Action on agricultural emissions

Evidence, analysis and recommendations

30 APRIL 2019

Interim Climate Change Committee

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Foreword

Nei rā ka tau mai rā te ao hurihuri nei! He hau mai tawhiti tiaki taiao e hora nei!

He tohu raukura. He tohu tipuna rangatira. He toki kuruponamu ra!

Tihei mauri ora, kōkiritia te kaupapa nei!

E rau rangatira mā – Nāu! Nāku! Na tātou mo nga uri! Tēnā koutou. Tēnā tātou! Kia ora tātou katoa!

See now the changing world swirls about us, an alighted breeze, beckoning our heritage – wisdoms that bind and re-forge our resolve for and guardianship of this our natural world!

As with the raukura plumes of our forebears, bearing sacred greenstone we make headway.

Advance and overcome!

Our greetings, and our acknowledgments to all. Kia ora tātou katoa!

Dr David Prentice
Chair

Ms Lisa Tumahai
Deputy Chair

Dr Harry Clark

Dr Jan Wright

Dr Keith Turner

Dr Suzi Kerr

The Interim Climate Change Committee began work on 1 May 2018. Although our Terms of Reference were set by the Government, we are an independent committee and have been vigilant in guarding that independence. That said, we have not worked in isolation, but engaged with a wide variety of individuals, organisations, and businesses.

Within the Terms of Reference, we were asked to answer two questions, and to do so using evidence and analysis. One of the questions is concerned with electricity, and is the subject of another report. The other – the subject of this report – is concerned with policies to help reduce agricultural greenhouse gases.

There are no easy answers, so our response to this question is inevitably somewhat complex. We have endeavored to listen to and be fair to farmers. We have been conscious of the impacts on rural communities, the international context in which New Zealand operates, and other related environmental issues such as water quality and biodiversity conservation.

The policy package we put forward in this report recognises farmers as stewards of their land. We have designed the package to integrate into farmers' day to day planning, and to ensure that over time it incentivises real change.

One thing is clear – New Zealand must take action to reduce agricultural methane and nitrous oxide because these gases form such a large proportion of our national greenhouse gas profile. There is often less focus put on nitrous oxide – but this is a potent and long-lived gas and must be a part of efforts to achieve a net zero target.

Currently, there is a debate about whether New Zealand can and should reduce its methane emissions. This is a valid discussion to have. Whatever the target relating to methane ends up being, we know that we need to reduce emissions. It is time to get on with the job.

The actions we are recommending in this report are stepping stones in a long journey – a journey that will stretch over decades. Continued delay is not an option. It is critical that we get started now.

Globally, we are not on track to achieve the goals of the Paris Agreement. Yet almost daily, right here at home, we are presented with reports that underscore the reality of a changing climate – whether it be coastal erosion and rising sea levels, more intensive floods, loss of New Zealand's glaciers or the warming Tasman Sea.

The eyes of many other countries are on New Zealand and the way we tackle our agricultural emissions. New Zealand must show that the farming sector can remain profitable while contributing to climate change goals.

We are grateful for the efforts of the many people who have contributed in various ways to this report.

Executive summary

The need to reduce greenhouse gas emissions is becoming increasingly urgent. In 2015, countries met in Paris and successfully negotiated a new international greenhouse gas agreement.

As part of the Paris Agreement, New Zealand has committed to reducing greenhouse gas emissions by 30% below 2005 levels. The New Zealand Government is now looking to set a 2050 reduction target in the *Zero Carbon Bill* expected to be introduced to the House of Representatives in the coming months. The Committee has not had a role in setting the 2050 target but has been asked to develop recommendations for policy that will help New Zealand meet whatever target/s are adopted as part of the Bill.

Agricultural emissions, methane and nitrous oxide, make up about half of New Zealand's reported emissions. Over the last 25 years, farmers have become more efficient and have reduced emissions intensity – or greenhouse gas emissions per unit of product – by about 1% each year. These improvements have helped stabilise methane and nitrous oxide emissions.

But this is not enough. Emissions of long-lived greenhouse gases (carbon dioxide and nitrous oxide) must collectively go to net zero to achieve the 'well below' 2°C temperature target set in the Paris Agreement. Methane emissions do not have to go to zero to achieve this target, but they must reduce.

Currently there is no policy in place in New Zealand to reduce agricultural emissions. The emissions from all other sectors are priced through the New Zealand Emissions Trading Scheme (NZ ETS). Originally the NZ ETS was designed to include all sectors and all gases, but agricultural emissions are not yet priced.

Policy is needed so that the agriculture sector plays its part in reducing emissions and helps the country meet future emissions targets cost effectively. If not, the burden of meeting targets will fall disproportionately on other sectors of the economy.

Any policy must fulfil the Tiriti o Waitangi principle of partnership and good faith with iwi/hapū and recognise the unique characteristics of Māori land.

There are ways to reduce agricultural emissions on farms now using existing management practices and through land use change, and there are promising options on the horizon, such as methane inhibitors.

Farmers are already working hard to address other environmental issues such as water quality. While reducing greenhouse gases could also be integrated into farmers' planning, many farmers do not currently have the information and support they need to reduce emissions on their farms.

Therefore, a policy package is needed that motivates all farmers to play a part in reducing agricultural emissions while supporting them to change farming practices or move toward lower emissions land uses. A policy that rewards actions at farm-level is critical in the long term to realise the full potential for emissions reductions.

The Committee has concluded that the best way to reduce livestock emissions is to price them through a farm-level levy/rebate scheme. A levy/rebate scheme is a simpler and less costly approach than including the 20,000 to 30,000 small farm businesses in the NZ ETS as it would avoid the need for farmers to trade emissions units.

The levy/rebate scheme should be integrated with the NZ ETS – specifically, the emissions covered should be part of the same decision-making process and rules for setting the NZ ETS cap.

The farm-level levy/rebate proposal is flexible and can deal with different targets for different gases so there is no need for a separate policy for different gases. The relative prices for the different gases can be adjusted. For example, if the Government was to set a different target for methane, the methane levy rate could be adjusted over time to ensure it reflects that target.

However, a farm-level levy/rebate scheme could not be fully implemented until 2025. For the agriculture sector to play its part in reducing emissions in the interim, the Committee recommends that agricultural emissions be priced through the NZ ETS at processor level as soon as practicable, ideally from 2020. Processors are already reporting agricultural emissions through the NZ ETS.

Fertiliser manufacturers and importers should also be fully included in the NZ ETS to cover emissions from nitrogen fertiliser. Pricing fertiliser emissions at this level would provide the same incentives as pricing them at farm-level. Unlike livestock emissions, this obligation should therefore remain at manufacturer/importer level until science progresses such that there is a material benefit of pricing these emissions at the farm-level.

The Government has stated that it would assist farmers and rural communities by providing 95% free allocation. Free allocation can be distributed in different ways. The Committee considers that the main reason for providing free allocation is to help manage the social impacts of emissions pricing, such as impacts on employment. The best way to do this at farm-level, while maintaining a strong incentive to reduce emissions, would be to base free allocation on a combination of both a farm's output and inherent land productivity. At processor level, output-based free allocation is the most appropriate method.

The Government has also stated that it would recycle the funds generated from pricing agricultural emissions back to the sector to 'encourage agricultural innovation, mitigation and additional planting of forestry.' The Committee considers that the funds should be put into a dedicated Agricultural Emissions Fund, with spending overseen by a board that includes representatives from the agriculture sector and iwi/Māori.

The Fund should be spent on programmes that directly help farmers and owners of Māori land to reduce emissions. For example, it could assist in getting information out to farmers through extension programmes, developing a greenhouse gas module for farm environment plans, developing tools to support decision-making, and building a knowledgeable farm adviser network.

New Zealand should not shy away from making these changes. The agriculture sector needs to get started on reducing methane and nitrous oxide emissions now. This will allow a just transition, while avoiding abrupt and disruptive changes such as those seen in the 1980s from the removal of agricultural subsidies and other policy changes.

New Zealand farmers are innovative and well-placed to take advantage of the opportunities that a well-managed transition can offer.

1. Introduction

1.1 The Interim Climate Change Committee

The Interim Climate Change Committee is an independent committee established by the Government to:

1. Provide advice on how surrender obligations could best be arranged if agricultural methane and nitrous oxide emissions enter into the New Zealand Emissions Trading Scheme, and
2. Plan for the transition to 100% renewable electricity by 2035.

This report is the Committee's advice on agricultural methane and nitrous oxide emissions (agricultural emissions). The Committee's advice on the transition to 100% renewable electricity has been provided in a separate report titled *Accelerated Electrification*.

The full Terms of Reference for the Committee can be found here **www.iccc.mfe.govt.nz**. The Committee is a precursor to the Climate Change Commission expected to be established by the *Zero Carbon Bill* process.

1.2 What we've done

The Committee has been asked to answer the question **'how surrender obligations could best be arranged if agricultural methane and nitrous oxide emissions enter into the New Zealand Emissions Trading Scheme'.** ***To answer this question, the Committee has looked at a range of policy options that could help reduce agricultural emissions.***

The Committee's role is to provide independent evidence, analysis and recommendations on the questions it has been asked. In reaching its conclusions it has considered several key sources, including reports from the Productivity Commission, Biological Emissions Reference Group, Parliamentary Commissioner for the Environment, and Prime Minister's Chief Science Adviser, done its own in-house analysis, and commissioned work from consultants. All of the consultants' reports are available on the Interim Climate Change Committee's website at **www.iccc.mfe.govt.nz**.

To test its analysis, the Committee convened an 'Agriculture Challenge and Review Group'.[1] This group met nine times over the course of the inquiry to challenge the Committee's analysis and to provide sector knowledge; not to reach consensus.

The Committee has engaged broadly on its analysis and recommendations. The Committee has met with over 600 individuals over 200 organisations at over 300 meetings and workshops. This engagement included farmers and growers from around the country, primary sector organisations, Māori land owners, foresters, NGOs and bankers.

In April 2019, the Committee had preliminary engagement with a Youth Forum comprising members from Generation Zero, Te Ara Whatu, Pacific Climate Warriors, School Strike 4 Climate, SustainedAbility, OraTaiao, and with member organisations of the NZ Climate Action Network. A key outcome from those engagements is a recognition that the Committee needs to engage widely, early and meaningfully with environmental non-governmental organisations in any future work.

1.3 What we've heard

Common themes the Committee has heard, and where they have been addressed.

FARMERS WANT TO TAKE RESPONSIBILITY

Policy on agricultural emissions should be applied at the farm-level. This will allow farmers to decide what actions to take and be rewarded for their individual efforts.
see Chapter 7

WHAT ACTIONS CAN FARMERS TAKE TO REDUCE EMISSIONS?

Many farmers want to reduce emissions but need guidance on the specific actions they can take. **see Chapters 4 and 5**

ACKNOWLEDGE FARMERS' PROGRESS TO DATE

Many farmers have already made changes to the way they run their farm. Those taking positive steps to improve environmental outcomes should be rewarded, but too often feel that they are penalised.
see Chapters 3 and 6

AN INTEGRATED SOLUTION WILL WORK BEST FOR FARMERS

Agricultural emissions are one of several environmental concerns that farmers have to address while still running a profitable business. These include biosecurity, access to water, water quality and biodiversity.
see Chapter 5

METHANE SHOULD BE TREATED DIFFERENTLY

Carbon dioxide and nitrous oxide stay in the atmosphere longer than methane. Farmers want methane to be treated differently from carbon dioxide and nitrous oxide.
see Chapters 3 and 8

FARMERS WANT TO BENEFIT FROM ALL THE TREES ON THEIR FARM

As growing trees sequester carbon dioxide from the atmosphere, farmers want to be able to use all the trees on their farm to offset or 'net off' their methane and nitrous oxide emissions. **see Chapter 11**

SOIL CARBON

Farmers want carbon dioxide that is taken up by their soils accounted for. **see Chapter 3**

KAITIAKITANGA MEANS WE MUST ACT ON CLIMATE CHANGE

Māori land owners are supporters of strong climate change policy. They want to see climate change addressed more holistically – in a way that considers intergenerational impacts, planning and responding to the impacts of climate change, and the overall transition to a low-emissions economy.
see Chapter 2

The unique characteristics of Māori land

Box 1.1:

For many iwi/Māori land owners, particularly of land governed under the Te Ture Whenua Māori Act 1993, decision-making differs from other land owners in several important ways:

- Iwi/Māori put significant weight on long-term, intergenerational impacts in their decision-making
- In addition to economic value, iwi/Māori put significant cultural value on the land, such as access to traditional medicines, hunting, providing social well-being, and maintaining connection to the land. This connection makes decision-making considerably more complex for iwi/Māori
- Iwi/Māori land holdings are often owned collectively, which means decision-making takes longer as it involves a larger number of people
- The sale of Māori land governed under the Te Ture Whenua Māori Act is subject to several significant restrictions (inalienability), which also include leasing or mortgaging the land. This results in a lack of access to finance or capital to use for land development.[2]

Furthermore nearly 80% of Māori land is of a less versatile land class (class 6, 7 and 8) and many parcels of Māori land are small and fragmented.[3]

These differences have led to significant areas of iwi/Māori owned land being underutilised for agricultural activities. These differences also affect the ability of many iwi/Māori land owners to respond to policy in a timely way, to minimise risk and maximise strategic opportunities. Any additional costs arising from an agricultural emissions policy could result in additional barriers for the continued development of iwi/Māori landholdings.

Policies to drive emissions reductions from the agriculture sector need to take specific consideration of these differences so iwi/Māori land owners and businesses are not disadvantaged.

INCORPORATING CHARACTERISTICS OF IWI/MĀORI OWNED LAND

The unique characteristics of iwi/Māori owned land means policy needs to allow iwi/Māori owned farm enterprises to equitably engage and take up opportunities. This includes consideration of the fact that some iwi/Māori land owners have been unable to develop their land and are also unlikely to sell it. **see Box 1.1 and throughout all chapters**

MAINTAINING RESILIENT RURAL COMMUNITIES

Land use change, in particular a shift to forestry, could have significant impacts on rural communities. **see Chapter 10 and Technical Appendix 6**

REDUCING GLOBAL EMISSIONS

If farmers are charged for their emissions, they will face costs that could affect their profitability and the way they farm. Farmers want assurance that this will reduce global emissions. **see Chapter 10**

CLIMATE CHANGE ACTION MUST BE AMBITIOUS

Young people and environmental and social NGOs highlighted the need for urgent and ambitious action on climate change. **see Chapter 2**

1.4 What an agricultural emissions policy needs to achieve

There are several different approaches available to encourage, drive and enable reductions in agricultural emissions. The Committee's role is to provide analysis and evidence on 'how best' to do this. The Committee evaluated each approach against the following criteria.

The approach should:

1. Reduce emissions, in a way that can accommodate different targets for different gases
2. Be cost-effective for the agriculture sector and for New Zealand
3. Be easy for farmers to understand and simple to comply with
4. Allow farmers to innovate and have flexibility to choose their own solutions
5. Reward farmers for taking positive actions
6. Assist the agriculture sector and rural communities through change.

Any policy must fulfil the principle of partnership and good faith with iwi/Māori. These criteria have an iwi/Māori dimension, and the Committee has considered the unique characteristics of Māori land interests throughout the analysis.

The Committee tested and refined the criteria following engagement, including with some farmers and growers around the country.

No one policy will address all the criteria equally. Trade-offs will need to be made, and a package of policies may be needed.

In constructing a policy package, the Committee was conscious that 'the perfect should not be the enemy of the good'. New Zealand needs to get started on a genuine transition to meet its climate change objectives. Policy can be adapted and improved as we learn more.

2. The climate change context

Global recognition of the need to act on climate change is not new. International climate change negotiations date back to the early 1990s and led to the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

In 2015, New Zealand joined the rest of the world in Paris to negotiate a new climate change agreement. In doing so, each country committed to holding the increase in warming to well below 2 degrees above pre-industrial levels, with efforts to limit it to 1.5 degrees. The Paris Agreement aims to foster climate resilience and lower greenhouse gas emissions while not threatening food production. It also requires that over time, countries will commit to increasingly ambitious targets to reduce greenhouse gases.[4]

To date, 185 out of 197 countries have ratified the Paris Agreement.[5]

New Zealand is also actively engaged in the Korinivia joint work on agriculture.

2.1 New Zealand's action on climate change

New Zealanders are increasingly expressing the need to address climate change and New Zealand businesses are responding by committing to reduce emissions.[6] The concept of* kaitiakitanga *– the need to care for our world and environment – underpins both Māori and non-Māori views on climate change.

Under the Paris Agreement, New Zealand has adopted a target to reduce emissions to 30% below 2005 levels by 2030.

In 2018, the Government consulted on a *Zero Carbon Bill*. Among other things, this addressed options for a 2050 target – including different targets for different greenhouse gases.[7] The *Zero Carbon Bill* is expected to be introduced to the House of Representatives in the next few months.

In New Zealand, the main policy tool for enabling the reduction in greenhouse gas emissions to meet targets is the New Zealand Emissions Trading Scheme (NZ ETS). The NZ ETS was introduced in 2008 and prices emissions from electricity and gas, transport, industry, waste, and forestry.[8]

The impact that the NZ ETS has had on emissions from the sectors that are included so far has been minimal, mainly due to low-emissions prices.[9] These low prices were, to a large extent, due to rules that allowed the unlimited purchase of international units, some of which had questionable environmental integrity.[10] These settings have now been changed and the price has recovered to around $25 per tonne of CO_2e over recent months.[11] Further amendments to make the NZ ETS more effective are expected later this year.[12]

Emissions of methane and nitrous oxide from agriculture are not subject to a price under the NZ ETS. Agricultural emissions were due to be fully included from 2015 but this was postponed indefinitely in 2012. If there is no policy in place to address agricultural emissions, the burden lies on other sectors to meet any targets through reducing emissions, offsetting emissions, or purchasing international emissions reductions.

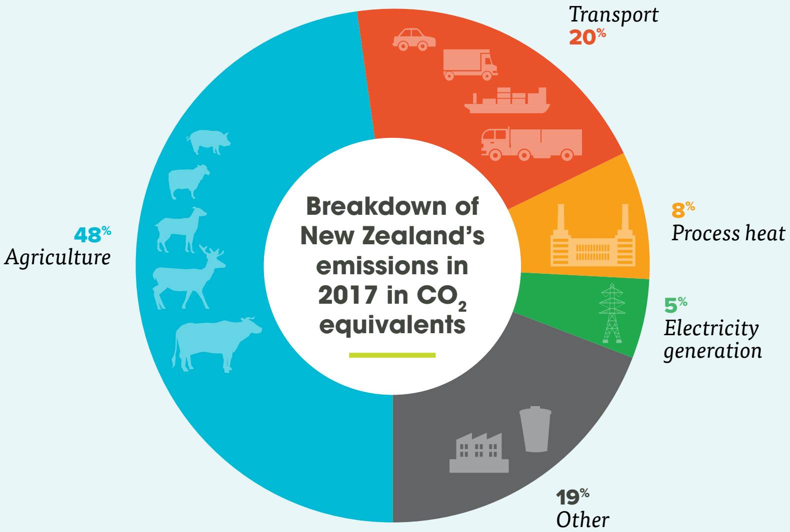


Figure 2.1: *Breakdown of New Zealand's emissions in 2017 in carbon dioxide equivalents.*
Source: Ministry for the Environment (2019)

In addition to encouraging the reduction of greenhouse gas emissions, New Zealand also needs to consider how to *adapt* to the impacts of climate change. Scientists project that New Zealand will see higher sea levels and more frequent flooding, droughts and higher temperatures. Some of those changes are becoming visible now.[13]

Adapting to climate change has been signalled as an important consideration as part of the *Zero Carbon Bill* process but was not within the remit of the Committee.

Local government will play a key role in responding to the impacts of climate change.

The Committee also heard concerns from a wide and diverse range of New Zealanders about the damaging impacts of climate change now and in the near future. These groups (including youth, iwi/Māori, refugees, migrants, people with disabilities, women and people of diverse genders and Pacific Peoples) hold valuable and necessary knowledge around adaptation and mitigation in climate action and want to be involved early in future policy work around both mitigation and adaptation.[14]

The Committee will pass on the concerns it heard to the Secretary for the Environment.

3. Agriculture and climate change in New Zealand

The agriculture sector is a significant contributor to New Zealand's economy. Each year it generates 35% of export revenue.[15] Our primary sector exports are sought after internationally. Most of our meat, wool, milk and wood are exported, and some of our crops, fruit and vegetables.

However, agriculture, particularly livestock farming, generates emissions of two greenhouse gases – methane and nitrous oxide.[16] Together, they make up almost 48% of New Zealand's reported greenhouse gas emissions.[17]

Farming in New Zealand is a dynamic industry. It has changed over the last century in response to market and environmental signals and will continue to change. As an example, in the last century we have seen a shift from sheep farming towards forestry, dairying and high value horticulture.[18]

Many farmers are already responding directly to environmental concerns and taking action to address biodiversity and water quality issues by, for example, changing fertiliser practices, fencing off streams, and allowing less productive land to revert to native forest.

Emissions of greenhouse gases – methane and nitrous oxide – are another environmental concern farmers need to address.

This chapter looks at:

- where emissions come from on farms
- different characteristics of agricultural greenhouse gases
- changes farmers have made to date and the impact these have had on emissions.

3.1 The sources and sinks of greenhouse gas emissions on farms

Sources of greenhouse gas emissions from farm operations vary from farm to farm depending on what the land is being used for.

Almost three quarters (71%) of reported agricultural emissions come in the form of methane from ruminant animals (**see Figure 3.1**). Ruminants (for example cows, sheep and deer) have a complex digestion process that uses microbes to break down and extract nutrients from fibrous plants like grass. As part of this process, other microbes produce methane that is burped and breathed out.

A further 21% of agricultural emissions are nitrous oxide, largely from the nitrogen in animal urine. Some of the nitrogen from urine in soil is taken up by plants as they grow, some is lost through leaching and a small amount is emitted as nitrous oxide. Nitrous oxide emissions also arise from the use of synthetic fertilisers on livestock, arable and horticultural farms.

The remainder of agricultural emissions are mostly methane from manure management, and carbon dioxide from fertiliser, lime and dolomite.

Many farms also have 'carbon sinks'. Trees and vegetation absorb carbon dioxide from the atmosphere when they are growing and store some of it as carbon. This process is called carbon sequestration. The carbon can be lost back to the atmosphere when trees are harvested or decay. Native forests, and trees that are not harvested, can store this carbon for hundreds of years. For more information on carbon stored in grass (**see Box 3.1**) and on carbon stored in soils (**see Box 3.2**).

Every farm has a unique emissions profile. Livestock farms generally have higher emissions per unit of land than horticulture and cropping farms.

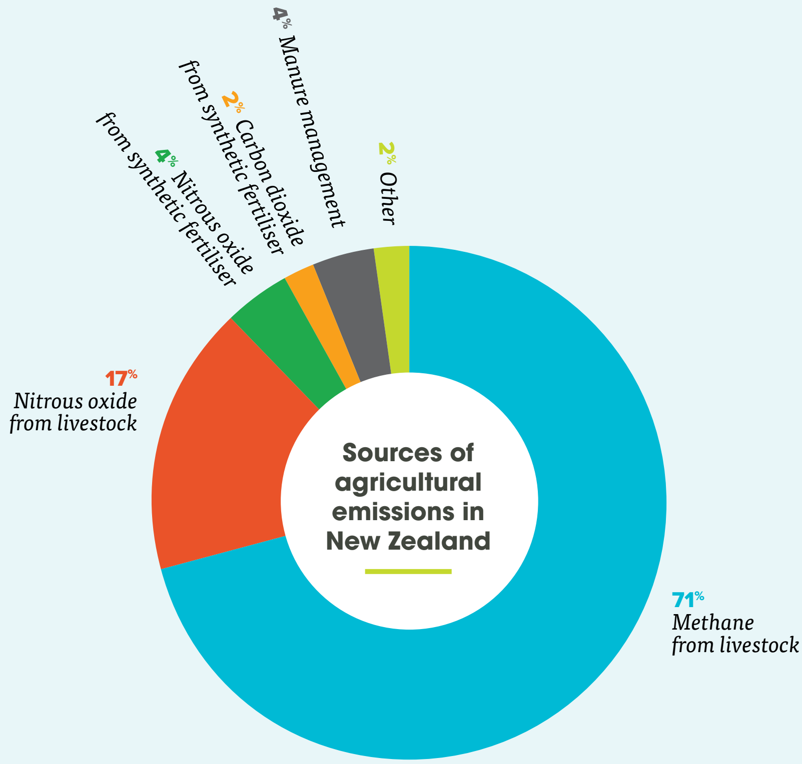


Figure 3.1: *The breakdown of New Zealand's agricultural emissions in 2017.*
Source: Ministry for the Environment (2019)

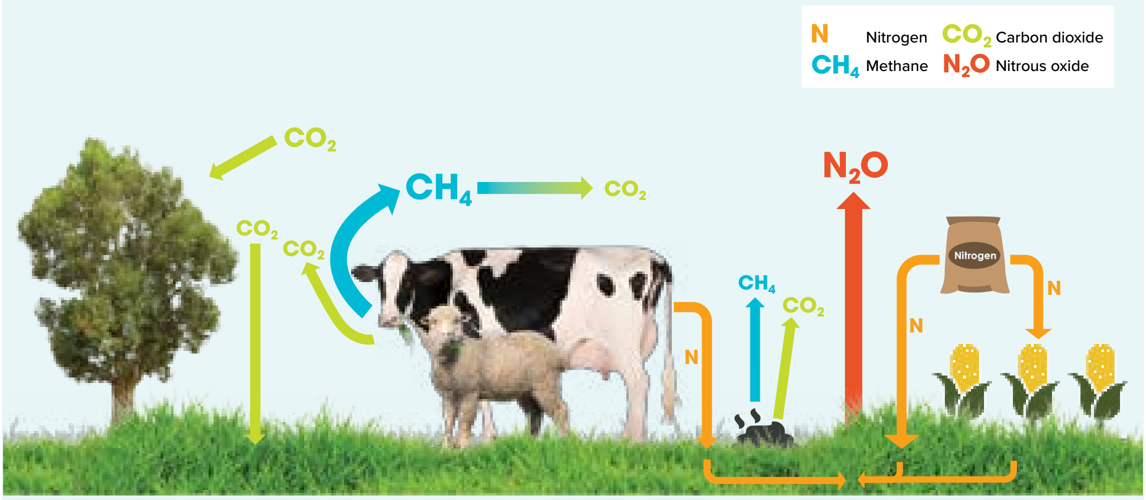


Figure 3.2: *The sources and sinks of greenhouse gas emissions on a farm.*

Why can't farmers benefit from the carbon stored in their grass?

