Chapter 23

# Ngā mahi whakaheke hauwaro-whakamahana
# Eventual reductions in biogenic methane

## Summary

The Minister of Climate Change asked us to give advice on the eventual reductions in biogenic methane emissions that might be needed for Aotearoa to contribute to limiting the global average temperature increase to 1.5°C above pre-industrial levels (the global 1.5°C effort).

We are not changing any existing targets – the Climate Change Response Act fixes the current targets which require biogenic methane emissions to reduce by 10% below 2017 levels by 2030 and by 24-47% by 2050. However, our finding will inform future emissions budgets, and we will review the targets in 2024.

We found that looking out to 2100, Aotearoa could be called on to reduce biogenic methane emissions further, to 49-60% below 2017 levels.

Most biogenic methane emissions (91%) in Aotearoa are from agriculture. These emissions are created through fermentation in the stomachs of ruminant animals such as cows and sheep.

Aotearoa can reach the 10% target by 2030 and the 24-47% target by 2050 without using new technology such as methane vaccines or inhibitors in agriculture. It is also likely these technologies will become available. This would increase the speed and efficiency of reducing biogenic methane emissions.

In this chapter we have looked at the emissions reductions needed globally, what Aotearoa might be able to achieve and how agriculture in Aotearoa might fit into a future global economy.

We have also looked at what additional contributions Aotearoa may need to make to global reductions, given the scale of agriculture and the relative expertise and wealth in our country. The contribution for Aotearoa will probably be in the mid-upper quartile of the proportional emissions reductions needed to achieve the the global 1.5°C effort.

### Changes in our final advice

This section is largely unchanged from our 2021 Draft Advice for Consultation.

Relatively few people commented in submissions on the long-term reductions in biogenic methane. Those that did gave a range of different perspectives, but did not provide relevant new evidence.

## Introduction

1 Under section 5K of the Climate Change Response Act 2002 (the Act), the Minister of Climate Change asked the Commission to provide a report assessing biogenic methane emissions in Aotearoa. Specifically, the Minister has asked the Commission to provide:

2 "advice on the potential reductions in biogenic methane emissions which might eventually be required by New Zealand as part of a global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above preindustrial levels.

3 In providing this advice the Commission must:

a) leave aside considerations on the current target range for biogenic methane specified in section 5(Q)(1)(b) of the CCRA;
b) consider the available scientific evidence on the global biogenic methane emissions reductions likely to be required to limit global average temperature increase to 1.5° Celsius above pre-industrial levels;
c) consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances; and
d) consider a range of potential scenarios for economic, social and demographic changes which might occur in New Zealand and globally until 2100."

4 The full text of the request and the terms of reference can be found on our website at https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/reviewing-new-zealands-nationally-determined-contribution-and-biogenic-methane/

5 We have interpreted part (a) to mean the Commission should not provide advice on the target range for biogenic methane emissions set for 2050. This is consistent with section 5T of the Act that sets out the limited circumstances when the Commission can review targets in the Act.

6 As there has not been a significant change in circumstances that would justify changing the 2050 methane target since it was set, the Commission would be unable to recommend a change to the 2050 target.

7 We have structured the analysis in this chapter around the considerations (b) to (d) above. Assessing these elements requires a mixture of quantitative and qualitative analysis. There are no exact numbers that can come out of a formula.

8 Judgements are required regarding trade-offs, where to prioritise efforts, and how the impacts and consequences of acting on climate change are distributed within Aotearoa across people, place, and time. Judgement is also needed to consider opportunities and trade-offs between Aotearoa and the rest of the world. This brings in concepts of equity and fairness.

9 In addition to the terms of reference, we must also consider the matters listed in section 5M of the Act (where relevant). These matters are considered throughout this report.

10 In this chapter we talk about methane, biogenic methane, and agricultural methane. Distinguishing between these three terms is important. Methane refers to all forms of methane emitted, including methane from agriculture, waste and fossil fuel extraction. Biogenic methane refers to methane from agriculture and waste. Agricultural methane refers solely to methane from agriculture.

11 While the request from the Minister requires us to consider the eventual reductions in biogenic methane, analysis that we have drawn on, including by the Intergovernmental Panel on Climate Change (IPCC), refers to agricultural methane.

12 Although these are slightly different, in Aotearoa agricultural methane makes up 91% of biogenic methane. So, for the purposes of our analysis we have applied analysis for agricultural methane as a proxy for biogenic methane. The IPCC does not separately identify biogenic methane from waste.

