

Chapter 9:

Which path could we take?

Our previous chapter set out several different future scenarios. The question is: what path should Aotearoa take now to put itself on track to meet the 2050 targets? The emissions budgets we recommend need to be both ambitious and achievable. This chapter presents analysis which supports the Commission's path to 2035 for reducing emissions.

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9.1 Introduction

The scenarios presented in the previous chapter help to investigate the uncertainty around the potential for future emission reductions. They also provide a range for the level of emissions in each of the budget periods consistent with meeting the 2050 target.

In arriving at recommended levels for the first three emissions budgets, we have identified a path to 2035 which, in our opinion, would be the best way to put Aotearoa on track to meeting the 2050 target. We have also tested alternative paths to ensure the recommended budgets can be met under a range of circumstances. Finally, we have offered recommendations on how the budgets should be met, including the use of flexibility mechanisms allowed under the Act.

9.1.1 An ambitious and achievable path

In arriving at its recommended budget levels, we have sought to strike a balance across the range of considerations laid out in the Climate Change Response Act. At the highest level, we have sought to arrive at a path that is ambitious as possible while still achievable.

We consider that the Tailwinds scenario – with its accelerated emissions reductions and lower reliance on forestry removals to meet the 2050 target – best represents the future Aotearoa should be aiming for. However, setting budgets in line with the Tailwinds scenario would entail significant delivery risks.

The Tailwinds scenario makes strong assumptions about the pace and scale of several key actions and technology developments; for example, it assumes widespread adoption of methane inhibitors and/or vaccines which are not yet commercially available. While it is hoped this and the other scenario assumptions can be realised, the high uncertainty means it might not be prudent to set budgets today which are reliant on them occurring.

Setting budget levels in line with the Headwinds scenario would entail much lower delivery risk due to conservative assumptions. However, we judge that doing so would fall short on ambition. The relatively slow pace of change would be less consistent with that required globally to limit warming to 1.5°C. While this path would still see Aotearoa on track to meet the 2050 target, it would do so with significantly more effort required in the period after 2035 and a greater reliance on carbon dioxide removals. It would also only put Aotearoa on course for the less ambitious end of the biogenic methane target range.

We have drawn on insights from the scenarios and individual measures to build up a path that we judge would best set Aotearoa up for meeting the 2050 target and the other considerations in the Act. We have sought to set budgets which could be achieved under a range of circumstances, and through measures which are available today. The wider impacts of the pathway have been assessed and are discussed in *Part 4: What this could mean for New Zealanders*. We then have considered what policies could be used to put Aotearoa on the path. This is discussed in *Part 5: How to make this happen*.

It is impossible for us to anticipate every new development which could reduce emissions in the future. However, there will be opportunities in the future for us to revise our analysis to incorporate new development when we advise on the level of subsequent emissions budgets.

Box 9.1: Setting a path that allows for international transport emissions

International aviation and shipping emissions fall outside the Paris Agreement. Although they are not covered by the Paris Agreement, international aviation and shipping emissions are being addressed internationally. The International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) have agreed on actions covering aviation and shipping emissions. Aotearoa is a party to both agreements.

The Commission will be called upon to recommend whether international transport emissions should be included in the 2050 zero emission target no later than 2024

Our emissions from international aviation and shipping are not currently part of the 2050 target. We will review whether these should be included in the 2050 target in 2024. We have tested to make sure that our path could allow Aotearoa to meet the 2050 net zero long-lived gas emissions target including international aviation and shipping emissions in case a decision is made in future to include these in the 2050 target.

9.2 Setting a path to 2035

We have applied the principles set out in *Chapter 2 of the Advice report* to help guide our advice on the path to 2035, and subsequently the recommended levels of the first three budgets.

9.2.1 Summary of our path

Table 3.1 below provides a summary of key actions in our path across the first three budget periods. In the following section we give a more detailed description of the changes that would happen within each sector.