Box 3.1:

Grass takes up carbon dioxide from the atmosphere as it grows. Like carbon stored in trees, carbon in grass is released when harvested or eaten. The difference between grass and trees is that the carbon stored in grass is released every few weeks and so does not accumulate. The carbon stored in trees accumulates and, even in plantation forestry, is stored for decades (see Figure 3.3).

Figure 3.3: The same quantity of carbon is stored in grass at the start and end of each year. While in a tree, the quantity of carbon stored increases year on year while the tree grows.

Can farmers increase the carbon stored in soils?

Box 3.2:

How much carbon is stored in soils depends on the land use, climate and soil type. For example, more carbon is stored under pasture than is stored under arable crops. In New Zealand, soils already contain relatively high levels of carbon.

The quantity of carbon stored in soils is not constant. Carbon from decomposing animal and plant organic matter is continually added to the soil while microbes continually decompose this organic matter and release some of it back to the atmosphere as carbon dioxide. Some carbon is also lost via leaching. It is the balance of these processes that determine if carbon stocks are changing.

If the soil carbon stock is increasing, then soils are a *sink* of carbon dioxide. Conversely, if the soil carbon stock is decreasing, the soils are a *source* of carbon dioxide.

Long-term data on whether New Zealand soils are gaining or losing carbon is limited. Some soils seem to be losing carbon, but others may be gaining carbon. Increases in soil carbon stocks are generally slow but circumstances outside of farmers' control, such as drought, can lead to the rapid loss of soil carbon.

Modelling studies suggest that there is potential for some soils to increase the quantity of carbon they store. Exactly how to exploit this potential is unclear at present. Some farm practices (for example the use of deeper rooted pasture plants) have been advocated as ways to increase how much carbon is stored in the soil, however there is currently no robust evidence of their effectiveness in New Zealand.

New Zealand researchers are further exploring how farm practice and climate can change soil carbon stocks and whether it is possible to accurately account for changes in stocks on individual farms.

3.2 A particular issue – the short life of methane

Methane is a powerful but relatively short-lived greenhouse gas. A methane emission stays in the atmosphere on average for about 12 years and disappears almost entirely within 50 years. By contrast, about 40% of every carbon dioxide emission remains in the atmosphere for more than a century, and a smaller fraction even for millennia.

The warming caused by methane is not as short-lived. The warming from an emission today will still be felt several centuries from now, as the climate absorbs and redistributes the heat trapped while the methane is in the atmosphere.[19]

Figure 3.4 shows the warming caused by emitting one tonne of methane and compares it with the warming caused by one tonne of carbon dioxide. Even though the warming from methane declines over time, a tonne of methane emitted today still causes more warming two centuries from now than a tonne of carbon dioxide emitted today.[20]

The good news is that we are not emitting equal quantities of greenhouse gases. **Figure 3.4** also shows the warming caused by New Zealand's *actual* emissions of methane, carbon dioxide, and nitrous oxide, for the year 2016. Methane emissions are still causing the most warming over the next few decades, but in the longer term, the weaker but longer lasting warming from carbon dioxide dominates, given the much larger quantity of emissions.

Nitrous oxide is a very powerful greenhouse gas with a lifetime of more than 100 years. Over a century or two, nitrous oxide is similar to carbon dioxide as it causes long-lived warming but it does not dominate because much less is emitted.

This comparison of individual yearly emissions is only one side of the story.

Due to the slow rate of breakdown, every emission of carbon dioxide adds to the concentration of carbon dioxide in the atmosphere. This cumulative effect means that net emissions of carbon dioxide and other long-lived greenhouse gases such as nitrous oxide must be reduced to zero to stop adding to existing warming. The sooner we reach net zero emissions of these gases, the less we will contribute to global warming.[21]

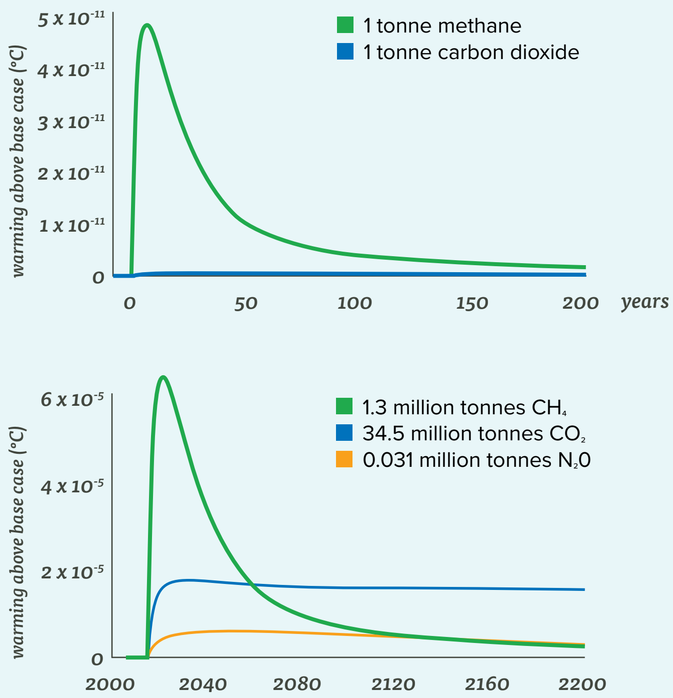


Figure 3.4: ***Top:*** *Tonne for tonne, methane causes more warming than carbon dioxide over at least 200 years.* ***Bottom:*** *New Zealand emits different quantities of different greenhouse gases, which affects the warming they cause and how quickly the warming disappears again.*

Note: Figure is based on New Zealand's emissions in 2016

If methane is emitted at a constant rate, methane concentrations will stabilise within about 50 years, as each new emission simply replaces a previous emission that is decaying naturally. Therefore, because methane does not accumulate methane, emissions do not have to drop to zero to stop them adding to global warming.[22]

However, if methane emissions continue at or near their current rates, they will keep the Earth a lot warmer than it would be without those on-going emissions.[23] The less methane we emit in future, the less we will contribute to global warming.[24]

How much methane should be reduced is a value judgement about how much total warming we are prepared to cause. Natural science alone cannot answer this question, or tell us how to prioritise methane reductions now relative to reductions in long-lived gases.

This depends on our relative concern about climate impacts at different points in time, as well as political judgement on the extent to which effort to reduce one gas might displace efforts to reduce the other. Choices will also depend on how society weights impacts on current and future generations, different expectations about humans' ability to adapt, to innovate, and to transition toward a low-emissions society without undue social cost.

3.3 How farming practices have helped limit methane and nitrous oxide emissions

Over the last 25 years or so, farmers have markedly improved the efficiency of their farming operations. Selective breeding has resulted in animals having the potential to grow faster, produce more milk and have more offspring. Improved pasture and feed management, improved animal health and more effective use of fertiliser have enabled farmers to make the most of these changes.

These changes have resulted in *emissions intensity* falling by about 20% over the last 25 years (**see Figure 3.5**). Without these changes, current emissions would have been 40% higher.[25]

Some farmers have also been fencing off marginal land and allowing it to slowly revert to native forest and scrub. This is good for biodiversity, for preventing erosion and the loss of topsoil into waterways, as well as for storing carbon. Land with recovering natives stores about 88 tonnes of carbon per hectare in the first 50 years.[26] It will go on growing and storing carbon, albeit at a slower rate, for 300 years.

Many farmers and Māori land owners have been putting in place Queen Elizabeth II (QEII) National Trust covenants and Ngā Whenua Rāhui kawenata to permanently protect the native forests and scrubland on their land.[27]

Farmers have also been planting riparian strips to filter out sediment and nutrients and prevent them from entering waterways. This helps to improve water quality, protect stream habitat and can also provide some shade for livestock. The grasses, flaxes including harakeke, shrubs, and trees planted in riparian strips also store small amounts of carbon (**see Chapter 11**).

Figure 3.5: *Emissions intensity – or emissions per unit of product – has decreased across the dairy, sheep and beef sectors since 1990.*

Source: Ministry for the Environment (2019) and Statistics New Zealand

3.4 How agricultural emissions are tracking

Despite the reduction in emissions intensity, total emissions from agriculture have increased 13.5% since 1990 (see Figure 3.6).[28]

Emissions from the dairy sector have more than doubled over the same time period. Although emissions per kilogram of milk have decreased, the dairy sector is producing much more milk than before.[29]

A 50% reduction in the number of sheep and a 25% reduction in the number of beef cattle have led to sheep and beef emissions decreasing by about a third since 1990.[30] Due to the increase in individual animal productivity and more integration between the beef and dairy sectors, lamb production has reduced by only 8% while beef production has increased 46%.[31] These trends show that reductions in greenhouse gas emissions do not necessarily mean a reduction in product volume, let alone profits.

The land area now used for sheep and beef farming has reduced by 32% since 1990.[32] Some of this land is now used for dairy production. Other areas are now planted in trees or being left to revert to natives.

Since 1990, there has also been a seven-fold increase in nitrogen fertiliser use.[33]

Although emissions of the agricultural gases have increased since 1990, they have been relatively stable since 2012. Government projections based on business as usual suggest that total agricultural emissions may fall slightly below current levels by 2030.[34]

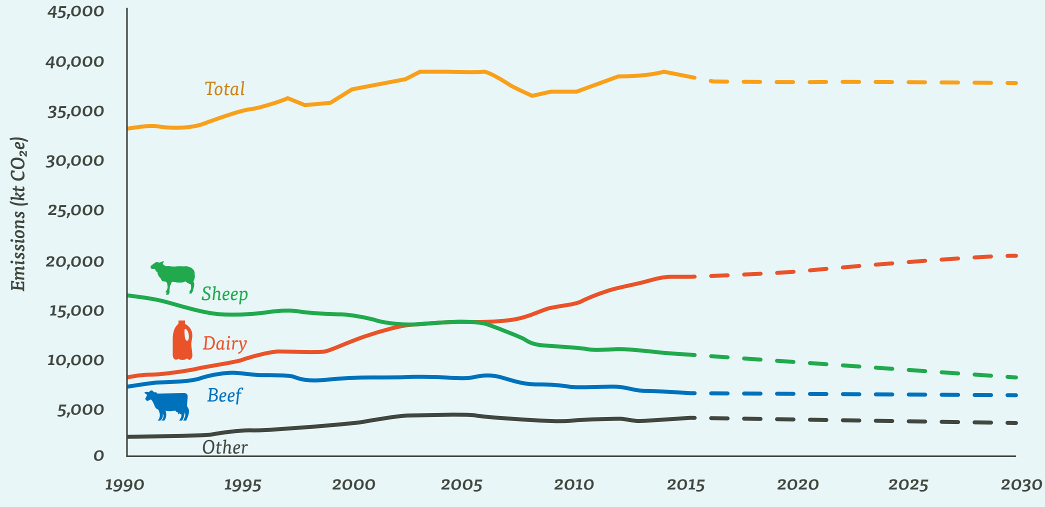


Figure 3.6: *New Zealand's actual and projected agricultural emissions (1990-2030).*
Source: Ministry for the Environment (2017a)

4. How can agricultural emissions be reduced?

There are actions that farmers can take now to reduce emissions.

However, there is no 'one size fits all' solution. Each farmer will need to identify the right mix of actions for them and their farm, taking into account their specific climate and soil conditions, current management system, and what advice and skills they can draw on.

This chapter starts out by looking at what farmers can do now to reduce emissions through changing farm practices and changing land use. It goes on to describe emerging technologies that could reduce emissions in the future.

These sections draw on several pieces of work commissioned by the Biological Emissions Reference Group that explore what farmers can do now to reduce emissions on farm.[35]

4.1 What farmers can do now to reduce emissions – changing farm practices

There are two main drivers of on-farm emissions:

- Methane emissions are largely a function of the quantity of feed eaten by an animal (dry matter intake). Generally, the methane emissions from predominately pasture fed livestock in New Zealand stay constant at around 21 grams of methane for every kilogram of feed eaten.[36]
- Nitrous oxide emissions are largely a function of the amount of nitrogen added to the land through fertiliser, urine and dung. A fixed proportion of this nitrogen is lost as nitrous oxide.

Unless technologies are developed that can change these relationships, reducing agricultural emissions from a farm relies on reducing total feed being produced and consumed, and/or reducing nitrogen applied to or deposited on land.

Some broad ways to reduce on-farm emissions include:

1. **Reducing stocking rates while maintaining production**

   Some farmers can optimise their farm system by focussing on how much energy goes into producing product as opposed to maintaining animals. If farmers reduce their stocking rate, for example by improving animal reproductive performance and removing non-productive animals, they can reduce total emissions. However, the impact on emissions depends on how the farmer chooses to use adjust other farm inputs to match the reduced stocking rate.

2. **Reducing production and reducing inputs**

   Some farmers could reduce emissions and maintain profitability by reducing production, while reducing inputs such as fertiliser and supplementary feeds (**see Box 4.1**).

3. **Using fertiliser more efficiently**

   Some farmers can reduce nitrous oxide emissions by using less nitrogen fertiliser or using fertilisers coated with a urease inhibitor.

4. **Using low-emissions feeds**

   There are feeds that can, in some circumstances, reduce methane or nitrous oxide emissions from livestock. Examples include forage rape, maize silage and fodder beet. The size of any reduction is highly farm specific.

5. **Better manure management**

   Manure is a minor source of agricultural emissions, mostly from methane produced during anaerobic storage. Farmers could reduce emissions by changing how manure is stored. Farmers could use bio-digesters to capture the methane emitted from anaerobic ponds, but it is unlikely to be cost-effective on most New Zealand farms.[37]

In total, the Biological Emissions Reference Group estimated that these mitigation options could reduce emissions by up to 10% across the pastoral sector.[38]

Reducing emissions while increasing profits on Owl Farm

Box 4.1:

While every farm is different, the experiences of individual farms can highlight possibilities for other farmers on how they might be able to reduce their emissions without reducing profits. Owl Farm near Hamilton, one of twelve DairyNZ Partnership Farms, explored a range of options to reduce greenhouse gas emissions alongside other objectives such as increasing profits, reducing nutrient losses, ensuring animal welfare and providing a safe and rewarding work environment.

Owl Farm has reduced total greenhouse gas emissions by 8% and lifted operating profit per hectare by 14% through improving management practices over the past two years. Based on additional modelling, further farm management changes involving reduced feed use and lowering the stocking rate is expected to increase profitability by another 21%, reduce nitrate leaching by 14% and greenhouse gas emissions by 13%. Owl Farm notes there is a potential downstream economic impact of reducing the intensity of their farming operation.

Achieving this outcome is challenging however and relies on highly skilled farm management and high-quality data to support decision-making. DairyNZ says that is why it supports customised Farm Environment Plans which recognise the unique situation of each farm and integrate efforts across greenhouse gases, water quality, biodiversity, and financial sustainability.[39]

4.2 What farmers can do now to reduce emissions – changing land use

Farmers can reduce emissions now by changing parts of their farm to different land uses. Many farmers already run mixed land use systems to reduce risk.

There are two key ways that farmers can offset their emissions:

1. **Planting trees to store carbon**

   Farmers can plant trees in gullies, bluffs or steep slopes, and allow less productive land to revert to native forest. Native forests will store carbon slowly but steadily for hundreds of years. Exotic plantation forests store carbon more quickly, but much of this is lost back to the atmosphere if the forest is harvested.[40]

2. **Diversifying into lower emissions land uses**

   Some farmers could reduce emissions by diversifying into lower emissions land uses, for example, horticulture, crops, pigs and poultry (**see Figure 4.1**).

When considering diversifying, reduced methane and nitrous oxide emissions need to be balanced with the carbon that could be lost from the soil. For example, moving from dairy farming to kiwifruit farming would reduce methane and nitrous oxide emissions by about 8 tonnes CO_2e per hectare each year. At the same time, carbon stored in soil would be slowly lost. Over a 20 year period, this would be equivalent, on average, to 2.8 tonnes CO_2e per hectare each year.[41]

Decisions will also need to factor the impact on profitability, management, and other environmental issues, such as water quality and quantity.

In theory, there are about two million hectares of land of the quality needed for horticulture and vegetable growing. The industry currently covers only about 120,000 hectares. The kiwifruit, apples and grapes industries are growing. However, under current economic conditions, the area is expected to increase by only about 5,000 hectares over the next few years.[42]

Expanding horticulture rapidly and profitably would require significant investment and development of new supply chains and markets, and access to skilled reliable labour.

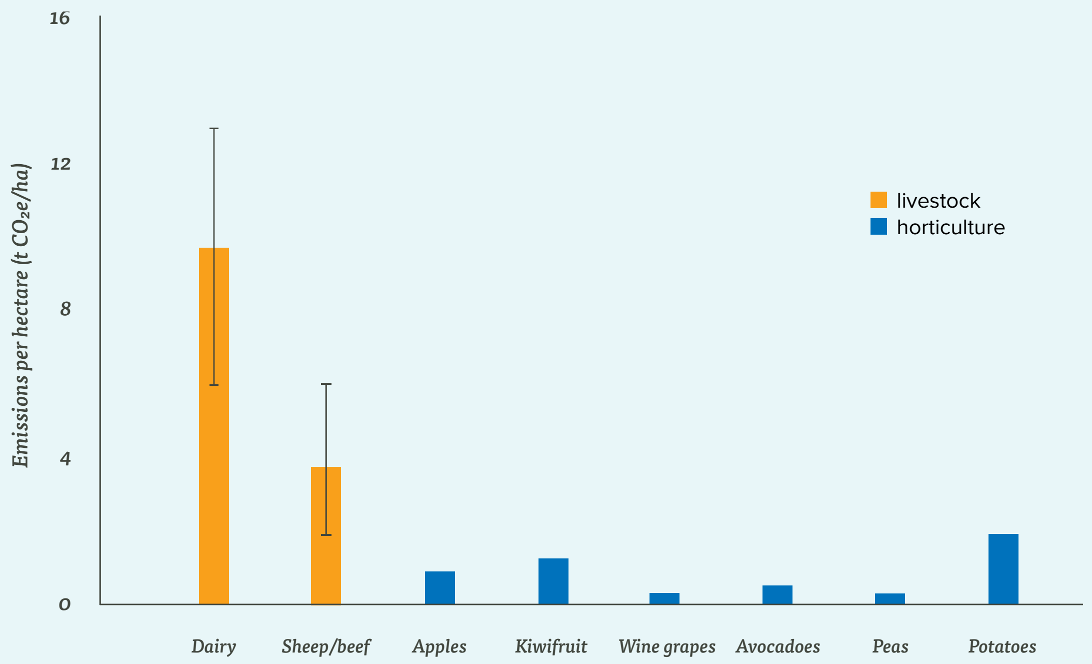


Figure 4.1: *Different land uses have different levels of emissions. Dairy and sheep/beef emissions represent the average and range of data as provided by DairyNZ and Beef + Lamb New Zealand, respectively.*
Source: DairyNZ, Beef + Lamb New Zealand, Thomas et al. (2019)

Figure 4.2: *Marginal areas of land that are planted in mānuka can sequester carbon dioxide, help to prevent erosion and the loss of top soil, while also being used to produce honey.*
Source: Comvita (2019)

Reducing emissions on Māori farms

Box 4.2:

Research has looked at how greenhouse gases can be reduced on Māori-owned pastoral farms. This research has looked at the greenhouse gas profiles and options to reduce net emissions for four case study farms around New Zealand.

The research tested various strategies such as lowering stocking rates, reducing fertiliser inputs and reducing forage cropping. The ability of each farm to maintain or increase productivity with lower inputs was found to be critical for these measures to be viable.

Larger reductions in net emissions could be achieved by changing land use on parts of the farms to tree crops like mānuka, and indigenous and plantation forestry, that sequester carbon. Overall, the study suggests that the largest emissions reductions could come from a combination of changes in farm practices and diversifying land use, but the economic viability of such changes depends on the price for carbon sequestration in forests.[43]

4.3 What farmers could do in the future to reduce emissions

As research progresses, new methods for reducing on-farm emissions are likely to become available. These methods include using low-emissions animals, nitrification and urease inhibitors, methane inhibitors and a methane vaccine.

BREEDING LOW-EMISSIONS ANIMALS

Livestock can be bred to emit less methane for each kilogram of feed they eat, in the same way they can be bred to produce more milk or meat.

Sheep that emit less methane have been identified and scientists are looking at how this low methane trait can be added into the sheep breeding index. It will take several generations for this genetic trait to filter through the sheep population, but it has the potential to reduce emissions by about 5%.[44] Low methane sheep are currently being tested in a large scale trial across the country.

Selective breeding for low methane cattle is further off. It is harder and more expensive to identify low emitting animals. Genetic markers, microbial markers and markers in milk are all being assessed for their suitability for use in breeding programmes.

NITRIFICATION INHIBITORS

Nitrification inhibitors spread on pasture and crops slow down the microbial processes in the soils that produce nitrous oxide. Nitrification inhibitors could be sold mixed in with nitrogen fertiliser or could be spread directly onto grazed pasture. The nitrification inhibitor DCD was used in New Zealand until it was withdrawn from use following the discovery of residues in milk. Research is underway for novel inhibitors that are more effective and present minimal risk of residues.

Urease inhibitors are used widely in New Zealand, and while they lead to only minor emissions reductions in themselves, they can improve the uptake of fertiliser by plants and help farmers reduce the total amount of fertiliser they use.[45]

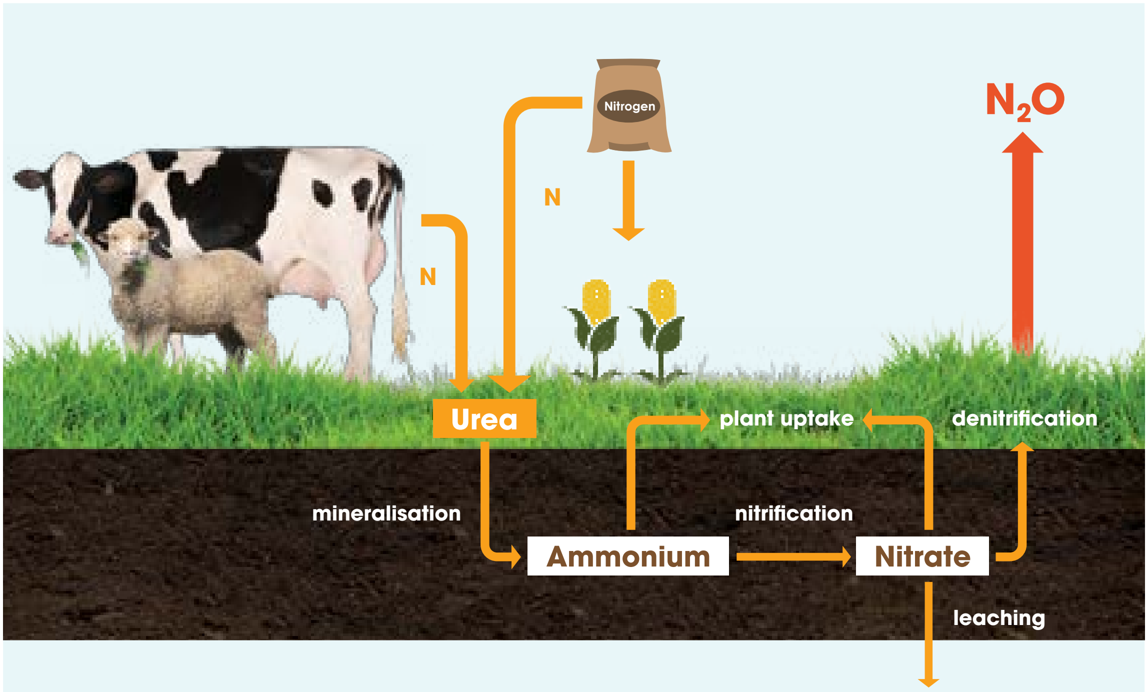


Figure 4.3: *The nitrogen in urea is broken down by microbes in the soil and can end up leaching as nitrate into water or being emitted as the greenhouse gas nitrous oxide. A urease inhibitor can slow down the reaction of urea to ammonium. While a nitrification inhibitor can slow down the reaction of ammonium to urea.*

METHANE INHIBITOR

A methane inhibitor is a chemical compound that inhibits methanogens – the micro-organisms in the animal's rumen that produce methane.