13 Relatively few submissions commented on the approach taken to assessing the eventual reductions in biogenic methane that may be necessary. Of those that did, submitters were mixed in whether the recommended reductions should be stronger or weaker.

14 Most submissions on this issue reflected submitters' preferences for overall ambition rather than providing new evidence for the level of reductions that might be required to limit the global average temperature increase to 1.5°C above pre-industrial levels (the global 1.5°C effort). As a result the approach and our findings in this chapter have not changed from our *2021 Draft Advice for Consultation*.

## 23.1 Consideration one: What global reductions of biogenic methane emissions might be required for the global 1.5°C effort?

15 Our first consideration is of the scientific evidence and analysis regarding what global reductions in biogenic methane are likely to be required for the global 1.5°C effort. This analysis is based on the *IPCC Special Report on Global Warming of 1.5°C.*

16 The long-term reduction in global biogenic methane emissions needed for the global 1.5°C effort depends on a number of factors. All the greenhouse gases have different warming properties.

17 Three key factors affect the contribution of different greenhouse gases to global warming: how much is emitted, how long the gases stay in the atmosphere, and the strength of their warming effects. Table 23.1 summarises these for carbon dioxide, methane and nitrous oxide – the three most important greenhouse gases in terms of their contribution to global warming. For further details, see *Chapter 1: The science of climate change* in the *2021 Supporting Evidence*.

*Table 23.1: Properties of carbon dioxide, methane, and nitrous oxide*

| Gas | Quantity of emissions | Duration in the atmosphere | Strength of warming effect |
|---|---|---|---|
| **Carbon dioxide** | Comprises the majority of global emissions, largely from fossil fuel combustion and deforestation.<br>Increasing by more than 1% per year over the last decade. | Long-lived gas that can last for centuries or milennia in the atmosphere. | Relatively small impact on per-molecule basis, but large effect with accumulation in the atmosphere over time.<br>Responsible for the majority of human-driven warming. |
| **Methane** | Accounts for the second largest share of global emissions.<br>Around a third of methane emissions are from fossil fuel extraction, distribution and combustion.<br>Biogenic sources comprise around 60% of total human-caused methane emissions globally. Largely stems from ruminant agriculture, rice cultivation, and organic waste decomposition. | Short-lived greenhouse gas.<br>Breaks down in the atmosphere after around 12 years. | Powerful warming effect on a per-molecule basis.<br>Responsbile for about one-fifth of all human-driven warming.<br>Some longer-term indirect warming effects through climate-carbon cycle feedbacks that endure after atmospheric decay. |
| **Nitrous oxide** | Relatively small quantity of emissions.<br>Mainly from industrial processes, agricultural soils, manure management and wastewater. | Long-lived gas with warming dynamics similar to carbon dioxide over decadal to centennial timeframes. | Powerful warming effect on a per-molecule basis.<br>Accumulates in the atmosphere over time. |

18 The combination of these factors – the quantity of emissions, their duration in the atmosphere and the warming effect of each greenhouse gas – all interact with each other to affect global temperature. This means the reductions in biogenic methane required for the global 1.5°C effort are dependent on the levels of other greenhouse gas emissions and emissions removals.

19 The global reductions in biogenic methane required for the global 1.5°C effort will depend on the level of carbon dioxide and nitrous oxide emissions over the next century. Therefore, it is not currently possible to know for certain what reductions in biogenic methane will be required. However, it is possible to identify the ranges of reductions of the different greenhouse gases that mean it is likely warming will be limited to 1.5 °C above pre-industrial levels.

### 23.1.1 Global pathways compatible with the global 1.5°C effort

20 The IPCC has assessed a large number of possible emissions reduction scenarios that would limit the global average temperature increase to 1.5°C above pre-industrial levels. Each scenario was designed to reach the temperature goal in the lowest-cost way possible.

21 The scenarios use current understanding of the relative costs of reducing emissions using known technologies. They do not include any direct emissions-reduction technologies applying to agricultural methane. The scenarios contain a range of assumptions about economic growth, technology developments, and lifestyles.

22 The IPCC assessment found 1.5°C compatible scenarios under a broad range of possible futures, with different economic and demographic developments. All of the 1.5°C compatible scenarios assume global population and food demand will increase over the course of the century, although some of the scenarios expect both population and food demand to drop by 2100.

23 Despite these common underlying features, the IPCC scenarios do differ in whether average global temperatures remain strictly within 1.5°C above pre-industrial levels, with some scenarios allowing global average temperature increase to exceed 1.5°C above pre-industrial levels before falling back below that level.