In relation to our long-term scenarios described in the previous chapter, our path would see reductions in long-lived gas emissions near the most ambitious end of the range (Figure 9.1). Net long-lived gas emissions would fall by 33% by 2030 and 64% by 2035 compared to 2018. Emissions reductions would mostly come from road transport and heat, industry and power, with gross carbon dioxide emissions roughly halving by 2035 (Figure 9.3, Figure 9.4). This path would set Aotearoa up to achieve net zero long-lived gas emissions in the early 2040s. If this was chosen, Aotearoa would be able to meet a net zero long-lived greenhouse gas target by 2050 that includes its share of international aviation and shipping.

For biogenic methane, our conservative approach to new technologies means that we have not assumed any adoption of a methane inhibitor or other methane reducing technologies that are not already available. Because of this, our path sees biogenic methane emissions towards the high end of the scenario range as all scenarios assumed some adoption of new technologies (Figure 9.4). Our path would push hard on driving changes to low emissions farm practices, alongside strong action to reduce methane emissions from landfills.

Table 9.1: Key transitions along our path.

		Budget 1	Budget 2	Budget 3
Transport	<i>Road transport</i>	Accelerate EV uptake Improve average efficiency of new ICE vehicles		Phase out new light ICE vehicles Electrify medium and heavy trucks
	<i>Reducing travel demand</i>	Encourage remote working for those who can Encourage switching to walking, cycling and public transport		
Heat, Industry and Power	<i>Non-road transport</i>	Electrification of rail	Biofuel blending Start electrification of ferries and costal shipping	
	<i>Buildings</i>	No new gas heating systems installed after 2025 Improve thermal efficiency		Start phase out of gas in buildings
	<i>Electricity</i>	Phase out fossil base-load generation	Transmission and distribution grid upgrades Reduce geothermal emissions	Expand renewable generation base Achieve ~95% renewable generation
	<i>Industrial process heat</i>	Replace coal with biomass and electricity		Replace gas with biomass and electricity
	<i>Agriculture</i>	Adopt low emissions practices on-farm	Adopt low emissions breeding for sheep	Encourage the adoption of new low methane technologies when available
	Land	<i>Native Forests</i>	Ramp up establishing new native forests	
<i>Exotic Forests</i>		Average 25,000 hectares per year of new exotic plantation forests		Ramp down planting new exotic plantation forests for carbon storage
Waste and F-gases	<i>Waste</i>	Divert organic waste from landfill Improve and extend landfill gas capture		
	<i>Hydrofluorocarbons (HFCs)</i>	Reduce import of HFCs in second-hand products Increase end-of-life recovery		

