Our approach to on-farm emissions

May 2023

Fonterra
Dairy for life

What's in this booklet

The information and mitigations provided to you in the on-farm actions section of this support document are primarily sourced from industry bodies such as DairyNZ and the He Waka Eke Noa partnership. While the information provided may identify possible opportunities to reduce your farm's greenhouse gas emissions, information should be considered as part of the whole farm system and decisions should be undertaken with relevant guidance from a Sustainable Dairying Advisor and/or a consultant. You are solely responsible for your own assessment and evaluation of the information and for the actions or decisions you take based on the information provided.

Fonterra has worked hard to provide up to date and factual information in this booklet, however, we do not guarantee the accuracy and completeness of the information contained within it. Fonterra shall not be liable for any loss arising from any actions or decisions taken by you based on the information contained in this document.

This document will be updated regularly to reflect industry best practice. To ensure you have the most up to date version, please contact your local Sustainable Dairying Advisor. Version May 2023.


Tiakina te whenua i tēnei rā,
hei oranga tangata mō ngā
rā e heke mai nei.
Caring for the land today, so that the land cares for us tomorrow.

A message from Miles

Kia ora,

When it comes to reducing our on-farm emissions, we are building on a strong position. This is thanks to New Zealand's natural advantages – like our grass-fed approach – combined with your efforts to be as efficient as possible.

We can be proud of the leadership position we have, which has been built on generations of farming ingenuity and innovation. At the same time, we need to protect and build on this advantage to stay competitive. We already differentiate the Co-op's milk and the products made from it through provenance and sustainability claims. But it's going to take ongoing action from all of us to keep ahead of our competition – which is coming not only from dairy producers but also potentially dairy alternatives – and meet the evolving needs of our customers, consumers and stakeholders.

Having an on-farm emissions (Scope 3) target is an important part of keeping our Co-op resilient for the future. We see a pathway, based on a Co-op wide approach of improving the emissions intensity of every kilogram of milksolids produced. This is to deliver against a target that is credible, meet the needs of our customers and consumers, while also maximising the production and efficiency of your businesses. This means the target needs to be in line with international best practice, the Paris Agreement and latest scientific consensus, and the Co-op needs to provide support to farmers to achieve it.

We acknowledge the work that many of you have already done and are continuing to do to reduce emissions, and don't underestimate the effort it takes to make change on-farm.

That's why there is already a lot of work going on across the Co-op to support you through existing tools, including the Farm Insights Reports and Farm Environment Plans. Our aim is to offer solutions that can be tailored to the unique attributes of each farm and delivered through our on-farm support teams.

We are also investing in R&D and partnering with others on potential breakthroughs, including through a joint venture between industry and government around the methane challenge. This work will accelerate as we continue to look for practical solutions that also support efficiency and the overall resilience of your individual farming businesses.

We appreciate every farm is at a different point in the journey, and the opportunities and challenges you face may be very different to those of your neighbour over the fence. No matter where you're at, we are here to support you. It's about working together to build the collective strength of the Co-operative.

Thank you for taking the time to consider this information and continuing the conversation about reducing on-farm emissions. This work will help future proof Fonterra, supporting our ambition to be a long-term sustainable Co-op for generations to come.

Ngā mihi,

Miles Hurrell

The challenge we face

Climate change is impossible to ignore and is also a complex topic. To cut through the many sources of information and support you in understanding more about climate change and dairy's contribution to it, we have listed a number of go-to resources to the right. Where this booklet does not answer all your questions on the topic, we are leaning on our other stakeholders in the industry to share further information with you. These and other resources can be found in the Reference Guide at the back of this booklet.

- **AgMatters**
- **DairyNZ**
- **The Ministry for Environment**
- **NIWA**
- **Intergovernmental Panel on Climate Change (IPCC)**
- **Food and Agriculture Organization of the United Nations (FAO)**

How does agriculture contribute to climate change?

The main agricultural greenhouse gases (GHG) are methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2):

Methane is produced in ruminants (e.g. cows and sheep) by methane producing micro-organisms. Most enteric methane is emitted when ruminant animals burp. The amount produced for each farm is directly related to the total feed intake for that farm (in-scope for Fonterra's on-farm emissions are all animals associated with the dairy platform including cows, heifers, calves and breeding bulls).

Nitrous oxide is emitted from soil when urine, faeces and fertilisers are broken down by microbes in the soil.

Carbon dioxide is produced when using vehicles and machinery. It is produced in the manufacturing and transportation of feed and fertiliser.

Carbon dioxide equivalent (CO_2e) is a term used to refer to the impact that all of the gases above collectively have on driving global warming and climate change. Further information on the warming potential and the measurement of agricultural GHGs can be found on **page 42**.

Of Fonterra's reported GHG emissions, farm-related activities account for about 90%. Manufacturing (9%) and supply chain (1%) make up the rest.

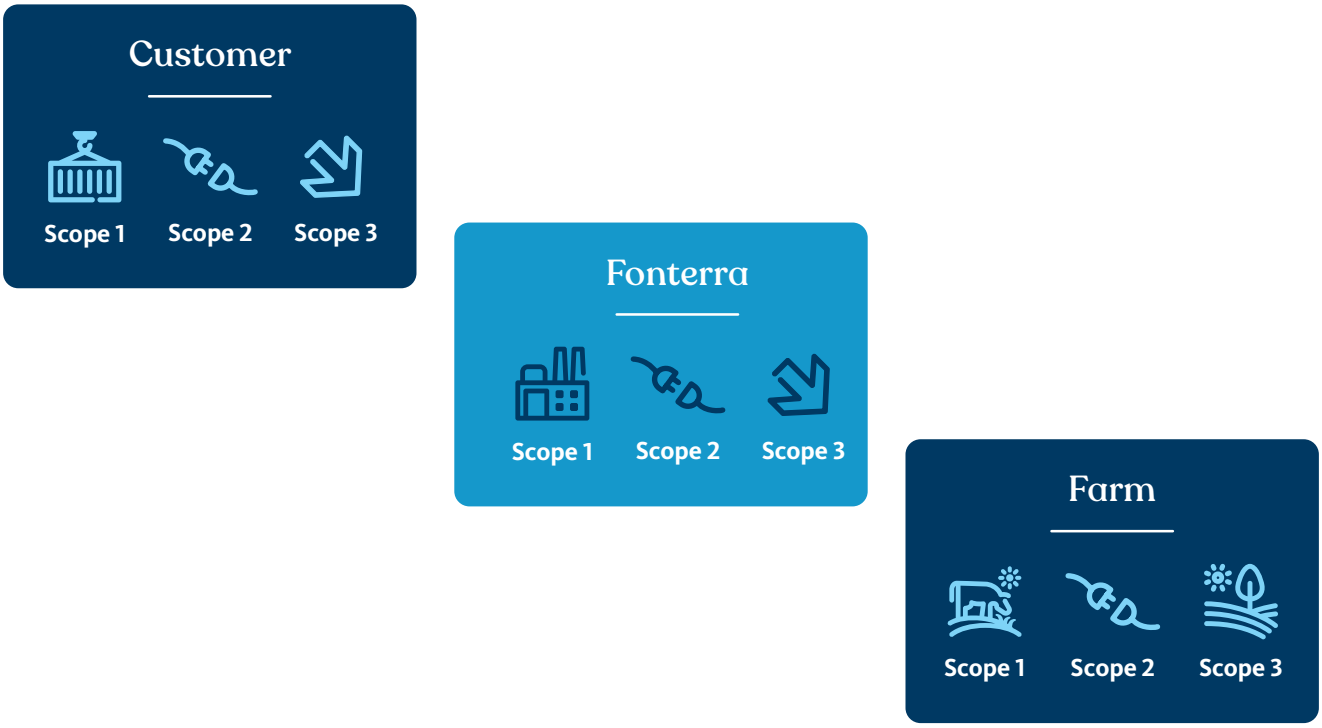
Fonterra's emissions footprint

Scope 1, 2 and 3 emissions

Scopes 1, 2 and 3 are used to account for all of the emissions that result from a company's operations through the entire supply chain. The definitions and examples can be found below:

Scope	Definition	Fonterra	Farmers
1	Direct emissions from sources owned by an organisation	Emissions from manufacturing sites and transport	All emissions on-farm including methane, effluent and nitrous oxide
2	Indirect emissions from the generation of purchased energy that an organisation uses	Emissions from electricity used at our sites and offices	Emissions from sourcing electricity
3	Indirect emissions occurring because of the activities of an organisation but generated from sources it does not own or control	Emissions from the milk we use to make products (Farmers' Scope 1, 2 and 3)	Emissions pre-farm gate e.g. manufacture of imported feed and fertiliser

Scope 3 emissions are used to help companies at an organisational level to understand and manage their emissions, including those resulting from its supply chain.



Fonterra set initial emission reduction targets for Scope 1 and 2 emissions in 2018, and have been making progress towards these as stated in **Fonterra's annual sustainability reports**. Fonterra is planning to announce an emissions intensity reduction (Scope 3) target – more on emissions intensity versus absolute on **page 7**. The intended target release date is mid-2023.

Absolute versus intensity

Emissions are predominantly reported in one of two ways: absolute emissions or by emissions intensity. It's important to understand the differences between these two methods.

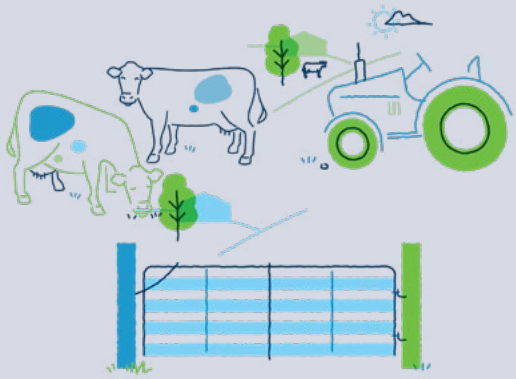
Absolute emissions refer to the total amount of GHGs being emitted, whereas **intensity** compares the amount of emissions to a unit of output, in this instance it's per kilogram of milksolids (kgMS). Both metrics can be found in the Environment section of your Farm Insights Report.

Your Farm Insights Report shows you absolute biological emissions on a per hectare basis ($kgCO_2e/ha$). This can be multiplied by the effective area of your farm to calculate your total absolute emissions per farm.

Emissions intensity is the emissions that are generated per unit of product. For dairy farmers, emissions intensity is the total on-farm emissions divided by the amount of milk the farm produces ($kgCO_2e/kgMS$).

New Zealand Government have set absolute emission reduction targets, while the intended Fonterra Scope 3 target will be based on emissions intensity reduction. This will support on-farm efficiency improvements and cater for many of our customers who consider emissions intensity in their purchasing decisions. Customers are interested in the amount of carbon that has been produced when making a certain ingredient (i.e. 1 MT of Whole Milk Powder). Both measures are important as by improving how efficiently a farm can produce milk, farmers are able to maintain productivity while reducing emissions on both an absolute and intensity basis.

Absolute emissions



Total amount of GHG emitted

EXAMPLE: FROM A FARM

1,741,824 $kgCO_2e$

Emissions intensity

Emissions per unit of product

EXAMPLE: KILOGRAMS OF MILKSOLIDS

12.9 $kgCO_2e/kgMS$

"To us, continuous improvement means remaining profitable and keeping our milk production at least stable while our on-farm emissions are perpetually going down. We are supportive of Fonterra guiding us in this direction by considering on-farm emission reductions on a per kilogram of milksolids basis, rather than reducing our cow or farm size to cut emissions. We appreciate all the support we can get in this area and believe we must work together as a Co-operative to meet our relative goals."

