**Level 3: Future Proofing Strategies**

**Biological Strategies**

**Teacher Note:**

**Discussion Questions**: These are designed to stimulate discussion and deepen understanding of the impact of strategies to reduce biological gas emissions on dairy farms.

Farmers can start making a difference now by improving efficiency, cutting back on nitrogen use, optimising feed and animal health, and managing effluent and pasture efficiently. Ongoing research and emerging technologies promise even more effective solutions, helping farmers achieve greater emissions reductions in the future while maintaining a sustainable and productive dairy industry.

**Strategies to Reduce Biological Greenhouse Gas Emissions on Dairy Farms Summary**

*Summary of DairyNZ Managing Green House Gas Emissions*

<https://www.dairynz.co.nz/environment/climate/managing-ghg-emissions/>

Reducing biological GHG emissions methane and nitrous oxide on dairy farms is not only achievable but can also improve farm efficiency, water quality, animal health, and profitability. Farmers are increasingly expected to manage emissions in response to government policy and Scope 3 targets set by dairy companies, banks, and international partners and markets.

**Understanding your farm’s emissions**

* Measure emissions using data from dairy companies, Overseer, or Farmax tools.
* Two key metrics:
  1. Biological emissions per hectare – used for government pricing systems.
  2. Emissions per kg of Fat and Protein Corrected Milk (FPCM) – relevant to Scope 3 targets.

**Main drivers of biological emissions:**

* Dry matter intake → methane.
* Feed protein content → nitrous oxide.
* Nitrogen fertiliser use → nitrous oxide.

**Current On-Farm Mitigation Strategies**

1. Manage fertiliser and feed use

* Create an annual nutrient budget.
* Reduce nitrogen fertiliser and supplementary feed.
* Use urease-coated fertilisers.
* Optimise timing and placement of nitrogen applications.
* Integrate plantain into pastures to reduce nitrogen surplus.
* Maintain soil fertility and match feed demand with pasture growth.

2. Manage total feed intake

* Evaluate and optimise stocking rate and animal performance.
* Cull low-performing animals early.
* Reduce stock wastage and replacement rates.
* Use genetic selection to improve feed efficiency over time.

3. Improve animal health management

* Enhance nutrition and feed efficiency.
* Prevent health issues like mastitis, lameness, and metabolic diseases.
* Improve reproductive efficiency to lower replacement needs and emissions.

4. Improve effluent management

* Develop an effluent management plan.
* Apply effluent appropriately to match soil and plant needs.
* Replace fertiliser use with effluent nutrients.
* Avoid anaerobic storage (which increases methane).
* Use treatments and proper storage for housing and stand-off pad effluent.

5. Plant or restore on-farm vegetation

* Plant riparian strips and restore wetlands.
* Enhance biodiversity, soil health, and water quality.
* Some plantings may qualify for ETS carbon credits.
* Create a farm planting plan and seek local support.

**Emerging & future mitigation options**

* Methane inhibitors, vaccines, and low-emission livestock/feeds are under development.
* Research programmes:
  + DairyNZ’s Less-Methane Project and Plantain Programme
  + Southern Dairy Hub for tailored regional strategies
  + AgriZero and NZAGRC for breakthrough technologies and practices

**Discussion questions**

1. Why is it important for dairy farmers to start investigating and implementing strategies to reduce greenhouse gas emissions now, rather than waiting for new laws / regulations or technology?
2. What role could new technologies like methane inhibitors or vaccines play in helping farmers reduce emissions? How might these change farming in the future?
3. How can planting trees or restoring wetlands on a farm help protect the environment and support farm sustainability?
4. What challenges might farmers face when trying to implement new emissions reduction strategies, and how could they overcome them?
5. How do government policies and company targets influence the decisions farmers make about reducing emissions?
6. In what ways can improving animal health and breeding contribute to long-term environmental and economic benefits for dairy farms?
7. How can understanding your farm’s emissions help farmers make better decisions about managing their land and animals?
8. Choose one strategy that a dairy farmer can use to reduce greenhouse gas emissions. Explain how this strategy helps lower the farm’s impact on climate change.
9. How could using one or more of these strategies help a dairy farm stay successful and profitable in the long-term?