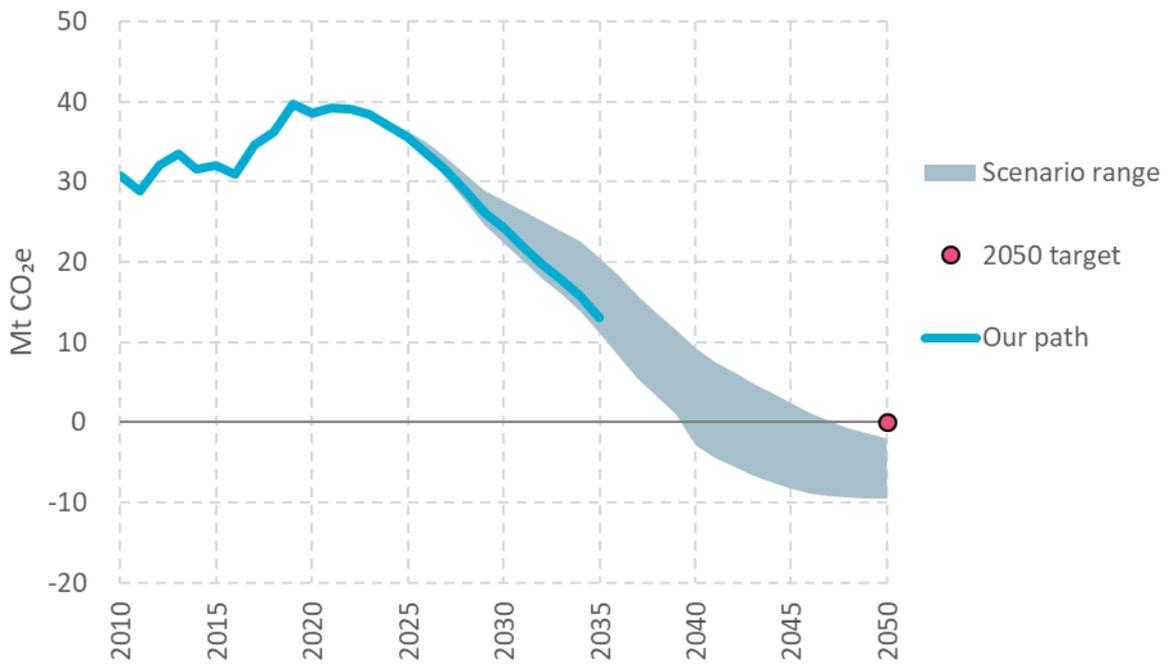


Figure 9.1: Net long-lived gas emissions in our path to 2035 compared with our scenario range.

Source: Commission analysis.

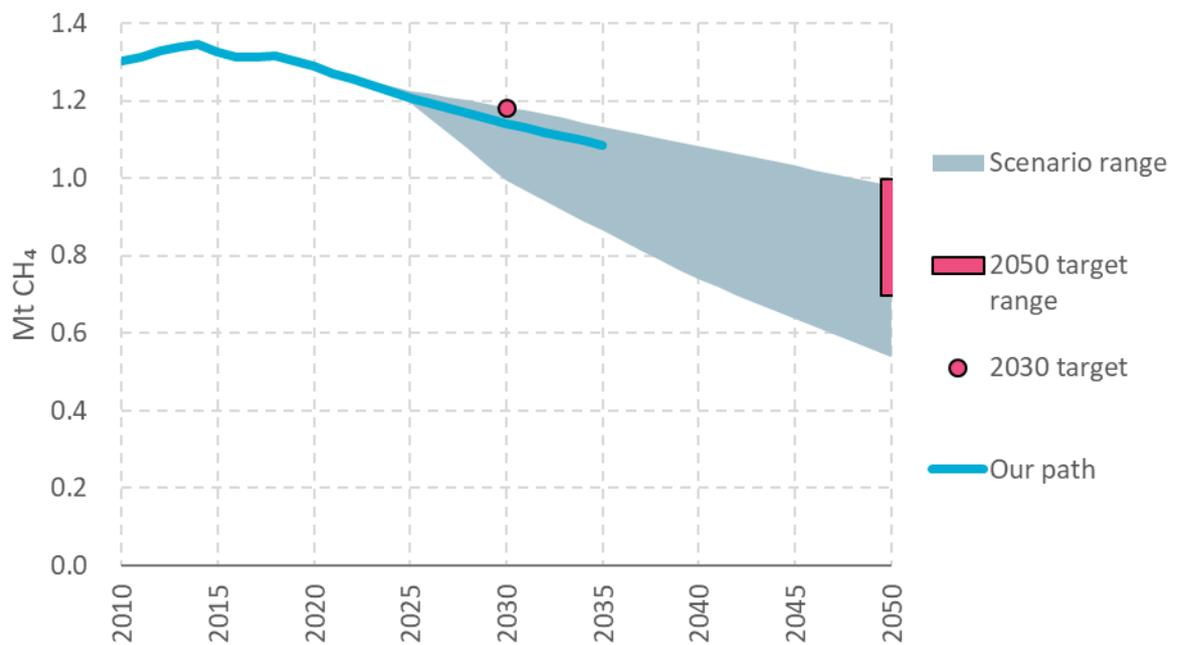


Figure 9.2: Biogenic methane emissions in our path to 2035 compared with our scenario range.

Source: Commission analysis.