To work effectively, the inhibitor needs to continuously influence the activity of the methane producing microbes. This makes effective mitigation challenging in grazing systems. It is easier to achieve mitigation in confined systems. A methane inhibitor, 3-nitrooxypropanol or 3NOP, has been developed by a Dutch company (DSM Nutritional Products) to work in these more confined livestock systems. It is expected to be available to buy later this year in some countries. Published trials suggest that 3NOP could reduce methane by a minimum of 30% if it is present in every mouthful of feed that an animal consumes. In New Zealand's grazing dairy systems, it has been estimated that if fed to animals twice a day when they are milked, it could potentially reduce methane emissions by about 5%.[46]

Research is underway to develop slow release inhibitors that could be used more effectively in New Zealand's pasture-based farming systems.

***Figure 4.4:** A methane inhibitor developed in Europe could reduce methane emissions by about 30% when fed in every mouthful of food in a feedlot. Given New Zealand's pasture fed farming system, this could reduce methane emissions by up to 10% in New Zealand if fed twice a day during milking.*

METHANE VACCINE

A methane vaccine could be used to trigger an animal's immune system to produce antibodies that suppress the activity of methanogens in the rumen. Research to develop a methane vaccine is in the early stages. Some success has been achieved in laboratory studies but it has not, so far, been proven to work in animals. This makes it difficult to say when it will become available. A recent report for the Biological Emissions Reference Group says there is *"low confidence that a vaccine will be available by 2030"* and *"medium-high confidence that a vaccine will be available by 2050"*.[47]

Scientists estimate that a methane vaccine could result in reductions in emissions from individual animals similar in magnitude to those of a methane inhibitor. Such a vaccine is likely to be suitable for use in most systems of production both nationally and globally.

GENETICALLY MODIFIED RYEGRASS

Genetically modified ryegrass has been developed by scientists at AgResearch and is currently being tested in field trials in the United States. Initial modelling suggests that using this grass could reduce both methane and nitrous oxide emissions from grazing animals, but there are no results yet from actual farm trials to confirm its efficacy. Current laws relating to genetically modified organisms would prevent use of this in New Zealand.

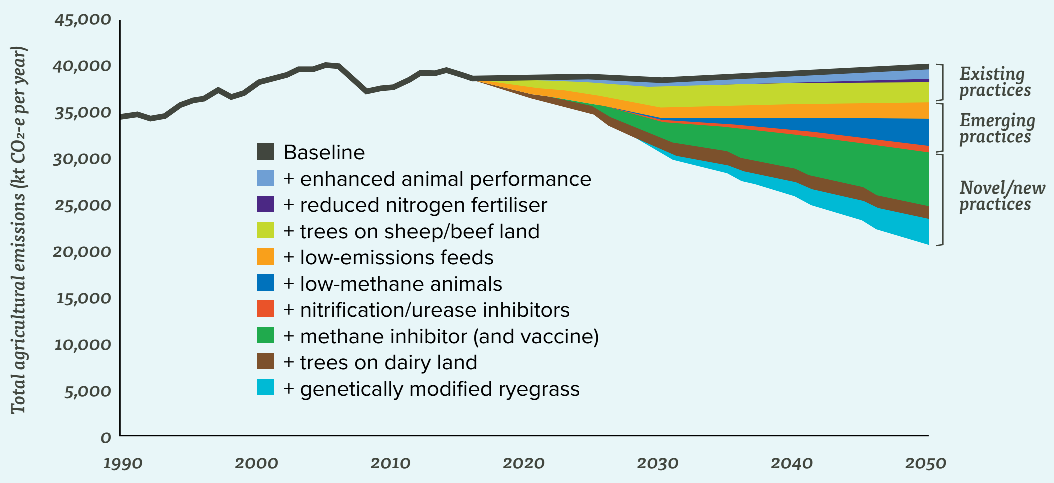


Figure 4.5: ***The cumulative effect of a comprehensive package of mitigation options for dairy, sheep and beef farms under maximum assumptions about efficacy and adoption rates. Note this is for on-farm emissions only and does not include fundamental land use change.***

Source: Reisinger et al. (2018)

4.4 Summary

There are a number of things that farmers can do now to reduce emissions on their farm.

Modelling studies suggest that on-farm practice changes could reduce emissions on some farms by up to 10% while still maintaining profitability. For other farms, achieving such reductions could be much more challenging, depending on their climate and soil conditions, current management systems, and skill level of farm management.

Much larger reductions in agricultural emissions would need to combine on-farm practice changes with major land use change and/or new technologies such as a methane inhibitor or methane vaccine.

The next chapter looks at how farm environment planning and extension programmes can build farmers' understanding of their options for reducing emissions and promote the implementation of mitigation practices.

5.

The role of farm environment plans, training and extension

***To reduce emissions, farmers will need to quantify their farm's emissions, understand what drives these emissions and be able to assess options for reducing them.*[48]**

A recent survey found that about 50% of farmers have some knowledge of how emissions could be reduced but only about 14% of farmers have quantified them.[49]

5.1 Farm environment plans

A farm environment plan is a comprehensive farm plan that considers environmental outcomes alongside traditional business outcomes. A variety of terms are being used to describe such plans, including Land and Environment Plans, and Farm Environment Management Plan.

Farm environment plans are increasingly being adopted by the agricultural sector as a key tool for improving farm environmental performance. Industry organisations and many milk processors have set targets for when their farmers need to have farm environment plans in place.[50] For example, the Good Farming Practice Action Plan for Water Quality (a joint industry/Government action plan) sets a goal for all farmers to have a farm environment plan in place by 2030. Beef and Lamb NZ has a goal for every sheep and beef farm to have a Land and Environment Plan by 2021.[51] Some regional councils are requiring farmers to use farm environment plans to manage nutrient losses.

Most farm environment plans in use now focus on improving water quality but the range of issues that farmers need to consider is increasing. Farm environment plans are increasingly promoted as ways to integrate multiple environmental objectives including water quality, soil conservation, biodiversity and greenhouse gases into traditional farm business plans.[52]

To be effective, farm environment plans need to be part of integrated farm systems planning that combine environmental goals with business objectives. Farmers need to be able to tailor actions to reduce emissions to their specific farm context and consider how those actions relate to broader farm goals including profitability and other regulatory requirements such as animal welfare and food safety.

The Committee agrees with the advice of the Prime Minister's former Chief Science Adviser that farm environment plans will be an essential component of a policy package designed to help reduce greenhouse gas emissions on-farm.[53] Farm environment plans need to be broadened to incorporate management of greenhouse gas emissions. A greenhouse gas component of a farm environment plan should take farmers through a process that involves:

1. Calculating agricultural emissions on the farm and their key sources. This could be done using a variety of methods (**see Chapter 7**)
2. Identifying carbon sinks on the property, such as regenerating native bush
3. Identifying options to reduce greenhouse gas emissions and their interaction with other environmental objectives
4. Estimating the interaction of specific mitigation actions with other business objectives, identifying priority actions for implementing and monitoring the impact of these actions.

There are some barriers to delivering farm environment plans that need to be addressed:

- **The scale**: Developing farm environment plans that incorporate greenhouse gas emissions for the 20,000 to 30,000 farm businesses in New Zealand will take time. Anecdotal evidence suggests a current waiting list of 12-18 months for farmers in Canterbury to access a certified farm adviser to help them with nutrient management planning as part of water quality regulation. The Waikato Regional Council also sees this as a challenge with about 5,000 farms in the region needing farm environment plans by 2026.[54]
- **The capability and capacity:** Farm advisers play an important role in building and implementing farm environment plans in a way that changes farmer behaviour.[55] There are currently very few farm advisers who can provide advice on the comprehensive range of issues farmers will need to consider in their plans.[56]
- **The cost:** Generally, farm environment plans range in price from $4,000 to $10,000 depending on the scale and complexity of the farm, the skill of the farm adviser working with the farmer, and the available information and data.[57]

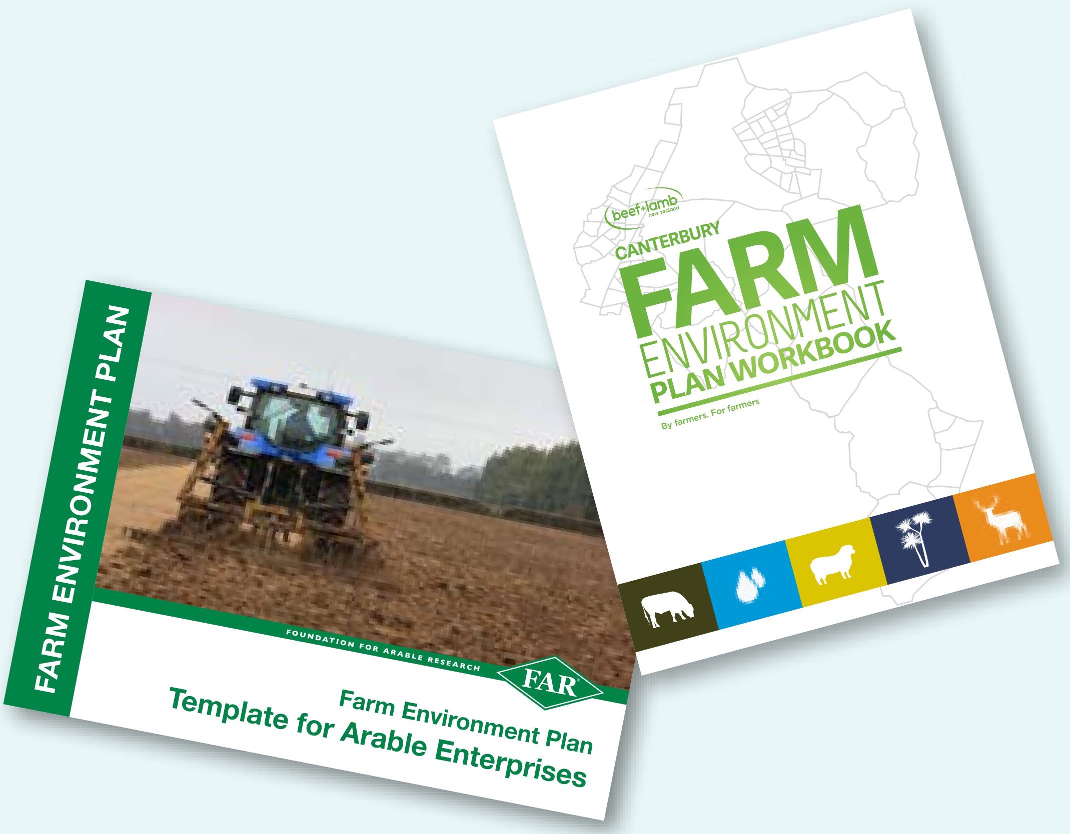


Figure 5.1 *Industry organisations have developed templates for farm environment plans for farmers.*

5.2 Good management practices to reduce agricultural emissions

The Committee supports the development of good management practices to help farmers identify ways to reduce emissions. These practices will assist the development and implementation of farm environment plans.

To help improve water quality, Environment Canterbury worked with primary sector organisations and Crown Research Institutes to develop a set of industry-agreed good management practices that are applicable across the country.[58] The impact of these practices cannot be easily quantified, but they serve as principles that can guide farmers in their decision-making. A similar approach could be adopted for greenhouse gas mitigation.

Farmers are currently less aware of the actions they could take to reduce emissions. A key challenge is that the impact of any specific practice on greenhouse gas emissions often depends not only on the specific practice itself but on a series of linked management decisions. For example, reducing replacement rates might be considered a good management practice as it reduces the number of non-productive animals on a farm. However, the impact on emissions depends on whether the number of productive animals is adjusted as a result, and on changes in fertiliser and supplementary feed-use to balance feed supply with feed demand.

Nonetheless, developing and effectively communicating the options for reducing emissions will be critical. It will assist farmers to select the options most suitable to their farm system and environmental and business objectives.[59]

5.3 Training and extension programmes

Based on a clear and consistent message from its engagement with the agricultural sector, the Committee considers that improved training and extension services will be needed to support farmers to identify and implement low-emissions practices.

Farmers, rural professionals, scientists and agriculture experts, primary sector organisations, central and local government will need to work together to develop a coherent training and extension package for farmers.[60] This package needs to:

- Build awareness of climate change and the need to reduce emissions – 'why'
- Provide information on practices to reduce emissions and low-emissions land uses – 'what'
- Provide practical support and skills to implement actions – 'how'.

Farmers get information in a range of ways, including from formal and informal networks, field days, rural professionals and their sector bodies.[61] An extension package will need to be delivered through a range of services, advisers and training programmes. It should build on services and networks that already exist. Advice should be delivered in a way that avoids duplication and is integrated with other advice and training farmers are receiving.

EXTENSION PROGRAMMES

Industry bodies, agricultural processors, fertiliser companies and central and local government are all involved in extension programmes to help farmers improve productivity, profitability and environmental outcomes. Many of these programmes include farmer to farmer learning through mentoring, farmer discussion groups, catchment groups, field days, farm visits and demonstration farms. Experts, such as agricultural scientists and farm advisers, will need to play a key role in supporting these farmer-led discussions.

Some industry bodies have started to incorporate climate change into these programmes, for example, DairyNZ's Dairy Action on Climate Change and Beef + Lamb's farms, trees and carbon workshops.[62] However, most extension programmes do not currently include climate change mitigation.

FARM ADVISERS AND RURAL PROFESSIONALS

Farmers will need advice from advisers and professionals who understand how emissions mitigation practices will work in their specific context. The Committee consistently heard that few advisers and rural professionals currently have this understanding.

Building the skill base of farm advisers will take some years. Farm advisers who have a nutrient management certification can now do a three-day course at Massey University focusing on greenhouse gases and qualify for a certification endorsement. There are currently 191 certified nutrient management advisers. Thirty nine of them are endorsed for greenhouse gases. In total 150 advisers will have completed the course by the end of 2019, but not all of those advisers are certified.[63]

Effective farm advisers draw on skills that develop with experience and ongoing professional development. Certified nutrient management advisers are required to complete 15 hours of professional development each year – including attending field days, conferences, workshops and learning modules – and their nutrient management reports are regularly audited for quality.[64]

A similar approach to ongoing development should be considered for any greenhouse gas emissions training.

BROADER AGRICULTURE TRAINING PROGRAMMES

The Government is currently proposing to reform New Zealand's vocational education system. One of the drivers of the reform is to ensure vocational training meets the needs of the future workforce in a changing world.[65] This is particularly the case for the rural workforce. Rural workers will need to work in different ways to implement lower emissions practices and move towards lower-emitting land uses.

In parallel, university courses for the agriculture sector are important to support strategic skills, reshaping agricultural sector markets and supply chains in the context of a potential price on emissions and changing international consumer preferences and markets.

Figure 5.2: *Farmers participate in a climate change workshop in the Waikato.*

SPECIFIC EXTENSION AND TRAINING SERVICES FOR MĀORI

There is evidence that the current mainstream models of agricultural education, training and extension services are not fit for purpose for Māori needs.

Due to the complexities around land ownership structures and governance, Māori land owners and those working on Māori land need bespoke solutions to address climate change.[66]

Programmes and advisory services that target the specific needs of Māori land owners with their unique governance and decision-making challenges, are more effective at supporting practice change than the current mainstream approaches.[67] To facilitate this, the Committee considers that specific funding for the development of Māori focused training and extension services is necessary. This is discussed further in **Chapter 13**.

5.4 Conclusion

Building the capability and capacity of farmers, farm advisers, and the wider agriculture sector to respond effectively to climate change policy will be critical. The Committee considers that achieving this will require an action plan, jointly developed by government and industry with specific recognition of Māori needs and perspectives (see Chapter 9).

Key elements of such an action plan should include:

- Developing a greenhouse gas module in farm environment plans that can work with the diversity of New Zealand farm systems, and increase the uptake of these plans
- Developing a set of good management practices that can help reduce emissions on-farm, alongside tools that help farmers integrate such practices within their farm systems
- Scaling up training and extension programmes for farmers, farm advisers, rural workers and other professionals that meet their diverse needs, including Māori focused training and extension services.

6. Policies for reducing agricultural emissions

Meeting New Zealand's emissions reduction targets will require every sector to make changes. All emissions sources except methane and nitrous oxide emissions from agriculture are already regulated through the New Zealand Emissions Trading Scheme (NZ ETS).

Farm environment planning, extension and training, and their implementation on a voluntary basis, will not be enough to achieve emissions reductions at the scale and pace that New Zealand needs to meet its targets.

The Committee considered a range of different policies that could be used to drive action on farms (**see Technical Appendix 3** for more detail). This chapter looks at three key types of policies that represent the spectrum of the policy options available:

1. *Mandatory farm environment plans with prescribed good management practices* that would require farmers to carry out specific actions
2. *Limits on emissions* that would require farmers to reduce emissions to below a certain level
3. *Price mechanisms* that would encourage farmers to make changes to reduce their exposure to an emissions price.

6.1 Mandatory farm environment plans with prescribed good management practices

Under this approach, every farmer would be required to have a farm environment plan and implement a set of good management practices. The plan would then be audited to check that it meets certain standards and that the plan is being implemented.

A key goal of such an approach would be to lift the performance of inefficient farms with high emissions per unit of product. This could lift the performance of the sector as a whole, given the very wide distribution of emissions across farms.

WHAT ARE THE ADVANTAGES?

This approach would be familiar to some farmers. Some farmers must already complete farm environment plans, which demonstrate how they will comply with good management practices for water quality.[68]

WHAT ARE THE DISADVANTAGES?

Mandating farm environment plans with prescribed good management practices does not guarantee emissions will reduce in line with targets. The adoption of a particular good management practice does not lead to predictable outcomes for greenhouse gas emissions. It is not one but a series of context-specific decisions, implemented with various degrees of ambition, that determine the impact on emissions including the direction of change (**see Chapter 5**).

This is a key difference from water quality, where some actions such as fencing off waterways will almost certainly reduce nitrate leaching, even if the amount of reduction will depend on other factors.

For this reason, mandatory good management practices do not seem a viable or sufficient way to achieve greenhouse gas reduction targets.

There are some future technologies, such as a methane inhibitor, that could be more amenable to compulsory good management practices as they could reliably and predictably reduce emissions on all farms.

Another major disadvantage of the good management practice approach is that it would not encourage or reward farmers to reduce emissions further by going beyond good management practice.

6.2 Putting limits on agricultural emissions

Farmers could be required to reduce methane and nitrous oxide emissions to within certain limits. This would put an implicit price on emissions for each farm, because there would be a cost to some farmers to achieving those limits.

There are various ways that limits could be set. At the crudest level, every farm could be required to reduce emissions by the same proportion relative to a base year, or there could be a maximum emissions limit per hectare, per tonne of product, or per stock unit. Limits could also be differentiated by farm type, region or land use potential.

WHAT ARE THE ADVANTAGES?

Emissions limits could be linked to national targets and regularly updated to ensure that emissions reduce to the level needed. Farmers would have clarity on what they need to achieve and the flexibility to choose what actions to take to meet their limits.

WHAT ARE THE DISADVANTAGES?

Emissions limits would be more costly to the agriculture sector and the New Zealand economy than is necessary. No matter what approach is used to set the limits, the costs of emissions reductions will vary, with some farmers having lower cost options than others.

With a limits based approach, each farmer would have to achieve the prescribed outcomes on their own farm regardless of how expensive it is for them to do so. Some farmers could make greater reductions at low cost but have no incentive to do so if they are already below the limit. This is economically inefficient for the sector.

The challenges around cost effectiveness are further exacerbated because limits would not just be set once, but a number of times over decades as New Zealand transitions towards long term targets.

6.3 Pricing agricultural emissions

A pricing policy puts an explicit price on emissions. Farmers would have to pay for emissions from their farm, but they can reduce this cost, and some could even be rewarded, by reducing emissions. Every tonne of emission reduced is a tonne that they don't have to pay for.

This would encourage farmers to factor the cost of emissions into their day-to-day business decisions and find cost-effective ways to reduce them. Responses could vary depending on the availability of current mitigation options and the time horizon of decision-making – these include changing behaviour now, investing in lower emissions technologies and practices, and innovating to find new mitigation solutions over the longer term (**see Figure 6.1**).

WHAT ARE THE ADVANTAGES?

As with a limit, pricing mechanisms are outcome-focused – they can be linked to national targets so that emissions reduce over time to the level required. Farmers have full flexibility to choose how and when to reduce emissions on their farm.

Compared to rules-based policies, pricing mechanisms have the best potential to deliver emissions reductions at least cost.[69] Some farmers have lower cost options for reducing emissions than others.[70] Farmers who can reduce emissions at a cost lower than the emissions price will generally do so, while other farmers may choose to pay for their emissions when it doesn't make financial sense to reduce them.

It also rewards farmers who do more on their farms, as every tonne of emissions reduced is a tonne that they do not have to pay for.

WHAT ARE THE DISADVANTAGES?

A disadvantage with pricing mechanisms is that each farmer would not be given their own limit or target to aim for. Instead, farmers would be expected to consider what mitigation options they have, and whether they are better off taking those options or paying for their emissions.

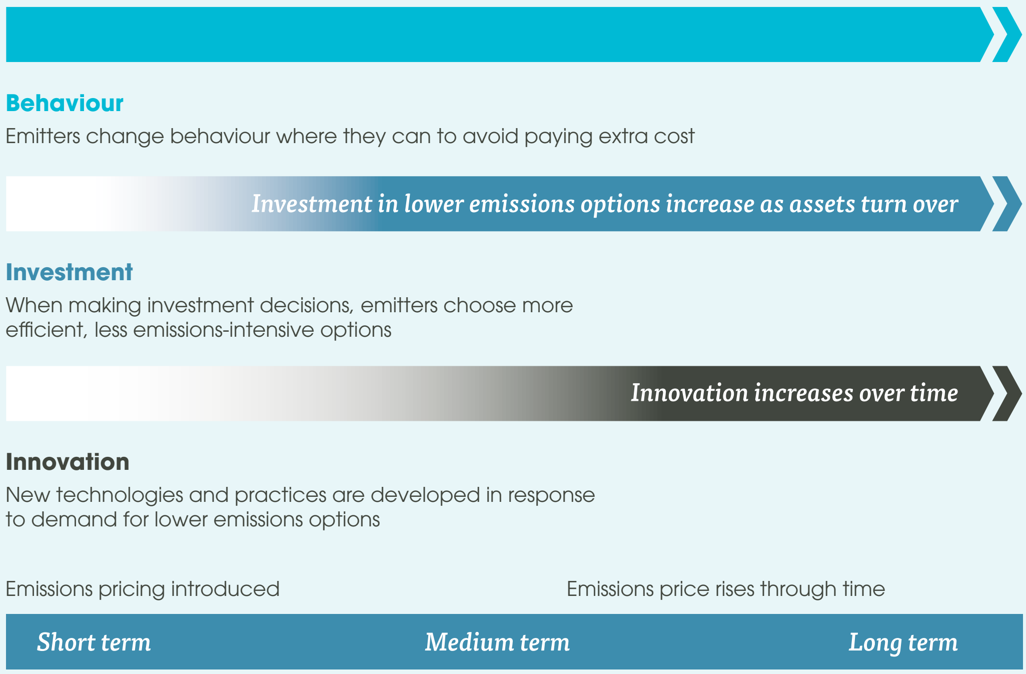


Figure 6.1: ***Individuals and businesses respond to emissions prices by changing behaviour, investing in lower emissions options, and innovating to find new solutions.***
Adapted from: *Ecofiscal Commission*

6.4 Conclusion

On balance, the Committee concludes that the best way to motivate all farmers to reduce emissions on their farms is by pricing them. A pricing mechanism would:

- Give farmers autonomy to choose what actions to take on their farm
- Reward farmers for taking positive actions and reward those farmers who do more
- Be managed in such a way to ensure that emissions reduce in line with targets
- Result in emissions reducing at lowest cost to the sector.

7. Two important features of a pricing policy

The previous chapter concludes that the best way to reduce agricultural emissions is by pricing emissions.

This chapter looks at two important features of any pricing policy:

1. Where the point of obligation should sit – at processor level or at farm-level
2. How agricultural emissions should be calculated.

7.1 Where should the point of obligation sit?

The point of obligation is the legal entity who needs to report data and directly face the price. Generally, the best place for the point of obligation is where emissions can be monitored with reasonable accuracy, where compliance can be enforced at reasonable cost, and on entities who can influence emissions reductions.

There are two main ways emissions could be priced in the agricultural sector – by regulating the processor, or the farmer.[71] There is a trade-off between the administrative costs on farmers and the Government and enabling farmers to take advantage of all the options available to reduce emissions. This trade-off is different for livestock emissions compared to emissions from nitrogen fertiliser.