Arbour Farm Ltd., Fonterra Suppliers

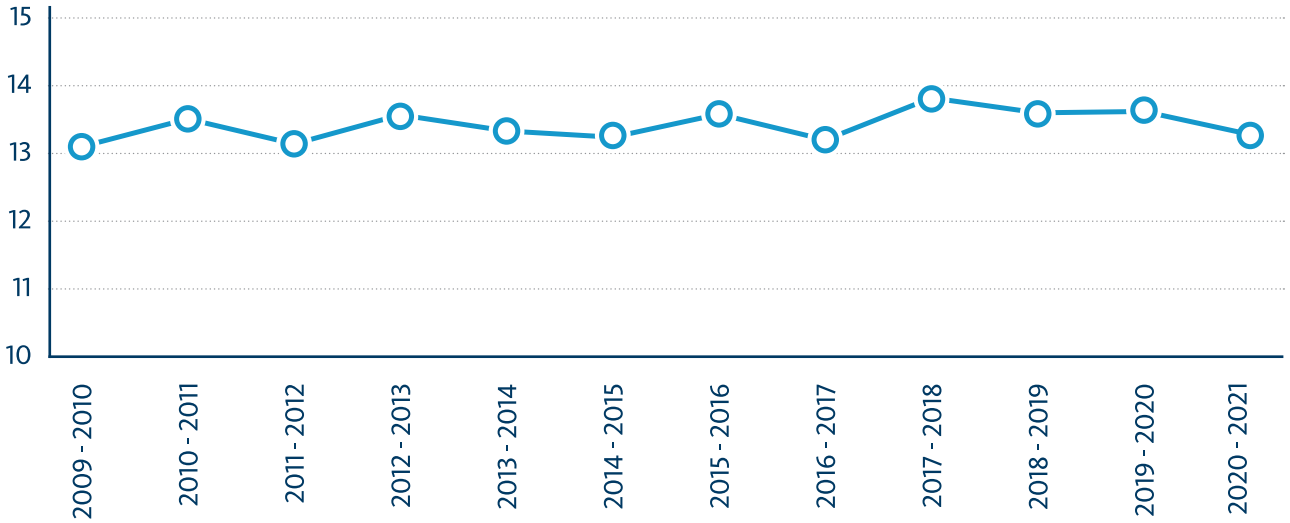
Fonterra's on-farm emissions by the numbers

The carbon footprint of New Zealand's on-farm milk supply is amongst the lowest in the world[1]. However, this leadership position should not be taken for granted, and will need increased focus to be maintained. Each year we commission independent analysis by AgResearch to calculate our footprint using the most up to date global data and guidelines to ensure we're maintaining our international credibility.

The average carbon footprint intensity of Fonterra's milk based on FY21 on-farm data is currently 11.08 kg of carbon dioxide equivalent per kgMS. If we include the impacts of land use, land use change and peat soils, this increases to 13.28 kg of carbon dioxide equivalent per kgMS.

On an intensity basis, on-farm emissions have been stable since 2007/2008, with minor fluctuations year-on-year. The biological efficiency of cows has improved, but this has largely been offset by higher pre-farm gate emissions from purchased items such as supplementary feed and fertiliser manufacturing.

Fonterra Intensity On-Farm Emissions (CO_2eq/kgMS)



What does Fonterra's on-farm emissions footprint include?

Our approach to measuring an on-farm emissions footprint accounts for emissions produced on the dairy platform, including the production of farm inputs, and also includes some activities on support land that relate to the milking herd. Accounting for wintering and replacement rearing practices provides a fuller picture of emissions from the production of milk. Another important part is the embedded emissions, or the emissions that are brought on to the farm through the production of fertiliser, imported feed, fuel and electricity. In addition to on-farm activities, Fonterra's footprint also includes emissions from land use and land use change.

Land use covers two main areas – the farming on peat soils in our supply chain, as drained peat emits greenhouse gases, and to a larger scale, deforestation that has occurred in the last 20 years.

Further information on what's included in Fonterra's carbon footprint, carbon sequestration, soil and pasture carbon can be found in the **Technical Information and Glossary section on pages 42 and 43.**

[1] Fonterra Sustainability Report 2022, Page 30, *www.fonterra.com/content/dam/fonterra-public-website/fonterra-new-zealand/documents/pdf/sustainability/2022/fonterra-sustainability-report-2022.pdf*

Why we need to reduce our on-farm emissions

An industry-wide perspective

"Kiwi dairy farmers are world leaders in the production of sustainable, low carbon milk. New Zealand's international brand, and the value of our products in international markets, is built on the hard work farmers have done on their own farms improving environmental practices. As international market expectations increase, our science shows that further gains are possible now through farm system efficiencies. And new technologies that we're working on right now, will offer farmers further opportunities to remain world leading."

DairyNZ

The drivers for our Co-op

We see four key drivers around why we need to set and deliver on an on-farm emissions reduction target:

- Our strategic choice to be a leader in sustainability
- Retain and support our high-value customers
- Continued access to funding and capital, for both the Co-op and farms
- Increased legal and reporting obligations

Our strategic choices

In 2021, Fonterra identified three strategic choices for its long-term strategy: to be a leader in sustainability, to be a leader in dairy science and innovation, and to focus on New Zealand milk.

These choices are interdependent and work together to shift our product offerings to a place of higher value while creating long-term resilience in the Co-op.

- From unique dairy product formulations to on-farm tools and researching methane-busting technologies, Fonterra is committed to leveraging our team of experts to lead in dairy science and innovation.
- Focusing on New Zealand milk enables Fonterra to gain the most value out of our unique farming practices and environment where we source our milk when competing on the global stage.
- Leading in sustainability is about building resilience in the Co-operative to ensure long-term success from one generation to the next. Four key areas of sustainability have been identified as a priority for the Co-op – climate, water, animal wellbeing and protecting and creating value from our sustainability position.

A Scope 3 target and clear roadmap to drive these reductions is a core element required to ensure the Co-operative strategy is delivered in full.

Customers, consumers and market access

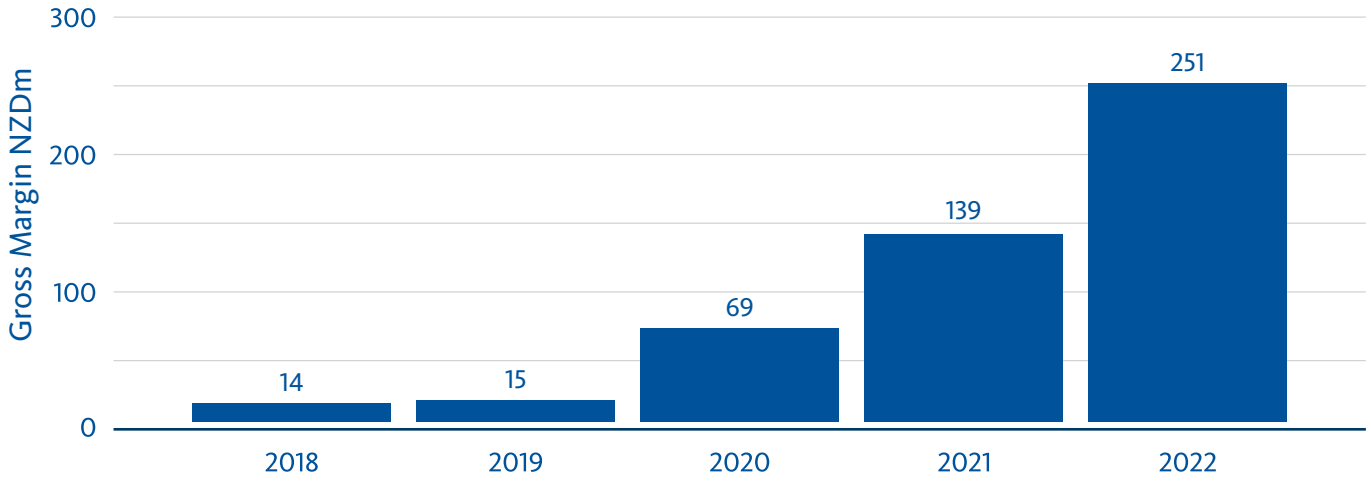
What began as several large scale multi-national customers setting Scope 3 targets five years ago, is now multiplying year on year. At current momentum, ~30% of 2030 business-to-business gross margin will come from sustainability-focused customers. In the past four years we have had an 18-fold increase in Sales Gross Margin linked to the number of customers who have set a Scope 3 target.

In many cases they're looking to Fonterra to help with meeting their targets by having a clear emissions reduction plan.

By leveraging our existing low-carbon footprint and accelerating our emissions approach to meet these expectations, we will ensure we remain competitive relative to other dairy producers or dairy-alternatives.

In many conversations with our customers, emissions is the first topic raised before entering further discussions on product sales. This has been a dramatic shift where a reduction plan is now a requirement rather than our low-carbon position being a reason to gain more value through premiums.

Cumulative value linked to customers with Science Based Target initiative (SBTi) commitments



Increase in Gross Margin linked to customers making SBTi commitments over time

Current customer targets

Customer	Target	Scope	Baseline
Mars	27% reduction by 2025 Net Zero by 2050	All Scopes	From a 2015 baseline
Nestlé	20% reduction by 2025 50% reduction by 2030 Net Zero by 2050 Dairy is responsible for Nestlé's largest group of emissions	All Scopes	From a 2018 baseline
Starbucks	50% reduction by 2030	All Scopes	From a 2018 baseline
Unilever	100% reduction of Scope 1 & 2 by 2030 Net Zero by 2039	Scopes 1 & 2 All Scopes	From a 2015 baseline
Yum!	46% reduction by 2030 Net Zero by 2050	All Scopes	From a 2019 baseline

Note – this list is not exhaustive and only identifies a small number from a growing list of customers setting ambitious climate related targets

In some markets, trade barriers may restrict products based on their carbon footprint, and we're already seeing this happen. In late 2022, the European Union proposed a carbon border adjustment tax that would make imported goods (currently excludes agriculture) subject to a carbon price through the European Union's Emissions Trading Scheme.

Access to funding

"We are actively engaging in dialogue with clients and encouraging them to consider within the context of their own business what are those key strategic risks and opportunities that sustainability represents to them. This is particularly important when making major long-term investment decisions and farm systems decisions."

Blake Holgate, Head of Sustainable Business Development, Rabobank NZ

Banks, insurers and financial institutes are beginning to request details on the steps the Co-op is taking to reduce it's carbon footprint. An example of this heightened focus is evident from five of New Zealand's key agricultural banks recently signing up to the United Nations Net Zero Banking Alliance, requiring them to set targets. This means both the Co-operative's and farmers' access to funding will likely include emissions targets.

To enable continued access to capital, Fonterra's sustainability credentials and aspirations need to be aligned with investor expectations.

There is also opportunity to receive discounts, such as lower interest rates on loans linked to sustainability performance. **Refer to the Centre for Sustainable Finance on what banks' net zero pledges mean.**

Legal and reporting obligations

In 2024, Fonterra becomes one of over 200 businesses in New Zealand that will be required to disclose climate risks and opportunities, performance and status on climate-related metrics and targets against new mandatory Climate Standards. We are well prepared for this new regulation, with our annual sustainability reporting providing a good foundation. Additional reporting obligations are an important driver for elevating our approach to considering related risks and opportunities.

Regulation and emissions pricing

We acknowledge that the New Zealand Government has an important role to play in co-ordinating the country's response to climate change. Credible emissions reduction policies should help to maintain New Zealand's international reputation while also ensuring all dairy processors continue to compete on a level playing field.

In 2019, the Government established emissions reduction targets in legislation. These were a gross reduction of methane as a short-lived gas of 10% by 2030, with a reduction range of between 24% and 47% by 2050, and a reduction in the longer-lived gases such as nitrous oxide and carbon dioxide to net zero by 2050.