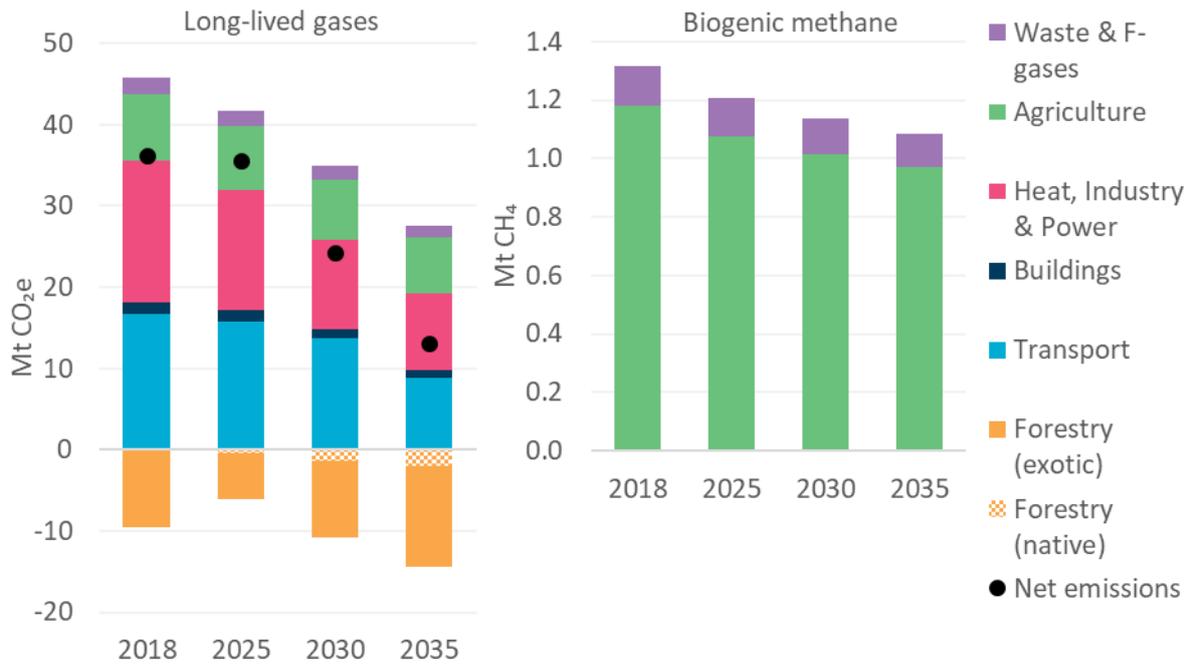


Figure 9.3: Snapshots of emissions in 2025, 2030 and 2035 in our path, compared with 2018.

Source: Commission analysis.