RUMINANT LIVESTOCK EMISSIONS (92% OF TOTAL AGRICULTURAL EMISSIONS)

If the point of obligation sat at the processor level, processors would be likely to pass the costs on to farmers through reduced pay-outs for milk or meat. All farmers would face the same cost per unit of product despite the variability in their emissions footprint. They could reduce this cost only by reducing output, including by changing land use (**see Table 7.1**).[72]

In contrast, a farm-level point of obligation would enable a wider range of mitigation options to be recognised – including emissions reductions from reducing output but also management practices that reduce emissions intensity. A farm-level point of obligation is preferred by many in the agriculture sector.

Further, methods for calculating emissions on farm could incorporate emerging or new technologies as they become available, such as breeding low methane animals. The on-farm management practices that reduce emissions intensity may only have a modest impact on emissions now, but will be especially important in the future as more technologies are developed (**see Table 7.1**).

However, this greater potential for more on-farm mitigation needs to be balanced against the administrative costs of a farm-level point of obligation. Estimates suggest that operating a processor-level point of obligation will cost around $3 million compared to a minimum of $15 million to run at farm-level.[73] The extra cost of a farm-level policy is mainly due to it applying to 20,000 to 30,000 farmers.[74] The costs of a farm-level policy could be much higher if a complex calculation method was required, with much of those additional costs potentially borne by farmers.

Table 7.1: ***The incentives for farmers to reduce livestock emissions differ for a processor-level as compared to a farm-level point of obligation.***

	Processor-level point of obligation	Farm-level point of obligation
De-intensification	✓	✓
Land use change or diversification	✓	✓
Mitigations on-farm that reduce emissions intensity	X	✓
Novel technologies that reduce emissions intensity	X	Can be included

On balance, the Committee concludes that emissions from livestock should ideally be priced at the farm level so that all options available to farmers for reducing emissions could be recognised. Over the next 30 years, more mitigation options will become available and so the benefits of a farm level point of obligation will become increasingly important for meeting targets and can be expected to outweigh the relatively high administrative costs.

While a processor-level point of obligation has drawbacks, it has value as a starting point. This is particularly so if more nuanced methods for calculating emissions are used that offer additional options for farmers to reduce emissions other than reducing production. For example, using not just tonnes of meat or milk solids, but also livestock age classes and individual farm dairy cow numbers (**see Technical Appendix 2**).

NITROGEN FERTILISER EMISSIONS (APPROXIMATELY 6% OF TOTAL AGRICULTURAL EMISSIONS)

Farmers would receive the same incentive to reduce fertiliser emissions whether priced at the farm or at the fertiliser manufacturer and importer (**see Table 7.2**). Although science suggests that local factors, such as soil moisture and soil type, may impact how much nitrous oxide is emitted from a given type of fertiliser, the relationships are not yet well enough understood to be quantified in a robust way. Therefore, the only recognised way to reduce emissions from a given type of fertiliser is to use less of that fertiliser.

If an emissions price were placed on fertiliser manufacturers and importers, they would likely pass emissions costs on through the price of their products. So, farmers who use less fertiliser would reduce their emissions and would directly benefit through reduced exposure to the emissions cost. This would be fully consistent with the approach to pricing emissions from petrol in New Zealand.

Table 7.2: ***The incentives for farmers to reduce emissions from nitrogen fertiliser are the same for a processor-level and farm-level point of obligation.***

	Processor-level point of obligation	Farm-level point of obligation
More efficient fertiliser use	✓	✓

Evidence shows that farmers respond to higher fertiliser prices by using less of it, but there are also skill and knowledge barriers around how to use fertiliser most effectively.[75] Understanding fertiliser's contribution to emissions and how to improve fertiliser practices should still be supported through farm environment planning. This supports efficient fertiliser use while avoiding the costs of a farm-level point of obligation.

A farm-level fertiliser policy would significantly increase administrative costs due to the need to include farms that are solely horticulture or arable, in the system. Sector estimates suggest that there are at least 5,000 horticulture farmers.[76]

The Committee concludes that policy for addressing emissions from nitrogen fertiliser is best placed at the fertiliser manufacturer and importer level given the cost and lack of additional benefit of a farm-level point of obligation. This reflects the current state of scientific knowledge and data to calculate fertiliser emissions at farm and national level. However, the point of obligation should be re-assessed in the future if science advances such that there are other verifiable options at farm-level for reducing fertiliser emissions.

MINOR SOURCES OF AGRICULTURAL EMISSIONS

There are several other smaller sources of emissions from agriculture including carbon dioxide emissions from liming, and methane and nitrous oxide emissions from non-ruminant livestock such as pigs, poultry and horses. Further information on how to address these sources can be found in **Technical Appendix 1**.

7.2 How can agricultural emissions be calculated?

When it comes to reducing agricultural emissions, the first step is knowing what the emissions are. A farm's methane and nitrous oxide emissions cannot practically be measured as this would require measuring emissions from each animal and each paddock. However, the factors that drive emissions are well understood, and there are various ways that a farm's emissions can be calculated.

Emissions from nitrogen fertiliser are calculated by multiplying a fixed emissions factor (for example kilograms of nitrous oxide per tonne of fertiliser) by the tonnes of fertiliser applied.[77]

There are several different ways to calculate livestock emissions. These vary in complexity. The most basic calculations use the farm's milk or meat production or stock numbers. More complex methods (for example the approach used in the national greenhouse gas inventory and largely implemented in Overseer) need data on stock numbers, animal size, animal performance and diet characteristics.

The calculation method used influences what mitigations can be recognised. The more basic calculation options are simpler and less costly to use but are highly averaged and do not recognise all mitigation actions. For example, these methods may only recognise changes in emissions resulting from changing the level of production and/or the number of stock (**see Figure 7.1**).[78]

The more complex options require farmers to collect more data and are therefore more expensive (**see Figure 7.1**). However, the more complex options give more farm-specific values and recognise a wider range of mitigation actions, for example increasing animal performance or using low-emissions feed.

The method chosen for calculating emissions for a pricing policy is limited by the auditable information available. At the processor level, milk and meat processors know how many tonnes of milk solids or meat have come through their processing facility. They may also have or be able to acquire information on stock numbers and/or livestock age classes. Fertiliser manufacturers know how many tonnes of a particular type of nitrogen fertiliser they sell.

The availability of auditable farm specific data will differ depending on the farm type. For example, the livestock numbers on trading farms vary throughout the year and farmers may not all record information related to this stock with the same level of detail and quality.

There may be opportunities to improve data quality and reduce the costs of calculating emissions by improving data sharing with systems or processes that farmers already use. One way of doing this could be to use the New Zealand Farm Data Standards in the emissions calculation and reporting system.[79] This could enable farmers to leverage information held in other tools or systems (for example stock reconciliations or feed data) for emissions calculations.

Any complex emissions calculation method should be simple enough for farmers to understand and use in farm planning, and it needs to have transparent quality assurance.[80]

For detailed information on calculating emissions, **see Technical Appendix 2**.

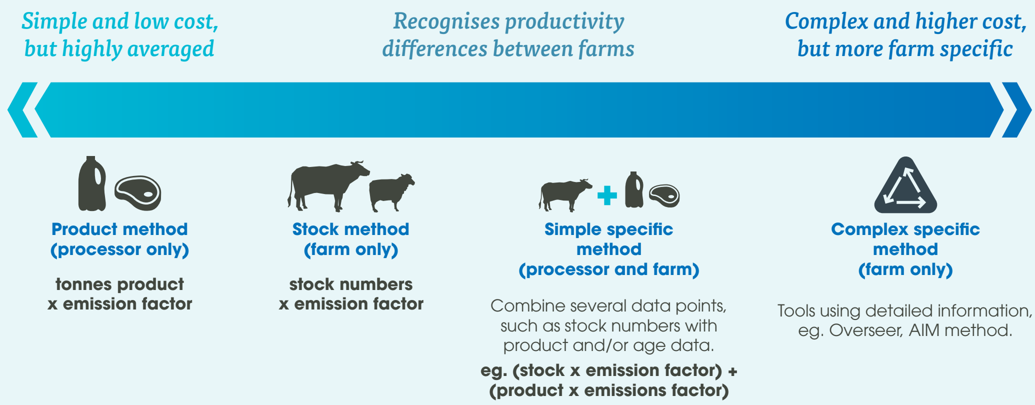


Figure 7.1: *There is a spectrum of methods for calculating livestock emissions.*

7.3 Conclusion

On balance, the Committee concludes that emissions from livestock should ideally be priced at the farm-level, whereas emissions from nitrogen fertiliser should be priced at the fertiliser manufacturer and importer level.

Calculating emissions at farm-level is possible, as long as a balance is struck between the desire to capture as much farm-specific detail as possible and the cost and availability of data.

A farm-level policy for livestock emissions would recognise all the mitigation options available to farmers, which will be increasingly important as New Zealand works towards its long-term targets.

The incentive for farmers to reduce fertiliser emissions is the same whether these emissions are priced at the farm or fertiliser manufacturer and importer level. The additional cost of pricing fertiliser emissions at farm-level is not justified. However, the point of obligation should be re-assessed in the future if the science advances and other credible options are found for reducing fertiliser emissions.

8.
What type of pricing policy should be used?

The previous chapters conclude that livestock emissions should be priced at farm-level, and fertiliser emissions should be priced at the fertiliser manufacturer and importer level.

This chapter considers what type of pricing policy should be used. It looks at three options:

1. Including agricultural emissions in the New Zealand Emissions Trading Scheme (NZ ETS)
2. A dual cap ETS or methane quota system
3. A levy/rebate scheme for agricultural emissions.

8.1 Including agricultural emissions in the NZ ETS

Emissions trading schemes work by putting a cap or scheme-wide limit on total emissions. Emissions units equivalent to the cap are allocated to businesses through a combination of auctions and free allocation. The limited supply of units generates a market and an emissions price.

Every business in the scheme must surrender one unit for every tonne of emissions. Emitters can reduce emissions to reduce the quantity of units they need to surrender and/or reduce the higher costs they face as a result of the scheme. Across all emissions sources, emissions reductions must be sufficient to achieve the cap.

New Zealand has had an emissions trading scheme since 2008 (the NZ ETS). All New Zealand's emissions, except agricultural methane and nitrous oxide, are currently covered by the NZ ETS. Including agricultural emissions in the NZ ETS would align with the way other sectors are treated.

This approach differs for livestock and fertiliser emissions:

- If **livestock emissions** were priced at farm-level using the NZ ETS, farmers would be required to make decisions about when and how to buy and sell units. Many farmers are likely to find this complex and costly given the relatively small scale of both their emissions and their businesses
- If **fertiliser emissions** were priced at processor-level using the NZ ETS, fertiliser manufacturers and importers would have several options to manage emissions price risk, such as hedging or forward contracts. It would also bring them in line with other emitters of similar size and capability.

8.2 A dual cap ETS or methane quota system

A variation on the NZ ETS would be to split out methane into its own trading system, as has been recommended by the Productivity Commission.[81] This could be done through either:

- A dual cap ETS with one cap for methane emissions and another cap for other gases
- A methane quota system for methane emissions and the NZ ETS for other gases.

Both systems would create similar incentives to the NZ ETS. However, a dual cap ETS or methane quota system would add further cost, complexity and risk for farmers.

With a dual cap ETS, farmers would need to trade two different types of units, with two prices driven by the two different caps.

With a methane quota system, farmers would need to trade in two entirely different systems with different rules – in the methane quota system for methane and in the NZ ETS for their nitrous oxide emissions and carbon sequestered by trees.

Splitting out methane in this way would also mean that farmers wouldn't be able to use carbon sequestered by trees to offset methane emissions.

There are other ways that different targets for different gases can be factored into a pricing mechanism. For more information, **see Technical Appendix 4**.

8.3 A levy/rebate on agricultural emissions

Agricultural emissions could be priced using a levy/rebate scheme. Farmers would pay a set price for their emissions. This price would be set and updated each year to align with the NZ ETS price unless there are different targets for different gases. In the case of different targets for different gases, the relative prices could be adjusted over time to ensure they reflect the different targets.

This would essentially be the same as including the sector in the NZ ETS, but without the risks and costs of farmers having to trade units. The Government would need to factor the expected level of agricultural emissions, including the anticipated effect of the levy/rebate scheme, into decisions about the NZ ETS emissions cap and ensure that total emissions stay within an overall budget. This would integrate the levy/rebate scheme with the NZ ETS.

This approach would be similar to the existing synthetic greenhouse gas levy. This levy was established to avoid putting a large administrative burden on importers of products containing small amounts of these gases.[82] It is also linked to the emissions price generated by the NZ ETS.

In a levy/rebate scheme – depending on how any free allocation is distributed – some farmers would pay for their emissions while others would receive a rebate (**see Chapter 10**).

This approach differs for livestock and fertiliser emissions:

- If **livestock emissions** were priced at farm-level using a levy/rebate scheme, it would be less complex and therefore less costly for farmers to comply with as they wouldn't have to trade in emissions markets. In brokerage costs alone, this could save farmers up to $500 per transaction or $12 million for the sector as a whole each year.[83]

  A levy/rebate scheme would also provide farmers with some certainty about their emissions costs for the upcoming year. As the price would be fixed in advance each year, the price would be less variable than the emissions price in the NZ ETS.
- If **fertiliser emissions** were priced at processor-level using a levy/rebate scheme, fertiliser manufacturers and importers would need to manage their emissions price risk indirectly rather than by trading units they need for compliance. This would be different to the way other emitters of similar size and capability who participate in the NZ ETS are treated.

8.4 Conclusion

The Committee concludes that, if livestock emissions are priced at the farm-level, then a levy/rebate scheme is the best way to enable that. This will reduce the cost, complexity and risk for farmers that would come with trading units in the NZ ETS, dual cap ETS or a methane quota system, and won't affect cost-effectiveness or New Zealand's ability to manage the transition toward long-term targets.

If fertiliser emissions are priced at the processor level, then the NZ ETS should be used. Fertiliser manufacturers and importers would then be treated in much the same way as other similar sized emitters. They could also more easily make use of the risk management options offered by the NZ ETS that can be useful for businesses of their size.

Treating methane differently in a levy/rebate scheme

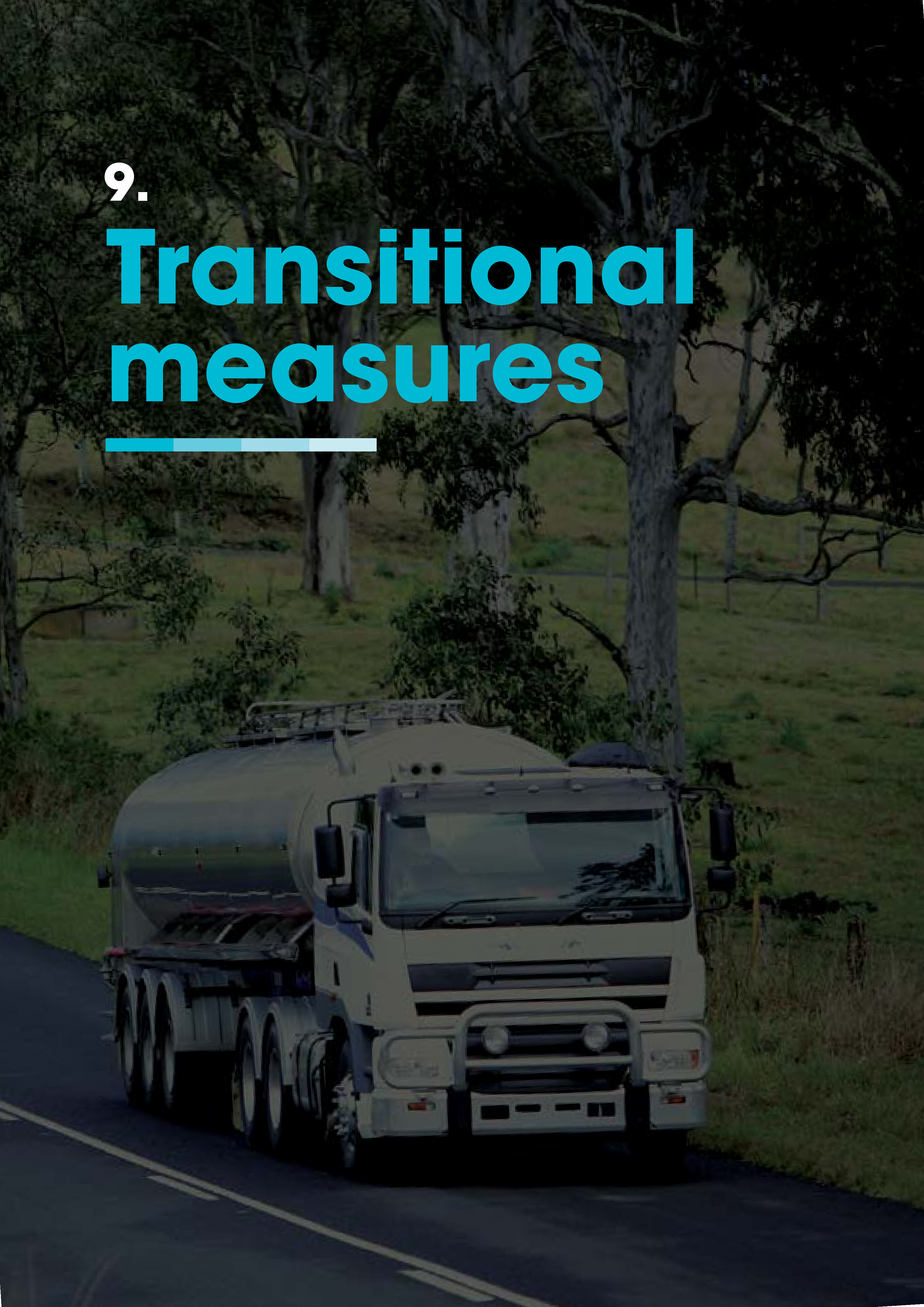
Box 8.1:

The Government consulted on different options for the 2050 target, including different targets for long-lived and short-lived gases. It is not the Committee's role to recommend targets, but to provide advice on policies that can achieve whatever target(s) the* Zero Carbon Bill *may contain.

A levy/rebate scheme can accommodate different targets for different greenhouse gases by adjusting the relative price for each gas. The price that applies to methane could be determined and adjusted over time to ensure it reflects a different target for short-lived gases. The process for adjusting the methane price should be explicitly spelled out in legislation, and should be based on advice from the independent Climate Change Commission that is expected to be established under the *Zero Carbon Bill*.

How any policy can deliver a target that treats methane differently than other gases is described further in **Technical Appendix 4**.

9. Transitional measures



The Committee recommends that livestock emissions be priced through a farm-level levy/rebate scheme and recognises that implementation will take time.

This chapter looks at the steps needed to implement a farm-level levy/rebate scheme and outlines an interim option for pricing livestock emissions.

9.1 What is required to implement a farm-level levy/rebate scheme?

Implementing a farm-level levy/rebate scheme will be no small task. This needs to be done in collaboration with the entire agricultural sector, including farmers and owners of Māori land.

The steps needed to develop and implement a farm-level emissions levy/rebate scheme include:[84]

1. **Amending the Climate Change Response Act** to include a start date for the farm-level levy/rebate scheme, and add enabling provisions to implement the levy/rebate scheme
2. **Policy design work** in collaboration with industry and iwi/Māori to support implementation, including:
   a. *developing an emissions calculations method.* The Government will need to work with the agricultural sector and iwi/Māori (including owners of Māori land) to determine calculation methods. The development process will need to evaluate available, auditable farm data and processes for updating and improving methods over time.
   b. *confirming and refining the method for free allocation.* This needs to include deciding on the balance between land-based and output-based allocation, developing a map of inherent grass growth potential for land-based allocation, determining eligibility rules, and working with iwi/Māori to make sure owners of Māori land are not disproportionately disadvantaged.
   c. *clarifying other implementation details* related to point of obligation, reporting, audit and compliance.

   If the simplest calculation methods and approaches are selected, it could be possible to establish all regulations needed by the end of 2021.
3. **Building a system to administer the levy/rebate scheme**, including information technology requirements. This would include Government appointing and funding an appropriate agency to administer the system. Gathering requirements and designing, building, testing and implementing a system would likely take up to two years.
4. **Registering farmers in the levy/rebate scheme.** Registering 20,000–30,000 participants will take time. The Committee sees value in having at least one year of mandatory reporting of emissions before the financial levy/rebate comes into effect in order to test the system. A longer voluntary reporting period would help to build farmer familiarity with the system.

If only simple calculation methods and limited farm-level data are used, the levy/rebate scheme could start effectively by 2023. However, an overly simple approach may not capture key mitigation options and risks being seen as lacking credibility and relevance by farmers.

The Committee recognises that setting a 'go-live' date of 2025 allows time to develop and agree on sufficiently complex emissions calculation methods, ensure farm-level data is available for emissions and allocation methods, and undertake more robust systems testing (**see Figure 9.1**).

Planning the implementation for 2025 would also better enable owners of Māori land to respond to a farm-level levy/rebate scheme, given the challenges for decision-making on collectively owned land.

Taking all this into account, the Committee considers it reasonable that a farm-level levy/rebate scheme for livestock emissions could be in place by 2025.

To provide policy certainty and planning certainty for farmers, the start dates for mandatory reporting and for levy/rebate obligations should be put into legislation.

DEVELOPING AND IMPLEMENTING A JOINT ACTION PLAN

Alongside work to implement the pricing regulation, Government should put an action plan in place as soon as possible to ensure that farmers can respond effectively to the farm-level policy by 2025. This action plan needs to be co-developed with the sector and iwi/Māori (including owners of Māori land).

The action plan should not only inform policy design choices, but also needs to:

- **Build the capability of farmers and farm advisers** to enable them to identify and implement appropriate farm-scale mitigation practices and land use change, and increase the capacity of farm advisers to support farmers
- **Support farmers to take early action** to reduce emissions through exploring, testing and sharing their experiences
- **Support on-going research and development** to expand the range of mitigation options available and improve monitoring, reporting and verification at farm scale.

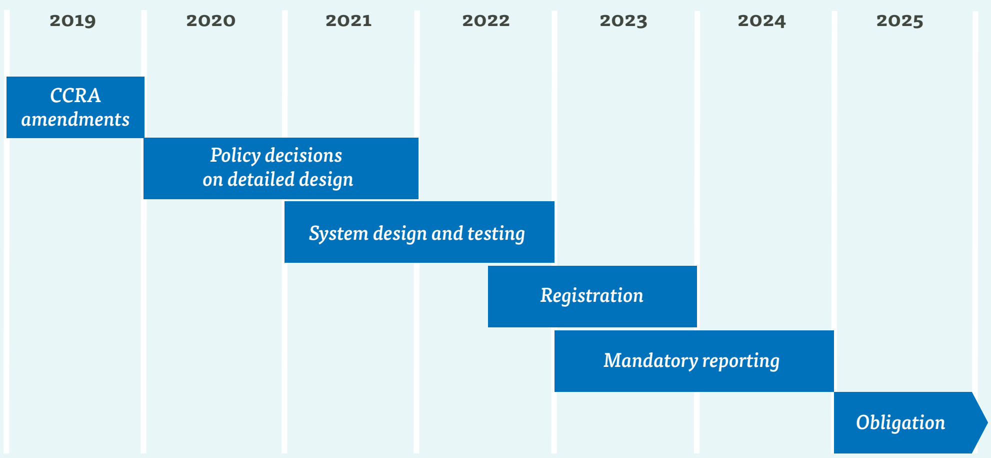


Figure 9.1: *Timeline of steps for implementing a farm-level levy/rebate scheme.*

9.2 What should happen in the interim?

Waiting until 2025 means further delays in the full engagement of the agriculture sector in the process of moving towards a low-emissions sector. There is a need to act now.

Interim measures are needed that:

- create a policy framework that can endure over time
- ensure that tools to support a farm-level levy will be in place by 2025
- give certainty that a price-based policy will be applied to agricultural emissions.

The Committee considered different ways to meet these objectives. These include:

- a formal agreement between the Government and sector, but without any regulatory requirements, until the farm-level levy/rebate scheme comes into effect, and
- exposing farmers to emissions prices indirectly by requiring processors to surrender units for livestock emissions in the NZ ETS.

Certainty about the future direction of policy will be important to allow farmers and the wider agriculture sector to factor an emissions price into investment decisions. However, there is no perfect way to get started now while moving towards better arrangements in the future.

These different approaches create different types of risk regarding policy certainty, and resourcing and implementing an action plan.

A FORMAL AGREEMENT BETWEEN THE GOVERNMENT AND SECTOR

The agriculture sector could formally agree with the Government to take certain actions and/or deliver certain outcomes as part of a Joint Action Plan.

A formal agreement between the sector and Government aligns with a collaborative approach to implement durable policy. It would encourage the use and testing of industry data about farm-level emissions and economic performance to inform policy design.

This approach is focused on tangible outcomes and leaves the sector in full control of how it delivers these. It would also align with sector strategies to ensure the widespread uptake of farm environment plans to manage diverse environmental outcomes.