He Waka Eke Noa – a partnership between the Government, primary sector representatives and iwi/Māori – was set up the same year to look at how agriculture would meet targets through a combination of emissions levies and incentive discounts and pricing. The farm-level pricing framework is yet to be finalised and passed into legislation by the Government, but we expect it will take effect from 2025, with farmers exposed to a levy from that point. We will support our farmers with implementing the system once it's confirmed.

Our approach to set and work towards a Scope 3 on-farm emissions target is separate to this, but intended to be complementary.

While the Government's targets are related to absolute biological emissions reductions, our approach includes a strong focus on emissions intensity. The difference between absolute and intensity based targets are explained on **page 7**. Our focus on intensity-based emissions targets supports the aspirations of our customers to reduce emissions per kgMS.

While He Waka Eke Noa may have got more of the headlines, there is also co-related regulatory change in Freshwater Management. From a practical perspective, many of the mitigations and practices that support on-farm efficiency and emissions reduction also help reduce a farm's impact on water quality. Understanding and managing these dual Government climate and water quality ambitions are important considerations for Fonterra.

Our approach to on-farm emissions

We acknowledge the work that many of you have already done and are continuing to do to reduce emissions. But it's also clear that together we need to accelerate progress in reducing our collective on-farm emissions to maintain our competitive edge.

A key part of our on-farm emissions approach is setting a target and working alongside you to deliver it.

As mentioned earlier in this booklet, having an on-farm (Scope 3) target will help us secure and retain high value customers and enable the Co-operative and our farmer owners to meet regulatory requirements and access finance.

This section covers more information about what a target would mean for our Co-operative and how we plan to work alongside you to get to where we need to be.

Setting an on-farm emissions target

We first signaled our intention to set an on-farm (Scope 3) emissions target at our 2022 Annual Meeting. We are planning to announce an emissions intensity reduction target – see further explanation on **page 7** about the difference between absolute emissions and emissions intensity targets. It's important that the target is in line with the Paris Agreement and scientific consensus as well as international best practice, and considers feedback we have heard through farmer engagements. The intended target release date is mid-2023.

Science Based Targets initiative

The Science-Based Targets initiative (SBTi) is a global body that promotes best practice in science-based target setting and independently assesses companies' targets. Targets are considered 'science-based' if they are aligned to meet the goals of the Paris Agreement – limiting global warming to 1.5°C above pre-industrial levels. The Paris Agreement was adopted by countries under the United Nations Framework Convention on Climate Change on 12 December 2015.

SBTi supports companies in their target setting and is used by our customers and competitors both globally and locally. For example, Mars has an SBTi-approved target of 27% reduction in Scope 1, 2 and 3 emissions by 2030 while Nestlé has an SBTi-approved target of 50% for these emissions within the same timeframe. See **page 11** for further details on these and other customer targets.

Fonterra is also intending to seek SBTi validation of its on-farm emissions target. SBTi validation helps to show our people, customers and the wider world that we're committed to be at the forefront of low-emissions food production.

Time horizons for our emissions reduction pathway

Tools and support available today

Adoption of best practice on-farm – Emissions intensity can be lowered now by improvements in animal health and wellbeing, improvements in feed quality and capitalising on nitrogen-efficient cultivars or alternative pastures, such as plantain. Find more on this in the **On-Farm Actions section** in the second half of this booklet.

We are committed to further developing the tools and services we provide. These can be tailored to the unique attributes of your farm and delivered in a personal way through our Farm Source team.

What we're looking into for the future

In the longer term we are anticipating that new technology and innovations will enable further emissions reductions. We're investing in our own research and development as well as partnering with others to try and find breakthroughs that will further support farmers. For example:

- As part of our Greenhouse Gas Mitigation Programme we currently have 18 different projects underway working to solve the biogenic methane challenge in partnership with others. Within these projects are more than 30 trials in progress – from feed supplements to manure management and more.
- One project that farmers may be familiar with is **Kowbucha™**. It has shown potential to reduce methane and may provide other benefits in early life intervention trials.
- Another trial, which we recently expanded, is with a type of seaweed called **Asparagopsis**, a feed supplement that has shown potential for methane reduction in cows.
- In December 2022, Fonterra announced that it would be investing up to $50m over the next four years in a public private partnership with Government and industry to develop and commercialise practical tools and technologies for farmers.
- We're also partnering with Nestlé to develop a commercially viable net zero carbon emissions dairy farm in the Taranaki, as well as implementing a GHG farmer support pilot programme (**see page 17**).
- We are also collaborating with other organisations to explore further opportunities.

How land use and land use change also plays a part

Land use or land use change is an important consideration when looking out how our Co-op can work towards an on-farm emissions (Scope 3) target. Land use change can contribute to emissions by increasing carbon dioxide in the atmosphere, with vegetation removal being the main cause of this. For example, converting forestry to pasture means that the carbon that was stored by the trees is released into the atmosphere in the form of carbon dioxide.

On the other hand, there are opportunities to reduce emissions in this area. For example, by planting along marginal grazing areas (ensuring the right tree in the right place) and protecting current carbon stocks in existing vegetation through zero deforestation.

We're planning for existing and expected on-farm planting to play a part in our overall emissions reduction. At the same time, land use change that has happened in the past will also have an influence on how we get to our on-farm emissions target **– for more information see Technical Information page 43.**

Getting there together

Our farmers continue to make improvements in on-farm efficiency which has co-benefits for lowering the carbon footprint of our milk. We are committed to further developing the tools and services we provide so that the right support is offered, and collaborating with our stakeholders to unlock opportunities for improvement on-farm.

Taking variation between farms into account

All farms will start from a unique position in terms of their carbon footprint and the opportunities they have available on-farm. This is due to management practices and factors that are unable to be easily changed by the farmer. No matter what point a farm is at along the journey, we are here to support them.

The reduction we're looking to achieve through efficiency gains on-farm is collective across all milk supplied to the Co-op.

While all farmers have an opportunity to reduce emissions by increasing on-farm efficiencies, these will be different for each farm. We also acknowledge the changes that some farmers have already made to reduce their environmental impact.

However, all reductions – big or small – across different farming operations will help us achieve this collective target.

Our aim is to offer solutions that can be tailored to the unique attributes of each farm and delivered in a personal way through our on-farm support teams.

Cost benefit for farmers

By focusing on on-farm efficiency improvements, we expect the cost of change will be mitigated by the savings accrued from such improvements. Such opportunities can be found in the optimisation guidance in the Farm Insights Report – for example, money is saved if fertiliser application is optimised.

Practice changes that work best for some farms may require capital investment. This is dependent on each individual farm and will have different costs to change and value opportunities.

The support we're providing farmers now

Farm Insights Reports

Every Co-operative farmer receives a Farm Insights Report which provides useful information on milk production and quality, animal wellbeing and performance, and the farm's environmental performance. The reports include farm-specific biological GHG data at both an intensity (per kgMS) and an absolute level (per ha). This is the first step in understanding your farm's emissions profile and benchmarking its performance relative to similar farms.

It also identifies efficiency opportunities such as potential improvements in fertiliser optimisation, lowering the somatic cell count and reducing animal health events. These all have co-benefits for reducing the on-farm carbon footprint. **You can find out more on this in the On-Farm Actions section.**

Farm Insights Reports are provided to all farms and utilise the data we collect to meet regulatory and market access requirements and, most importantly, to add value to our products in market. Through this data, we're able to provide much needed proof points to our customers of the care you take of your farm, environment and animals.

Farm Source Hub and Retail

Our Farm Source retail arm links farmers to agricultural products that support the running of healthy farming businesses. The extensive range of products also provides a platform to deliver technologies that may provide efficiency and GHG benefits to farmers.

Farm Environment Plans

Our Sustainable Dairying Advisors create tailored Farm Environment Plans (FEPs) using industry-leading mapping technology. These plans identify risks alongside actions and recommended completion dates to help guide farmers in risk mitigation. All Fonterra supplying farms will have an FEP delivered by 2025. The plans include many sections, one of these being Greenhouse Gas where opportunities to reduce on-farm emissions will be identified.

On-farm Digital Applications

Our digital tools and services are constantly evolving to meet farmer needs, and there are always developments in the pipeline that will continue to enhance the way farmers access, view and compare key business data.

The digital Dairy Diary can be used to capture on-farm data and information, allowing for credible insights to be produced.

The On-Farm app can be used to access instant updates on a farm's milk production and a month's worth of milk quality stats, with these insights supporting live analysis of the farm's performance.

Milk Vat Monitoring System (MVMS) is also offered to Fonterra suppliers, providing real-time data to reduce risk of milk being lost, downgraded or disposed of, which all help to support a more efficient system.

On-farm support teams

We provide environmental expertise and support across our experienced team of Sustainable Dairying Advisors, Area Managers, Technical Sales Representatives, and others.

As we support our farmers to build their own knowledge and understanding on these topics, we are committed to building our own internal capability as well and will continue to share learnings and expertise with our farmers.

The support we're providing farmers now cont.

The Co-operative Difference Payment

The Co-operative Difference payment encourages farmers to adopt new and emerging practices that support the long-term success of the Co-operative. It achieves this through differentiating the price our farmers are paid for their milk based on the practices adopted on each farm.

A significant number of our farmers have been achieving The Co-operative Difference payment on some level, which is a great indication of the high-quality milk and good on-farm practices being carried out. On average, the milk from farms who achieve Te Tihi through The Co-operative Difference has a 7% lower footprint than farms that do not achieve The Co-operative Difference.

Whilst the Te Tihi achievement criteria was not developed with a specific focus on reducing emissions per kgMS, the measurable difference in the footprint shows that farmers adopting the new and emerging practices in Te Tihi have a positive co-benefit on emissions footprints as at 2023. As the emissions reduction target is Co-op wide, we have not included it as a specific criterion in The Co-operative Difference Framework or the Fonterra Farmers' Terms of Supply.

On-farm customer projects

Outside of our many partnerships in the **Greenhouse Gas Mitigation Programme** described earlier, we are also looking to partner with customers to support our farmers on their emissions reduction journeys. One of the best examples of this is partnering with Nestlé to develop a commercially viable net zero carbon emissions dairy farm. We are also working with a group of farmer volunteers on a GHG farmer support pilot programme, providing one-on-one assistance in identifying opportunities for emission reductions on-farm.

On top of the great work already being carried out, we know we can do more. We believe that with the right support and investment we can set our farmer owners up well to achieve further emission reductions on-farm to meet targets, minimise the impacts of carbon pricing and protect the future of our farms. We also acknowledge that to significantly reduce on-farm emissions we need to do more together. The following section provides guidance on actions that could be taken to reduce on-farm emissions and increase efficiencies.

"As both a Fonterra dairy farmer and a Regional Councillor we are all of us in the same space with the need to work together on reducing emissions. We have to do it in a way that least affects production and farmer income during an inflationary period. We really need to work together to find the best possible outcome. Working together always achieves better outcomes than being forced to do it later."

Neil Walker, Taranaki Regional Councillor / Fonterra Supplier

On-farm actions

The best options to reduce and mitigate on-farm GHG emissions for each farm will vary depending on factors such as the farm system and location.

When considering your farm's emissions, it is also important to understand absolute emissions versus emissions intensity. Absolute emissions refers to the total amount of greenhouse gases being emitted whereas intensity compares the amount of emissions to a unit of output. By improving how efficiently a farm can produce milk, farmers are able to maintain productivity while reducing emissions on both an absolute and intensity basis.

The following pages have been designed to support you by providing information and specific actions that you can take to reduce GHG emissions and your farm's carbon footprint. We acknowledge some farmers have already put many of these actions into practice, and this is by no means an exhaustive list, but it does provide a good opportunity to consider 'what next' while sharing consistent guidance with all farmers.