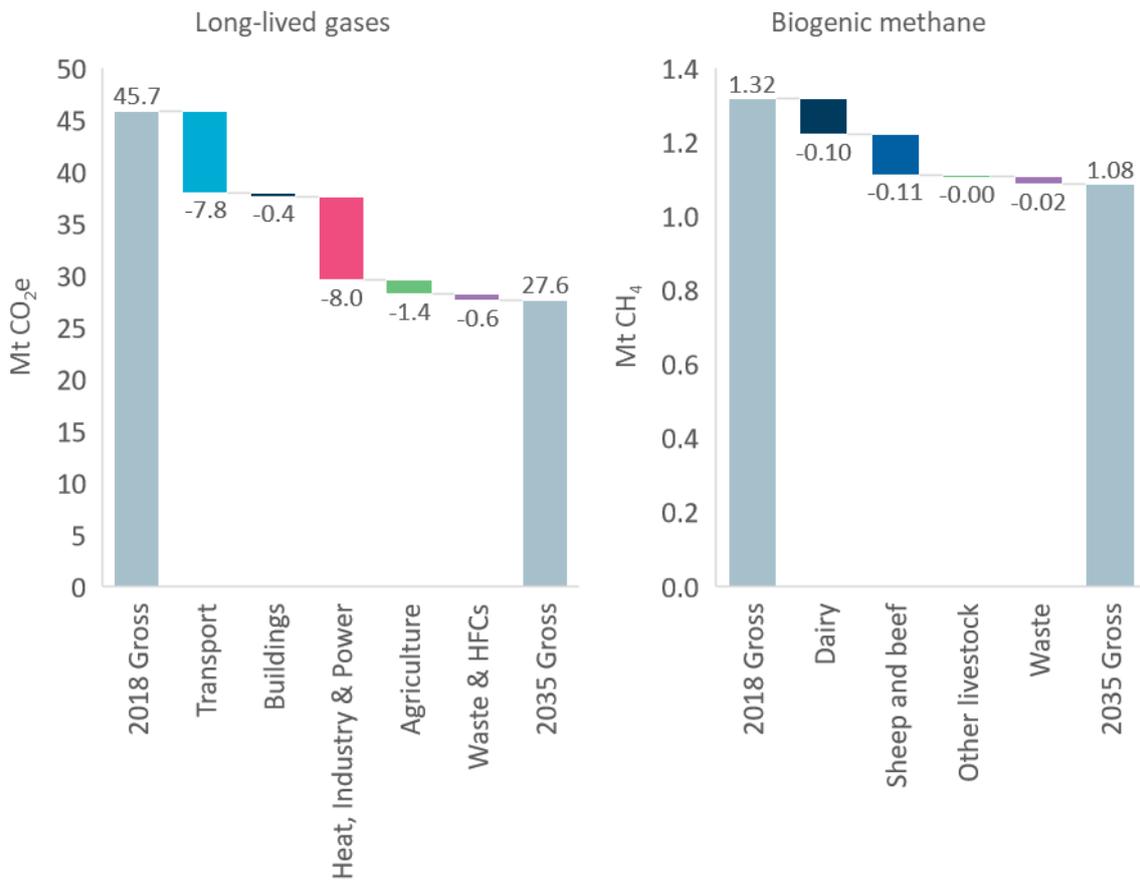


Figure 9.4: Reductions in emissions by sector from 2018 to 2035 in our path

Source: Commission analysis.

9.2.2 What our path looks like in each sector

Our path combines a broad portfolio of current and emerging measures to reduce our emissions. The following sections describe the measures and actions envisaged in each sector under our path.

Transport

Under our approach to meeting the 2050 targets, Aotearoa would need to almost completely decarbonise land transport. This means changing how most vehicles are powered, including heavy vehicles.

Road vehicles

Electric vehicles are currently more expensive to purchase than internal combustion engine vehicles but are cheaper to run. Their upfront costs are expected to fall further leading to significantly lower lifetime costs. In addition to saving emissions, they also improve local air quality and reduce noise pollution. For these reasons, our path sees ambitious adoption of light electric vehicles, including cars, vans and utes, with no further internal combustion engine light vehicles imported after 2032. This would mean more than half of all light vehicle travel would be in electric vehicles by 2035, and 40% of the light vehicle fleet would be electric vehicles by 2035 (Figure 9.).

In our path medium and heavy trucks are slower to electrify because of the greater daily distances they need to travel. Of the trucks imported in 2030, 15% of medium trucks and 8% of heavy trucks would be electric. By 2035, these would increase to 84% and 69% respectively.