24 The scenarios with little or no overshoot have been estimated to be the most likely to deliver the best overall social, economic, and environmental outcomes. Higher levels of overshoot are associated with higher cumulative emissions and greater climate impacts and adaptation needs. Scenarios with higher overshoot also rely on high levels of emissions removal technologies such as carbon capture and storage that may not be feasible. We have therefore chosen to only consider scenarios with no or limited overshoot.

25 Each of these different scenarios result in different rates of emissions reductions for each greenhouse gas. The interquartile range of emissions reductions ranges for carbon dioxide, agricultural methane and nitrous oxide in these scenarios are summarised below in Table 23.2.

26 We have used the interquartile range as it excludes more extreme model results that are less likely to be feasible. The emissions reductions here are associated with scenarios with a 50-66% probability of limiting the global average temperature increase to 1.5°C above pre-industrial levels.

27 Scenarios closer to the lower quartile range have greater methane reductions and are less likely to lead to global average temperature overshooting 1.5°C above pre-industrial levels. Conversely, scenarios closer to the upper quartile range have smaller methane reductions and are more likely to lead to global average temperature overshooting 1.5°C above pre-industrial levels and rely on carbon dioxide removals in the latter part of the century to bring temperatures back down.

28 The IPCC has noted that relying on large scale carbon dioxide removals represents a major risk that the world will not be able to limit the global average temperature increase to 1.5°C above pre-industrial levels.

29 The benefit of early reductions in methane emissions was reiterated in the work of the UN Environment Programme and the Climate and Clean Air Coalition. Their 2021 report ***Global Methane Assessment: Benefits and costs of mitigating methane emissions*** emphasises that the short atmospheric lifetime of methane means that making emissions reductions early will result in faster reductions in concentrations, and will more rapidly slow the rate of warming.

***Table 23.2: Change in greenhouse gas emissions in IPCC pathways with no or limited overshoot***

| | **Percentage change relative to 2010** | | |
|---|---|---|---|
| | 2030 | 2050 | 2100 |
| **Net carbon dioxide emissions** | -40 to -58% | -94 to -107% | -121 to -136% |
| **Agricultural methane emissions** | -11 to -30% | -24 to -47% | -37 to -60% |
| **Agricultural nitrous oxide emissions** | +3% to -21% | +1% to -26% | -6 to -39% |

Note: in some of the scenarios, nitrous oxide stays the same or increases out to 2050. This reflects the lack of mitigation options that exist for this gas, and the fact that some nitrous oxide emissions are an inevitable by-product of agricultural practices.

30 The pathways that had the greatest chance to limit the global average temperature increase to 1.5°C above pre-industrial levels, all required rapid emissions reductions of greenhouse gases between now and 2030 and then somewhat slower reductions out to the end of the century. These pathways have several other features in common:

- Emissions of carbon dioxide and other greenhouse gases peak in the 2020s and then rapidly reduce through the 2030s and 2040s
- Emissions of nitrous oxide have relatively smaller reductions. This reflects fewer options to reduce this gas
- Emissions of methane reduce significantly through the next 20 years, but do not reach zero by 2050 or 2100. This reflects the short-lived nature of the gas, and the smaller range of mitigation options currently available
- Emissions of long-lived greenhouse gases reduce to be near zero by 2050

31 Most of the pathways have some gross emissions remaining in 2050. These come from hard-to-abate sectors like cement manufacturing. As a result,carbon dioxide needs to be removed from the atmosphere to make sure net emissions reach net zero and remain there.

32 Overall, the IPCC scenarios show that at least a 37% reduction in agricultural methane is required to have a 50-66% chance of limiting the global average temperature increase to 1.5°C above pre-industrial levels by 2100.

33 Simply maintaining the current level of warming from methane is not enough, as it would require the world to reach net zero carbon dioxide by 2030 to keep the global average temperature increase below 1.5°C above pre-industrial levels. We consider this to be infeasible and consequentially that the global warming contribution from methane must be reduced if the global 1.5°C effort is to be successful.

34 The reductions in methane assessed by the IPCC used a 2010 base year. The current biogenic methane targets for Aotearoa use a 2017 base year. As the country's biogenic methane emissions in 2010 and 2017 differed by less than 1%, the percentage reduction is essentially the same. In the rest of this chapter we present reductions in biogenic methane against 2017 levels for ease of comparison with the existing targets.

## 23.2 Consideration two: What reductions of biogenic methane could Aotearoa make to contribute to the global 1.5°C effort, recognising national circumstances?

35 Our second consideration is of the potential contribution Aotearoa could make to reducing biogenic methane emissions, in light of national circumstances. We analyse the sources of biogenic methane emissions, the opportunities for Aotearoa to reduce biogenic methane emissions and key aspects of national circumstances that affect these.