Working in conjunction with your Farm Environment Plan, Farm Insights Report, and with your Sustainable Dairying Advisor, this information provides guidance to improve the efficiency of your farm and help ensure that you are getting maximum milk production for the lowest emissions. Lowering your absolute on-farm emissions can be achieved through efficiency gains by maintaining production from less inputs.

Every action taken towards becoming more efficient, while avoiding intensification, works towards lowering your farm's carbon footprint. Continuous improvement through Farm Environment Plan recommendations and actions should see your farm's carbon footprint lower year on year. You will be able to monitor progress through your annual Farm Insights Report.

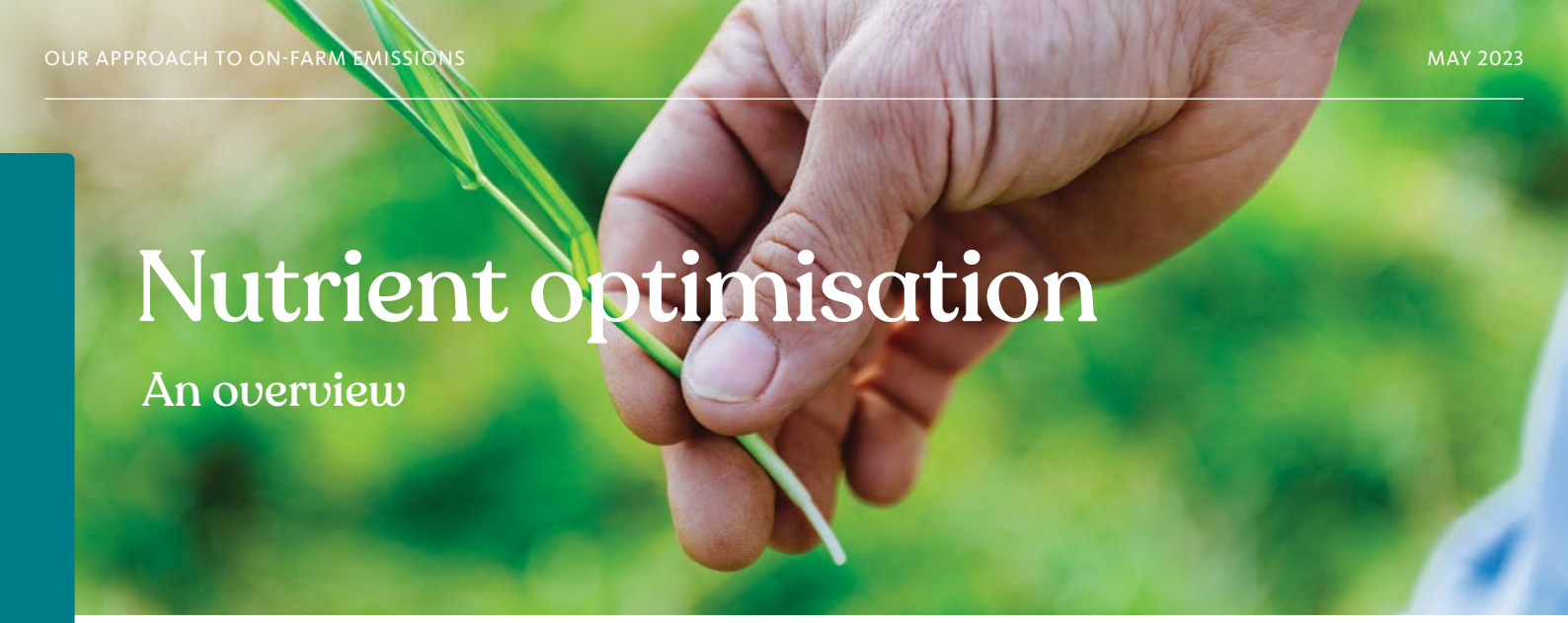
Working together

Throughout this document there are references to your Farm Insights Report. If an opportunity is identified in your Farm Insights Report then undertaking the corresponding action in this booklet may provide a valuable step for you to consider on the journey to reducing your farm's carbon footprint.

Click to see your digital Farm Insights Report

To increase overall farm efficiencies, it is important to consider using tools available to help with data keeping where possible. The Dairy Diary App is a good way to record animal treatments, feed, fertiliser and effluent applications, agrichemical spraying, grazing and monthly hygiene checks – most of this data is then easily transferred to your Farm Dairy Records each year. We continue to develop and improve data collection and digital platforms.

You can search 'Dairy Diary' in your phone's app store. QR codes to download the app are also at the back of this booklet.



Nutrient optimisation

An overview

Fertiliser efficiency has an impact on a farm's emissions footprint in two ways:

- **Biological emissions:** using less nitrogen fertiliser reduces the amount of nitrous oxide (N_2O) produced in the soil.
- **Non-biological emissions:** reduction of emissions from fertiliser production and transport.

The aim of fertiliser efficiency and improving emissions intensity footprint on-farm is to produce the same amount of pasture and crops from less fertiliser input.

Fertiliser efficiency gains can be achieved from a broad range of farm management actions. However, the most impactful actions to increase a farm's fertiliser efficiency come from optimising your fertiliser application and effluent use – which this document focuses on.

Although termed 'fertiliser' efficiency, there is a lot more than just what fertiliser you apply and at what rate. It is about considering all the decisions and management factors that happen on-farm that will influence pasture response to fertiliser.

It is important to understand the difference between Purchased Nitrogen Surplus (PNS) and your efficiency measure. PNS is an indicator of risk – it is how much nitrogen is left over in the system that could be lost to water or the atmosphere. It is very important that when focusing on efficiency gains, the risk of nitrogen leaching is not increased, so keep an eye on your PNS.

The benefit of improving efficiency by reducing the nitrogen applied to grow the same yield of pasture is three fold – you will reduce your emissions footprint, you will reduce your PNS, and you will reduce spend on fertiliser.

Reduce nitrogen applied

ACTION:

Minimise purchased nitrogen surplus through reduced use and/or better utilisation of fertiliser

Reducing nitrogen (N) inputs on a farm scale, reduces the amount of nitrogen cycling through the soil-animal system. This minimises surplus nitrogen in the soil, therefore decreasing the risk of nitrogen leaching into water or being lost as nitrous oxide (N_2O) to the atmosphere.

Working together

If an opportunity to optimise fertiliser use is identified in the Environment section of your Farm Insights Report, then minimising purchased nitrogen surplus may be a valuable step for you to consider on the journey to reducing your farm's carbon footprint.

What action can I take?

- Consider the type of fertiliser used. Do you need other elements at the same time or nitrogen only?
- Apply nitrogen using a “little and often” approach. This keeps individual application rates low to maximise plant uptake.
- Make sure the nitrogen rate applied matches the response available for the time of season.
- Maintaining high levels of clover in your pasture can reduce the need for nitrogen fertiliser applications.
- Soil test prior to planting crops to ascertain the starter fertiliser mix actually required based on predicted yield, cultivation, previous crop etc. Further testing may be required but, as a minimum, test to know what you are starting with. Most pre-cultivation soil tests cover Phosphorus (P), Potassium (K), and Sulphur (S) but not nitrogen (N). Nitrogen tests can be useful, so ask for this to be included.
- You can use reputable industry tools for feed and nutrient budgeting to plan your nitrogen fertiliser inputs for pasture.
- Review your fertiliser plan with your fertiliser rep or consultant.
- Use reputable or Spreadmark accredited contractors for spreading accuracy.
- Further information and strategies to reduce nitrogen fertiliser use successfully are outlined by DairyNZ in the link below.

Additional Information

DairyNZ | Reducing Nitrogen Fertiliser Use
www.dairynz.co.nz/environment/on-farm-actions/reducing-nitrogen-fertiliser-use/

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Coated nitrogen fertiliser

ACTION:

Select inhibitor coated nitrogen fertilisers to reduce the amount of nitrogen applied

In inhibitor coated fertilisers, the urea is coated with a urease inhibitor which slows down the conversion of nitrogen (N) to ammonia. This results in less applied nitrogen being lost to the atmosphere as ammonia gas (volatilisation). As per current guidance, this means you can reduce the amount of fertiliser required compared with a non-coated product by up to 10% without affecting production[1]. By using less fertiliser, there will be less nitrous oxide (N_2O) emitted. When using coated nitrogen fertiliser, reducing the amount used compared with a non-coated fertiliser by 10% (to account for the nitrogen that is no longer lost as ammonia) also reduces the risk of nitrogen loss to water.

As at July 2022, it is estimated that coated urea is approximately 3% more expensive than uncoated urea[2]. As less coated urea is required to achieve the same pasture response, if this is combined with other good farming practices, it reduces the total tonnes of nitrogen required per farm which has a financial benefit as well as reducing the risk of environmental impact.

What action can I take?

- Discuss the suitability, benefit and the impact of timing on using coated urea in your system with your fertiliser rep or consultant.
- Use coated urea products (urease inhibitors) to increase effectiveness of urea applications.

Additional Information

[1] **He Waka Eke Noa | Farm Planning Guidance**
hewakaekenoa.nz/he-waka-eke-noa-greenhouse-gases-farm-planning-guidance-march-2022-final/

[2] **DairyNZ | Managing Nitrogen Fertiliser**
www.dairynz.co.nz/feed/pasture/growing-pasture/managing-nitrogen-fertiliser/

Timing and placement

ACTION:

Manage timing and placement of nitrogen fertiliser applications

The extent to which timing and placement of fertiliser applications reduce nitrous oxide (N_2O) emissions can be highly variable between farms. Better timing and placement of nitrogen fertilisers should result in less surplus nitrogen (N) accumulating in soil, lowering nitrogen leaching into water and loss to atmosphere. The magnitude of this benefit will depend on the amount of nitrogen fertiliser used on-farm.

When considering timing and placement, even at peak growth rates it can take 21 days to see full response, and in the shoulders this can extend out to 6 weeks. Use your growth rates as an indicator – fertiliser can be thought of as a multiplier, so applying when you have good growth gets a better return than when growth rates are low due to temperatures or soil moisture. Consider the time to achieve full response along with your round length. If you are on a 25 day round but growth rates are slow, you could be waiting 4-5 weeks for a full response.

Higher rates also increase the risk of loss via leaching if soil moisture exceeds saturation, or volatilisation if you do not receive sufficient rainfall/irrigation following application.

What action can I take?

- For cropping, apply nitrogen fertiliser at planting and split subsequent nitrogen fertiliser applications to target specific crop growth stages.
- For pasture, only apply nitrogen fertiliser when:
  - there is a genuine feed deficit;
  - nitrogen is the limiting nutrient;
  - there is sufficient soil moisture; or
  - the soil temperatures are above 6ºC and rising.
- Use weather forecasts to time application of nitrogen fertilisers prior to effective rainfall. Apply when it's raining or about to rain, or use at least 10mm of irrigation straight after application.
- Maintain and calibrate fertiliser spreading machinery in accordance with the manufacturer's operating manual.
- Use reputable or Spreadmark accredited contractors for spreading.
- Use digital GIS technology to record applications.
- Ensure farm maps are accurate and the correct amount of fertiliser for the area is ordered.
- Record fertiliser placements to get annual loading rates.
- Use available documentation to review fertiliser timing and placement annually.

Effluent as fertiliser

ACTION:

Use all captured effluent as a fertiliser, enabling reduced nitrogen fertiliser use

The timing of animal effluent application affects nitrogen utilisation. Targeting the application of effluent to when the crop is most efficient at absorbing nutrients can reduce the need to apply extra (synthetic) fertiliser, reducing the emissions of nitrous oxide (N_2O).

