintenance.

CASE STUDY

Improving efficiency and resilience on a Bega Valley dairy farm

A 174-hectare dairy in the Bega Valley milks 380 Friesian cows, producing about 2.8 million litres of milk annually. Operating on a pasture and forage system with supplementary irrigation, the farm has focused on growing more of its own feed and on protecting biodiversity by fencing 49 hectares of remnant vegetation and managing 12 hectares of tree plantations.

Through participation in the Bega Better Farms Program, the farmer identified practical ways to improve productivity while lowering emissions. Growing and using more homegrown feed (9.46 tonnes per hectare, above the regional average) reduced reliance on imported feed and cut methane emissions per litre of milk. Smarter nitrogen management helped limit fertiliser-related emissions and reduce costs, while the farm's tree plantations and vegetation provided valuable carbon storage and biodiversity benefits. Together, these actions improved efficiency, reduced the farm's net emissions to below the regional average, and strengthened its environmental credentials.

Methane reduction in livestock

Improving herd productivity
(e.g. weaning rates, faster market weight, low-emissions pastures and forages)

Reduces emissions by up to **20 %**

Feed and nutrition management
(e.g. feed additives, feed digestibility, manure and waste management)

Reduces emissions by **10** to **90 %**

Breeding and genetics
(e.g. selective breeding and cross-breeding)

Reduces emissions by **10** to **20 %**

Breeding and genetics

Selective breeding and cross-breeding

You can reduce methane emissions by breeding cattle and sheep that naturally produce less methane or are more feed-efficient. You can do this through selective breeding or by crossbreeding animals that have proven low-emission traits. Large projects led by ZNE-Ag CRC and Meat & Livestock Australia (MLA) are currently developing DNA-based tools to predict methane output and identify animals with these desirable traits.

This could result in steady reductions in methane intensity over time as low-emission genetics are built into the herd. Methane reductions can be around 1–2% per year, and these accumulate over time, potentially reducing methane emissions by 10–20% after 10 years.

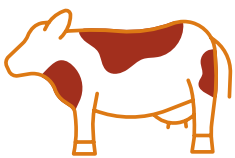
You should consider that genetic improvement is a gradual process that requires multiple generations to deliver measurable change. You should also consider selecting a balanced index of traits that affect profit and include methane, as this will yield the best results. Focusing on methane reduction traits alone would not be as profitable.

Future solutions

Research at ZNE-Ag CRC is developing new solutions to help farmers reduce livestock emissions. One project is testing biodegradable rumen devices that release methane-reducing agents inside the animal. Early trials have shown methane cuts of more than 60%.

Another CRC project is collecting data from thousands of animals to create genomic breeding values (gEBVs) for low-methane traits in cattle and sheep. This work will help farmers select animals that are naturally more efficient and productive, while producing fewer emissions per kilogram of beef or lamb.

The CRC is also developing new low-emission feed crops (such as sorghum) and pasture species with compounds that reduce methane. These innovations will provide farmers with more tools for practical, large-scale methane reduction in the future.



Reducing emissions from horticulture

Where do horticulture emissions come from?

Horticulture has a different emissions profile from other agricultural industries, with a larger share coming from carbon dioxide produced by energy use in diesel engines, irrigation pumps, and electricity for cold storage or processing. Nitrous oxide is the other main greenhouse gas emitted, particularly in intensive vegetable and orchard production with high fertiliser use. Methane plays only a minor role in horticultural emissions. Given this emissions profile, the actions to reduce nitrous oxide from fertiliser outlined in the cropping section are also relevant to horticulture.

For example, in potato production, around half of all emissions come from carbon dioxide associated with energy use, with the rest from nitrous oxide released from fertiliser use.

Horticulture solutions in practice: what can be done now?

Horticulture businesses can take action now by cutting energy use with renewables, optimising fertiliser use by using Enhanced Efficiency Fertilisers or green fertiliser options, adopting precision farming approaches, improving soil health, and building carbon stores through tree planting.

Renewable energy

You can reduce emissions by improving energy efficiency across your horticultural farm by switching from diesel to solar- or battery-powered irrigation pumps and tractors, maintaining and upgrading machinery, and adjusting irrigation schedules to cut fuel and power use.

This could result in lower fuel and energy costs, reduced carbon dioxide emissions, and greater energy independence, helping position your business for future low-emission market opportunities.

You should consider the initial investment costs and maintenance requirements of renewable energy systems.

Future solutions

ZNE-Ag CRC is developing practical ways to increase carbon storage and make better use of renewable energy in Australian farming systems. The CRC is investigating how solar panels can work alongside crops and pastures to improve productivity and energy generation at the same time, an approach known as agrivoltaics. The project is exploring the best setups for different farm systems and how combining solar with farming can boost both food and energy production.

CRC partner, the Queensland Department of Primary Industries, has a ‘Steak and Wood’ project in collaboration with Meat and Livestock Australia, which is testing different tree-planting designs (such as blocks, rows or alleyways) to find the best balance between carbon storage and livestock productivity.

New renewable energy technologies are also being trialled on horticultural farms, including battery-powered tractors and machinery that could soon help farmers cut diesel use and running costs.