However, a key challenge is that agreeing the specific outcomes, and monitoring and ensuring timely delivery of the Joint Action Plan under such an arrangement would be difficult. Each minor delay would most likely be insufficient to trigger a wholesale review of the approach. However, any delays would create uncertainty and risks to the full implementation of the farm-level levy/rebate scheme by 2025, and would send an unclear investment signal.

A further challenge is that the funding required to support the action plan would be substantial, and it may be difficult for the sector to reliably raise the required resources. Any shortfall in funding from the sector would further add to the risk of delaying the policy or would have to be compensated by a greater share of the cost being borne by the Government.

Significant additional investment would be needed if the action plan was intended to go beyond basic readiness by the sector for the farm-level policy and also support early actions in the form of on-farm trials, pilot studies and extension, alongside capability building.

Overall, the Committee considers that a voluntary collaborative approach to 2025, even if supported by a formal agreement, creates a substantive risk to the resourcing and timely implementation of the farm-level levy/rebate scheme for livestock emissions. This would result in on-going policy uncertainty that could weaken investment signals and reduce preparedness by the sector for agricultural greenhouse gas policy that helps meet New Zealand’s targets.

INCLUDING PROCESSORS IN THE NZ ETS

Pricing livestock emissions through a processor point of obligation in the NZ ETS is another way to increase policy and investor certainty, and get early engagement from the agriculture sector in its implementation.

Agricultural processors are already required to report their greenhouse gas emissions annually in the NZ ETS. Pricing those emissions through the NZ ETS would be possible from 2020, depending on the speed of changes to the Climate Change Response Act and the need to provide adequate notice. Starting the pricing in 2020 would ensure the agriculture sector begins to contribute to mitigation along with other sectors well before 2025.

This approach would provide certainty that emissions will be priced, and would send a clear and credible signal to farmers and the wider agriculture sector to begin factoring emissions prices into investment decisions now.

Requiring processors to participate fully in the NZ ETS would generate funds that could be recycled back to the sector to help implement the action plan, and to ensure the sector is ready for a farm-level policy by 2025.

The Committee recognises that pricing livestock emissions at processor level in the NZ ETS would expose farmers only to an indirect incentive to reduce emissions via reduced pay-outs (**see Chapter 7**). This would not reward farmers who reduce their emissions intensity, but it would encourage farmers to reduce emissions by de-intensifying production or diversifying land use within or across farms.

The price signal to farmers would be muted, given the Government's commitment to provide 95% free allocation.[85] While this can be seen as a negative, it ensures the start to climate policy is gradual and avoids disruptive change. The Joint Action Plan, supported by the funds generated by this approach, could support additional early action by farmers through benchmarking, trials and pilot studies, and extension programmes.

A key concern heard by the Committee is that once a processor-level price mechanism is in the NZ ETS, the pricing policy would not move to farm-level as planned.[86] This is a legitimate concern but, in the Committee's view, getting started with a weak incentive to reduce emissions is preferable to not having one at all.

To further mitigate this concern, the Committee considered whether farmers could opt into the farm-level levy/rebate scheme before 2025 while the processors still face a price in the NZ ETS. However, all elements of the farm-level scheme would need to be in place for an effective opt-in process, which makes this option difficult. It may be more feasible to set up targeted pilot programmes with some farmers who volunteer (and could be supported under the Joint Action Plan) to participate in the farm-level scheme on a trial basis before it is rolled out formally. These ideas should be explored further as the scheme is being developed.

9.3 Conclusion

Successful implementation of a credible and effective farm-level levy/rebate scheme for livestock emissions will take about five years. Government, industry and iwi/Māori, including owners of Māori land, need to work together on an action plan to get the sector fully prepared for effective implementation of this policy by 2025.

To provide certainty, the dates for mandatory reporting (by 2023) and for the commencement of levy obligations (by 2025) should be put into legislation.

However, New Zealand cannot wait until 2025 to get started on addressing livestock emissions. In the interim, the Committee considers agriculture processors should be fully included in the NZ ETS as soon as practicable.

This inclusion is straightforward to implement and will:

- Send a clear and credible signal to factor an emissions price into investment decisions
- Generate funds that can be used to support farmers to reduce emissions and ensure the sector is ready for a farm-level levy/ rebate scheme by 2025
- Provide a gradual transition for the sector to become part of New Zealand's domestic response to climate change.

To address concerns about policy lock-in, it will be important for the Government to demonstrate and communicate effectively how this approach is fully aligned with and facilitates a farm-level levy/rebate scheme for livestock emissions by 2025.

10.

Assisting farmers and rural communities through free allocation

The Government has committed to assisting the sector with 95% free allocation of emissions units if agriculture was included in the NZ ETS.[87] Free allocation is the term used to describe an allocation of emissions without cost to specific businesses by the Government.

Free allocation can help farmers and rural communities deal with the increased costs from pricing emissions and the challenges of changing farm practices. The annual cost to the agriculture sector with 95% free allocation would be around $50 million rather than around $1 billion without it at the current emissions price.[88] On average, the cost of emissions with no emissions reductions and a 95% free allocation is shown in **Table 10.1**.

Although the agricultural sector as a whole will receive a 95% free allocation, the method used to provide it can significantly alter how these costs are distributed across individual businesses.

Free allocation is different to how the term 'allocation' may be used in water policy, where it often refers to a farm-specific limit for a water take or discharge.

In the NZ ETS, free allocation is considered transitional assistance. The intent is to reduce the level of assistance over time through a well-signalled phase-out, for overall economic efficiency and equity reasons.

This chapter covers:

- The purpose for providing allocation
- The methods that can be used for farm-level and processor-level policies
- An option for capitalising free allocation
- How adjusting free allocation over time could be handled.

***Table 10.1:** Average cost at an emissions price of $25 per tonne of CO_2e with 95% free allocation.[89]*

Per dairy cow	$4.60	Per kilogram milk solids	$0.01
Per head of non-dairy cattle	$2.30	Per kilogram beef	$0.01
Per sheep	$0.47	Per kilogram sheep meat	$0.03
Per deer	$0.86	Per kilogram venison	$0.04
Per tonne of urea	$2.92		

10.1 The purpose of allocation

The primary purpose of pricing emissions is to encourage emissions reductions. Any free allocation method needs to balance:

- Minimising the overall costs to New Zealand of reducing emissions, with
- Helping farmers and rural communities deal with increased costs imposed on them, and the transition to low-emissions agriculture.

There are several reasons for providing free allocation, such as to:

- Avoid severe social impacts from rapid changes – for example impacts on employment from reduced livestock production and land use change
- Not disadvantage farmers who have low-emissions or have already taken steps to reduce them
- Reduce the financial burden on farmers with high existing debt – reduced cashflows may affect some farmers' ability to service debt incurred before the policy was introduced
- Reduce impacts from existing farm assets losing value, such as land or farm infrastructure investments
- Reduce the risk that production shifts offshore in a way that increases global emissions – emissions leakage
- Reduce stranded processing assets, such as early retirement of dairy and meat processing plants.

As a result of analysis and engagement with the sector, the Committee considers the main reason for providing free allocation to the agriculture sector is to help manage the social impacts of emissions pricing on farmers and rural communities (**see Box 10.1**).

The Committee considers that the risk of emissions leakage is a lesser concern (**see Box 10.2**). This contrasts with decisions made in 2009 about industrial allocation in the NZ ETS, which focused on reducing the risk of emissions leakage.

Impacts on rural communities

Box 10.1:

A concern with policy that addresses agricultural emissions is that it could negatively impact rural communities, particularly if it results in rapid land use change to forestry.[90]

This concern reflects the experience of rural communities in the late 1980s when the removal of agricultural subsidies led to wholesale and rapid land use change. This negatively impacted rural communities through reduced employment and population, and demographic changes that in turn affected key social institutions such as schools, libraries and sports clubs. Rural communities that had diverse businesses and land uses, and strong social and cultural capital, were generally more resilient to change.[91]

The impact of the rapid changes in the 1980s highlights possible consequences if policies aren't designed to enable gradual change and support farmers, rural workers and rural communities.

A quantitative study on the likely scale and location of land use change resulting from pricing agricultural emissions suggests that:

- The dominant driver for land use change is the price on carbon sequestration for forestry, not the price on agricultural emissions
- Change is spread broadly across the country and is not concentrated in a single area or region
- Impacts on direct employment from land use change are expected to be small at national level but could have more significant implications at regional and local scales
- Where relatively low-value sheep and beef land is converted into forestry, the absolute impact on employment may not be large, but there may be an impact on populations that already have lower than average employment levels and suffer higher levels of deprivation.[92]

These potential impacts should not stand in the way of policies to reduce agricultural emissions. Rather it reinforces the need to get started on reducing emissions from agriculture to avoid the need for more rapid change later. It underlines that **the pace of change must be managed carefully.**

There are two important areas for further work:

- Research on the likely consequences on rural land-values and profits, and more detailed analysis of implications for rural employment, demographics and social services, to inform any advice on phasing down the allocation rate
- Identifying communities and population groups most vulnerable to rural change in response to climate policies, in order to co-design programmes that can strengthen resilience and support diversification of land-based activities.

For further information, see Technical Appendix 6.

The risk of emissions leakage

Box 10.2:

Farmers and agricultural processors have expressed concern that reducing agricultural emissions in New Zealand could result in higher global emissions. Understanding this risk involves considering two questions:

- Will climate policy in New Zealand decrease the international competitiveness of agricultural producers, leading to reduced exports?
- If New Zealand exports less dairy or meat, will other producers increase their output of livestock products (and consequently emissions), and if so, will this result in increased global emissions?

The answers are slightly different for dairy and drystock.

In the near term, dairy is unlikely to reduce significantly due to climate policy because it is a highly profitable land use compared to alternatives. Capital investments also mean production intensity is unlikely to drop rapidly.

Even if New Zealand exports decreased, regions that could increase dairy production are mostly in Western Europe or North America (for example California). These have highly efficient, export-oriented production systems with emissions footprints of dairy production similar to ours. Farmers in these locations also face significant environmental regulations (including pollution pricing) on nitrate, ammonia and phosphorus emissions. These countries have generally adopted economy-wide emissions caps, meaning that even if their agricultural emissions were to increase, other sectors of their economy would have to reduce their emissions even more.

Putting all these factors together, the risk of emissions leakage for dairy appears to be low in the near term.

The drystock sector is potentially more responsive to emissions prices although the driver for land use change is likely to be because forestry is becoming more profitable, not because of a price on agricultural emissions. If a significant decrease in meat production were to occur, the risk of leakage is greater because not all of our competitors are developed countries with economy-wide emissions targets. However, New Zealand producers' increasing efforts to differentiate their products on quality, environmental credentials and provenance may moderate this risk.

In summary, the risk of leakage does not appear high in the near term and can be mitigated further by providing allocation strategically. In the longer term, potential changes in consumer demand and the rise of synthetic and plant-based proteins may have more influence on product volumes than domestic climate change policy. Nonetheless, it will be important to keep an eye on global markets and actions by competitors to ensure that domestic climate policy contributes to global environmental benefits.

For further information, see Technical Appendix 7.


SCHOOL
BUS
ROUTE

10.2 Allocation at farm-level

In a levy/rebate scheme with free allocation, the net obligation for a farmer each year would be worked out as follows:

Net obligation = (emissions - allocation) x levy rate

If a farmer's emissions exceed the allocation of emissions provided, they would face a cost. Where their emissions are equal to or less than the allocation, they would face no cost or receive a rebate.

There are several different ways of distributing allocations. How it is done alters how costs are distributed across individual farmers, what incentives farmers have to reduce emissions, and how farmers and rural communities are supported through change.

The Committee has looked at five different allocation methods:

- Grandparenting
- Proportional
- Output-based
- Land-based
- A hybrid of output-based and land-based.

This section outlines some analysis of how the options affect costs and incentives. This has drawn on data from the DairyNZ Economic Service, Beef + Lamb New Zealand Economic Service, and Ministry of Primary Industries.[93] It includes graphs of how the options might change the distribution of costs on farms. It also includes graphs showing how allocation options alter the reward or reduced cost on farm when a farmer reduces emissions (marginal price incentive). There are two incentives to consider:

1. reducing emissions intensity
2. reducing emissions by reducing production.

GRANDPARENTED ALLOCATION

A farmer's allocation would be determined by historic farm data, such as emissions, stock numbers or production. A farmer would receive the same volume of free allocation each year, as long as the allocation rate (95%) remains constant.

Who it advantages and disadvantages

Farmers with higher historic emissions would benefit the most from this method.[94] Farms that have already reduced emissions or who have not intensified would be disadvantaged. It is likely to disproportionately disadvantage land that is underdeveloped including Māori owned land.

Effect on incentives

This method preserves incentives to reduce emissions. At an emissions price of $25 per tonne, farmers would save $25 for every tonne of emissions they reduce either through reducing emissions intensity or production, or conversely face a $25 penalty for each increased tonne.

Reasons for using this method

This method would reduce the extent of stranded farm assets because it allows farmers to continue operating as they have historically with minimal additional cost. The strong incentive for farmers to reduce production means it gives no protection against emissions leakage risk.

Drawbacks of this method

This method could be practically challenging to implement because it requires several years of historic farm data and that data might not be readily available for all farmers.

Many farmers dislike this method. They see it as rewarding polluters, while penalising farmers who were already low emitters or those who have already acted to reduce emissions.[95]

PROPORTIONAL ALLOCATION

A farmer's allocation would be a proportion of their annual emissions, meaning the allocation volume would change each year depending on the farm's actual emissions. It would be worked out as follows:

Allocation = annual farm emissions x allocation rate (95%)

Who it advantages and disadvantages

This method would provide the least differentiation among farmers, as everybody pays for 5% of their emissions regardless of their emissions intensity or intensity of land use. No farmer receives a rebate.[96] (**see Figure 10.1**)

Effect on incentives

This method greatly weakens incentives for farmers to reduce emissions either through reducing emissions intensity or through reducing production (**see Figure 10.2**). This is because the more they emit the more allocation they receive.

Reasons for using this method

This method would be very simple to implement.

Drawbacks of this method

This method weakens incentives in a way that fundamentally limits the emissions reductions delivered by the policy. Therefore, other methods would be preferred over this one.

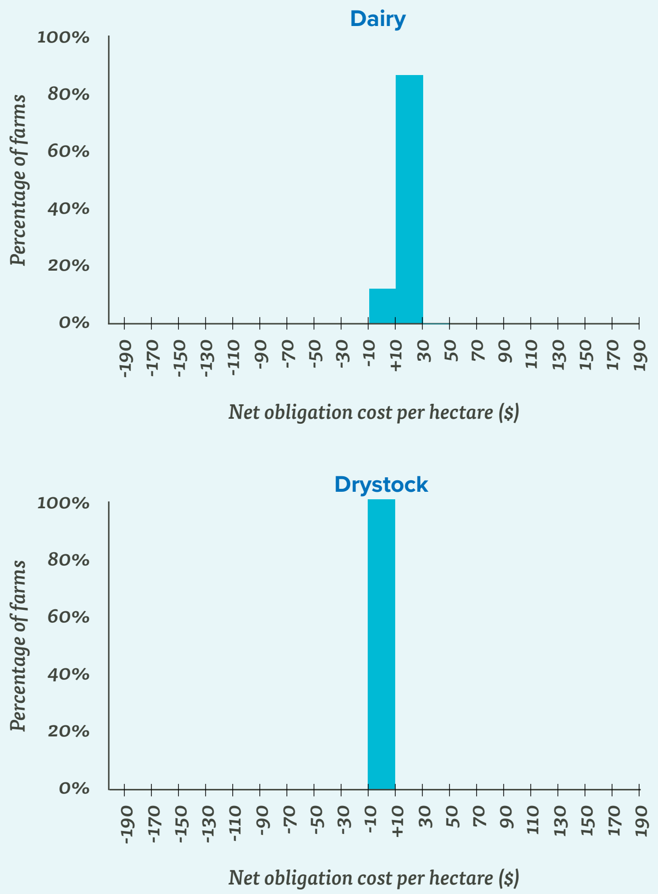


Figure 10.1: *Net obligation cost per hectare using proportional allocation. In these samples, the lower to upper quartiles range from $12 to $18/ha for costs to dairy farmers, and from $3 to $5/ha for costs to drystock farmers.*

Source: DairyNZ, Beef + Lamb New Zealand, Ministry for Primary Industries

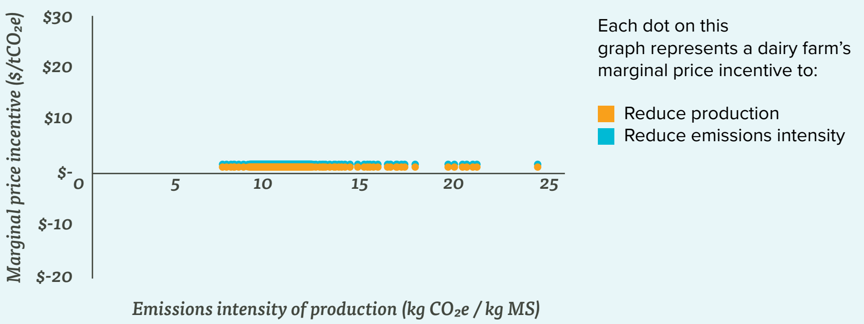


Figure 10.2: *Marginal price incentives under proportional allocation. This method weakens incentives to reduce emissions. Rather than saving $25 for every tonne of emissions that they reduce, a farmer would only save $1.25 a tonne.*

OUTPUT-BASED ALLOCATION

A farm's allocation would be based on its annual output, for example of milk solids for dairy, or stock numbers for drystock farming.[97] This is the method that is used for industrial allocation in the NZ ETS.

If a farm's annual output increases, the amount of allocation increases. Conversely, if output decreases, the allocation decreases. A farm's allocation would be worked out as follows:

Allocation = annual farm output x allocation factor x allocation rate (95%)

The allocation factor would be based on the national average emissions intensity per unit of output or average emissions per animal.

Who it advantages and disadvantages

Farms with lower emissions intensity per unit of production would benefit from this method while those with higher emissions intensity (which likely includes some underdeveloped land) would be disadvantaged (**see Figure 10.3**).

Effect on incentives

Farmers would be encouraged to reduce emissions by becoming more emissions efficient, rather than by reducing production. In fact, this method could encourage farmers who are very emissions efficient to increase production (**see Figure 10.4**).

Reasons for using this method

Output-based allocation would slow the pace of change for rural communities and mitigate the risk of emissions leakage because it keeps livestock production higher than it otherwise would be. The reduced pressure for change may also be beneficial for iwi/Māori owned land, whose decision-making processes can be lengthy due to ownership structures. It also creates fewer barriers to development of underdeveloped land.

Drawbacks of this method

Downsides of output-based allocation include that it would:

- encourage investment in new processing assets and on-farm infrastructure, which may later become stranded
- encourage farmers to intensify, which may conflict with other environment objectives such as water quality
- mean that some cost-effective emissions reductions such as de-intensifying or changing land use don't get taken up.

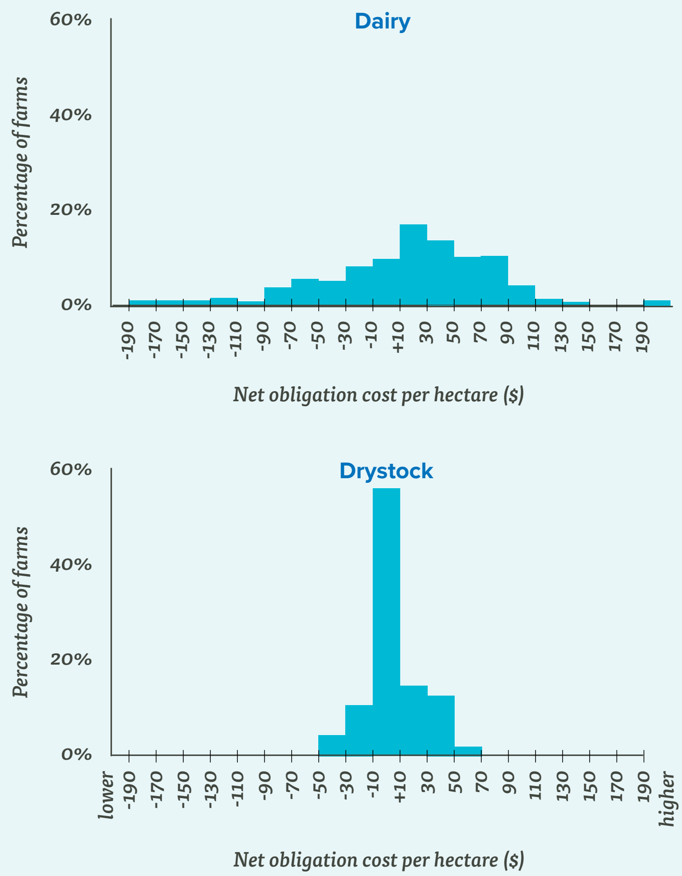


Figure 10.3: *Net obligation cost per hectare using output-based allocation. Farmers with lower emissions intensity would receive a rebate (shown as negative numbers in the above graphs) while less efficient farmers would pay the levy. In these samples, the lower to upper quartiles of the levy/rebate range from -$19 to $58/ha for dairy farmers, and from -$6 to $14/ha for drystock farmers. The greater spread for dairy reflects the wide range of emissions intensity across dairy farms.*

Source: DairyNZ, Beef + Lamb New Zealand, Ministry for Primary Industries

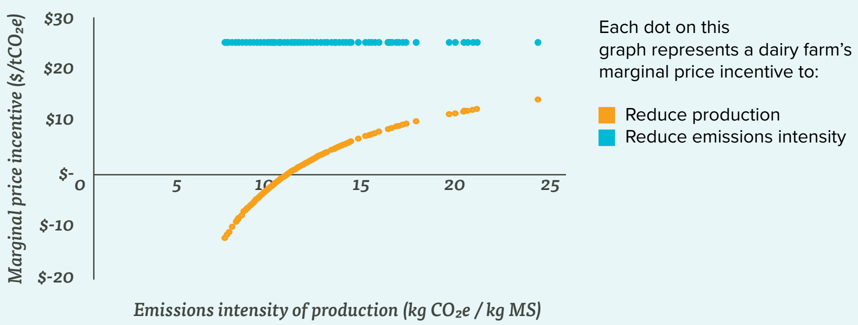


Figure 10.4: *Marginal price incentives under output-based allocation. With this method there would be a full incentive to reduce emissions intensity. The incentive to reduce production would vary farm-by-farm depending on their emissions intensity of production. Some very efficient farms would be encouraged to increase production, as their marginal allocation would be greater than marginal emissions for increases in output (as shown in the graph by farms below the x-axis).*

LAND-BASED ALLOCATION

A farmer's allocation would be determined by farm land area and quality. There are several ways that this could be done, but all would use a similar equation to the below:

Allocation = land area x allocation factor/s x allocation rate (95%)

The allocation factor/s would vary the amount of allocation given per hectare, based on the land's characteristics. Farmers would receive the same amount of allocation from year to year, unless they increase or decrease the size of their farm.

The allocation factors would ideally be based on a proxy for the productive capacity of the land. Land is an asset that is likely to lose value in the near term due to emissions pricing. The land's productive capacity is a key influence on agricultural land values.

Any proxy used should be based on robust data at an appropriate scale for farm-level allocation decisions. Land Use Capability has been used as such a proxy in freshwater allocation policies. However, Land Use Capability has been used as such a proxy in freshw was developed for regional planning purposes and the existing national map is not at farm-scale resolution.

An alternative, more tailored to free allocation to ruminant livestock farms, could be to develop a national map of intrinsic grass growth potential, using characteristics such as soil types, slope, climate, rainfall and aspect. There is extensive national spatial data available on such characteristics. This would allow a map to be developed that is suitable for determining farm-scale greenhouse gas emissions allocation volumes.

Who it advantages and disadvantages

The proxy that the allocation rate per hectare is based on determines how the costs would be distributed across farms. Generally, land-based allocation would benefit farms with lower stocking rates and lower emissions per hectare (**see Figure 10.5**). Underdeveloped land, including some Māori owned land, would do well under this method. Farms with high stocking rates would be disadvantaged particularly if their production is emissions intensive.

Effect on incentives

This method incentivises reductions in production and emissions intensity. (**see Figure 10.6**)

Reasons for using this method

Basing free allocation on a proxy related to land value or productive capacity would assist land owners whose land may decrease in value due to emissions pricing.

Drawbacks of this method

Land-based allocation is not the method best targeted at protecting rural communities from rapid change or preventing emissions leakage. This is because it preserves the full incentive to reduce production. Implementing a land-based method may also be complex.