### 23.2.1 The sources of biogenic methane in Aotearoa

36 In 2019, gross emissions of biogenic methane were about 1.35 $MtCH_4$ in Aotearoa. Agriculture is the largest source of biogenic methane at around 91%, with the remainder from waste (Figure 23.1).

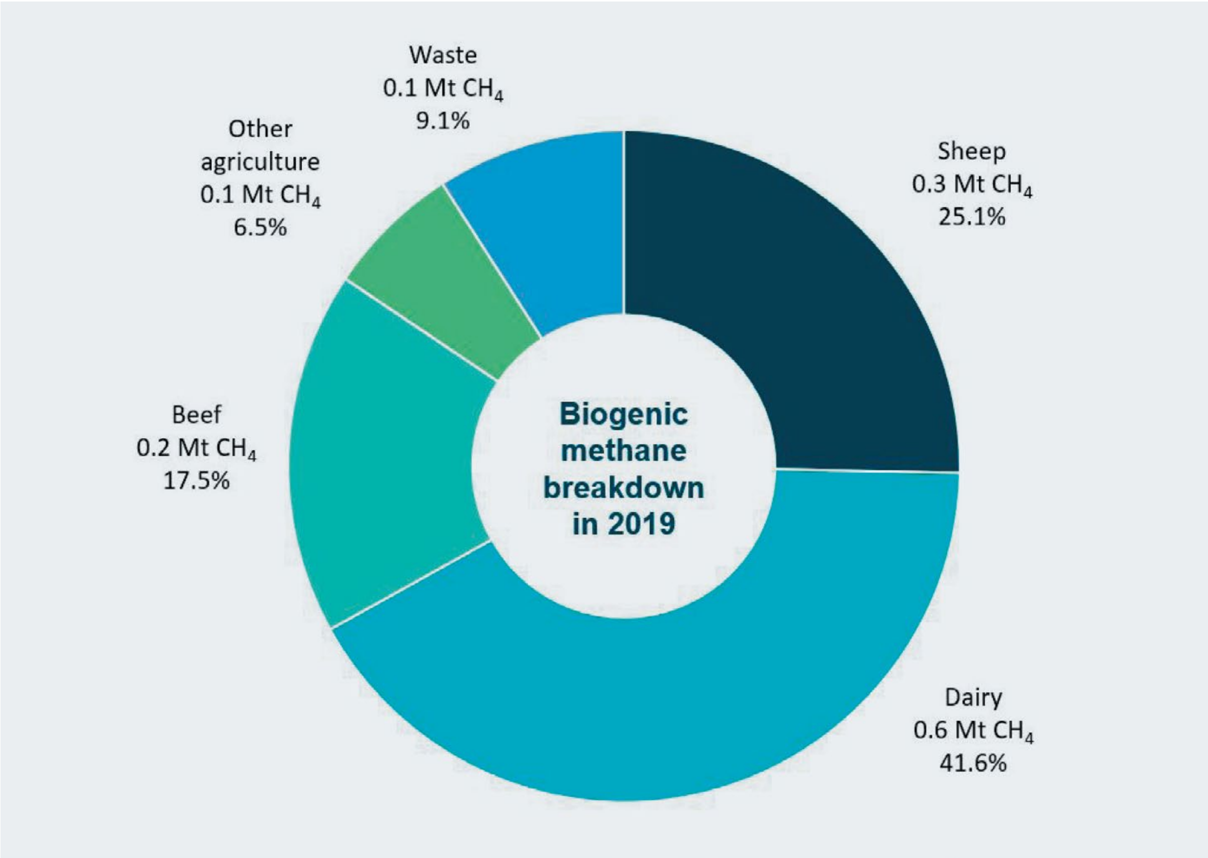


*Figure 23.1: Aotearoa biogenic methane emissions by sector 2019.*
Source: MfE, New Zealand's Greenhouse Gas Inventory 1990-2019

*Agriculture*

37 Aotearoa has a well-developed agricultural sector that makes up a much larger part of the economy than in many other developed nations. Around 9.7 million hectares of the 26.8 million total hectares in Aotearoa are used for pastoral agriculture. The main agricultural products by volume are meat, dairy products and wool, with the vast majority being exported.

38 Figure 23.2 shows the breakdown of historic biogenic methane emissions from agriculture and those projected under current policies (termed the Current Policy Reference case). Dairy, sheep and beef farming account for the majority of these emissions, although the former has increased historically while the latter has decreased. For more information on these trends and the Current Policy Reference case see ***Chapter 11: Where are we currently heading?*** in the ***2021 Supporting Evidence***.