Other emissions reduction strategies

All types of farms can reduce their net emissions by storing carbon in trees, soil, and biochar, or by switching to renewable energy. These strategies can improve productivity, resilience, and environmental performance.

Carbon sequestration

Planting trees

You can reduce net farm emissions by planting trees on unproductive or marginal land, or by integrating trees into farm systems through agroforestry. These plantings store carbon as they grow and can also provide shade, shelter and biodiversity benefits. Tree planting can also earn Australian Carbon Credit Units (ACCUs) under approved methods, particularly through permanent forest establishment.

This could result in a 20–33% reduction in total farm emissions over 30 years by planting trees on 5–12% of high-productivity land.

You should consider that carbon benefits build over time and can be influenced by factors such as rainfall, soil type, tree species, and planting design.

Biochar

You can add biochar, a charcoal-like material, to soils to build soil organic matter that locks away carbon. This helps reduce carbon emissions while also improving long-term carbon storage in soils and better crop and pasture productivity through improved soil health.

This could result in a 10–42% increase in crop yield with biochar addition, with the greatest increases in low-nutrient, acidic soils (common in the tropics) and in dryland sandy soils.

You should consider that purchasing biochar is an additional cost to your farm, and its benefits depend on the biochar source, soil type, and how it is applied.

Renewable energy

Reducing reliance on fossil fuels

You can cut carbon dioxide emissions and energy costs by switching from fossil fuels to renewable energy, such as solar or wind, for irrigation pumps and other on-farm operations.

This could result in lower fuel and energy costs, reduced emissions, and improved energy security.

You should consider the costs associated with installing solar and battery systems, as well as other renewable energy infra-structure.

CASE STUDY

Planting trees on a Queensland beef property

A Central Queensland beef property, operating over 17,500 hectares, created a 38-hectare native tree corridor with 17 local species to increase grass and tree cover, biodiversity and carbon storage. The property also registered a soil carbon project, adopted rotational grazing and wet-season spelling, and planted legumes. They measured baseline soil carbon and vegetation cover using remote sensing, and the farm participated in Meat and Livestock Australia's Environmental Credentials Platform and a NAB Green Loan to support investment. This work was a collaboration with the Fitzroy Basin Association.

Benefits included increased soil carbon, improved drought resilience, and recognition of sustainable credentials. Initial challenges to tree survival were addressed through better planning, tree guards, and mulching. The project shows how tree planting and careful management can reduce net emissions, boost productivity, improve drought resilience, and earn credibility with financiers.

Opportunities for farmers

Participating in carbon markets

Australian farmers can earn income through carbon markets by getting paid for reducing greenhouse gas emissions or storing carbon in soils and vegetation. These efforts generate carbon credits, which can be sold to governments, companies, or organisations that want to offset their emissions.

There are 2 main types of carbon markets:

- **Regulated markets** – such as the Australian Carbon Credit Unit (ACCU) scheme, run by the Australian Government. Farmers can earn ACCUs through approved projects such as reforestation, soil carbon improvements or better manure management.
- **Voluntary markets** – such as schemes like Verra or Gold Standard, where companies or individuals choose to buy credits to meet their own climate commitments. There are no legal obligations for these voluntary pledges, but demand is growing as more businesses commit to reducing their carbon footprint.

Some businesses are now backing emission reduction projects within their own supply chains, a practice known as insetting. This involves generating emissions reductions or carbon removals within a company's value chain, often creating co-benefits for both suppliers and producers. For example, a meat processor might help fund the use of feed additives on supplying cattle properties to reduce methane emissions and then count those reductions towards its own emissions footprint. The key difference between insetting and traditional offsetting approaches is that the climate benefit stays within the supply chain, rather than being traded externally.

Taking part in carbon markets can provide new income streams and help strengthen your farm's sustainability credentials. However, it's important to ensure your project follows credible methods, uses accurate data, and keeps carbon stored for the long term.

Considerations for carbon farming

Carbon farming involves changing the way you manage land or livestock to reduce emissions or store more carbon in soils and vegetation — and getting paid for it through carbon credits or other incentives. It can bring productivity, income and environmental benefits, but it's important to understand the risks, costs and responsibilities before getting started.

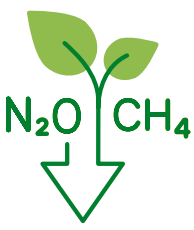
1. **Check if your land is suitable** Not all land stores carbon the same way. Rainfall, soil type, temperature and how the land has been used before will affect how much carbon can be stored in soil or trees.

2. **Balance production and carbon** Planting trees or changing management practices can reduce the area available for grazing or cropping, so it's worth planning carefully to find an approach that allows simultaneous farm production and carbon benefits.

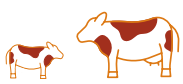
3. **Biodiversity and co-benefits** The type of trees you plant and where you put them can affect local plants and wildlife. Some plantings can improve biodiversity and even qualify for biodiversity credits under some state programs, such as NSW.