**Answers**

1. Why is it important for dairy farmers to start investigating and implementing strategies to reduce greenhouse gas emissions now, rather than waiting for new laws / regulations or technology?

It is important for dairy farmers to start investigating and implementing strategies to reduce greenhouse gas emissions now because waiting could make it harder and more expensive to adopt and implement later. Early action helps farmers avoid future penalties or costs if tighter laws or regulations come into effect. By reducing emissions now, farmers can improve their farm’s efficiency, lower costs, and start to protect the environment earlier. Taking steps early prepares farmers for changing market demands and regulations, ensuring their farm remains competitive and sustainable in the long term.

1. What role could new technologies like methane inhibitors or vaccines play in helping farmers reduce emissions? How might these change farming in the future?

New technologies like methane inhibitors or vaccines could directly reduce the amount of methane cows produce. This would help farmers lower their greenhouse gas emissions without reducing milk production. In the future, these tools could make farming more sustainable and meet tighter environmental standards.

1. How can planting trees or restoring wetlands on a farm help protect the environment and support farm sustainability?

Trees and wetlands act as natural filters that improve water quality by trapping nutrients particularly nitrogen and phosphate. They also provide shade and shelter for animals, improve soil health, and absorb carbon dioxide, helping to reduce greenhouse gases.

1. What challenges might farmers face when trying to implement new emissions reduction strategies, and how could they overcome them?

Challenges include costs, lack of knowledge, or needing new skills and equipment. Farmers can overcome these by seeking advice from experts, accessing government or company support programs, sharing knowledge with other farmers, and gradually adopting new practices.

1. How do government policies and company targets influence the decisions farmers make about reducing emissions?

Policies and targets create rules and goals that farmers must meet to keep farming, attracting a higher price for milk, getting bank loans and avoiding fines. These incentives encourage farmers to adopt better practices and technologies to reduce emissions and protect the environment.

1. In what ways can improving animal health and breeding contribute to long-term environmental and economic benefits for dairy farms?

Healthier animals produce more milk with less feed, which reduces emissions. Better breeding can create animals that need less feed and are more efficient. This lowers costs and emissions, helping the farm be more productive and profitable over time.

1. How can understanding your farm’s emissions help farmers make better decisions about managing their land and animals?

Knowing where emissions come from helps farmers target their efforts on the biggest problems, like reducing fertiliser use or improving feed efficiency. This makes emissions reductions more effective and helps improve overall farm performance.

1. Choose one strategy that a dairy farmer can use to reduce greenhouse gas emissions. Explain how this strategy helps lower the farm’s impact on climate change.

Strategy: Managing fertiliser and feed use efficiently.

By using fertiliser and feed carefully, farmers reduce the amount of nitrogen lost to the environment, which cuts nitrous oxide emissions, a potent greenhouse gas. It also lowers methane emissions by matching feed to animal needs. This reduces the farm’s overall emissions.

1. How could using one or more of these strategies help a dairy farm stay successful and profitable in the long-term?

Using these strategies improves efficiency, reduces waste, and lowers costs like fertiliser and feed. Healthier animals and better pasture management increase milk production. Protecting the environment ensures the farm can keep operating sustainably as regulations become stricter.

**DairyNZ Managing Green House Gas Emissions**

<https://www.dairynz.co.nz/environment/climate/managing-ghg-emissions/>

**Reducing biological greenhouse gas emissions on your farm is achievable, and many of the solutions have co-benefits, such as increased farm system efficiency and improvements to water quality, animal health and profitability. Below are some practical options to consider for your farming system.**

Climate change is an increasing focus worldwide. Dairy companies, banks and other institutions both in New Zealand and overseas are setting scope 3 targets that address emissions behind the farm gate. These are in addition to the Government’s climate targets and other policies for managing and reducing biological emissions. More information on [Scope 3 emissions targets](https://www.dairynz.co.nz/environment/climate/understanding-on-farm-emissions/).