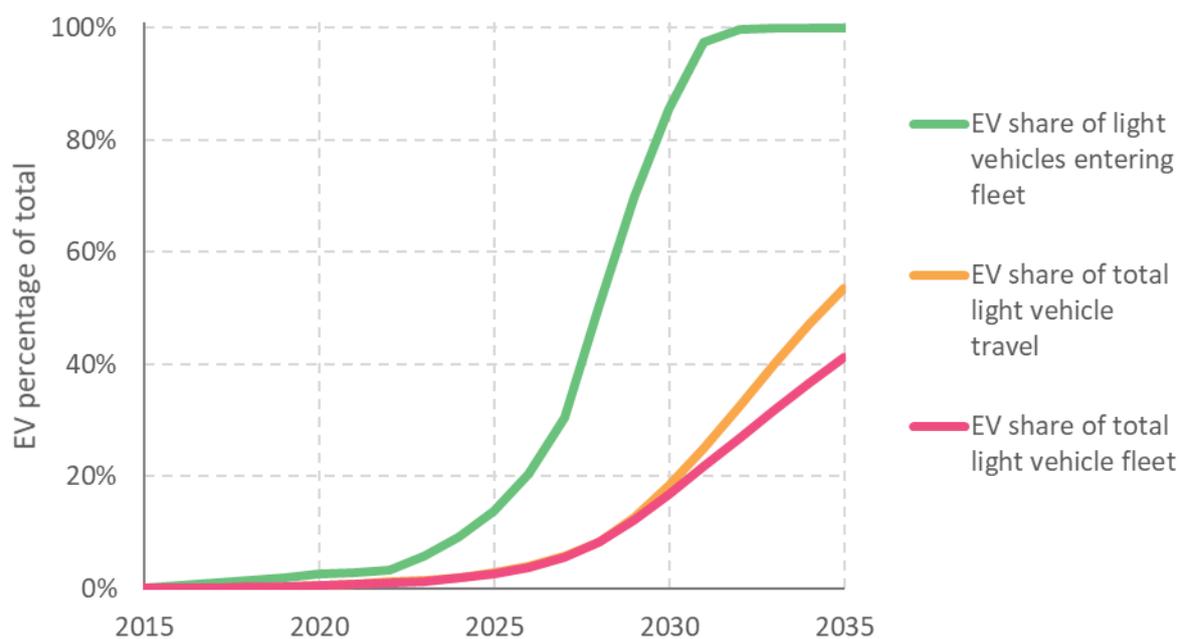


Figure 9.5: Uptake of light electric vehicles in our path.

Source: Commission analysis.

To meet our proposed emissions budgets Aotearoa would need to phase out imports of light internal combustion engine vehicles sometime between 2030-2035. Achieving this phase out is ambitious, but achievable with strong supporting government action. This timeframe is consistent with the phase out dates being set by a growing number of countries.

While electric vehicle supply grows, there would also need to be a focus on importing more efficient internal combustion engine vehicles, including increasing the share of conventional hybrids. Our path assumes the average efficiency of light internal combustion engine vehicles improves by 15% by 2035, or around 1% per year.

Reducing demand for private vehicles

In addition to changing the vehicles we drive, changes to how and how much New Zealanders travel play an important role in our path. We assume the average household travel distance per person can be reduced by around 7% by 2030, for example through more compact urban form and encouraging remote working. We also assume that the share of this distance travelled by walking, cycling and public transport can be increased by 25%, 95% and 120% respectively by 2030. Overall, this would see total household vehicle travel staying relatively flat despite a growing population (Figure 9.5).