***Figure 23.2: Historic and Current Policy Reference case biogenic methane emissions from agriculture***

*Waste*

39 Aotearoa has high per capita waste production and resulting biogenic methane emissions compared to many other developed countries. Figure 23.3 shows the historic biogenic methane emissions from waste and those projected under current policies.

40 The main sources of these emissions are landfills, some of which use landfill gas capture (LFG) technology and farm fills. For more information on these trends and the Current Policy Reference case see ***Chapter 11: Where are we currently heading***? in the ***2021 Supporting Evidence***.

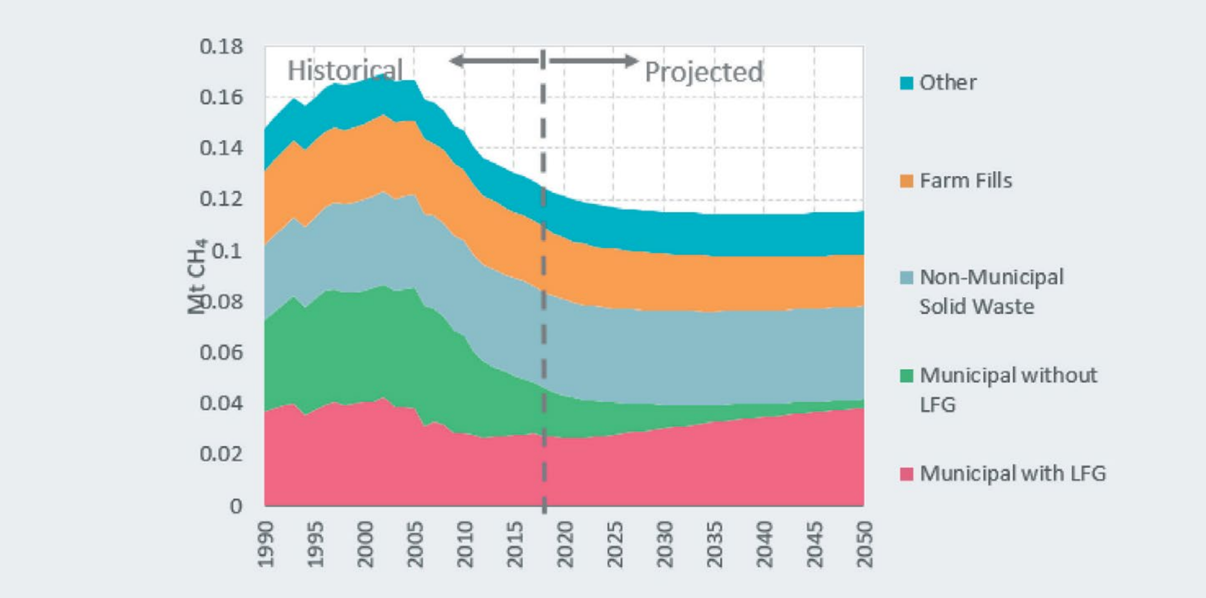


*Figure 23.3: Historic and Current Policy Reference case biogenic methane emissions from waste*

### 23.2.2 How much could biogenic methane emissions be reduced?

41 As part of our analysis, we have identified a number of opportunities to reduce biogenic methane emissions from agriculture and waste.

*Agriculture*

42 In Aotearoa, biogenic methane emissions from agriculture are largely a function of the amount of feed each animal eats and total animal numbers. Reducing methane from agriculture therefore relies largely on changes to farm management practices that reduce total feed being produced and consumed.

43 Adjusting stocking rates, supplementary feed and other inputs can improve emissions-efficiency on-farm. Changing land use to lower emissions activities such as horticulture, could also reduce methane emissions.

44 New technologies also offer potential for reducing methane emissions. Selective breeding of sheep to be low emitting is already being implemented. Breeding these traits through the national flock is estimated to reduce total biogenic methane from sheep and beef farming by 3% by 2035. Breeding for low-emissions cattle has commenced.

45 Other promising emissions-reducing options that could be on the market in the next few years include a methane inhibitor. Research into a vaccine that could supress methane emissions is ongoing. Some submitters particularly Iwi/Māori submitters cautioned about the possible animal health, food safety and environmental effects these options could have.

46 If Aotearoa were to pioneer the development of these methane technologies, Aotearoa would also be able to make significant contributions to global emissions reductions through helping disseminate them internationally.