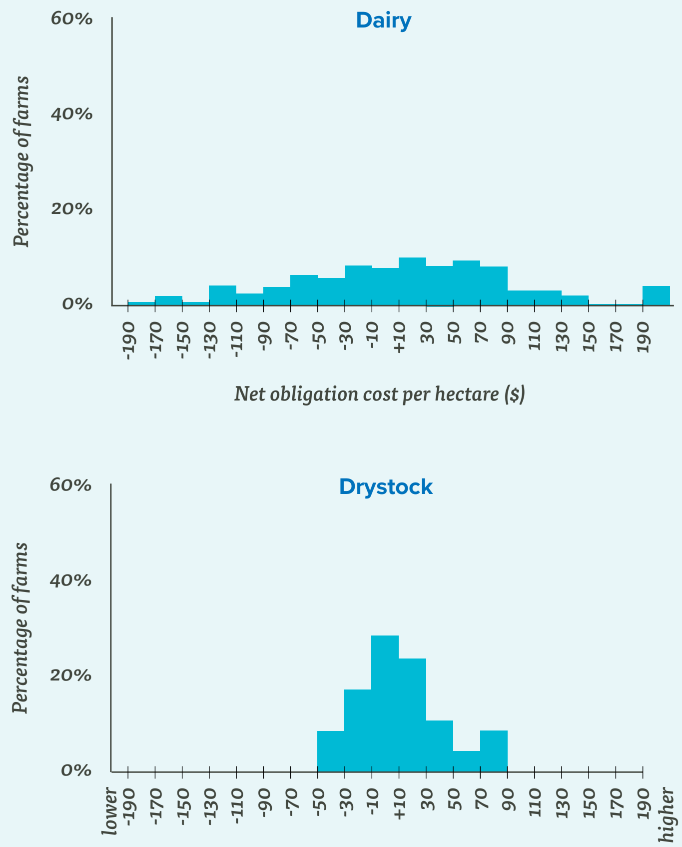


Figure 10.5: *Net obligation cost per hectare using land-based allocation (flat rate/ha). Farmers with lower emissions relative to their land's potential would tend to receive a rebate while farmers with higher emissions relative to their land's potential would generally pay a levy. In these samples, the lower to upper quartiles range from -$37 to $69/ha for dairy farmers, and from -$10 to $29/ha for drystock farmer.*
Note: these graph costs were modelled using a flat rate per hectare for all land, whereas ideally a land-based allocation should vary according to data on land characteristics.

Source: DairyNZ, Beef + Lamb New Zealand, Ministry for Primary Industries

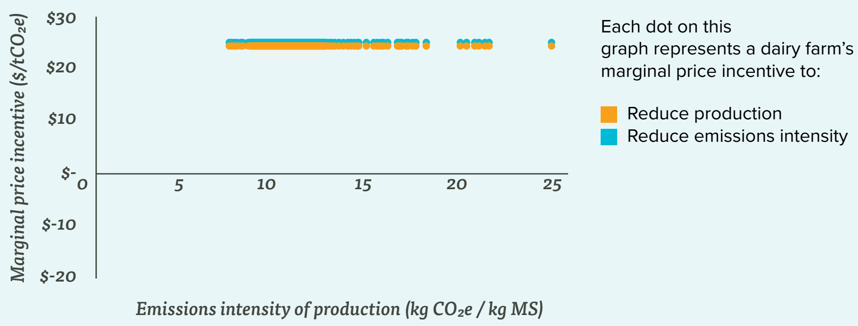


Figure 10.6: *Marginal price incentives under land-based allocation. With this method farmers would save the full $25 by reducing a tonne of emissions through either reducing emissions intensity and/or reducing production.*

HYBRID OF OUTPUT-BASED AND LAND-BASED ALLOCATION

A farmer's allocation could be determined through a combination of the output-based and land-based methods – a hybrid method. A hybrid method could be done, for example, by allocating half of the 95% free allocation through the land-based method and then the other half through the output-based method within each sector. Sector specific output-based allocation factors allow total allocation across sectors to be controlled – so that each sector receives 95% of its emissions through free allocation.

The ratio with which these methods are combined will influence the extent to which the incentive to reduce production is weakened, and how costs are distributed across farmers. This is discussed in more detail in **Technical Appendix 5**.

Who it advantages and disadvantages

Farmers who are highly emissions efficient and have low emissions relative to their land's potential will benefit the most from this method. Those who are least efficient with high emissions relative to their land's potential will be disadvantaged by this method. (**see Figure 10.7**)

Effect on incentives

This method would weaken the incentive to reduce production as compared to fully land-based allocation, but to a lesser extent than fully output-based allocation. It could also discourage highly efficient farms from increasing production. It would maintain a full incentive to improve emissions intensity. (**see Figure 10.8**)

Reasons for using this method

A hybrid method provides a balance of benefits of both output-based and land-based allocation. It weakens the incentive to reduce production to some extent so slows the pace of change, but not so much as to drive farmers to increase production.

It also helps to reduce some of the extreme outcomes of the cost distribution as compared to the fully output-based or land-based methods.

Drawbacks of this method

Implementing a hybrid approach would be somewhat more complex than implementing one method by itself.

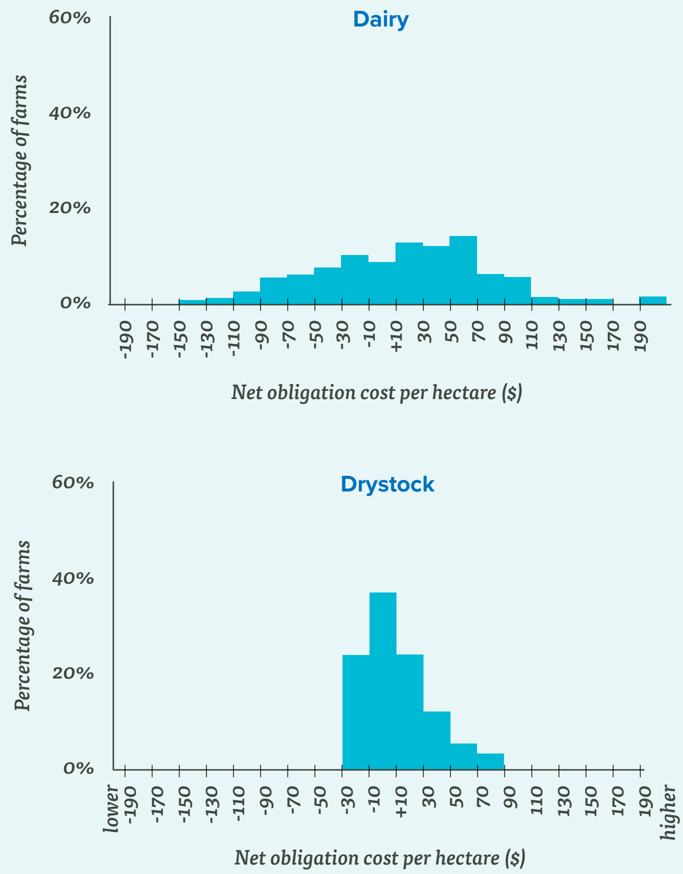


Figure 10.7: *Net obligation cost per hectare using hybrid allocation. Farmers with both low emissions relative to their land's potential will benefit the most from this method and lower emissions intensity would receive a rebate while farmers with both high emissions relative to their land's potential and higher emissions intensity would pay a levy. In these samples, the lower to upper quartiles range from -$28 to $57/ha for dairy farmers, and from -$8 to $20/ha for drystock farmers.*

Source: DairyNZ, Beef + Lamb New Zealand, Ministry for Primary Industries

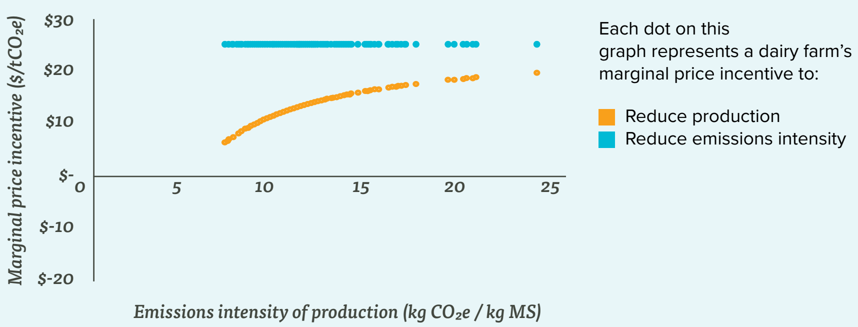


Figure 10.8: *Marginal price incentives under hybrid allocation. The incentive to reduce production is somewhat weakened but not as much as with output-based allocation. In this example no farm sits below the x-axis. The ratio of land to output allocation could be set in a way to ensure that the marginal allocation is not greater than marginal emissions for increases in output.*

CONCLUSIONS ON FARM-LEVEL ALLOCATION

No method can address every issue of concern to farmers, to iwi/Māori, to the wider agricultural sector and to rural communities. Every method for free allocation has pros and cons.

The Committee considers that the *cons* significantly outweigh the *pros* when it comes to grandparenting and proportional allocation. Output-based and land-based allocation both have merits. However, the Committee prefers a hybrid of these two approaches because it would:

- Slow the pace of change to avoid significant social impacts in rural communities
- Not disadvantage farmers who have low-emissions or have already taken steps to reduce
- Provide strong rewards for farmers who improve their emissions intensity
- Avoid encouraging farmers to increase production
- Give some protection against emissions leakage.

Further work will be required to better understand the impacts and design details of allocation. Key issues for further work are outlined at the end of this chapter.

10.3 Allocation at processor-level

For a pricing policy with a processor-level point of obligation, the only viable options are proportional and output-based allocation.

Grandparenting allocation to processors would create lump sum gains for historically large processors, thereby mitigating their losses from stranded processing assets, but with no benefits for any of the other concerns free allocation aims to address.

A land-based allocation for processors is not practical because it would require knowing the land characteristics of the individual farmers supplying the processor.

Both the proportional and output-based methods result in identical incentives and cost impacts. This is because at the processor level both emissions and free allocation are calculated based on output (emissions per kilograms of milk solids or kilograms of meat).

The Committee considers that output-based allocation would be the most appropriate method to use at processor level because it is consistent with other sectors in the NZ ETS. This issue is discussed in more detail in **Technical Appendix 5**.

10.4 An option to capitalise free allocation for experimentation

Farmers could be given the option to capitalise their free allocation. Rather than receiving their allocation year-by-year, they could be given it as an advance lump-sum payment. Farmers who choose to take up this option would then face the full cost of their livestock emissions over the period covered by the lump-sum.

The purpose of this option would be to give some farmers more resources and encourage movement towards low-emissions land uses and low-emissions technologies and practices. Their experiences could help other farmers learn about these options and lower the cost and risk of later mitigation.

This approach is similar to grants provided for pine forests under the One Billion Trees programmes (formerly the Afforestation Grant Scheme). Under this programme Government provides funding for the planting of small to medium-sized forests. In the case of grants for pine forests, in exchange the forests cannot be registered in the NZ ETS for a set period (six years). This is because part of the grant is a capitalisation of the units those pine forests would earn over that period.

This option requires further development and consultation to flesh out the details and ensure the policy is well thought through. **See Technical Appendix 5** for more information.

10.5 Adjusting free allocation over time

Free allocation is transitional assistance so how it changes over time needs to be considered.

The recommended output- and land-based free allocation methods use an equation similar to that below to determine allocation amounts for farms or processors:

Allocation = land area or output x allocation factor/s x allocation rate (95%)

Therefore there are two aspects to consider for adjustments over time:

- Technical adjustments to allocation factors, to ensure allocation remains at the intended level of assistance
- Phasing down the free allocation rate (the 95% level of assistance).

TECHNICAL ADJUSTMENTS TO ALLOCATION FACTORS

With the output- and land-based allocation methods, allocation factors per unit of output or per hectare, calculated using data from the national inventory, are used to determine the amount of allocation provided.

The emissions intensity of agricultural production in New Zealand has fallen at a rate of about 1% per year over the last 25 years and further reductions are expected in the near term. If the agricultural allocation factors do not take this into account, in a few years the amount of allocation provided to agriculture would be 100% of actual agricultural emissions. This would be over-allocation.

To avoid this situation, the Committee proposes that the livestock-related allocation factors for both processors and farmers be set to decline in line with anticipated business as usual improvements in emissions intensity.

For example, if in year 1 the allocation factor per unit of output (for example, per tonne of milk solids) is 10 tonnes of CO_2e, and the anticipated business as usual improvement is 0.5%, in year 2 it should be set at 9.95 tonnes of CO_2e.

In addition, the adoption of new technologies and practices could change the business as usual level of emissions intensity. The extent and timing of these are difficult to anticipate. Instead, a periodic review of allocation factors could incorporate the effects of this.

PHASING DOWN THE ALLOCATION RATE

Over the course of this inquiry, farmers have expressed concern about how quickly the allocation rate (95%) could be phased down.

The Committee's view is that any phase down of free allocation should be well signalled and predictable, so that farmers can adequately factor changes into their investment choices and other business decisions. It should not be subject to ad hoc or arbitrary decisions made at short notice.

There are three things that need to be balanced when considering whether and how to change the free allocation rate:

- **Staying within emissions budgets** that will get smaller overtime
- **Costs to the taxpayer** as free allocation is an expense to the Crown and giving out less would provide more resources that could be used for other public benefits
- **Changing needs for free allocation** as the sector transitions and other countries implement agricultural emissions policies
- Any change to the level of free allocation should be informed by robust, objective analysis. This should involve an assessment of whether the reasons for free allocation are still valid. Part of this would be to look at the likely consequences on rural land values and profits, more detailed consequences for rural employment, demographics and social services, and emissions leakage.

For this reason, the Committee considers that any future changes to the level of free allocation should be informed by independent advice from the Climate Change Commission that is expected to be established under the Zero Carbon Bill.

The process and criteria for the Commission's advice on allocation rates should be outlined in law – either in the *Climate Change Response Act* or the *Zero Carbon Bill* – to give farmers certainty on the process.

10.6 Conclusion

There are several potential objectives for agricultural allocation. Choosing an allocation method depends on which objectives are considered most important. The Committee consider the main objective for agricultural free allocation should be to help manage the social impacts of emissions pricing. Managing the risk of emissions leakage is a lesser concern.

The Committee considers that the most appropriate farm level method for free allocation is a hybrid of output and land-based allocation because it would:

- Slow the pace of change to avoid significant social impacts in rural communities
- Not disadvantage farmers who have low emissions or have already taken steps to reduce emissions
- Provide strong rewards for farmers who improve their emissions intensity
- Avoid encouraging farmers to increase production
- Give some protection against emissions leakage.

Further work required to design details of a hybrid farm level free allocation method includes:

- Rules on eligibility, including ensuring rules do not disproportionately disadvantage Māori land
- Developing the productive capacity proxy for land-based allocation
- Determining the ratio of output- to land-based allocation.

Iwi/Māori, including owners of Māori land, need to be included in this process so that the unique characteristics of Maori owned land are considered in the policy design.

The most appropriate method of free allocation at processor level is output based, for consistency with other sectors in the NZ ETS.

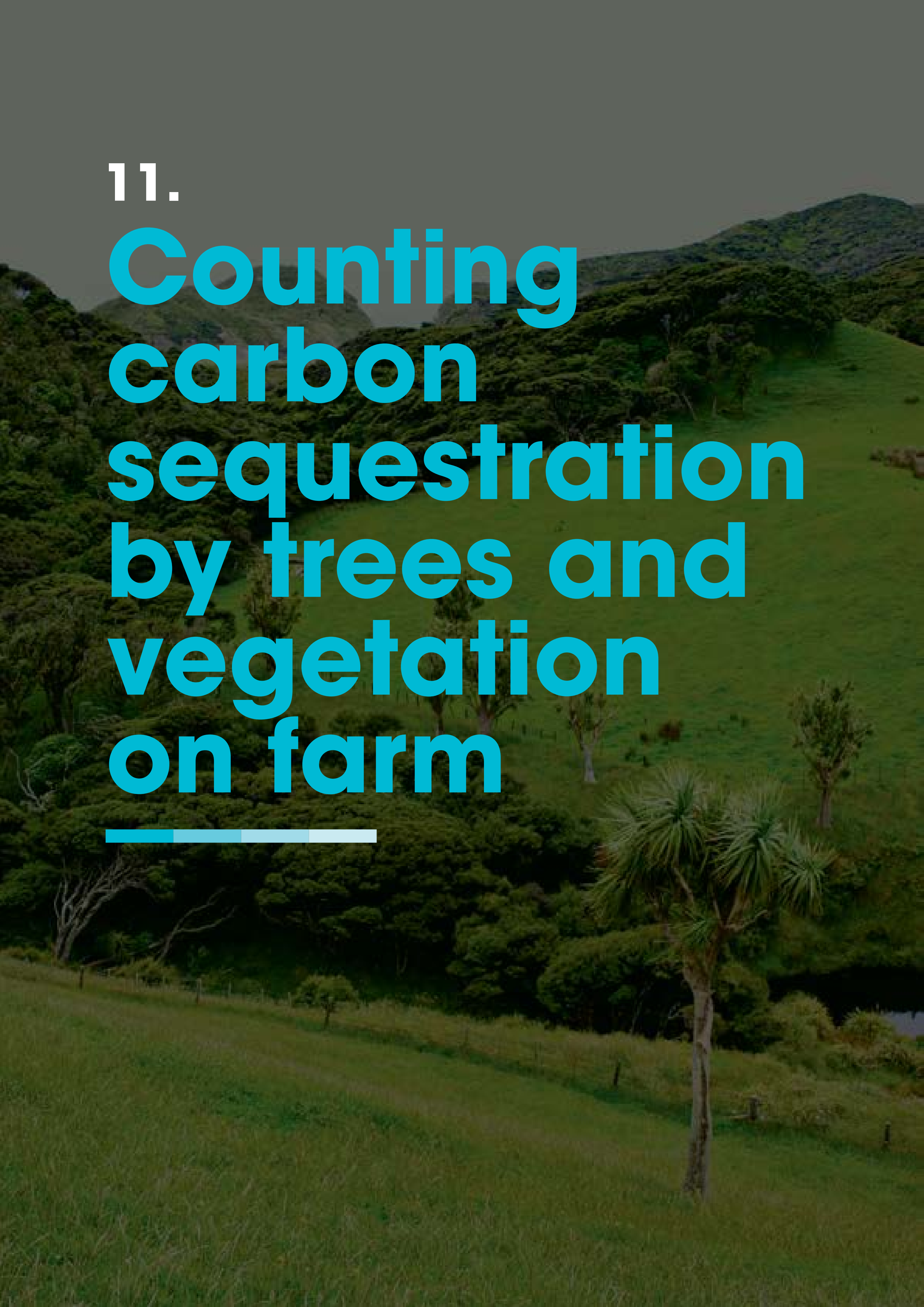
Government should further consider giving farmers the option to **capitalise free allocation** to encourage take up of low emissions technologies, practices and land uses.

Allocation factors related to livestock production should be set in advance in a way that ensures they reduce in line with expected improvements in emissions intensity, with periodic reviews to update them to take account of less predictable changes such as the widespread adoption of a new mitigation technology.

Any **phase down** of the 95% free allocation rate should be well signalled and predictable. Changes in the level of free allocation should be informed by independent advice from the Climate Change Commission that is expected to be established under the *Zero Carbon Bill*.

11.

Counting carbon sequestration by trees and vegetation on farm



Farmers and industry representatives have expressed a sense of unfairness that all emissions sources incur an obligation, but not all sinks receive a reward. They have expressed a desire to be able to count all the carbon sequestered in trees and vegetation on farms and take a holistic approach to emissions by 'netting off' at farm-level.

When considering emissions pricing, the Committee agrees it is important to provide incentives for as many emissions sinks as possible. However, there are several challenges associated with this.

Currently trees must meet strict criteria to be counted as a carbon sink and only trees meeting these criteria can count toward New Zealand's emissions reduction targets and receive units through the NZ ETS. This chapter looks at whether there is scope to recognise and reward farmers for carbon sequestered by trees that don't meet the criteria (for more detail, **see Technical Appendix 8**).

11.1 Pre-1990 forests

Under current rules, sequestration of carbon that occurs in pre-1990 forests under business as usual management is not counted towards New Zealand's targets and is not rewarded under the NZ ETS. However, if exotic plantation forests are harvested and not replanted, the carbon lost is counted against targets and an NZ ETS liability is incurred.[98]

Changes in management practices, for example through specific pruning, can increase the rate of carbon stored in pre-1990 forests. The government estimates the aggregate impact of these changes in management practices when communicating progress towards New Zealand's targets.[99] However, it is difficult to do this at the level of an individual forest. This is because there is a lack of robust data quantifying how much management practices increase the rate of carbon storage. In addition, verifying any changes would be administratively challenging and costly. Costs could reduce in the future through advances in aerial imagery/aerial sensing technology.

Once there are robust and cost-effective methods to quantify additional carbon sequestration at the individual forest scale, it could be possible to reward forest owners who undertake such practices.

It is a different issue whether and how to provide any reward for carbon sequestered in pre-1990 forests under business as usual management. The target accounting rules could be changed to capture this, but changing those rules would not lead to any additional removal of carbon dioxide from the atmosphere and would create some challenges. Under the Paris Agreement, recognising this sequestration would mean that New Zealand would need to revise the target to maintain the current level of ambition. This is because any changes to target accounting cannot make the target easier to meet. Revising the target would lead to additional cost and uncertainty.

The Committee considers that the challenges of changing the 2030 target to count business as usual carbon sequestration in pre-1990 forests outweigh the benefits at this time. After 2030 it may be more feasible to explore different rules and include all carbon stored in pre-1990 forests.

Changing the NZ ETS rules to reward this carbon sequestration would alter the distribution of the costs of meeting our targets. Allowing farmers to gain from this forest land would need to be offset by losses to other New Zealanders.

11.2 Smaller lots of trees and vegetation

Many farmers have smaller areas of trees and vegetation on their farms. These include small lots of exotic and native trees, shelter belts, pole plantings, riparian strips and wetlands. Any carbon sequestered by these trees and vegetation is not currently recognised. The current accounting rules are that a forest sink must be at least a hectare in area and on average greater than 30 metres wide to be counted towards our national target. This is also the threshold for eligibility for the NZ ETS.

When the target accounting rules were chosen in 2006 it was considered that the costs of monitoring and verifying changes in these small areas outweighed their benefit to the country.[100]

There is generally a lack of robust data on the amount of carbon sequestered in small lots of trees and vegetation. However, recent research gives some indicative data (**see Table 11.1**).[101]

Table 11.1: *The potential for different types of vegetation to sequester carbon*[102]

Vegetation type	Rate of carbon sequestration (expressed in tonnes of CO_2e per hectare per year)*
Small lots of exotic and native trees	6.5 (native) – 26.3 (exotic)
Shelterbelts	6.5 (native) – 26.3 (exotic) (Note: varies greatly depending on plant type and size. Shelter belts managed at a constant height and width will have limited sequestration potential once they reach a farmer's desired dimensions)
Pole planting	2.0
Riparian planting	0-5.28 (Note: varies greatly depending on the plant type and size)
Wetlands	0-2.0

* The amount of carbon dioxide removed equates to 44/12 times the amount of carbon stored, given the different molecular weights of carbon dioxide and of carbon.

New Zealand could amend the target and NZ ETS accounting methods to count these trees and vegetation, but the costs of measuring and monitoring at a national scale could be significant. It could be more beneficial to focus on counting those types of trees and vegetation with the greatest sequestration potential, which might be small lots of native and exotic trees. Any changes to target accounting cannot make the target easier to meet.[103]

There is also insufficient data on the area of these small blocks of trees and vegetation at a national scale, and how they changed over time. This data would be necessary for those trees and vegetation to be counted toward targets. The data available suggests that at the national level since 1990, more of these small blocks of trees and vegetation have been lost than gained.[104]

If carbon sequestration in small blocks of trees and vegetation could earn units under the NZ ETS, the farmer would incur the costs of monitoring and reporting that vegetation, along with a liability if those trees were removed. The government would incur costs from verifying the on-going existence of those trees. These costs could reduce as new technologies such as aerial sensing become more accurate and lower cost.

It is worth noting that even under existing rules, only about 60% of forest land area that would be eligible for units in the NZ ETS is in fact earning units.[105] The government is working on removing some of the barriers to this, such as introducing an averaging approach for plantation forests, and potentially mapping eligible land. This work should continue as a high priority to maximise the benefits of forestry to farmers and forest owners.

Even if small blocks of trees and vegetation do not count toward targets, the government could still choose to reward farmers for planting those trees outside of the NZ ETS. However, the government would have to justify the public benefit of that spending on grounds other than meeting climate change targets. Any reward would have to be based on the wider benefits associated with planting, particularly of native trees. For example, the Billion Trees programme is targeted at delivering improved social, environmental and economic outcomes for New Zealand.[106]

11.3 'Netting off' at the farm gate

'Netting off' at farm gate would involve deducting the carbon sequestered in trees and vegetation from the emissions of methane and nitrous oxide before assessing any liability incurred under the farm-level levy/rebate scheme. This aligns with the way farmers want to think about their farms – as a system.

Netting off could remove some of the transaction costs that farmers would face if they wanted to cover their levy costs by selling units from their forests earned through the NZ ETS. It would not remove the need to assess eligibility of trees and vegetation, to report those trees or vegetation, or protect farmers from the liability if the trees or vegetation were removed.

The ability to net off could be incorporated into any tool for calculating emissions in a levy/rebate scheme, and in the interface of any levy/rebate scheme with the NZ ETS for forestry. To be workable and avoid loopholes, a netting off approach would have to align with the same rules and processes that apply to the NZ ETS.[107]

11.4 Conclusion

There is a sense of unfairness among farmers and foresters created by the fact that under the recommended policy, all emissions sources would be counted but not all sinks.