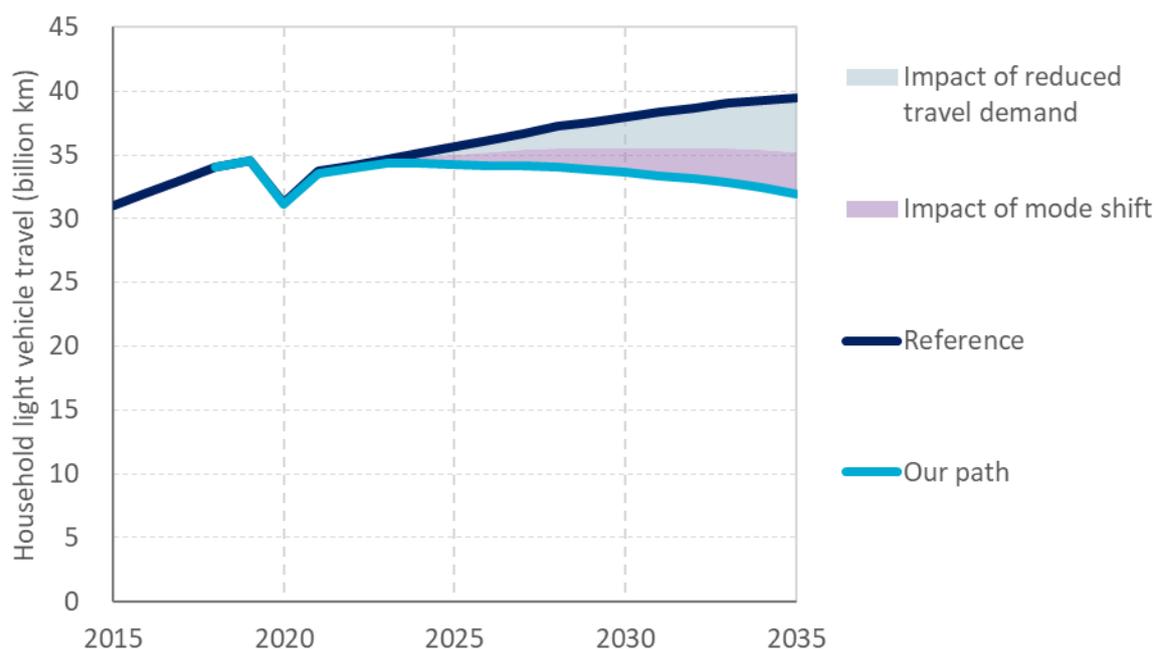


Figure 9.5: Household light vehicle travel in our path compared with under current policies.

Source: Commission analysis.

Emissions from freight can be reduced by switching some freight movements from road to rail and coastal shipping. Our path assumes 4% of freight tonne-kilometres can switch by 2030. Further reductions in freight emissions could be achieved by completing the electrification of the Auckland to Wellington railway line and electrifying the Hamilton to Tauranga railway line.

Our path is consistent with assuming that most new public transport ferries would be electric beginning almost immediately. There are only a few coastal shipping and Cook Strait ferry ships, but our path is consistent with assuming that new ones would be plug-in hybrid. These plug-in hybrid ships could be increasingly operated in electric mode as battery costs decline.

Biofuels

There will continue to be a need for liquid fuels for some transport uses, such as off-road vehicles and equipment, aviation and shipping. Aotearoa should take action to scale up the manufacture of low emissions fuels like biofuels or synthetic e-fuels in the first three emissions budget periods. Our

path assumes 70 million litres of low emissions fuels could be made by 2030 and 140 million litres by 2035. This equates to roughly 3% of total domestic liquid fuel demand in 2035, or 1.5% of total fuel demand including international transport, under our path.

Buildings

Under our approach to meeting the 2050 targets, Aotearoa would need to improve the energy efficiency of buildings, alongside decarbonising the energy used for heating, hot water and cooking.

Homes

Improving the energy efficiency of homes reduces emissions and can improve the occupants' health, particularly for low-income households. Because homes in Aotearoa are typically underheated in winter, households may choose to heat their home more after improving energy efficiency, rather than reducing their energy use or emissions (see chapter 5). We assume that existing homes' energy intensity improves by 6% by 2035. We assume newly built homes are 35% more energy efficient compared to today's performance.

It is already feasible to transition away from heating homes with coal and natural gas. Heat pumps already offer a lower cost way to heat homes than natural gas. For hot water, where feasible, electric resistive hot water cylinders offer an alternative to natural gas systems with comparable costs. Heat pumps will offer a lower cost option to heat most new commercial and public buildings. For existing buildings, renovations offer an opportunity to replace fossil fuel heating systems, such as gas central heating, with lower emissions alternatives such as heat pumps or biomass.

Commercial and public buildings

Commercial and public buildings offer large opportunities to improve energy efficiency through improved insulation and greater control of energy use. New commercial and public buildings can be built to higher standards, and existing buildings retrofitted to achieve these improvements. Our path assumes a 30% improvement in commercial and public buildings' energy intensity is possible by 2035 compared to today's performance.

Commercial and public buildings can quickly transition away from coal to alternatives such as biomass which could use existing boilers. Our path assumes that by 2030 coal use in commercial and public buildings has been eliminated. The Government announcement in 2020 that all coal boilers in public sector buildings will be phased out is a step towards this.

Avoiding lock-in of new gas heating systems

Fossil fuel heating systems will typically last for 20 years or longer. Our path looks to avoid new heating systems having to be scrapped before the end of their useful lives. This means that our path assumes all new space heating or hot water systems installed after 2025, either in new buildings or when replacing existing systems, are either electric or biomass. No further natural gas connections to the grid, or bottled LPG connections occur after 2025. This would allow time for a steady transition, to be on track for a complete transition away from using natural gas in buildings by 2050.