*Waste*

47 We have identified three broad opportunities for reducing biogenic methane emissions from waste. These are:

- Reducing total waste generation by improving resource efficiency and supporting consumers to reduce household waste
- Increasing the amount of waste diverted from landfills by, for example, turning what would have gone to landfill as 'food waste' into compost
- Ensuring that landfills that receive organic waste have high efficiency LFG systems, that capture the majority of the methane produced

48 These opportunities are discussed in more detail in *Chapter 8: Reducing emissions from waste* of *2021 Supporting Evidence*.

### 23.2.3 Overall

49 Our analysis to inform emissions budgets indicates that it is possible to reduce total biogenic methane emissions by between 10-24% below 2017 levels by 2030 and 24-57% below 2017 levels by 2050 through reducing biogenic methane emissions from both agriculture and waste.

50 The lower ends of these reductions (10% by 2030 and 24% by 2050) can be achieved using currently available practices and technologies. The development of new technologies such as a methane inhibitor would provide greater flexibility and unlock the upper range of reductions.

51 Reaching the higher range of biogenic methane reductions (24% by 2030 and 57% by 2050) without new technology would likely require significantly reduced agricultural production from livestock and land-use change. For more details on our scenarios and projected emissions reduction paths see *Chapter 6: Long term scenarios to 2050.*

52 After 2050, there is a high level of uncertainty around what opportunities to reduce biogenic methane may become available and how effective they will be. This makes it difficult to estimate what levels of reductions are likely to be achievable.

### 23.2.4 Important national circumstances that relate to potential biogenic methane emissions reductions

53 There are several important national circumstances that should be taken into account when considering biogenic methane emissions reductions in Aotearoa.

54 Firstly, there are obligations to uphold the principles of partnership, protection, participation and equity under Te Tiriti o Waitangi/The Treaty of Waitangi. As discussed in ***Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable***, Iwi/Māori hold approximately $20.4 billion in assets in the forestry and agriculture sectors with potential for further development.

55 Any targets and associated policies should be developed in partnership with Iwi/Māori to avoid compounding historical disadvantages.

56 Secondly, Aotearoa has a responsibility as a developed country to take a leading role in reducing greenhouse gas emissions under the United Nations Framework Convention on Climate Change and the Paris Agreement. This responsibility is discussed further in ***Chapter 21: The global 1.5°C effort and Nationally Determined Contribution for Aotearoa***. This responsibility means that the country's contribution to meet a fixed temperature target should be more than the global average.

57 Thirdly, Aotearoa is one of the most greenhouse gas efficient producers of red meat and dairy products in the world. The climate, topography, rainfall patterns and soil types make much of the country suited to pastoral farming.

58 Combined with access to international markets and the need to compete with subsidised international producers, this has helped drive improvements in efficiency across pastoral production systems of Aotearoa. In a low-emissions future where red meat and dairy products continue to be consumed there is good reason to believe that production in Aotearoa would still be globally competitive, and result in less emissions than product from less efficient export competitors.

59 Internationally, Aotearoa leverages its expertise in efficient agricultural production to support emissions reductions and sustainable development in other countries. The Government's role in founding and funding the Global Research Alliance on Agricultural Greenhouse Gases is a key example of this. Its ability to credibly lead such initiatives is enabled and underpinned by the country's innovative ecosystem of farmers, researchers and agriculture experts. The value of these international contributions should also be considered in assessing biogenic methane emissions reductions.

60 Fourthly, the large role played by agriculture in the economy of Aotearoa should also be considered when considering reductions in biogenic methane. Reductions in biogenic methane that come at significant cost to agricultural industries could have negative social and economic consequences as discussed in *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable.*

61 At the same time, the long-term viability of these industries may require reductions in biogenic methane to maintain access to international markets and to meet evolving domestic and international consumer preferences. This is discussed more in the next section of this chapter.

62 On balance, we consider that the country's national circumstances do not provide sufficient reason to reduce biogenic methane emissions by less than other developed countries in contributing to the global 1.5°C effort.

## 23.3 Consideration three: What social, economic and demographic changes may occur?

63 Our third consideration is of the the key social, economic and demographic factors and changes that may occur until 2100 – both within Aotearoa and globally – that could affect the contribution Aotearoa makes to biogenic methane emissions reductions. This section steps through some of the key trends that we have incorporated into our analysis.

### 23.3.1 Population growth and food demand

64 The world population is expected to continue to increase over the century, reaching more than 9 billion people by 2050. The growth in the global population is expected to slow over the century, although by how much is uncertain. Estimates used in the *IPCC Special Report on Global Warming of 1.5°C* suggest the global human population is expected to increase to between 9-11 billion by the end of the century.