Additionally, the timing of effluent application has a big effect on the quantity of nitrogen (N) absorbed by the crop so can also help reduce environmental impacts such as leaching and evaporation.

Generally, crops have a low requirement for nitrogen in autumn. The later effluent is applied, the shorter the time plants have to utilise the nitrogen. This is because organic nitrogen needs to be mineralised before it can be utilised. A high utilisation rate of effluent in autumn can only be achieved if appropriately small amounts are applied.

More efficient off paddock capture of effluent and its safe return to land will reduce the risk of nitrogen (N), phosphorus (P), and *E. coli* entering into water.

What action can I take?

- Develop a plan to ensure that effluent applications coincide with high growth rates and lower soil moisture levels.
- Effluent storage facilities need to be sufficient to enable applications to be made when soil and growth conditions are optimal.
  Talk to your local Farm Source store about a solution for maintaining effluent in a liquid state for ease of spreading.
- Regularly monitor effluent composition and record location of effluent applications to minimise fertiliser applications on effluent blocks.
- Where a stand off pad or barn is used, capture the effluent and reuse this as fertiliser.
- Utilise effluent solids (stone trap/feed pad etc) as a fertiliser 6 weeks prior to crop planting.
- Look at your effluent area, can the area size be expanded?
- For further information and additional strategies on using effluent as fertiliser **– See Effluent storage page 35 for more information**

Did you know?

When animals are stood off pasture and effluent is captured, methane emissions are likely to increase if effluent is stored in anaerobic conditions.

Farm Source | Effluent Solutions
store.nzfarmsource.co.nz/partnerships/services/effluent-solutions

DairyNZ | Managing and Operating Effluent Systems
www.dairynz.co.nz/environment/on-farm-actions/effluent/managing-and-operating-effluent-systems/

Pasture and crop husbandry

ACTION:

Manage pasture and crop husbandry to optimise production

Achieving your farm's potential pasture growth is a priority. Good farming practices, such as maintaining optimal fertility and good soil structure, use of lime and efficient irrigation, will encourage use of soil nutrients and water infiltration. This can improve the response to applied fertiliser.

The degree to which these practices reduce emissions depends on whether total nitrogen fertiliser inputs can be reduced, production can be made more efficient or other inputs (such as imported feed) can be reduced.

With good grazing management you should maximise the amount of pasture you grow. Maximising this feed means reduced fertiliser and supplementary feed input is required, resulting in less nitrous oxide (N_2O) emissions.

What action can I take?

- Optimise fertility for the soil type, slope and climate.
- Monitor for pests and diseases regularly and address as appropriate.
- Optimise pasture growth and manage grazing rotations appropriately.
- Undertake regular visual soils assessments (VSAs).
- Ensure pugging and compaction are minimised during wet weather.
- Keep soils within optimum ranges as outlined in soil tests.
- Measure pasture quantity and quality regularly.
- If weeds are an issue, investigate changes to paddock preparation and the timing of regrassing.
- Review pasture performance and renewal programme.
- Know the difference between your highest yielding paddocks and the lowest.
- Talk to your local Technical Sales Representative (TSR). Topics for conversation may include: N efficient cultivars, climate, deficit periods and different areas of farm suited to different pasture species.

Additional information

DairyNZ have additional feed management information including seasonal management, production systems, supplements and crop and pasture types. You may also look at the FeedRight programme. FeedRight is a learning package of tools, resources and training for rural professionals and farmers who provide advice and/or make decisions on-farm.

DairyNZ | Feed
www.dairynz.co.nz/feed/

DairyNZ | Feed Management Tools
www.dairynz.co.nz/feed/feed-management-tools/

DairyNZ | FeedRight Tool
www.dairynz.co.nz/feed/nutrition/feedright/

Landcare Research | VSA Field Guide
www.landcareresearch.co.nz/publications/vsa-field-guide/

Irrigation

ACTION:

Consider the infrastructure and soils on your farm and how you can best match supply to any variation of soil and crop/pasture across the farm

Irrigation management not only plays a vital role in the overall pasture growth during the season, but also contributes to the efficient use of fertiliser. Moisture is required to transport fertiliser through to soil following application in order for it to be available for plant root uptake. If there is insufficient rainfall or irrigation after application then fertiliser nitrogen can 'volatilise', meaning it is lost to the atmosphere. This increases emissions from fertiliser, reducing the remaining amount of nitrogen available to the plant and the time available to see a pasture growth response before the next grazing. When used efficiently, irrigation can be very useful in areas where growth is limited by soil moisture.

What action can I take?

- Monitor weather forecasts so irrigation is used efficiently.
- Make sure your irrigation system is bucket tested, nozzles are fitted according to instructions and maintenance programmes are followed.
- Understand the variation of soils and their needs across your farm.
- Monitoring the current soil moisture (ideally separate measurements for different soil types and irrigation systems) allows you to maintain plant available water at optimum levels and adjust according to the forecast.
- See your local Farm Source store for information on flow meters and monitoring solutions to check how water systems are operating and to automate irrigation.

Examples

1. If there is no rain forecast and your soils do not have a large water holding capacity, you are likely to target a moisture level closer to field capacity. Whereas the same soil but with a large rainfall event forecast in two days may mean you allow soil moisture to drop a little which provides more room to absorb the rainfall without it causing soil drainage.
2. Where irrigation infrastructure allows, and the fertiliser truck is due to arrive, is there ability to make sure that you do not water the paddock until after the fertiliser is applied? Small changes like this could have a large impact on the overall response to fertiliser and total yield achieved.

Emissions from urine

ACTION:

Reduce nitrous oxide (N_2O) emissions from urine

Cows eat pasture or crops that are rich in nitrogen (N) for the majority of the year. Nitrogen is a component of amino acids which are the building blocks of all proteins. However, cows only use a fraction of this protein to support their growth and productivity. This results in excessive nitrogen passing through the cow and out in urine and dung, which creates very concentrated patches of nitrogen in the soil.

Urine patches can contain the equivalent of up to 1000 kg N per hectare making them a major source of nitrous oxide (N_2O) losses from grazed pastures. These losses are increased under wet conditions when soils become anaerobic (which promotes the production of nitrous oxide).

Dietary protein balance

Although it is important that the energy concentration of the diet is kept constant, feeding more protein than required is inefficient. When introducing feeds other than pasture, it is important to know both the energy content (ME) and protein content so energy is kept constant and excess protein is minimised.

Maize silage has a beneficial impact on nitrous oxide emissions due to its lower nitrogen concentration than pasture. Its lower energy content means a slight increase in dry matter consumed and therefore methane (CH_4) emissions.

Plantain works at two levels. At the cow level, a diet including at least 30% plantain results in less nitrogen excreted and a more dilute urine, reducing the nitrogen load at a urine patch level. It also works in the soil to reduce the level of nitrous oxide produced.

Nitrification inhibitor systems are available that use targeted application of fertiliser and nitrous oxide inhibitors at a patch level to minimise leaching and nitrous oxide emissions.

What action can I take?

- Know the protein content and metabolisable energy (ME) of the diet.
- Talk to your Technical Sales Representative (TSR) about plantain and ways in which it could be incorporated into your farming system.
- If plantain is sown, check the current proportion in the sward using the DairyNZ Plantain Assessment tool using the link below.

Additional Information

DairyNZ | Plantain Assessment
www.dairynz.co.nz/feed/crops/plantain/assessing-plantain-on-farm/

DairyNZ | Benefits of Plantain
www.dairynz.co.nz/feed/crops/plantain/environmental-benefits-of-plantain/

Animal Efficiency

An overview

Improving your animal efficiency can benefit your farm profitability, animal wellbeing, and the wellbeing of the planet.

One of the key drivers of emissions intensity is the amount of dry matter (DM) our cattle eat to produce each kilogram of milksolids – this reflects the amount of methane (CH_4) produced from each kgDM of feed consumed. This is influenced by production per kg liveweight, the quality and energy density of feed and the amount of wastage in the system.

Production per kilogram of liveweight

Cows need a certain amount of feed to support maintenance and growth requirements, then extra feed on top of that to produce milk.

For a cow to produce more milk she needs to eat more, therefore her absolute emissions will increase (she will produce more methane in total). However her maintenance requirement will stay the same. This means the methane produced from the maintenance feed is spread across more milk so the emissions intensity reduces (she produces less methane per kgMS). By selecting more efficient cows you also minimise the potential for increasing total emissions on-farm. This enables you to get maximum milk production for the lowest emissions.

Feed quality and energy density

The amount of methane produced is broadly dependent on the weight of dry matter consumed. This means cows consuming a poor quality feed will produce more methane to get the same amount of energy (and milk). Improving the quality of pasture or supplementary feed, or balancing nutrition to improve feed conversion, will reduce the amount of methane produced per kgMS produced.

Wastage

Wasted milk – cows that are sick will produce less milk and will also have their milk discarded while undergoing treatment. Diseases such as BVD and Facial Eczema can cause sub-clinical production loss without any obvious signs of illness in the herd. Loss of milk production through the impact of disease or the discarding of milk increases emissions per kgMS.

Culling or cow loss – similarly, a higher number of deaths or culls increases the number of animals needed for replacements and their associated emissions. Improving animal health and reproductive performance will consequently improve emissions intensity.

This section of the document will provide you with important information and initial steps that you can take on-farm to improve your farm's animal efficiency. You should focus on those actions in your Farm Environment Plan which will reduce the footprint of your farm and review your Farm Insights Report to see how your farm compares to your benchmark group for efficiency.

Nutrition

ACTION:

Increase feed efficiency

Type and quality of nutrition affects emissions in three ways:

1. Higher energy (MJME/kgDM) reduces the dry matter of feed required for maintenance and production, reducing the methane produced per kgMS.
2. Reducing excess protein, and balancing the diet to support efficient digestion of protein, can improve production and reduce nitrous oxide emissions. **See Emissions from urine page 26 for more information.**
3. Shifting to farm grown feeds or by-products in place of off-shore sourced feeds (such as PKE or soya meal) reduces embedded emissions. **See Imported feed page 36 for more information on embedded emissions.**

What action can I take?

- Do a feed budget.
- Monitor the Body Condition Score (BCS) of your herd and adjust feed intakes to match targets.
- Get a plate meter to measure pasture covers and inform your planning.
- Understand optimal round length on your farm through discussion with your consultant.
- Talk to your Technical Agronomy Specialist (TAS), farm consultant, or nutritionist about feeding and nutrition.

Nutrition

When feed management decisions are being made, it is important to consider the composition and characteristics of different feeds, and the implications of including them into the farm system. Maximising quality and feeding to generate efficient per cow production will improve your farm's carbon footprint.

Pasture quality

The ability to grow and harvest quality pasture for dairy cows is the main driver of profitability for the farm business. Every additional tonne of pasture harvested per hectare can be worth up to $300/ha increase in profit on-farm[1].