The Government should prioritise work underway to improve the NZ ETS for forestry, to make it easier for forest owners to identify eligible forest land and register it in the NZ ETS.

The key reason why not all carbon sequestration is eligible to earn units in the NZ ETS is because not all sinks count toward New Zealand's targets.

Data on the amount of carbon sequestered by additional management practices in pre-1990 forests and in small blocks of trees and vegetation on farms is limited, and monitoring would be costly with current technology.

It would not be trivial for New Zealand to change either its accounting rules for targets or to obtain the additional data necessary to quantify additional carbon sequestration. The costs of doing so may outweigh the benefits, at least for some types of trees and vegetation. Nevertheless the Government should further explore the scope to recognise and reward:

- enhanced forestry management practices that sequester additional carbon in pre-1990 forests
- carbon sequestration by small blocks of trees and vegetation.

To minimise transaction costs, if there is a farm-level levy/rebate scheme the Government should look at the feasibility of an approach for netting off sequestration by trees against farm emissions liabilities.

12.
Facilitating opportunities

The Committee has looked at a range of policy options that could help reduce agriculture emissions. It's important to recognise that there are other factors across the supply chain that affect primary production in New Zealand and drive behaviour towards or away from lower emissions practices and land use.

This chapter explores some of those other drivers, how they impact on the ability to reduce agriculture emissions and what Government's role is in removing barriers or assisting the sector to make the most of opportunities. It specifically looks at how the following factors influence a move towards lower emissions agriculture:

- Corporate sustainability values
- Access to markets
- Government regulations
- Stimulating innovation.

Miraka's focus on kaitiakitanga

Box 12.1:

Kaitiakitanga is a core value of Miraka and drives behaviour in the factory and across its farm supply base.

Miraka's view is that responsiveness to the environment prepares them for future environmental challenges, including climate change. Processing practices such as monitoring energy use and emissions, auditing waste streams, researching alternative technologies, utilising re-useable or recyclable materials are all part of this.

Miraka works with all its milk supply farmers and provides tools, resources, and access to expertise on sustainable farming practices. Te Ara Miraka – Farm Excellence Programme is a long-term commitment to provide Miraka farmers with the ability to care for the land, achieve profitability, produce quality milk, and build stronger communities. Te Ara Miraka aims to produce first class milk with the lowest environmental impacts and greatest farming efficiencies.

Miraka suppliers are audited annually against the Te Ara Miraka standards and, to incentivise change, farms meeting these standards stand to gain an additional 20 cents per kilogram of milk solids on top of their milk pay-out. Farmers doing less well receive a progressively smaller proportion of the 20 cent premium. Farmers not aligned with the programme's objectives and values face termination of their supply relationship with Miraka.

12.1 Corporate sustainability values

Some farmers incorporate sustainability into their decision-making as it aligns with their values. Māori in particular place significant importance on their relationship with the whenua and the role it plays in sustaining and nourishing people.

There are examples within the sector where companies are beginning to embed cultural and environmental values as part of a journey to sustainability (**see Box 12.1**).

Government and industry can accelerate the uptake of sustainable practices by highlighting success stories within training and extension programmes.

12.2 Access to markets

OPENING UP OPPORTUNITIES IN NEW OVERSEAS MARKETS

When it comes to opportunities in new markets, exporters can approach new markets themselves, or seek help from the Government to negotiate access through trade agreements. For new products, gaining access into markets is more difficult.[108]

While the Government can help with this, the negotiation process takes time and Government negotiators must prioritise what products and markets to focus on. For example, it took four years of negotiations for New Zealand Avocado to be able to export avocados to China.[109]

The Government prioritises sector requests for help with trade access based on the potential scale of the trade. The potential future markets for lower emissions products needs to be factored into this.

RETAINING ACCESS TO EXISTING MARKETS

New Zealand agricultural products may increasingly be required to meet certain standards to maintain or gain access into key international markets.

When commercialising new technologies, the Government needs to work with international regulatory agencies and trading partners to ensure that solutions that help reduce emissions also comply with food safety or other standards.

Current assurance programmes do not include greenhouse gas emissions. The Government and sector should remain alert as markets may increasingly ask for some sort of greenhouse gas assurance. It may even become a requirement for access into some markets.

SUPPLY CHAIN PRESSURE

Companies manufacturing or selling high value goods may require assurance that the inputs they use meet specific environmental standards. New Zealand farmers and processors supplying raw products to these companies may need to meet certain standards. For example, the food company Danone has committed to becoming carbon neutral across their full supply chain by 2050 and will require that their suppliers support this.[110]

DIFFERENTIATING INTO HIGHER VALUE PRODUCTS

Traditional economic strategies in the meat and milk sector have focused on commodities, which make up the majority of New Zealand's exported products.[111]

Recently, there has been more focus on the need for New Zealand to shift from commodities into value-added products.[112] Government has a role in removing barriers, and in some places enabling this shift. The Primary Sector Council has been set up by the Government to develop a vision for the sector and support the sector in maximising opportunities.[113]

Internationally, there are examples of Government-led branding initiatives, such as Ireland's Origin Green. There is a question as to whether branding is better left to the sector and individual companies so as not to dilute existing brands and maintain the reputations of current high performers.

However, the New Zealand economy benefits from brands such as 100% pure New Zealand. There may be opportunities to build on this brand and develop new brands as is happening with Taste Pure Nature, the red meat sector brand.

CONSUMER PREFERENCES

Food traceability and sustainability are becoming a big issue for consumers worldwide as consumers want to know where their food comes from, how it was raised or grown, and that it has been produced in a safe, ethical and sustainable way.

Some New Zealand agriculture businesses are already responding to these signals. For example, Icebreaker and Allbirds, brand partners of New Zealand Merino, are already leveraging off their environmental credentials. New Zealand Merino is working with their brand partners to look at the opportunities for differentiating products based on low greenhouse gas emissions.[114]

There could be more opportunities for New Zealand businesses to do this.

***Figure 12.1:** New Zealand agriculture businesses are responding to consumer preferences such as the desire to know where their food comes from.*

12.3 Government regulations

Regulations (other than climate change) could present barriers to actions to reduce agricultural emissions. New climate regulations could also present a barrier to emerging or less conventional land uses if not carefully implemented, for example where land uses are merged such as agroforestry. Existing regulation that stakeholders identified as presenting potential barriers include:

- New Zealand's rules on genetic modification
- Council rules preventing land use change
- Te Ture Whenua Māori Act 1993.

NEW ZEALAND'S RULES ON GENETIC MODIFICATION

New Zealand's rules on genetic modification could be a barrier to developing lower emissions technologies. One such example is a genetically modified ryegrass that has been developed by scientists at AgResearch but has had to go through field trials in the United States due to New Zealand's rules on genetic modification.[115]

The science surrounding genetic modification has evolved.[116] Other countries have changed their rules in recent years and it is not uncommon for livestock overseas to eat genetically modified feeds.

On the flip side, being free of genetic modification provides a unique characteristic that New Zealand products can trade on.

As flagged by the Royal Society and others, it could be timely for New Zealanders to have an open debate about the use of genetic modification in New Zealand.

COUNCIL RULES PREVENTING LAND USE CHANGE

Rules relating to land use change set by councils can prevent shifts to lower emissions land uses. Two ways that council rules could prevent land use change are:

- Land use conversion controls – some councils restrict certain types of land use change, sometimes for meeting water quality standards
- Subdivision controls – these often exist to protect the amenity of rural areas and prevent fragmentation of rural land into smaller blocks. However, these could prevent conversion to horticultural land with lower emissions – as often horticultural land can exist on smaller blocks. The kiwifruit industry could not have expanded in the Bay of Plenty if subdivision controls were in place.[117]

TE TURE WHENUA MĀORI ACT

Engagement with iwi/Māori land owners highlighted concerns around how the *Te Ture Whenua Māori Act* constrains the responsiveness of Māori land owners to new strategic opportunities.

As detailed in **Box 1.1**, decision-making on Māori land under the Act is different from other land. These differences include restrictions on use of assets as collateral and long decision-making timeframes. These differences could constrain the ability of iwi/Māori land owners to minimise risk and maximise strategic opportunities in response to agricultural emissions policy.

For example, the inability to utilise Māori land as collateral, or to be borrowed against has a considerable impact on an entity or a group's ability to raise the necessary capital to develop or invest in changing to a low-emissions land use or infrastructure to support changes to farm practice.

The Act is intended to protect further alienation of Māori land. Further consultation is needed to determine whether the restrictions imposed under *Te Ture Whenua Māori Act* constrain Māori land owners from responding to any climate change policy.

12.4 Stimulating innovation

Innovation will play a key role in transitioning to lower-emissions agriculture. This includes farmers themselves innovating, as well as research and development.

The Productivity Commission looked closely at the role that innovation will play and recommended that the Government give greater priority and resources to low-emissions innovation. Specifically, they found that where there is an issue unique to New Zealand, such as agricultural emissions, there is strong reason to invest in innovation.[118] The impacts of this investment could deliver significantly more value than money put in.[119]

Investments into agricultural emissions research has already identified practical solutions. More solutions are being developed but these will rely on continued Government and private sector investment.

The Government will need to carefully balance its priorities for research, based not only on current market potential but opening up new opportunities. This includes market analysis, developing new low-emissions products and the supply chains to tap into new markets.

Some of the funds raised through a price on emissions could cover the industry's contribution to research and development of options to reduce agricultural emissions (**see Chapter 13**).

12.5 Conclusion

The Government should be aware of what other factors affect behaviour toward, or away from, lower emissions practices and land use.

Some of these factors are directly within Government's control and could exist in other regulation. Others are values and market driven, and the Government's role will be less direct such as to facilitate opportunities that create new markets for low-emissions products.

13. Recycling funds back to the sector

Pricing methane and nitrous oxide emissions as discussed in the previous chapters could raise funds in the order of $47–95 million each year over the first decade of operation.[120]

The Government has stated that it would recycle money generated from emissions pricing back to the sector and farmers *"to encourage agricultural innovation, mitigation and additional planting of forestry"*.[121]

Recycling money in a directed way is not new. In New Zealand, the $4 billion each year that is collected from fuel excise duties, road user charges and other fees, is reinvested in land transport. Money from the waste levy is also recycled back into projects to reduce waste. It is also common internationally to recycle funds from emissions pricing into other programmes to reduce emissions, and studies show that this tends to increase the acceptability of price-based policies.[122]

This chapter looks at how the funds from emissions pricing could be recycled back to farmers in a transparent way, and what programmes and policies could be funded.

13.1 Transparency and governance around recycling funds

Any recycling of funds from emissions pricing back to the sector should be done in a way that is open and transparent to farmers, the wider sector and the public.

To provide the sector with certainty, the money generated from a pricing policy should be put into a dedicated 'Agricultural Emissions Fund'. The establishment of this Fund and the requirement to recycle funds should be outlined in legislation.

Legislation should also specify that the Fund be overseen by a board that includes representatives from the agriculture sector (including farmers) and iwi/Māori land owners for effective co-governance. All board members will need to understand and take into account the unique circumstances for owners of Māori land when making decisions.

The Committee recognises the current development status and unique governance and decision-making challenges of Māori land, and that current mainstream extension and training services are not adequately meeting the needs of Māori land owners.[123] An appropriate portion of the Fund should therefore go toward supporting iwi/Māori land owners to ensure those needs can be addressed appropriately.

The legislation should also set out clear criteria for how the money in the Fund should be spent (discussed in more detail in the next section), require that information on how it has been spent be made public, and require that funded programmes are regularly reviewed to ensure they are delivering value and are consistent with the criteria.

The funds generated from pricing agricultural emissions will vary from year to year depending on the emissions price, level of free allocation, and total emissions from the sector. However, most of the funded programmes would need to span multiple years to be effective, and so require certainty in their funding from year to year. The Government could guarantee that the Fund receives a minimum amount each year.

13.2 What activities could the fund support

The Committee considers that the Fund should be spent on programmes that will directly help farmers reduce emissions.

While emissions pricing will encourage farmers to change behaviour by altering the economics of activities that reduce emissions, cost is not the only barrier. Other barriers include, for example, a lack of information and training on how to reduce emissions, risk and uncertainty around new technologies or practices, regulatory barriers and/or access to capital to make changes.[124]

Programmes are needed that address these barriers and help farmers on the ground. The Board that will be established to oversee the Fund will need to prioritise spending. The Committee has not undertaken a rigorous analysis of priorities and gaps. However, based on the evidence the Committee has heard, possible areas for investment include the following:

FARM ENVIRONMENT PLANNING

As outlined in **Chapter 5**, farm environment plans are a practical tool that farmers are increasingly using and integrating with wider business planning. Funds could be spent on building and disseminating a climate change module to sit alongside the other modules in farm environment plans.

Farmers will also need access to farm advisers who have specific expertise in agricultural emissions, to assist in developing farm environment plans.[125] Funding could be used to develop agriculture emissions training and certification programmes for farm advisers. It could also support farm advisers to attend these programmes and fund farmers to contract certified farm advisers.

EXTENSION

Extension will be a key part of building farmers' awareness and providing them with the information they need to reduce emissions. Funds could be targeted toward building awareness through a range of media, building reliable information sources, running workshops and training courses for farmers, rural workers and other rural professionals.

As outlined in **Chapter 5** investment of funding in extension services developed and delivered by Māori, and for iwi/Māori, will be critical to ensure uptake of those services by iwi/Māori land owners, governors, managers and staff.[126]

As a sense of scale for extension projects, the Government's recently announced Extension Service Model will work with 1,200 farms over four years at a cost of about $3 million. Extension 350 in Northland is targeting 350 farmers with a budget of around $800,000 – $900,000 each year.[127]

The nationwide Red Meat Profit Partnership, funded jointly by the sector and by the Government through the Primary Growth Partnership, has a budget of $64 million over seven years. Its purpose is to increase productivity and profitability in the red meat sector through a range of extension programmes. It aims to reach 2,400 farm business through extension 'action networks' by September 2019.[128]

TOOLS FOR TO CALCULATING EMISSIONS

Another specific area that could be funded is the development of user friendly decision support tools for farmers. Such tools could enable farmers to calculate their emissions, how they sit relative to their peers, and test scenarios for reducing emissions on their farm including their implications for business performance and other environmental objectives.

If Overseer were the agreed tool for calculating greenhouse gas emissions in the levy/rebate scheme, funds could be directed towards ensuring its consistency with the national greenhouse gas inventory, its ability to interface with other information systems used by farmers, and incorporating additional mitigations that reduce emissions.[129]

INCREASING ADOPTION OF TECHNOLOGIES AND PRACTICES

The Fund could be used to help increase the adoption of technologies and practices that have been proven to reduce emissions. For example, farmers could be given grants for pilot studies to trial emissions reduction measures on farms, capturing the necessary data to monitor and verify reductions, and ensuring that results and experiences from such trials are made available widely to other farmers.

THE SECTOR'S CONTRIBUTION TO AGRICULTURAL RESEARCH

The Fund could be used to cover and perhaps increase the industry's contribution into research and development of options to reduce agricultural emissions. The sector currently contributes $2.3 million each year to such research.[130]

The Committee considers, however, that the Fund should not be used to reduce the Government's contribution to general agricultural greenhouse gas mitigation research. There has and will continue to be broad public benefit (not just to the agriculture sector) from investing in this research.[131] The Government currently invests about $15 million each year into research on reducing agricultural methane and nitrous oxide, and this support should continue through mechanisms other than the Fund.

Increased funding for greenhouse gas mitigation research was a key recommendation of the Productivity Commission and the Committee has heard consistently that the sector urgently needs more cost-effective mitigation options.

ADMINISTRATION OF THE FUND

In addition to funding programmes and projects, some of the funds will also need to be used to administer the Fund. This should be kept as low as possible, and might be around 5% of the Fund.[132]

It is the Committee's view that this Fund should not be used to establish the systems for administering the levy/rebate scheme, or for costs associated with compliance and enforcement of that policy. The costs of implementing the policy itself should be met primarily by the Government, as is the case with other sectors.

All funded programmes would need to be consistent with New Zealand's trade policy settings and international obligations under the World Trade Organisation. This is a requirement of other funding mechanisms in the agriculture sector, such as the Primary Growth Partnership that support activities of a similar nature.

13.3 Conclusion

Funds generated from pricing agricultural emissions should be put into a dedicated Agricultural Emissions Fund. This Fund should support programmes that directly help farmers to reduce emissions.

An appropriate portion of the fund needs to go toward supporting iwi/Māori land owners, recognising their unique circumstances.

This Fund should be overseen by a board that includes representatives from the agriculture sector and iwi/Māori land owners to ensure effective co-governance. All board members will need to understand and take into account the unique circumstances for owners of Māori land.

14. Recommendations

The need to reduce greenhouse gas emissions is becoming urgent. Countries have committed to hold warming to well below 2 degrees above pre-industrial levels, with efforts to limit it to 1.5 degrees. To achieve this, every part of society will need to play a role in reducing emissions.

The agriculture sector is a significant contributor to New Zealand's economy. The sector generates 35% of New Zealand's export revenue.

However, agriculture, particularly livestock farming, generates emissions. Together, the two main agricultural greenhouse gases, methane and nitrous oxide, produce 48% of New Zealand's reported greenhouse gas emissions.

In New Zealand, all emissions, except agricultural methane and nitrous oxide, are covered by emissions pricing.

Our farmers are amongst the best in the world in efficiently producing high quality food and have reduced emissions intensity by about 20% over the last 25 years. These improvements have helped stabilise methane and nitrous oxide emissions.

But this is not enough. To meet global temperature goals, emissions of long-lived greenhouse gases (carbon dioxide and nitrous oxide) must collectively go to net zero. Methane emissions do not have to go to zero to achieve these goals, but they must reduce.

There are things that farmers can do right now to further reduce emissions while maintaining profitability. Current options could reduce on-farm emissions by up to 10%, but with variable costs across farms. Other technologies on the horizon, such as a methane inhibitor that can be fed to cattle, and land use change toward low-emissions land uses could lead to greater reductions.

In reaching its recommendations, the Committee has been mindful that there is no 'one size fits all' approach to reducing emissions on a farm. The solutions that work for one farmer may not be the best for another. We have recommended a framework that has the flexibility to account for this and that can adapt over time.

Any policy must fulfil the Tiriti o Waitangi principle of partnership and good faith with iwi/hapū and recognise the unique characteristics of Māori land.

The Committee appreciates farmers are already working hard to address other environmental issues such as water quality. Where possible, approaches should be integrated to allow farmers to manage their environmental impact holistically.

To ensure a gradual change the transition needs to start now. New Zealand farmers are innovative and there will be opportunities. Government needs to work with the sector to identify and capitalise on these opportunities.

The following sections outline the Committee's recommendations for reducing methane and nitrous oxide emissions from agriculture.

14.1 Introduce a farm-level levy/rebate scheme on livestock emissions by 2025

The Committee was asked by the Government **'how surrender obligations could best be arranged if agricultural methane and nitrous oxide emissions enter into the New Zealand Emissions Trading Scheme (NZ ETS).'** ***To answer this, the Committee looked at a range of policy options for reducing methane and nitrous oxide emissions.***

The Committee considers that a farm-level levy/rebate scheme is the best approach for addressing livestock emissions in the long term. This approach would:

- Incentivise farmers to take advantage of all possible opportunities to reduce emissions
- Provide farmers with the flexibility to decide what solutions work best on their farm
- Drive innovation by rewarding farmers who reduce emissions the most
- Cost-effectively reduce emissions across the agriculture sector
- Reduce the cost, complexity and risk to farmers as they wouldn't have to trade units.

The levy/rebate scheme should be integrated with the NZ ETS – specifically, the emissions covered should be part of the same decision-making process and rules for setting the NZ ETS cap. The levy rate would be set and updated each year to align with the NZ ETS price unless there are different targets for different gases.

The levy/rebate scheme could accommodate separate targets for different greenhouse gases by adjusting the price for each gas. In this case, prices should be revised over time to ensure they are delivering on targets that will be defined in the *Zero Carbon Bill*. Any adjustment to prices for gases with separate targets should be based on advice from the independent Climate Change Commission, also expected to be established under the *Zero Carbon Bill*.

It will take time to put in place a farm-level levy/rebate scheme for livestock emissions. The Government needs to develop an action plan that lays out all the necessary steps and timeframes for implementing a levy/rebate scheme by 2025. The development of this plan should involve the agriculture sector and iwi/Māori, including owners of Māori land. The plan needs to include setting up a system to administer the levy/rebate scheme, developing emissions calculation and free allocation methods, plus developing and implementing programmes to support farmers to take early actions to reduce emissions.

To provide certainty that a farm-level levy/rebate scheme will eventuate, the Government should put the start dates for mandatory reporting and full obligations in legislation.

Recommendation 1

The Committee recommends that the Government:

a. Specifies in legislation that farmers will start reporting their emissions in 2023, and face obligations for their livestock emissions under a levy/rebate scheme by 2025
b. Develops an action plan with the agriculture sector and Iwi/Māori, including owners of Māori land, outlining the necessary processes to introduce a farm-level levy/rebate scheme on livestock emissions by 2025
c. Outlines in law the process by which any decisions will be made on changes to the price on methane to achieve different targets for different gases.

14.2 Price livestock emissions at processor-level through the NZ ETS in the interim

It will take about five years to implement a levy/rebate scheme. New Zealand cannot wait until 2025 for the agriculture sector to contribute to efforts to reduce emissions. The sector also needs the right investment signals as soon as possible to help farmers and agribusinesses make informed decisions.

As an interim measure, agricultural emissions should be priced through the NZ ETS at processor level, ideally by 2020 or as soon as practicable considering the need to give processors sufficient notice. While this would not provide the same incentives to farmers to reduce emissions as the farm-scale levy/rebate, it would get the agriculture sector started on a pathway to reduce emissions and contribute to New Zealand's emissions targets.

Recommendation 2

The Committee recommends that the Government amends the Climate Change Response Act *to price methane and nitrous oxide emissions from livestock at processor level in the NZ ETS as soon as practicable.*

14.3 Price nitrogen fertiliser emissions through the NZ ETS

The Committee considers that fertiliser emissions should be priced at the fertiliser manufacturer and importer level rather than the farm-level.

At this stage, the only recognised way to reduce greenhouse gas emissions from fertiliser is to use less. The incentive for farmers is the same whether these emissions are priced at the farm or fertiliser manufacturer and importer level. Farmers would be able to take the higher price into account and consider how to improve their fertiliser practices through farm environment planning.

Science suggests that local factors, such as soil moisture and soil type, may impact how much nitrous oxide is emitted from fertiliser. These factors are not yet well enough understood to be incorporated into emissions calculations. The point of obligation should be re-assessed in the future if practice-specific options are found for reducing fertiliser emissions.

Recommendation 3

The Committee recommends that the Government amends the Climate Change Response Act *to price synthetic nitrogen fertiliser emissions at the manufacturer and importer level in the NZ ETS as soon as practicable.*

14.4 Assisting farmers and rural communities through free allocation

The Government has said that if agricultural emissions are included in the NZ ETS, agriculture will be given 95% free allocation of the sector's total emissions. The Committee assumed this 95% free allocation would apply for any pricing mechanism.

The Committee has evaluated various free allocation methods. The choice of method depends on the key reasons for providing allocation.

The Committee considers that the main reason for agricultural allocation should be to help manage the social impacts of emissions pricing on farmers and rural communities, with emissions leakage risk as a lesser concern.

The Committee concludes that the most appropriate **allocation method** for both the dairy and drystock sectors is a hybrid of an output- and land-based allocation. This approach would:

- Slow the pace of change to avoid significant social impacts in rural communities
- Not disadvantage farmers who have low emissions or have already taken steps to reduce
- Provide strong rewards for farmers who improve their emissions intensity
- Avoid encouraging farmers to increase production
- Give some protection against emissions leakage.

Further work is required to develop the detailed rules for a hybrid farm-level allocation method. This work needs to include developing a suitable proxy for the productive capacity of land on which to base land-based allocation, determining the ratio of output- to land-based allocation, and eligibility rules. This further work should factor in the unique characteristics of Māori land and ensure that they do not disproportionately disadvantage owners of Māori land.

The Government should further consider giving farmers the option to **capitalise their free allocation** to encourage the uptake of low emissions technologies, practices and land uses and thereby accelerate farmer innovation and learning.

Allocation factors related to livestock production should be set in advance in a way that ensures they reduce in line with expected improvements in emissions intensity, with periodic reviews to update them to take account of less predictable changes such as the widespread adoption of a new mitigation technology.

Any **phase down of the allocation** rate should be well signalled and predictable. Changes in the rate of allocation should be informed by independent advice from the Climate Change Commission that is expected to be established under the *Zero Carbon Bill*.

Recommendation 4

The Committee recommends that the Government:

a. Uses a hybrid of output- and land-based allocation for livestock emissions in a farm-level levy/rebate scheme, subject to further work and consultation on
   - a suitable proxy for the productive capacity of land
   - determining the ratio of output-based to land-based allocation
   - eligibility rules

b. Considers an option for farmers to capitalise their allocation in exchange for facing the full costs of their livestock emissions for the period covered by the lump-sum

c. Sets livestock-related allocation factors so that they reduce in line with expected improvements in emissions intensity, with periodic reviews to account for less predictable changes in emissions intensity

d. Outlines in law the process by which any decisions on the phase down of the free allocation rate will be made.