65 This growing population will need to be fed. As the majority of meat and dairy produced in Aotearoa is exported, changes in global demand for these products could have important consequences for domestic biogenic methane emissions.

66 A number of estimates exist for changes in food demand, which include both an increase in total amount and changes in the type of food required. The Food and Agriculture Organization of the United Nations (FAO), estimated the need to double global food production by 2050 to meet the expected demand of around 9.7 billion people, although this need is not evenly distributed around the world. The FAO also predicts increasing demand for animal products, fruit and vegetables and more processed foods, due to a combination of increasing wealth and greater urbanisation.

67 The majority of global population growth and increased food demand is expected to occur in regions that are not currently major export destinations for Aotearoa, such as sub-Saharan Africa and South Asia. Most of the dairy and meat exports are currently targeted at middle-class and premium consumers in China, Europe, and North America.

68 In addition to global population growth, incomes in many developing countries are expected to rise and bring with them an expanded global middle-class. There is a clear relationship between increasing incomes and consumption of meat and dairy products.

69 In a future where meat and dairy products remain in high demand, there is good reason to expect Aotearoa can continue providing these to the world if Aotearoa can maintain and strengthen its position as one of the lowest emissions producers.

### 23.3.2 Demand for low-emissions agricultural production

70 Both globally and domestically, there are growing concerns about the environmental impact of food – including for greenhouse gases. In response, a number of agricultural accreditation and sustainability schemes have been established, such as Toitū Envirocare's farm carbon certification programme. A number of producers in Aotearoa have already signed up to such schemes.

71 The rapid development of alternative protein industries has built on consumer preferences for environmentally sustainable products. These include plant-based protein products and synthetic meats grown in laboratories, many of which have lower emissions, water and land-use footprints than conventional animal agriculture products. The rapid expansion of these industries, which often promote themselves as more sustainable alternatives to animal agriculture, could compete with agricultural exports.

72 Overall, the impact of growing alternative protein markets remains uncertain but appears to push in the direction of reducing methane emissions from agriculture, either through reduced demand and production or through the need to reduce emissions per unit of product to help maintain a niche market.

73 Rising consumer expectations could favour producers in Aotearoa if consumers place a premium on lower-emissions varieties of the products they already consume. Red meat and dairy products from Aotearoa are already some of the least emissions intensive in the world but, shifts in preferences for low-emissions products could negatively impact exports if preferences move away from these products entirely.

74 A Gallup poll showed almost 1 in 4 Americans reduced their meat consumption in 2019, with environmental concerns being the second ranked reason after health. These trends are likely to be stronger in Europe and North America than in emerging markets in Asia and Africa.

### 23.3.3 Other environmental challenges

75 Other environmental challenges are related to waste and agriculture in Aotearoa. These include freshwater quality, soil health, biodiversity loss and soil erosion. The growing pressure of these challenges combined with efforts to address them may have important consequences for efforts to reduce methane emissions.

76 Freshwater quality has been a particular focus of attention over the last few decades as large areas of sheep/beef were converted to dairy. Although rates of nitrogen and pathogen loss into waterways varies with land management, rates of nitrogen loss into waterways are generally higher from dairy operations than from sheep and beef farming and forestry.

77 In some parts of the country where there have been large-scale land conversions, such as Canterbury, Southland and the central North Island, indicators of water quality and ecological health have significantly declined.

78 Declining freshwater quality is a threat to many native species, this is also exacerbated by the clearance and conversion of native habitats – such as forests, wetlands and natural grasslands – often into pasture.

79 High levels of nutrient and pathogen loss from pastoral farms can also have human health impacts. Samples of groundwater used for drinking have found that areas with high livestock numbers are more likely to have nitrate-nitrogen levels in the water that can cause health concerns.

80 Disease-causing bacteria carried by farm animals can include Escherichia coli, Campylobacter, Leptospira, and Salmonella and there is a high risk of these bacteria spreading to farm workers and others in rural communities. The most frequently notified disease in Aotearoa is campylobacteriosis, and evidence shows this disease is diagnosed more often in areas with more intensive animal farming.

81 Waste management is also associated with other environmental challenges. While modern, engineered landfills mitigate some of the environmental impacts associated with their construction and management, they have wider ecological effects which may lead to landscape changes, loss of habitats and displacement of fauna. Waste leaching, particularly from older landfills, can also contaminate nearby soils and aquifers.