Regular assessment of farm pasture covers combined with the appropriate planning and management tools for the season (e.g. feed wedge, spring rotation planner or autumn planner) provides vital information for making feed decisions. Improving pasture yield or quality also allows us to reduce imported supplements. **– see Pasture and crop husbandry page 24 for more information.**

Supplement quality

Some supplementary feeds ferment differently in the rumen and reduce methane (CH_4) per unit of feed intake, while others have a lower nitrogen (N) concentration meaning less nitrogen is excreted onto pastures and nitrous oxide (N_2O) emissions are reduced. Supplement quality can vary and may not provide the benefits you're expecting. When choosing supplementary feeds, consider the amount of MJME/kg DM that the feed is providing to the overall diet. Feed testing can tell you more about the quality of your supplement (including energy and nitrogen concentrations) in case the allowance needs adjusting. **– see Imported feed page 36 for more information.**

[1] Dairybase via DairyNZ, *https://www.dairynz.co.nz/feed/pasture/*

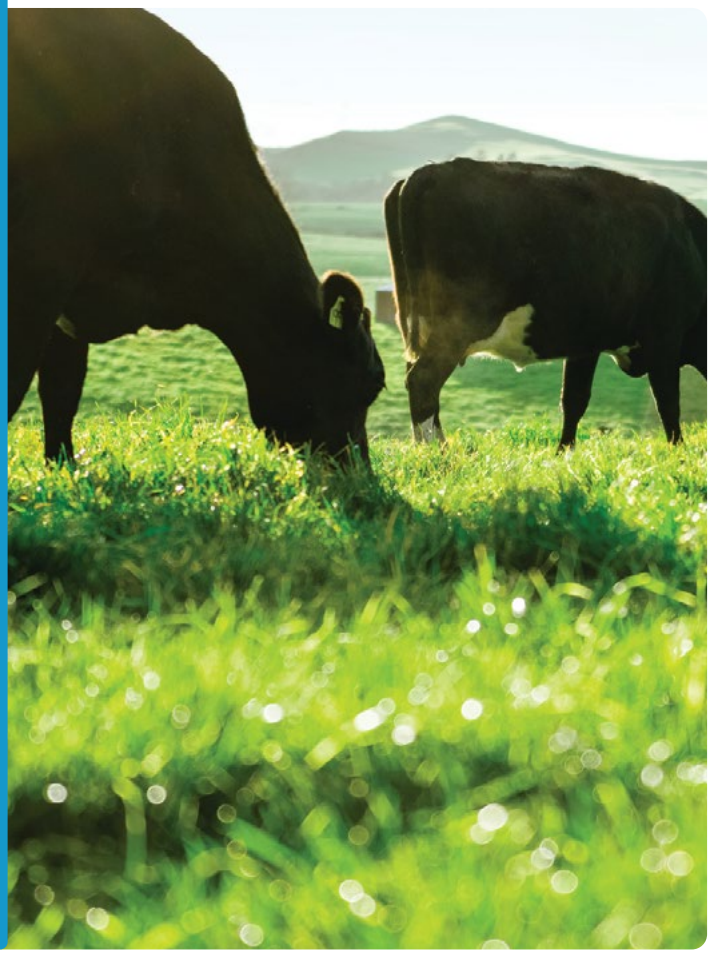
Health

ACTION:

Identify opportunities to improve animal health

Animal health is key to producing the best milk quality and quantity from the cows in the herd. The better the animal health in the dairy herd, the better the chance the cows can maximise their milk production and be as efficient as possible.

Overall animal health performance will also have an effect on your herd's emissions intensity. Lameness, metabolic disease, trace element deficiencies, and infectious diseases such as BVD and Johnes Disease, can all reduce the productive and reproductive performance of your herd, reducing the volume of milk produced and increasing wastage.



What action can I take?

- Prevention is better than cure. Consult with your vet or Regional Food Safety & Assurance Manager (RFSAM) to get information on how to prevent common animal health issues.
- Complete your Animal Wellbeing Plan and identify issues for animal wellbeing early.
- Use ZincCheck to ensure your herd has the best protection before the Facial Eczema season starts.
- Order a bulk milk BVD antibody test.
- Use DairyNZ tools to identify issues and manage cow health. Tools include:
  - Healthy hoof app
  - Lameness field guide
  - Lameness scoring poster
  - Johne's Disease management guide
- Consider utilising available cow monitoring technologies for early detection of health issues.

Additional Information

See the Mastitis (page 30) and Environmental Stress (page 31) pages for more information

DairyNZ | Cow Health
www.dairynz.co.nz/animal/cow-health/

DairyNZ | Lameness Tools
www.dairynz.co.nz/animal/cow-health/lameness/

Mastitis

ACTION:

Identify opportunities to minimise mastitis and somatic cell counts (SCC)

Mastitis is a key cause of wastage on a dairy farm. Reduced production, discarded milk and impact on reproduction all increase the emissions per kgMS by reducing the amount of milk supplied to the factory. It is also painful for the infected animal and takes time and money to treat. Additionally, reducing cases that require treatment will reduce the risk of development of antibiotic resistant bacteria.

Example

Research shows that cows with subclinical mastitis have decreased milk production. For the average sized farm of 440 cows producing 169,400 kgMS with a SCC of 172,000, reducing their SCC to 100,000 would result in an increase in milk production by 1.6%, or an additional 2,742 kgMS, and a drop in emissions intensity of 0.5%.

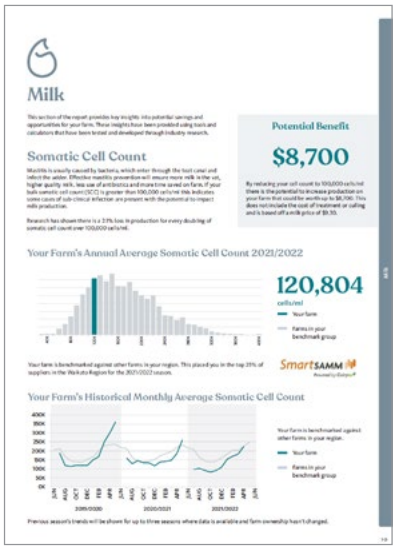
If the milk production gains provided the farmer with the ability to reduce their stocking rate slightly while maintaining milk production, then both absolute emissions and emissions intensity can be reduced.

What action can I take?

- Use the SmartSAMM Gap Calculator to work out the economic benefit of achieving your goals.
- Use the DairyNZ Healthy Udder guide for quick tips and the right procedures to prevent, find and treat mastitis.
- Prevention is better than cure – consult with your vet or Regional Food Safety & Assurance Manager (RFSAM) to get information on how to prevent mastitis and other common animal health issues.

Working together

Your Farm Insights Report highlights the financial cost of clinical mastitis cases and tracks the milk production losses due to SCC in the last season. Milk production losses also affect the footprint of the milk from your farm.



Additional Information

SmartSAMM | Gap calculator
www.dairynz.co.nz/animal/cow-health/mastitis/tools-and-resources/about-smartsamm/

DairyNZ | Healthy Udder Guide
www.dairynz.co.nz/publications/animal/healthy-udder-guide/

Environmental stress

ACTION:

Mitigate environmental stress

Environmental stress can impact animal wellbeing and milk production as voluntary feed intake can drop, while energy demands to cope with increased or very low temperatures increase. This can result in decreased milk production and quality which then increases the emissions intensity of the milk.

Heat

Cows begin to experience heat stress at much lower temperatures than humans and prefer temperatures below 20°C. All areas of New Zealand get hot enough to cause heat stress during summer.

Cold

Cold stress is rare until ambient temperatures fall below -10°C, except in wet and windy conditions. Depending on the health and the Body Condition Score of the herd, and the weather situation, wet and windy conditions require an additional intake of 0.5 – 3 kg DM/cow/day.

Drought

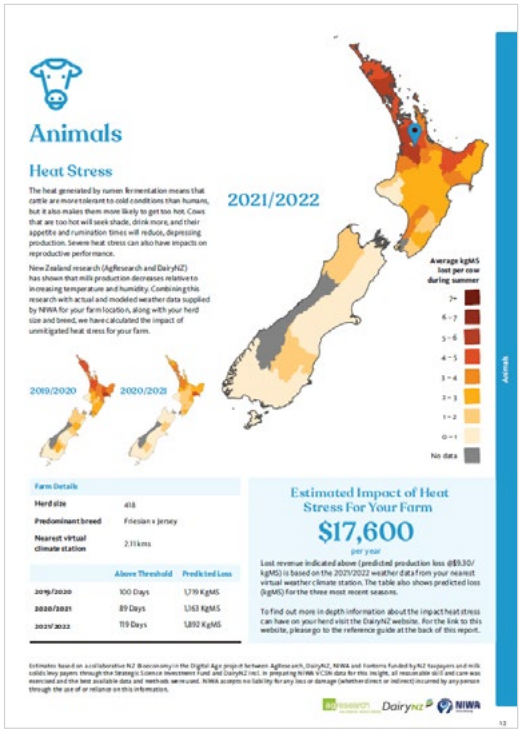
The risks to animal wellbeing for drought are similar to that of heat stress but with the added complexity of reduced feed availability on-farm.

Working together

The Animals section in your Farm Insights Report provides you with your farm's heat stress risk. Understanding the potential impact of heat stress on your farm, and developing strategies to manage this will improve efficiency on your farm.

What action can I take?

- Review your Farm Insights Report - have opportunities for your farm been identified?
- Discuss with your vet ways to combat heat stress and make sure that it is included in your Animal Wellbeing Plan.
- Have a wet weather contingency plan.
- Have a drought management plan.
- Make sure cows have access to shade and plenty of drinking water.
- Changes to milking and feeding routine can help when shade isn't enough. Consider using animal shelters that provide shade during the day, and in paddocks over night when it is cooler.
- Cooling with water can help combat heat stress, consider misters in the shed or sprinklers in the holding yard.
- Consider strategically placing crops which would reduce walking times to combat heat stress.



Genetics

ACTION:

Know the breeding worth of individual cows in your herd

Animals with a high Breeding Worth (BW) are more environmentally efficient than lower genetic merit animals as they partition more of their consumed feed into milksolids production and less into waste. This results in reduced nitrogen (N) in urine and faeces as more is used for milk protein production. Additionally, by converting more of the feed into milk, the amount of methane (CH_4) produced per kgMS is also decreased.

Reproduction

Genetics play a role in a cow's reproductive performance, for the animal itself and the sire that she is mated to. New Zealand's seasonal dairy farming system entails a condensed calving pattern with cows required to conceive within 12 weeks from calving on average. This has resulted in strong selection for fertility through culling of non-pregnant cows and relatively strong emphasis on fertility in BW, the national breeding objective that drives sire selection.

Environment

Genetic solutions are also being researched for breeding lower methane emitting cows, cows that are more heat tolerant, and cows with general health, wellbeing and productivity traits. All of which will lower the emissions produced per kgMS.

What action can I take?

- Herd test to know which cows are performing well and which ones aren't.
- Weigh your cows at least once a year as that information together with the herd test provides an efficiency metric on an individual cow basis (kg milksolids per kg liveweight). Weigh cows:
  - After morning milking.
  - Between 100-200 days in milk.
- Develop a breeding plan and track the BW of your herd over time.
- Use sexed semen to improve the number of replacements from your superior cows.
- Breed cows of low genetic worth with beef sires.

Reproduction

ACTION:

Improve herd reproduction performance

Improving reproductive performance can make a sizeable impact on your emissions.

There is no simple recipe for achieving good reproductive performance. Every farm is different and will require its own reproduction management plan. The aim of a reproduction management plan is to maximise the rate at which the cows in your herd get in-calf.

6 week in-calf rate

This is the percentage of your herd that gets in-calf during the first six weeks of mating. The industry target for 6-week in-calf rate on New Zealand dairy farms is 78%. The more cows in-calf early, the fewer cows will be empty at the end of mating. Lift the reproductive performance of your herd and raise your 6-week in-calf rate by getting your cows in-calf early. Improvement in 6-week in-calf rate can give more days in milk as this longer lactation increases per cow production. This also reduces the greenhouse gas intensity per kgMS.

Replacement Rate

Replacement rates contribute to a farm's carbon footprint as heifers produce emissions while they grow. All of these emissions are produced before she has her own calf and starts lactating. Having a lower replacement rate also maintains an age structure that improves per cow production thereby lowering the emissions intensity of the milk they produce.