Farmers will be expected to understand their farm emissions, and individual organisations are outlining how their scope 3 target will impact farmers. Each organisation may have a different approach, and it is important you work with them directly to understand their requirements.

There are several options available now that you can consider for managing your farm’s emissions. DairyNZ and others are researching solutions that will help farmers continue to reduce emissions and improve farm performance in the future.

**Understanding your greenhouse gas numbers**

The first step is finding out what your farm’s greenhouse gas (GHG) emissions are and where they come from.

Most dairy companies will provide your farm’s GHG numbers, along with other environmental information, via an annual report. Another option to understand your emissions is to look at your Overseer or Farmax file.

Most dairy company reports will show a farm’s emissions as two numbers:

1. **Biological emissions per hectare**: this figure, multiplied by the total effective hectares for a farm, gives the total or ‘absolute’ emissions number for a farm. This is likely to be the focus for any future government pricing system for biological emissions.
2. **Emissions per kg/MS**: this is a farm’s emissions intensity number and is the focus for dairy company and bank ‘Scope 3’ targets. This can either be in the form of per kg MS or per kg FPCM.

Note: from 1 June 2025, Fonterra will be reporting emissions per kg Fat and Protein Corrected Milk (FPCM) and not emissions per kgMS. FPCM is a calculation that normalises milk to a standard scale, allowing farms to compare their results over time. In New Zealand, 1kg MS is roughly equivalent to 13kg FPCM.

There are three main drivers of on-farm biological emissions:

1. **Dry matter intake:** this drives biological methane emissions (21.6g of methane is produced per kg DM eaten) and has a strong correlation with nitrous oxide emissions.
2. **Protein (nitrogen) content of the feed:** this drives nitrous oxide emissions.
3. **Amount of nitrogen fertiliser used:** this drives nitrous oxide emissions.

For more information on the sources of emissions on a farm, see our [Understanding on-farm emissions page](https://www.dairynz.co.nz/environment/climate/understanding-on-farm-emissions/).

Once you understand your farm’s emissions profile, you can consider where and how you can make changes to manage and reduce your emissions.

**Managing on-farm emissions now**

There are five actions available to farmers now that can help reduce emissions. These actions will also help improve farm system efficiency and may have co-benefits for freshwater outcomes and biodiversity.

* Manage fertiliser and feed use to improve the efficiency of production.
* Manage the total feed eaten on the farm.
* Improve animal health management to increase on-farm efficiency.
* Improve the management of on-farm effluent.
* Look at opportunities to plant or restore on-farm vegetation.

**Manage fertiliser and feed use to improve the efficiency of production**

Managing fertiliser and feed use can help minimise loss to waterways and improve the efficiency of pasture and crop rotation. There is a strong link between reducing nitrogen loss and biological greenhouse gas emissions. Making these efficiency improvements can also reduce emissions on-farm if the total feed eaten is decreased or production is increased with the same inputs.

What you can do on farm:

* Prepare an annual nutrient budget with your trusted farm consultant or fertiliser representative.
* Minimise surplus nitrogen through [reduced use of nitrogen fertiliser](https://www.dairynz.co.nz/feed/fertiliser/managing-nitrogen-fertiliser-use/) and supplementary feed.
* Use urease-coated fertilisers which reduce losses of ammonia from urea use and maximise the nitrogen available for plant uptake. This means less nitrogen needs to be used and less nitrous oxide is emitted.
* Manage the timing and placement of nitrogen fertiliser to reduce the amount of nitrogen applied while still increasing pasture growth.
* Consider the use of [plantain](https://www.dairynz.co.nz/research/science-projects/plantain-potency-and-practice/) in your pasture sward. Research has shown it can help reduce nitrogen surplus.
* Undertake regular testing to ensure correct [soil fertility](https://www.dairynz.co.nz/feed/soil/fertility/).
* Monitor and maintain [soil phosphorus levels](https://www.dairynz.co.nz/environment/nutrients-and-contaminants/reducing-phosphorus-loss/) below or within the target ranges for the soil-type and crop.
* Match feed demand with pasture growth and utilisation. Balancing pasture growth and utilisation is key to optimising stocking rates that result in the same or higher profit with lower inputs.
* Manage [pasture](https://www.dairynz.co.nz/feed/) and [crop husbandry](https://www.dairynz.co.nz/feed/crops/) to optimise production through fertility, rotation, and inputs, while minimising damage from compaction, diseases, and pests.
* Store fertiliser in a contained system to minimise losses and calibrate and maintain fertiliser spreading equipment.