82 Changes in the way land and waste are managed could also have impacts on biogenic methane emissions. For example, limitations on land-use change to dairy to protect water quality are likely to limit additional methane emissions, while initiatives that promote diversion of waste from landfills or the retirement of erosion prone land from pastural farming may result in reduced methane emissions.

### 23.3.4 Overall

83 Overall we assess that there are good reasons for Aotearoa to expect to reduce biogenic methane emissions by at least the global average as part of contributing to the global 1.5°C effort. The country's relatively efficient food production compared to other global exporters of similar products and a growing global population suggest that Aotearoa might be expected to take a smaller than average reduction in biogenic methane.

84 However other factors, such as increasing awareness of the environmental impact of animal-based products, and local environmental challenges, would suggest that Aotearoa could make a greater than average reduction in biogenic methane.

## 23.4 Findings

85 In summary, we make the following findings in relation to each of the considerations requested by the Minister.

*Consider the available scientific evidence on the global biogenic methane emissions reductions likely to be required to limit global average temperature increase to 1.5°C above pre-industrial levels*

86 The global reductions in biogenic methane required to limit the global average temperature increase to 1.5°C above pre-industrial levels would depend on the level of carbon dioxide and nitrous oxide emissions over the next century.

87 Therefore, it is not currently possible to know for certain what reductions in biogenic methane will be required. However, it is possible to identify the ranges of reductions of the different gases that mean it is likely warming would be limited to 1.5 °C above pre-industrial levels.

88 Overall, the IPCC pathways show that at least a 37% reduction in agricultural methane is required to limit the global average temperature increase to 1.5°C above pre-industrial levels by 2100.

89 Simply maintaining the current level of warming from methane is not enough, as it would require the world to reach net zero carbon dioxide by 2030 to keep warming below 1.5°C. We consider this to be infeasible and consequentally that the global warming contribution from methane must be reduced if the global 1.5°C effort is to be successful.

*Consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances*

90 Our scenario analysis indicates that it is possible to reduce total biogenic methane emissions in Aotearoa by between 10-24% below 2017 levels by 2030 and 24-57% below 2017 levels by 2050 through reducing biogenic methane emissions from both agriculture and waste.

91 The lower ends of these reductions (10% by 2030 and 24% by 2050) can be achieved using currently available practices and technologies. The development of new technologies such as a methane inhibitor would provide greater flexibility and unlock the upper range of reductions.

92 Reaching the higher range of biogenic methane reductions (24% by 2030 and 57% by 2050) without new technology would likely require significantly reduced agricultural production from livestock and land-use change. For more details on our scenarios and projected emissions reduction paths see *Chapter 6: Long term scenarios to 2050.*

93 On balance, we consider that national circumstances do not provide sufficient reason for Aotearoa to reduce its biogenic methane emissions by less than other developed countries in contributing to the global 1.5°C effort.

*Consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances and local and global economic, social, and demographic trends*

94 The country's relatively efficient food production and a growing global population suggests Aotearoa might be expected to take a smaller than average reduction in biogenic methane. However other factors, such as increasing awareness of the environmental impact of animal based products and local environmental challenges, would suggest that Aotearoa could make a greater than average reduction in biogenic methane.

95 Overall we assess that there are good reasons for Aotearoa to expect to reduce biogenic methane emissions by at least the global average as part of contributing to the global 1.5°C effort.

## Where does this get us?

96 Our assessment of the IPCC scenarios has identified the range of global reductions in biogenic methane that are compatible with the global 1.5°C effort. These are represented by the interquartile range of modelled pathways. The pathways in the top half of this range are the ones with greater reductions in methane and less reliance on unproven carbon removal methods. They have also been estimated to be the most likely to deliver the best overall social, economic and environmental outcomes.

97 Fundamentally, it is our judgement that there is no reason to anticipate that Aotearoa would be expected to contribute less than the middle of the IPCC range for reductions of biogenic methane.

## Recommendation 33

**Reductions in biogenic methane that might be required of Aotearoa in the future as part of a global 1.5°C effort**

We advise that the reductions in emissions of biogenic methane that Aotearoa may eventually need to make as part of a global effort to limit the global average temperature increase to 1.5°C above pre-industrial levels could be between 49% and 60% below 2017 levels by 2100.

98 Our analysis suggests that the successful development of a methane vaccine or inhibitor suitable for pastoral systems would help reduce the country's biogenic methane emissions by more than 50%.

99 There is a role for agricultural products from Aotearoa in a low-emissions future, both for the nutrition it can provide and the valuable natural products such as wool. However, to create and maintain the market for those products, Aotearoa needs to be able to demonstrate their genuine climate, environmental, social and cultural credentials.