Culling

Measuring cow performance shows you who your best and worst cows are. Having this information helps you to decide which cows you should keep replacement heifers from, and which you should cull. Getting culls off farm earlier may help to reduce your farm's footprint as you are no longer having to feed these cows. This feed can then be better utilised by the remaining and more efficient producing cows.

What action can I take?

- Get a Fertility Focus report and read it with your breeding company rep, vet or in-calf advisor.
- Have a go at the DairyNZ and LIC gap calculators to see what savings could be made with improved reproduction.
- Remove culls or empties from your herd as soon as possible.
- Talk to your breeding company rep about improving your fertility Breeding Value (BV).

InCalf Fertility Focus Report

The InCalf Fertility Focus Report is a DairyNZ report designed to assess herd reproductive performance.

This report uses existing herd data to calculate and present the most important measures of herd reproductive performance, in a standard format. It then compares your herd's performance against industry targets.

The Fertility Focus Report for your herd can be detailed, intermediate or basic depending on the quality and number of records you have recorded on the database. You should be able to produce reports for up to three years to monitor performance over successive seasons.

Additional Information

LIC | Gap Calculator
www.lic.co.nz/support-and-advice/reproduction/get-your-cows-calf-early-get-ahead/

DairyNZ | Reproduction and Mating
www.dairynz.co.nz/animal/reproduction-and-mating/

Other Emissions

An overview

The following section discusses sources of emissions not related to animal efficiencies or nutrient optimisation. This includes the impact of effluent storage, the embedded emissions in farm inputs, and the energy related emissions from electricity and fuel use. Many of these categories are smaller contributors to the farm footprint but collectively they contribute more than 20% of the emissions attributed to production on an average farm and a lot higher on some farms.

Effluent storage

Methane emissions from effluent storage ponds is the second largest source of methane emissions on the farm. While the amount of methane released from ponds is a lot less than that released from the cow as enteric methane, there are a number of effective options to reduce its production. From implementing new technologies and management practices to improving infrastructure and optimising pond design.

Emissions generated in manufacturing farm inputs

These are the 'Scope 3' emissions for your farm. They are the emissions that are generated in producing the farm inputs that we purchase and import on to farm and are also known as embedded emissions. This includes all agrichemicals and refrigerants, but the main two categories of inputs are fertilisers and feed. The manufacture of fertilisers can create a high level of emissions especially those that are derived from fossil fuels such as urea.

The embedded emissions in feed include the greenhouse gases associated with farming the products (fertilisers, fuel etc), and also the impacts that this farming has (deforestation and the cultivation of peat soils). On top of the emissions created during production, there are further emissions considered in transport of the products on to farm, especially when these products are sourced offshore.

Fuel use

The use of fuel is a contributor to the carbon footprint on a New Zealand dairy farm with fuel use for transport and farm machinery contributing about 2% of the farm's footprint. There are emissions related to the production and transport of the fuel on to farm but also from the release of carbon dioxide into the atmosphere when the fuel combusts.

Electricity use

Emissions are created in generating and using electricity. While a large proportion of electricity used on-farm for operating the shed, fences and irrigation is generated from renewable sources (mainly hydroelectric), there is still a proportion that is needed to be generated using fossil fuels (coal or gas). This proportion of renewable energy varies from year to year and so the contribution to the farms footprint from electricity varies also. While electricity use is a relatively small part of the farm's footprint, it is one that we have solutions available to either reduce use or shift to renewable production. The good thing is that many of these solutions have the co-benefit of saving money!

Effluent storage

ACTION:

Reduce methane (CH_4) from effluent storage

Storing effluent enables you to recycle nutrients back to the farm and minimise fertiliser costs and inputs. However, while the manure is in storage, it produces and emits methane (CH_4). The amount of methane produced depends on the time the effluent is stored in anaerobic (without oxygen) conditions and the ambient temperature. Separating the solids prevents them from entering anaerobic storage ponds. Effluent emissions increase as more effluent is captured from off-pasture infrastructure.

Alternative effluent systems

There are systems available that limit the methane entering the atmosphere. Methane from ponds can be captured and either destroyed by flaring or used as an energy source.

Alternatively, effluent can be treated with polyferric sulphate to reduce the amount of methane produced. Co-benefits include reduced phosphorus (P) solubility which minimises reactive phosphorus losses once the effluent is applied to the land and a reduced *E.coli* load. Utilise commercially available infrastructure and systems so that the polyferric sulphate is mixed effectively.

What action can I take?

- Actively manage the effluent pond to its lowest level and regularly remove and apply any solids to pasture – particularly in the warmer months when the methane (CH_4) production potential is higher.
- Ensure applications are at agronomically sensible rates and time applications to avoid high soil moisture and minimise nitrous oxide emissions from effluent applications.
- Take a look at the DairyNZ guidance for dairy effluent management.

Additional Information

DairyNZ | Energy Capture Systems
www.dairynz.co.nz/media/2546503/energy-capture-systems-effluent-tech-note.pdf

DairyNZ | Effluent Management
www.dairynz.co.nz/environment/on-farm-actions/effluent/

Imported feed

ACTION:

Understand the full implications of supplement use

Each feed type has a different feed value, cost and emissions footprint associated with it. Using the life cycle assessment approach, the embedded emissions associated with each feed type can be calculated. Embedded emissions are the emissions associated with growing, producing, processing, harvesting, and transporting the feed.

Emission levels in dairy cattle are affected by the feed eaten, including type, quantity and quality, and nitrogen fertilisers used on pasture and crops. Farmers can utilise these factors to help reduce emissions intensity. Importing feed to your farm system will increase emissions, so if you can grow and eat more homegrown feed you can:

- Reduce the requirement for imported supplement;
- Reduce costs; and
- Reduce total emissions due to the embedded emissions of supplement feed (e.g. from transport, cultivation, processing etc).

Adjust stocking rate (feed demand) to increase home grown feed and reduce bought-in feed. Supplements should be used tactically to address a true feed deficit or feed imbalance.

Additional Information

When considering a change in supplementary feed, it may be helpful to check what is considered farm grown feed for The Co-operative Difference metric **– see the Factsheet for more information.**

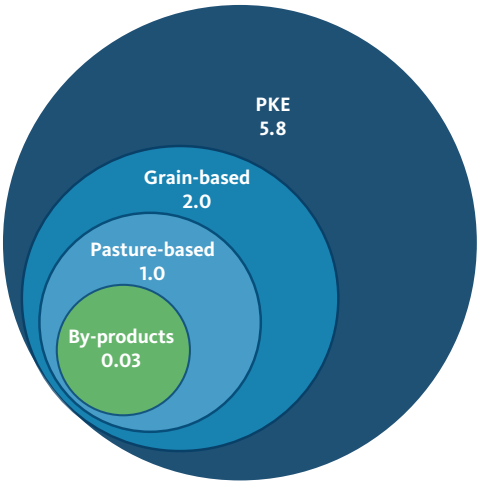
The Co-operative Difference | Farm Grown Feed
www.fonterra.com/content/dam/fonterra-public-website/fonterra-new-zealand/campaign-images/codof/docs/co-operative-difference-farm-grown-fact-sheet.pdf

[1]DairyNZ | Common Feed Supplements
www.dairynz.co.nz/feed/supplements/common-feed-supplements/

What action can I take?

- Maximise your pasture utilisation and strategically use supplements to fill nutritional deficits.
- Use low nitrogen content supplementary feeds as much as practicable. Talk to your local TSR for more advice specific to your farm system.
- Minimise wastage of feeds. For example, PKE wastage rates when fed in bins is 10-20%, compared with 30% and above when fed out in the paddock[1]. PKE blends with molasses also produce less dust and wastage.
- Don't forget about the milk response to supplements and how this can change over the year and in response to the quality of the pasture.

By-products (apples, kiwifruit,etc) have an emissions factor (CO_2e per kg DM) that is 0.03 of the emissions factor of pasture-based feeds such as lucerne or pasture silage. Whereas grains and pellets produce double the amount of emissions when compared with pasture-based feeds. PKE has the highest emission factor – 5.8 times the emissions of pasture silage. This is predominantly due to where it is grown and how it is processed and transported to New Zealand.



Energy and Fuel

ACTION:

Minimise the electricity and fuel use on your farm

The use of fuel and electricity both contribute to the emissions on your farm. In the shed, small actions such as doing routine maintenance and reducing fossil fuel use by minimising machinery usage can all have a big impact.

Start by getting efficient with your total farm energy use, then start thinking about investing in renewable energy production, or the selection of more efficient or electric machinery.

Reducing electricity and fuel consumption will reduce the cost of these utilities and will have a greater benefit in the long-term. Fuel prices include a carbon tax of 18.1c per litre of petrol and 20c per litre of diesel[1] – both of these have risen 5c over the last 12 months alone as of March 2023.

[1] MTA, Guide to Fuel Prices, *mta.org.nz/motorists/guide-to-fuel-prices*

What action can I take?

- Find out if the Farm Source partnerships with either Genesis or Meridian may benefit you and your farm.
- Prioritise routine maintenance.
- Get your plate cooler and refrigeration system serviced.
- If thinking about a refrigeration system upgrade, consult with your Sustainable Dairying Advisor. *Consider if the Farm Source partnership with energy efficient Coolsense is right for your farm.*
- Ensure correct tyre pressures for better fuel consumption on vehicles.
- Adopt minimum tillage cultivation techniques.
- When replacement is needed, consider a more efficient pump motor for the irrigation and stock water system.
- Consider if there is any unnecessary power and/or other energy being used in the in the production system (a walk-through with an energy consultant may help).
- Have a consult with a rural solar or wind energy expert.
- Invest in renewable energy – you may be eligible for sustainability linked loans to assist with this.
- Invest in electric farm vehicles to reduce fuel consumption on-farm.
- Consider if your milking schedule is working for your farm. Milking schedules such as once a day, 10 in 7, or 3 in 2 reduce energy consumption on-farm.

Additional Information

Coolsense | Farm Source Partner
www.coolsense.co.nz/landing-page-for-farmsource/

Genesis | Farm Source Partner
www.genesisenergy.co.nz/for-business/business-types/farm-and-dairy/fonterra-farmsource

Meridian | Farm Source Partner
www.meridianenergy.co.nz/agribusiness/rural-supplier-offers/farmsource

DairyNZ | Milking Efficiency
www.dairynz.co.nz/milking/milking-efficiently/

Plant retired or unproductive land

ACTION:

Capture and store carbon in vegetation

The way in which we manage our land is an important consideration when it comes to reducing emissions. There are many benefits from planting trees or protecting existing plants on-farm. It can improve erosion control, waterway nutrient levels and biodiversity, while providing shade and shelter. As the shrubs and trees grow, they also capture and store carbon dioxide (sequestration). While there are many benefits to plantings, having the right plant planted in the right place, for the right purpose, is important.

Riparian planting

Planting indigenous (native) plants in riparian areas reduces nutrient run-off into the water, improving water quality. Once established, indigenous plantings minimise weed management and reduce erosion. Larger species can also be planted on the border of the riparian buffer to provide shade for stock in warmer months.

Marginal areas

Planting trees on marginal land (such as slopes or gullies) can boost carbon storage while having a minimal effect on pasture availability. Planting out marginal areas can provide shade and shelter for stock as well as protect the land from erosion.

How does carbon sequestration impact on my farm's GHG intensity?

Carbon removals (sequestration) can be set against the emissions created on-farm, resulting in lower net emissions. When divided across the total pool of milksolids produced, this gives a net emissions intensity that takes into account the carbon removed.

Is my planted area eligible for carbon credits or offsets?

In New Zealand, we have both regulated and voluntary carbon trading markets that eligible land can be registered with to earn carbon credits. Carbon credits are allocated for every year an eligible and registered forest sequesters carbon from the atmosphere. These carbon credits can then be sold to others who want to offset their carbon emissions.