4. **Keeping carbon stored** Carbon stored in trees and soil needs to stay there for decades. Events such as fire, drought, or changes in land management can release the stored carbon, so long-term management and monitoring are required.

5. **Financial and legal factors** Carbon projects can involve costs for measurement, auditing, and compliance, and may include legal agreements tied to the land. Always seek expert advice before signing contracts or committing to a project.



Stocktake of on-farm emissions reduction actions

Action	Result	Considerations
Cropping and soil management		
If I switch to Enhanced Efficiency Fertilisers... 	I could lower overall fertiliser-related emissions. For example, I could cut nitrous oxide emissions by up to 60% in wheat crops and 56% in pastures.	Enhanced Efficiency Fertilisers currently cost more than standard fertilisers and have not shown consistent improvements in plant growth.
If I apply fertiliser precisely, at the right rate, depth and time...	I could increase plant yields for the same or less fertilise and save money.	Precision approaches use technologies such as GPS, variable rate controllers, and in-season monitoring.
If I replace convectional urea with 'green urea'...	I could lower my farms Scope 3 emissions and help reduce total agricultural emissions.	Green urea currently costs more than standard urea, but those costs may decline as renewable energy becomes cheaper.
If I include legumes in rotation... 	I could reduce nitrous oxide emissions by up to 55% and save as much as 80% on fertiliser.	Leaving legume residue on the soil longer and adjusting fertiliser rates to account for the legume can cut emissions significantly without affecting yields.
If I use cover crops or reduce fallow periods...	I could increase yield by 5–15% in winter cereal crops following summer cover crops, depending on soil type and rainfall.	The benefits of cover crops vary by region – they're often helpful in high-rainfall areas but can reduce soil health and yields of the next crop in low-rainfall zones.
If I increase soil carbon through stubble retention, minimal tillage or maintaining groundcover...	I could improve moisture retention, helping to sustain pastures during dry periods and increasing plant biomass by up to 30%.	Maintaining long-term soil carbon gains can be challenging, as success depends on factors such as climate, land management, nitrogen content, vegetation cover, and soil properties.
Livestock management		
If I improve livestock weaning rates... 	I could reduce emissions intensity per kilogram of liveweight by 20%.	Some measures that improve livestock weaning rates come at an increased cost to farmers.
If I ensure my animals reach market weight faster...	I could reduce emissions per kilogram of liveweight by 25%.	Some measures that reduce time to market can come at an increased cost to farmers.
If I monitor cow weight to target moderate sized cows....	I could reduce emissions intensity by 6%.	Moderate sized cows are a good target, rather than small cows, to avoid dystocia.

Action	Result	Considerations
If I plant low-emissions pastures and forages, such as Leucaena, Brassicas, Biserrula, and Desmanthus…	I could reduce emissions by between 20–40%, depending on the species grazed.	Most low-emission species are legumes with high nutritive value, so they will increase the rate of animal weight gain, leading to faster turnoff.
If I use feed additives such as Bovaer® or red seaweed…	I could directly cut methane emissions by 10–90%, depending on the additive and whether it is a grazing or feedlot system.	Some feed additives are expensive and may not boost productivity. Delivery of some additives to grazing livestock is still being developed.
If I improve feed digestibility by using higher-quality forage… 	I could reduce emissions intensity by 5–50%.	Improving feed quality may require changes to pasture species, grazing management, or supplementary feeding, which can increase costs or labour.
If I compost and capture methane emissions from manure and lagoons…	I could cut methane emissions by 60–90% through gas capture and use, and by 10–40% through composting or windrow treatment of separated solids.	Installing systems to capture or manage methane from manure can involve upfront costs and maintenance.
If I breed animals in a way that selects for low methane and /or high feed-efficiency…	I could steadily lower herd or flock methane missions by about 1–2% per year, accumulating to about 10–20% after 10 years.	Genetic improvements often require several generations to show clear results. Selecting a balanced index of traits that affect profit *and* include methane will yield the best results.
Horticulture		
If I improve energy efficiency by switching to solar- or battery-powered irrigation pumps and tractors and reduce fuel use…	I could lower fuel and energy costs, reduce carbon dioxide emissions, and gain greater energy independence, helping position my business for low-emission market opportunities.	Renewable energy systems require upfront investment and ongoing maintenance.
Other emissions reduction strategies		
If I plant trees on unproductive land or along tree corridors or use agroforestry…	I could reduce total farm emissions by 20–30% over 30 years by planting on 5–12% of high productivity land.	Carbon benefits build over time and can be influenced by factors such as rainfall, soil type, tree species, and planting design.
If I add biochar to build soil organic matter… 	I could increase crop yield by 10–42%, especially in low-nutrient, acidic soils and in dryland sandy soils.	Purchasing biochar is an additional cost to your farm, and its benefits depend on the biochar source, soil type, and how it is applied.
If I switch from fossil fuels to renewable power…	I could lower fuel and energy costs, reduced emissions, and improved energy security.	There are costs associated with installing solar and battery systems, as well as other renewable energy infrastructure.

More information

Whether you're looking to collaborate, have a question, or just want to learn more about ZNE-Ag CRC, get in touch with our team today.

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