14.5 Recycling funds through an Agricultural Emissions Fund

Pricing methane and nitrous oxide emissions could raise between $47–$95 million per year over the first decade assuming an emissions price range of $25-$50 per tonne of CO_2e.

The funds from pricing agricultural emissions should be put into a dedicated Agricultural Emissions Fund. This Fund should be spent on programmes that will **directly** help farmers reduce emissions. An appropriate portion of the Fund should be directed towards supporting iwi/Māori land owners, recognising their unique circumstances.

Given uncertainty about future emissions and emissions prices, the Government should guarantee that the Fund receive a minimum amount of funding each year to give certainty for multi-year investments.

This Fund should be overseen by a board that includes representatives from the agriculture sector and iwi/Māori, including owners of Māori land, to ensure effective co-governance. All board members will need to understand and take into account the unique circumstances of owners of Māori land.

The priorities for the Fund will need to be determined by its Board but could include, for example, support for a greenhouse gas module in farm environment plans, and support for extension programmes and capability building.

The performance of the Fund should be reviewed regularly to ensure money is being well spent and provides value.

Recommendation 5

The Committee recommends that the Government, in amending the* Climate Change Response Act*, includes the requirement that the funds generated from pricing methane and nitrous oxide emissions from agriculture are recycled directly back into programmes that help farmers to reduce emissions. This should specifically include:

a. The establishment of an Agricultural Emissions Fund
b. The establishment of a Board to oversee spending of the Fund that ensures co-governance with iwi/Māori, including owners of Māori land. All Board members must understand and take into account the unique characteristics of Māori land
c. Criteria for allocating money from the Fund, including providing appropriate support to owners of Māori land
d. The requirement for the Board to report annually on how funds have been spent and the effectiveness of that spending.

14.6 Counting carbon sequestration by trees and vegetation on farm

Farmers and industry representatives have consistently raised the issue that not all trees and vegetation on farms can earn NZ ETS units for sequestering carbon.

The Government should prioritise work underway to improve the NZ ETS for forestry, to make it easier for owners of **eligible forest land** to register and benefit from the carbon dioxide sequestered by their forests.

Farmers cannot earn units for sequestration in **pre-1990 forests** but incur a liability if these forests are harvested but not replanted. This creates a perception of unfairness among farmers and foresters but reflects the rules that applied under the Kyoto Protocol and which New Zealand has committed to apply until at least 2030. Changing those rules would be very challenging and mean that New Zealand would have to increase the ambition of its 2030 target.

Rewarding farmers for sequestration that occurs under business as usual in pre-1990 forests would not lead to additional sequestration, and therefore would need to be offset by losses to other New Zealanders. It may be more feasible to explore different rules for targets after 2030.

There is scope under current rules to reward farmers for intentional forestry management practices that increase how much carbon is sequestered in pre-1990 forests. However, the impact from these intentional practices is not yet easy to quantify for individual forests. The Government should further investigate how additional removals could be robustly measured at this scale and if so, how farmers and foresters could benefit from this.

Farmers are unable to earn units for carbon sequestered in **smaller lots of trees and vegetation.** The cost of measuring, registering and reporting removals could outweigh the benefits for some types of vegetation. The Government should investigate how farmers could be rewarded in a cost-effective way, considering changes in monitoring technology. Alternatively, the Government could choose to reward farmers outside of the NZ ETS for the wider benefits of planting trees.

A system for **'netting off' at the farm gate** would allow farmers to deduct carbon sequestered by eligible forests from methane and nitrous oxide emissions under the levy/rebate scheme. This would reduce transaction costs for farmers having to participate in a levy/rebate scheme for their emissions in addition to trading units for their sinks in the NZ ETS. Details of how such a netting off scheme would interact with forestry in the NZ ETS would need to be worked through.

Recommendation 6

The Committee recommends that the Government:

a. Prioritises work underway to improve the NZ ETS for forestry, to make it easier for forest owners to identify eligible forest land and register it in the NZ ETS
b. Investigates opportunities to recognise and reward forestry management practices that store additional carbon in pre-1990 forests
c. Investigates opportunities to recognise and reward small plantings on farms
d. Investigates the feasibility of 'netting-off' carbon removals and agricultural emissions within the farm-level levy/rebate scheme.

14.7 Opening up opportunities

Regulatory and trade barriers – outside of climate policy – could affect the response to agricultural emissions policy, either positively or negatively.

Taking action on agricultural emissions may create opportunities to enhance the NZ Inc brand to the benefit of New Zealand businesses. The Government should consider how to assist the sector and potential future businesses take advantage of these opportunities, including by opening up markets for new and emerging products.

Barriers to action can arise from regulation outside of climate policy. For example, New Zealand's restrictions on genetically modified organisms could restrict the development and testing of emerging mitigation options. However, New Zealand farmers may also benefit from genetically modified free status.

Other regulations can restrict land use change to lower emissions land uses, for example, subdivision rules under the *Resource Management Act*. Also, owners of Māori land have less ability to reduce emissions by changing land use or farm systems, given the diverse governance arrangements created through a range of statutes.

Stimulating innovation is important for opening up opportunities. Key to this will be considering all options that could potentially reduce emissions. The Government should continue to fund research into technologies to reduce agricultural emissions and options for alternative land uses and their supply chains.

Recommendation 7

The Committee recommends that the Government:

a. Investigates barriers to reducing emissions created by non-climate regulation and options to remove them
b. Investigates how to facilitate opportunities to create new markets for low-emissions products.

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In keeping with the Committee's independence, all conclusions and recommendations in this report are our own.

Endnotes

1 Representatives in the Agriculture Challenge and Review group included: Beef + Lamb New Zealand, Dairy Companies Association of New Zealand, DairyNZ, Deer Industry New Zealand, Federated Farmers of New Zealand, Federation of Māori Authorities, Fertiliser Association of New Zealand, Fonterra, Horticulture New Zealand, and Meat Industry Association.

2 Whetu Consultancy Group (2019); BERL and FOMA (2019); Funk (2009).

3 Nana (2019); Harmsworth et al. (2012).

4 The Paris Agreement to the United Nations Framework Convention on Climate Change

5 UNFCCC website, Paris Agreement – Status of Ratification, url: **https://unfccc.int/process/the-paris-agreement/status-of-ratification**

6 EECA (2019). To date, 86 New Zealand businesses have signed up to the Climate Leaders Coalition and have committed to 'voluntarily measuring and reporting their greenhouse gas emissions, setting a public emissions reduction target consistent with keeping within 2°C of warming, and working with suppliers to reduce their emissions.' (Climate Leaders Coalition website, Actions, url: **https://www.climateleaderscoalition.org.nz/action)**

7 Ministry for the Environment (2018a).

8 Climate Change Response Act 2002, Part 4 and Schedule 3.

9 Ministry for the Environment (2016).

10 Kollmuss et al. (2015).

11 OMF Commtrade Carbon website, url: **https://www.commtrade.co.nz/**

12 Ministry for the Environment website, Proposed improvements to the New Zealand Emissions Trading Scheme, url: **http://www.mfe.govt.nz/consultation/ets**

13 Royal Society of New Zealand (2016); Intergovernmental Panel on Climate Change (2014).

14 New Zealand is a signatory to, and has obligations under, a number of other relevant international agreements such as the United Nations Convention on the Rights of Persons with Disabilities and the United Nations Declaration on the Rights of Indigenous Peoples.

15 This is based on 2018 data from Statistics NZ that can be accessed at: **https://www.stats.govt.nz/information-releases/goods-and-services-trade-by-country-year-ended-june-2018**

16 The agriculture sector also generates carbon dioxide emissions from transport, electricity use and processing. These are not counted as agricultural emissions and so are not address in this report.

17 Ministry for the Environment (2019). The breakdown of New Zealand's emissions profile is based on the metric GWP_{100}. More information on metrics can be found in **Technical Appendix 4**.

18 Ministry for the Environment & Statistics NZ (2018).

19 Intergovernmental Panel on Climate Change (2013); Gillet and Matthews (2010); Reisinger (2018).

20 Graphs have been calculated using the methodology described in Reisinger (2018) and national greenhouse gas inventory data for the year 2016.

21 A strong argument can be made to focus on reducing gross emissions rather than relying on tree planting to offset emissions (Parliamentary Commissioner for the Environment (2019)). Nonetheless, the world will continue to add to further warming until long-lived greenhouse gases collectively reach net zero emissions.

22 Allen et al. (2016, 2018).

23 A recent report by the Parliamentary Commissioner for the Environment (Parliamentary Commissioner for the Environment (2019)) shows that New Zealand's methane emissions are responsible for significantly more warming at present than the cumulative fossil carbon dioxide emissions since the mid-1800s. This is consistent with the recently developed GWP* metric, which compares the warming effect from a constant rate of methane emissions with the warming from a cumulative amount of carbon dioxide emissions (see Allen et al. (2016, 2018)).

24 Intergovernmental Panel on Climate Change (2018).

25 Reisinger and Clark (2016).

26 According to Schedule 4 of the Climate Change (Forestry Sector) Regulations 2008, indigenous forest can sequester 324 tonnes of carbon dioxide (equivalent to 88 tonnes of carbon) per hectare over 50 years.

27 QEII National Trust (2018).

28 Ministry for the Environment (2019).

29 Since 1990-1991, the milk solids processed in New Zealand has increased from 599 million kilograms to 1,840 million kilograms (LIC & DairyNZ (2018)).

30 Beef + Lamb New Zealand (2018a).

31 This data comes from Beef + Lamb New Zealand (2018b) and Statistics New Zealand. The total weight of graded meat (domestic & export) has increased from 465,000 tonnes in 1990 to 677,000 tonnes now.

32 Ministry for the Environment (2018b).

33 The use of synthetic nitrogen fertiliser has increased from 59,265 tonnes in 1990 to 442,900 tonnes in 2017. (Ministry for the Environment (2019)).

34 Ministry for the Environment (2017a).

35 Reisinger et al. (2017); Reisinger et al. (2018); Clothier et al. (2017).

36 A detailed description of the agricultural greenhouse gas inventory methodology can be found in Pickering and Gibbs (2018).

37 Reducing emissions by changing the timing of when manure is spread would be subject to improvements in the science and methodologies underpinning the national greenhouse gas inventory (Reisinger et al. (2018)).

38 Biological Emissions Reference Group (2018).

39 Owl farm (2019).

40 If trees are used for harvested wood products, the carbon returns to the atmosphere more slowly as the carbon is locked in the wood products.

41 Based on the national inventory, 15 tonnes of carbon would be lost from each hectare of soil over a 20 year period by changing land use from dairy to horticulture. This is equivalent to an emission of 55 tonnes CO_2e per hectare over the 20 years, or on average 2.8 tonnes CO_2e per hectare per year.

42 Based on industry predictions, kiwifruit is predicted to increase by around 1,000 ha in the near future, grapes are predicted to increase by 2,000 ha over the next 3 years, and apples are predicted to increase by around 1,600 ha between 2015 and 2020 (Clothier et al. (2017)).

43 Scion (2017).

44 Reisinger et al. (2018).

45 Reisinger et al. (2018)

46 Reisinger et al. (2018).

47 Reisinger et al. (2018).

48 Motu Economic and Public Policy Research (2019); AgFirst (2016); Pers. comm., Robyn Dynes, 1 April 2019.

49 Ministry for Primary Industries (2019).

50 DairyNZ (2017); Fonterra (2018); Beef + Lamb New Zealand (2018c); Deer Industry New Zealand (2018).

51 Good Farming Practice Governance Group (2018); Beef + Lamb New Zealand (2018c).

52 Beef + Lamb New Zealand (2018c).

53 Prime Minister's Chief Science Adviser (2018).

54 Campbell (2018).

55 Brennan (2017); Blaschke and Ngapo (2003); Brown (2016).

56 Based on conversations with agricultural sector representatives.

57 BECA (2018); Brennan (2017); Brown (2016).

58 Councils and primary sector organisations provide additional guidance on the specific actions that farmers can take to meet each good management practice. For example, DairyNZ (2016); Deer Industry New Zealand (2018); Foundation for Arable Research (nd).

59 Bailey (2018).

60 Bailey (2018); AgFirst (2016).

61 Ministry for Primary Industries (2019).

62 DairyNZ and Fonterra (2017).

63 Pers. comm. Fertiliser Association of New Zealand, 16 April 2019.

64 Nutrient Management Adviser Certification Programme website, url: **http://www.nmacertification.org.nz/Site/Nutrient_Management/become-certified/**

65 Reform of Vocational Education website, url: **https://conversation.education.govt.nz/conversations/reform-of-vocational-education/**

66 BERL and FOMA (2019).

67 BERL and FOMA (2019); Phillips and Mitchell (2010); Chauvel and Rean (2012).

68 Good management practices are core to mandatory farm plans for water quality. In 2015, Environment Canterbury worked with primary sector organisations and Crown Research Institutes to develop good management practices to improve water quality. These are not just applicable in Canterbury but are relevant across the country.

These good management practices are used to help farmers plan what actions they can take to improve nutrient run-off and sediment loss into waterways. For example, one of the good management practices is 'To the extent that is compatible with land form, stock class and intensity, exclude stock from waterways.' (Matrix of Good Management (2015)).

69 Partnership for Market Readiness and International Carbon Action Partnership (2016); OECD (2013).

70 Van Reenan (2019).

71 Note, the term 'processor' is used to refer to dairy processors, abattoirs or live animal exporters in the case of ruminant livestock, and fertiliser manufacturers or importers in the case of nitrogen fertiliser. The term 'farmer' could refer to either the land owner, stock owner or business owner, although stock owner is unlikely to be a practical option. (Agriculture Technical Advisery Group (2009); KPMG (2013)).

72 Processors could be given the option to apply for a lower 'unique emissions factor' that recognises that their suppliers emit less than the average. However, this would involve considerable effort for processors to prove that their suppliers have lower emissions than the national average. To get a unique emissions factor, processors would need data about these farmers' on-farm productivity improvements and use of mitigation technologies to prove their emissions are lower than the national average. If successful in proving this, the processors emissions costs would be lower, and they could pass this on to their farmers. This option may not be very feasible in the drystock sector in particular where farmers may frequently change processors. However, options exist to use other data that meat processors have available already such as the age of certain animals at slaughter, which could be used in the calculation of emissions at processor level (**see Technical Appendix 2**).

73 This cost is the cost to both the Government and the sector. This cost could be up to $39 million if the farm-level policy involved a complex method requiring certified farm advisers to run OVERSEER and paying brokerage costs to buy or sell emissions units (BECA (2018)).

74 Exactly how many farmers are included depends on thresholds for participation. BECA (2018) numbers are based on an estimate of 24,000 farmers included in the scheme.

75 Although the extent of this response is affected both by the scale of the fertiliser price increase as well as prices for farm outputs (Austin et al. (2006); Jensen et al. (2005); Shadbolt (2012)).

76 Horticulture New Zealand (2018).

77 The calculation for nitrous oxide emissions from nitrogen fertiliser also considers the specific nitrogen content of the fertiliser.

78 Agriculture Technical Advisery Group (2009).

79 The Farm Data Standards are one of three data integration initiatives developed by the pastoral sector, with funding from DairyNZ, the Red Meat Profit Partnership and Ministry for Primary Industries through the Primary Growth Partnership. The Farm Data Standards aim to make it easier to transfer data across systems in the primary sector in a secure and efficient way. More information can be found on this website: **http://www.farmdatastandards.org.nz/**

80 Parliamentary Commissioner for the Environment (2018).

81 New Zealand Productivity Commission (2018).

82 Such as fridges, heat pumps and motor vehicles.

83 BECA (2018).

84 Based on information from Ministry of Primary Industries, Ministry for the Environment, Environmental Protection Authority and Inland Revenue.

85 At 95% free allocation, the agriculture sector would bear a cost of about $50 million per annum (at an emissions price of $25 per tonne of CO_2e) if processors had surrender obligations under the NZ ETS. If this cost were passed through to farmers in full, this would reduce their average milk pay-outs by about 1 cent per kg milk solids, and the average schedule for red meat by between 1 and 3 cents per kg.

86 Another concern the Committee heard is that including processors in the ETS for a limited period requires them to engage in emissions trading without sufficient capability to do so effectively. However, the ETS already includes many companies of similar or smaller size than many of the smaller agricultural processors. In addition, processors are used to trading in other markets given their global exports and some are already trading in the ETS due to the carbon dioxide emissions from their processing plants.

87 2017 New Zealand Labour Party and New Zealand First Coalition Agreement.

88 Assuming an emissions price of $25 and current emissions forecasts out to 2030 which indicate that 5% of agricultural emissions is on average around 2 million tonnes of CO_2e per year. This assumes no emissions reductions so is an over-estimate of actual cost.

89 Based on emission factors derived from an average of three years of agricultural emissions to June 2015, (Ministry for the Environment (2018b).

90 Parliamentary Commissioner for the Environment (2019).

91 Taylor (2019).

92 Riggs et al. (2019).

93 These datasets are not nationally representative, but usefully illustrate the range of possible impacts across a diverse group of farms. All analysis presented assumes a constant 95% allocation rate and $25 per tonne of CO_2e emissions price.

94 Note: the Committee has not modelled the cost impacts of grandparenting, due to lack of the necessary historic data.

95 There are also concerns of gaming. For example, some farmers have anticipated that their regional councils will use grandparenting for water quality. They have increased nitrogen applications so that their historical records are higher, and therefore their limit is higher.

96 To put these net obligation costs per hectare in context, according to the DairyNZ Economic Survey average dairy operating expenses over the 10 seasons from 2007-08 to 2016-17 were $4,893/ha, while according to the Beef + Lamb New Zealand Economic Service farm survey, over the nine seasons from 2009-10 to 2017-18 average working expenses for sheep and beef farms were $385/ha.

97 Stock is used as the proxy for production on sheep, beef and deer farms, given the wide range of products the drystock sector produces.

98 An assistance package equal to 55 million units was made available to owners of pre-1990 exotic forest to offset some of the economic impact of the NZ ETS (Ministry for Environment (2007)).

99 Ministry for the Environment (2017a).

100 Ministry for the Environment (2006).

101 Manaaki Whenua (2018); Reisinger et al. (2018).

102 Manaaki Whenua (2018); Reisinger et al. (2018).

103 New Zealand's Nationally Determined Contribution for 2030.

104 Land classified in the New Zealand greenhouse gas inventory as grassland with woody biomass (most closely representing land covered in small blocks of trees) has been in overall decline since 1990 (reference inventory). This means a change in accounting rules to include smaller woodlots in the definition of forests could result in an increase in New Zealand's net emissions not a decrease. However, this does not mean we should not account for such changes, as additional incentives to plant small lots of trees and avoiding their removal could result in additional sequestration occurring.

105 Manaaki Whenua (2018). In 2015, only 16% of the forest land registered in the NZ ETS was within forest blocks less than 100ha (Carver et al. (2017)).

106 Ministry for Primary Industries website, One Billion Trees Programme, url: **https://www.mpi.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees/**

107 The alignment between the NZ ETS and any netting off scheme needs to be carefully worked through to ensure no perverse incentives or unintended consequences are created, including the potential for short term divergence between the levy rate and the price in the NZ ETS to lead to arbitrage opportunities. For details see **Technical Appendix 8.**

108 The Catalyst Group (2014).

109 Ministry for Primary Industries (2018).

110 Danone website, Towards Carbon Neutrality, url: **https://www.danone.com/impact/planet/towards-carbon-neutrality.html**

111 Sapare (2018).

112 Sapare (2018).

113 Primary Sector Council Terms of Reference (2018).

114 Pers. comm., New Zealand Merino, 18 April 2019.

115 AgResearch news, 12 July 2018, Key step forward for game-changing grass.

116 Royal Society Te Apārangi (2018); Prime Minister's Chief Science Adviser (2018).

117 Journeaux et al. (2017).

118 New Zealand Productivity Commission (2018).

119 Motu Economic and Public Policy Research (2018).

120 This range was based on an emissions price range of $25 – $50 and 5% of New Zealand's projected annual agricultural emissions over 2021-2030, sourced from New Zealand's 2017 Seventh National Communication under the UNFCCC and the Kyoto Protocol (Ministry for the Environment (2017a)).

121 2017 New Zealand Labour Party and New Zealand First Coalition Agreement.

122 For example, the European Union requires that at a minimum 50% of funds from the EU ETS should go towards climate action. EU member states put these funds into programmes to develop renewable energy, improve energy efficiency in homes and buildings, shift to lower emissions transport and reduce deforestation. See also Klenert et al. (2018).

123 Whetu Consultancy Group (2019); BERL and FOMA (2019).

124 AgFirst (2016); Motu Economic and Public Policy Research (2019); Motu Economic and Public Policy Research (2018).

125 AgFirst (2016).

126 BERL and FOMA (2019).

127 Extension 350 (2018).

128 Red Meat Profit Partnership Action Network (2019).

129 Parliamentary Commissioner for the Environment (2018).

130 The Government funds agricultural climate change mitigation research through the New Zealand Agricultural Greenhouse Gas Research Centre ($4.8 million a year), Pastoral Greenhouse Gas Research Consortium (about $3.1 million a year from the sector, including the Crown Research Institute AgResearch, and $2.3 million a year from the Government) and Global Research Alliance (about $6 million a year).

131 Motu Economic and Public Policy Research (2018); AgResearch and Motu Economic and Public Policy Research (2018).

132 Between July 2013 and June 2016, $5.2 million was spent on administering the waste levy plus the Waste Management Fund. This includes the costs of levy collection, distribution, compliance and enforcement of levy collection (Ministry for the Environment (2017b)).

Glossary

2030 target	The target, tabled with the United Nations as New Zealand's first Nationally Determined Contribution, to reduce emissions by 30% below 2005 levels by 2030.
2050 target	The new long-term emissions reduction target or targets the Government proposes to introduce through the *Zero Carbon Bill*.
Adaptation	Actions to manage the unavoidable impacts of climate change.
Allocation factor	A factor used to determine the amount of free allocation a participant in an emissions pricing scheme receives. Also termed an "allocative baseline".
Allocation rate	The level of assistance provided through free allocation to specified emitting activities. The current Government has committed to an allocation rate of 95% for agriculture (ie, 95% of the sector's exposure to NZ ETS costs).
Climate Change Response Act 2002	The Act that provides a legal framework to enable New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. The Act also provides for the implementation of the NZ ETS and the synthetic greenhouse gas levy.
CO_2e	Carbon dioxide equivalent. The quantity of a given greenhouse gas multiplied by its global warming potential.
Deforestation	The conversion of indigenous and exotic forest land to another use, such as grazing. Deforestation involves clearing forest and not replanting within four years after clearing. It does not include harvesting where a forest is replanted as this is part of normal plantation forestry activities.
Emissions	Greenhouse gases released into the atmosphere from human activity.
Emissions factor	A value used to convent data on activities that cause greenhouse gas emissions (such as the number of animals on a farm) into estimates of actual emissions.
Extension	The application of scientific research and knowledge to agricultural practices through farmer education.
Farm environment plan	A tool to help farmers recognise on-farm environmental risks and set out a programme to manage those risks. These are unique to a property and reflect the local climate and soils, the type of farming operation, and the goals and aspirations of the land user.

Free allocation	The distribution of emissions or emissions units without cost to specific businesses by the Government.
Good management practice	Guidance describing farm management practices based on sound production methods that reduce the impact of farming activity on the environment.
Greenhouse gases	The atmospheric gases responsible for causing global warming and climate change. The gases covered under the UNFCCC are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).
Gross emissions	Gross emissions include emissions from agriculture, energy, industrial processes and product use (e.g. cement production, refrigeration) and waste. Emissions and removals from land use, land use change and forestry (LULUCF) are excluded.
Kyoto Protocol	A protocol to the UNFCCC that includes emissions limitation or reduction commitments for ratifying developed (Annex 1) countries.
Mitigation	Efforts to reduce or prevent emissions of greenhouse gases. It can involve using new technologies, renewable energy, making older equipment more energy efficient, or changing land uses, management practices or consumer behaviour.
Mt	Mega tonnes (million tonnes).
Net emissions	Net emissions include emissions and removals from the land use, land use change and forestry (LULUCF) sector, as well as those from agriculture, energy, industrial processes and product use, and waste.
Net obligation	The emissions obligation for a participant in an emissions pricing scheme, after the free allocation has been deducted from the calculation emissions liability.
NZ ETS	New Zealand Emissions Trading Scheme.
Paris Agreement	An agreement within the framework of the UNFCCC to address climate change after 2020.
Pre-1990 forests (target accounting definition)	Natural or plantation forest or shrub land established before 1 January 1990. See Table 6.2.2 of the New Zealand Greenhouse Gas Inventory (1990-2017).
Pre-1990 forests (NZ ETS definition)	Forest established before 1 January 1990 on land that remained in forest and was predominantly exotic species on 31 December 2007. See section 4 of the CCRA.
Post-1989 forest (NZ ETS definition)	New forest established after 31 December 1989 on land that was not forest at that date. These forests are eligible to earn NZUs in the NZ ETS. See section 4 of the CCRA.
UNFCCC	United Nations Framework Convention on Climate Change

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