The NZ Emissions Trading Scheme

Trees are eligible for the NZ Emissions Trading Scheme (ETS) if the land has changed from 'non-forest' to 'forest land' since 1st January 1990. The planted area also needs to:

- Have a minimum area of 1 hectare;
- Requires a minimum average width of 30 metres;
- Have a minimum canopy cover of at least 30% per hectare; and
- Trees must have the potential to reach over 5 metres in height.

Orchards/fruit and nut trees are not able to be entered into the ETS.

Other voluntary carbon markets

In addition to the ETS, there are other voluntary carbon markets, many with a native forest focus, which your forest land may be eligible for if it is not eligible for the ETS. These markets have their own conditions and registration processes to create certified carbon credits.

Plant retired or unproductive land cont.

Emissions levy rebates

The NZ Government's plan is for sequestration from on-farm vegetation to be recognised as part of the farm-level pricing system in 2025. However, the categories of plantings that will be eligible are still under discussion. The Government is committed to recognising the annual sequestration from:

- Land that is wholly or predominantly in indigenous woody vegetation, either planted, regenerated or a combination.
- Riparian margins: this includes vegetation planted after 2008 alongside a waterway of a minimum size that includes a predominant mix of woody vegetation.

Other categories of plantings have also been earmarked for investigation including native forests, riparian areas planted before 2008, perennial cropland, scattered forest, shelter belts and woodlots. Until the Government confirms its position, the ability to reduce the emissions levy through these planting categories is unknown.

Additionally, planted areas that are entered into the ETS or other voluntary carbon markets will likely not be eligible for levy rebates, and will not be counted towards reducing a farm's on-farm emissions footprint.

This is to stop the benefit of planted areas being double counted.

What action can I take?

Consider increasing woody vegetation on your farm through:

- Converting land that is less productive into indigenous vegetation or exotic forest.
- Establishing wetland forests in less productive wet areas within the farm system.
- Planting riparian setbacks. Some regional councils provide advice, support and funding for riparian plantings. Visit your regional council website for more information.

If considering planting on your farm - consult with our Farm Source partner Wildlands to see if they can help you get the right plants planted in the right place, for the right purpose.

Working together

Different vegetation types sequester different amounts of carbon. The Environment section of your Farm Insights Report provides some broad information on types of plantings and how much carbon they can sequester. Alternatively click the AgMatters clink below for more information.

Additional Information

Wildlands | Plant for Good
www.wildlands.co.nz/services/plant-for-good/

MPI | Different kinds of forest land and the ETS
www.mpi.govt.nz/forestry/forestry-in-the-emissions-trading-scheme/about-forestry-in-the-emissions-trading-scheme/different-kinds-of-forest-land-in-the-ets/

He Waka Eke Noa | FAQs
www.hewakaekenoa.nz/faqs/

AgMatters | Planting trees
www.agmatters.nz/actions/planting-trees/

Frequently Asked Questions

Below are some questions and answers on topics raised during our farmer engagement sessions:

Q. What does Fonterra's on-farm emissions footprint include?

Our approach to measuring an on-farm emissions footprint accounts for emissions produced on the dairy platform, including the production of farm inputs, and also includes some activities on support land that relate to the milking herd. Accounting for wintering and replacement rearing practices provides a fuller picture of emissions from the production of milk. Another important part is the embedded emissions, or the emissions that are brought on to the farm through the production of fertiliser, imported feed, fuel and electricity.

In addition to on-farm activities, Fonterra's footprint also includes emissions from land use and land use change. Land use covers two main areas – the farming on peat soils in our supply chain, as drained peat emits greenhouse gases and, to a larger scale, deforestation that has occurred in the last 20 years.

What we measure

Methane (Enteric, Effluent, Dung)
Nitrous oxide (Urine, Dung, Fertiliser, Soil)

BIOLOGICAL

Brought in feed
Fuels
Electricity use
Fertiliser production
Agrichemical production

NON-BIOLOGICAL

Q. How is the short-lived nature of methane gas considered compared to other greenhouse gases?

More than half of our on-farm footprint is due to biogenic methane, a 'short-lived' greenhouse gas. Despite being short lived, methane has a much stronger warming effect per unit of mass than carbon dioxide.

The short-lived nature of methane is recognised in New Zealand's split-gas approach to agricultural emissions but, because this effect is so potent and the impact of change in production of methane has a quicker impact than the long-lived gases, it is important to be reducing methane as well as getting the long-lived gases to net zero in order to have a chance at limiting warming and climate impacts.

Q. To what extent are innovations and technologies in the future likely to help the Co-op and its farmers address the emission reductions required to meet targets?

We're investing in our own research and development as well as partnering with others to try and find breakthroughs that will further support farmers (**see more on page 14**). However, it is widely accepted that it is unlikely for there to be one silver bullet solution for all farmers.

Although we are investing heavily into research & development, we must address emission reduction in every area we can to have the best chance at reducing our impact and achieving targets. This requires every area of our Co-op to do their part, from on-farm, to manufacturing, to R&D of GHG mitigation technologies.

Notwithstanding these potential technological advancements, there are still significant opportunities to reduce emissions from the use of currently available good farming practices, which we are working to support farmers with (**see more on pages 16-17**).

Support and Next Steps

Check out the additional resources listed in the Reference Guide. These cover a broad range of sources for more technical information and are respected industry sources. If you have questions specific to your farm, please reach out to your local Farm Source team. You can also call the Service Centre on **0800 65 65 68**

Q. What would likely happen if Fonterra did not set emission reduction targets?

By choosing to not commit to an on-farm emissions reduction pathway, Fonterra would be resisting the external pressures, demands and requests from key stakeholders and negatively impacting these commercial relationships (**see more on pages 9-12**).

It would create reputational damage risk due to the perceived resistance to change, signalling a lack of contribution to national and international climate change responses. A lack of action would also put existing value at risk, particularly if our global competitors improve on an efficiency basis. We see competition as not only coming from other dairy processors but potentially also dairy alternatives.

Q. Is there a possibility for Fonterra to only sell product to customers who do not have emission reduction requirements?

We have made a strategic choice to be a leader in sustainability, alongside our other choices to be a leader in dairy science and innovation, and to focus on New Zealand milk. These choices are interdependent and work together to shift our product offerings to a place of higher value while creating long-term resilience in the Co-op.

It is expected that sustainability focused customers will continue to grow into the future, with 30% of our business-to-business gross margin coming from these customers in 2030. Restricting ourselves to sales outside of these customers will likely impact our ability to obtain the highest value for our farmers' milk.

There are also other limits to where we can sell milk. We estimate that Fonterra currently has access to around 12% of global dairy consumption at tariffs of less than 10% and where we don't face a significant non-tariff barrier.

For the above reasons, we think choosing to only sell product to customers who do not have emission reduction requirements would not result in good outcomes for us. Even if we did, emission reductions would still be required by financial institutions and regulators.

Technical Information and Glossary

Term	Meaning
Carbon Sequestration	Carbon sequestration includes the carbon stored or sequestered by plantings from the atmosphere. We are looking to add carbon sequestration to our footprint reporting in future that may support some farms in an increasingly accurate calculation of their on-farm footprint. This requires measurement of planted areas on-farm and estimations of carbon stored through the various plant species and mixes. The increasing interest and investment in this area will provide New Zealand specific values for carbon sequestration – an area previously lacking in scientific evidence and accuracy.
Global Warming Potential (GWP) 100	GWP provides a common unit of measure of a greenhouse gas and its ability to trap extra heat in the atmosphere over time relative to carbon dioxide. The period of time is generally 100 years – hence GWP 100. For example, methane has a GWP of 27.2 in the IPCC 6th Assessment Report.
GWP*	GWP* is a new emissions accounting method that attempts to account for methane warming in a different way based upon changes of historic levels of emissions. GWP* is a very effective measure for understanding methane relative contribution of warming at a global level, but it does not translate well into understanding the impact at a country, co-operative, product or farm level. Due to its evolving status, GWP* does not yet have any formal recognition from certification bodies, trading blocks and customers. Regardless of the accounting method we adopt, the expectations are that we will reduce emissions.
Hydroxyl Radicals	A hydroxyl radical, a hydrogen atom bonded to an oxygen atom (OH), is extremely reactive – it can steal hydrogen atoms from other molecules to form water. Hydroxyls are found in our atmosphere and in the past, the concentrations have kept methane in check by reacting away the dangerous GHG within a decade. The hydroxyl radical reacts with methane (CH_4) by stealing a hydrogen molecule to create H_2O and CH_3, a methyl radical (not a GHG). There are some theories that methane rise is due to hydroxyl decreases. This is still a topic of debate between scientists, however, the increasing concentrations of methane are becoming more and more dangerous therefore any reduction in methane emissions will be beneficial. Especially if we can do so while improving efficiency on-farm.

Technical information and Glossary cont.

Term	Meaning
Land Use Change (LUC)	International guidance for Land Use Change (LUC) accounting involves the use of a 'responsibility window', which marks the period of time where the responsibility for losses of carbon that have happened in the past are accounted through the supply chain. This is recommended to be 20 years, therefore if land was converted from forestry into grazing in 2005, 5% of the carbon losses are attributed each year from 2005 until 2025. At this point, the carbon losses are fully accounted for.
Pasture Carbon	As mentioned above with carbon sequestration, pasture removes carbon from the atmosphere in the form of carbon dioxide as it grows. However, we do not count pasture carbon in our on-farm footprint. When pasture is harvested or eaten the carbon is released back into the atmosphere through respiration or decomposition. The carbon stored in grass is released every few weeks and so does not accumulate – on-farm this is reflected in the fact that the opening and closing pasture covers are generally similar each season with no net gain of biomass or carbon. At the end of its life cycle, methane breaks down into carbon dioxide and water vapour. This volume of carbon dioxide is broadly similar to the assumed volume of carbon that is stored by pasture via photosynthesis. This means that from an accounting perspective, the carbon added to the atmosphere from methane degradation and the amount of carbon removed from the atmosphere from pasture photosynthesis is broadly in equilibrium.
Soil Carbon	Soils store various levels of carbon that is not counted in our emissions footprint, excluding peat soil. While there is work to be done to understand what management changes could improve soil carbon, it is considered that most of our New Zealand soils are, at best, at steady state with relatively high levels of carbon – which is a good place to be. It will be as important to focus on reducing loss of carbon from these soils as trying to increase carbon stocks. There is also uncertainty about how soil carbon should be fairly accounted, especially during droughts, floods, or cultivation when soil carbon is lost.

Reference Guide

Dairy Diary App
Android
pg. 18

DairyNZ
Reducing Nitrogen Fertiliser Use
pg. 20

He Waka Eke Noa
Farm Planning Guidance
pg. 21

DairyNZ
Managing Nitrogen Fertiliser
pg. 21

Farm Source
Effluent Solutions
pg. 23

DairyNZ
Managing and Operating Effluent Systems
pg. 23

DairyNZ
Feed
pg. 24

DairyNZ
Feed Management Tools
pg. 24

DairyNZ
FeedRight Tool
pg. 24

Landcare Research
VSA Field Guide
pg. 24

DairyNZ
Plantain Assessment
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DairyNZ
Benefits of Plantain
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DairyNZ
Pasture
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DairyNZ
Cow Health
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DairyNZ
Lameness Tools
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SmartSAMM
Gap Calculator
pg. 30

DairyNZ
Healthy Udder Guide
pg. 30

DairyNZ
Reproduction and Mating
pg. 33

DairyNZ
Effluent Management
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DairyNZ
Common Feed Supplements
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Milking Efficiency
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Meridian
Farm Source Partner
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AgMatters
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LIC
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pg. 33

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The Co-operative Difference
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