**Manage the total amount of feed eaten on-farm**

The [total amount of feed eaten on a farm](https://www.dairynz.co.nz/resources?spotlight=7422) is a major driver of emissions. For every additional kg of total feed eaten per hectare, total methane emissions increase proportionally.

What you can do on farm:

* Evaluate your farm’s [stocking rate](https://www.dairynz.co.nz/feed/fundamentals/comparative-stocking-rate/), individual animal performance and the need for [supplementary feed](https://www.dairynz.co.nz/feed/supplements/) in your farm system.
* Identify and cull less productive stock early to reduce demand later in the season.
* Reduce wastage rates from unplanned losses so replacement rates can be optimised and total feed eaten reduced.
* Use [genetic selection](https://www.dairynz.co.nz/animal/breeding-decisions/) over time to increase animal performance and decrease livestock maintenance requirements. This is a long-term decision and will only yield a small response over time.

For more on the options that might be available in the future, check out DairyNZ’s [Less Methane project](https://www.dairynz.co.nz/research/science-projects/less-methane/).

**Improve animal health management to increase on-farm efficiency**

Increasing the performance of animals while reducing the need for replacements will lead to on-farm efficiencies and fewer greenhouse gas emissions. This is mainly through producing the same or more product with fewer animals.

What you can do on farm:

* Improving nutrition through increasing feed efficiency, the ME of feed, and farm-grown feed will reduce total feed eaten and therefore emissions.
* [Improved animal health](https://www.dairynz.co.nz/animal/animal-health/) through managing animal issues such as lameness, Johne's disease, metabolic issues, and other animal sickness will reduce wastage and improve on-farm efficiencies.
* Focus on [reduced mastitis](https://www.dairynz.co.nz/animal/mastitis/) and somatic cell counts to improve production, reduce wastage, and increase on-farm efficiency.
* [Improving the reproduction efficiency of the herd](https://www.dairynz.co.nz/animal/reproduction-and-mating/) will minimise wastage from later calving cows and not-in-calf cows. This can be done by focusing on the 6-week in-calf rate and the ‘Fertility Focus Report’ and will ultimately lead to reduced replacement rates and influence the timing of culling decisions.

**Improve the management of livestock effluent**

[Effluent](https://www.dairynz.co.nz/environment/effluent/) can be a source of nutrient loss, contaminants entering waterways and greenhouse gas emissions. However, it can also be a valuable resource that, [when managed well](https://www.dairynz.co.nz/resources?spotlight=7332), increases pasture production, and reduces fertiliser costs.

What you can do on farm:

* Consider developing an effluent management plan. This is a handy tool for bringing together all effluent needs on a farm, including regional rule requirements, location of waterways, buffer exclusions, and system maintenance schedules.
* [Spread effluent](https://www.dairynz.co.nz/environment/effluent/effluent-management-and-operation/) during appropriate soil conditions and at low application rates to minimise nutrient loading, match plant requirements, and minimise ponding and runoff to waterways.
  + This will also help reduce the N-surplus and therefore the nitrous oxide emitted from the soil.
* Test effluent regularly so that nutrient concentrations are known, and application rates can be adjusted.
* Use all effluent applications as a substitute for fertiliser applications, enabling reduced fertiliser on effluent application areas.
* Practice deferred effluent irrigation and [store effluent](https://www.dairynz.co.nz/environment/effluent/effluent-storage/) during inappropriate soil conditions.
  + Avoid storing effluent in anaerobic conditions as this will increase methane emitted. Options to reduce this include stirring, covering, or adding treatments like polyferric sulphate.
* Ensure careful management of effluent from housing and stand-off pads due to the volume created by both liquids and solids. Ensure that it doesn’t lead to increased risk of nutrient loss and increased emissions from application and storage.

**Opportunities to plant or restore on-farm vegetation**

Planting or restoring indigenous and exotic vegetation on farm can help improve erosion control, waterways, biodiversity, livestock shade and shelter, and soil health.

* Some types of vegetation may be eligible for earning carbon credits through the Emissions Trading Scheme (ETS), provided they meet [certain requirements](https://www.mpi.govt.nz/forestry/forestry-in-the-emissions-trading-scheme/about-forestry-in-the-emissions-trading-scheme-ets/how-forest-land-is-defined-in-the-ets/#:~:text=Size%20and%20cover%20requirements%20for,than%2030%25%20in%20each%20hectare). New plantings may also result in reduced on-farm emissions if there is land use change.
* Look at opportunities to protect and plant [riparian areas](https://www.dairynz.co.nz/environment/waterbodies-and-wetlands/riparian-planting/) and restore natural [wetlands](https://www.dairynz.co.nz/environment/waterbodies-and-wetlands/wetlands/). This improves waterways by filtering contaminants, preventing weeds, lowering temperatures, providing habitat, and reducing the impact of flooding.
* It can be helpful to have a planting plan for your farm which identifies the priority sites for planting.
  + Your regional council or local catchment group may offer support for some types of on-farm planting and restoration.

**What might be available in the future?**

There are a range of actions you can take now to reduce your farm’s emissions. Further options and solutions are being researched.

Technological and farm system solutions to reducing on-farm emissions, such as inhibitors, will be essential in assisting farmers to meet their emissions reductions goals. Research is underway to develop technological solutions and efficiency gains to help maintain New Zealand's position as one of the most emissions-efficient milk producers in the world.

**What is DairyNZ doing?**

DairyNZ has a range of research underway to assist farmers in reducing their emissions.

The [Less-Methane](https://www.dairynz.co.nz/research/science-projects/less-methane/) team at DairyNZ are working on several viable solutions to reduce methane emissions on New Zealand farms.

The [DairyNZ Plantain programme](https://www.dairynz.co.nz/research/science-projects/plantain-potency-and-practice/) aims to substantially reduce nitrogen lost to freshwater and greenhouse gas produced from farms.

The [Southern Dairy Hub](https://www.dairynz.co.nz/research/research-farms/southern-dairy-hub/) is looking at a range of issues that affect southern dairy farmers, including looking at the intricacies and differences of emissions profiles between farms and how best to optimise operations for reducing emissions.

**What are others doing?**

Alongside DairyNZ, other research and industry organisations are exploring new technologies and practices for reducing biological emissions, e.g. inhibitors, vaccines, low-emissions livestock and feeds and more. For more information see:

* [AgriZero](https://www.agrizero.nz/): a world-first partnership between New Zealand agribusinesses and the government to accelerate the availability of tools and technology to reduce methane and nitrous oxide emissions on New Zealand farms.
* [New Zealand Agricultural Greenhouse Gas Research Centre](https://www.nzagrc.org.nz/) (NZAGRC): coordinates much of the Government-funded research in New Zealand into agricultural greenhouse gas emissions, including methane, nitrous oxide, soil carbon and future farm systems, and a dedicated Māori research programme.
* [Ag Matters](https://www.agmatters.nz/actions/future-actions/): a website managed by the NZAGRC with information for farmers on actions to reduce agricultural emissions both now and in the future.