Figure 9.6 shows the outcome of these changes.

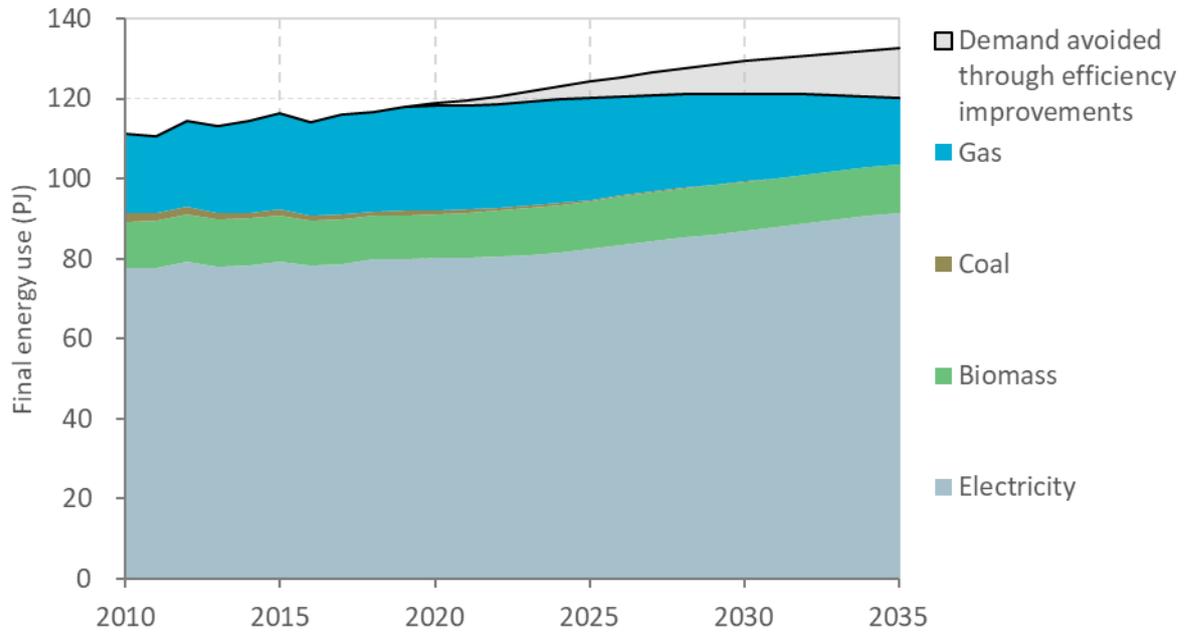


Figure 9.6: Energy use in buildings in our path.

Source: Commission analysis.

Electricity

The use of low emissions electricity allows other sectors to reduce emissions. Electrifying light passenger vehicles will require significant expansion in electricity generation capacity. Demand for electricity will also increase as buildings and process heat switch away from fossil fuels. Increased demand will need to be accompanied by expanding transmission and distribution infrastructure.

Electricity supply

Our path requires rapid expansion of renewable wind and solar generation in the 2030s and beyond to meet increased electricity demand as electric vehicles are widely adopted (Figure 9.7 and Figure 9.8). However, in the short term, electricity generation companies may not commit to this expansion in capacity while there is uncertainty around the future of the New Zealand Aluminium Smelter at Tiwai Point.

The New Zealand Aluminium Smelter is the single largest consumer of electricity. Over the last 5 years it used on average around 13% of the country's electricity. Its future is currently under review. If it leaves, this electricity would be available for other uses. In our path the Smelter closes gradually, coming to a full close in 2026.

Wind, solar and geothermal offer low cost and low emissions ways of generating electricity. Our path assumes that the build of in the 2020s pauses due the closure of the New Zealand Aluminium Smelter and resumes in the 2030s. This is illustrated in Figure 9.7 and Figure 9.8.

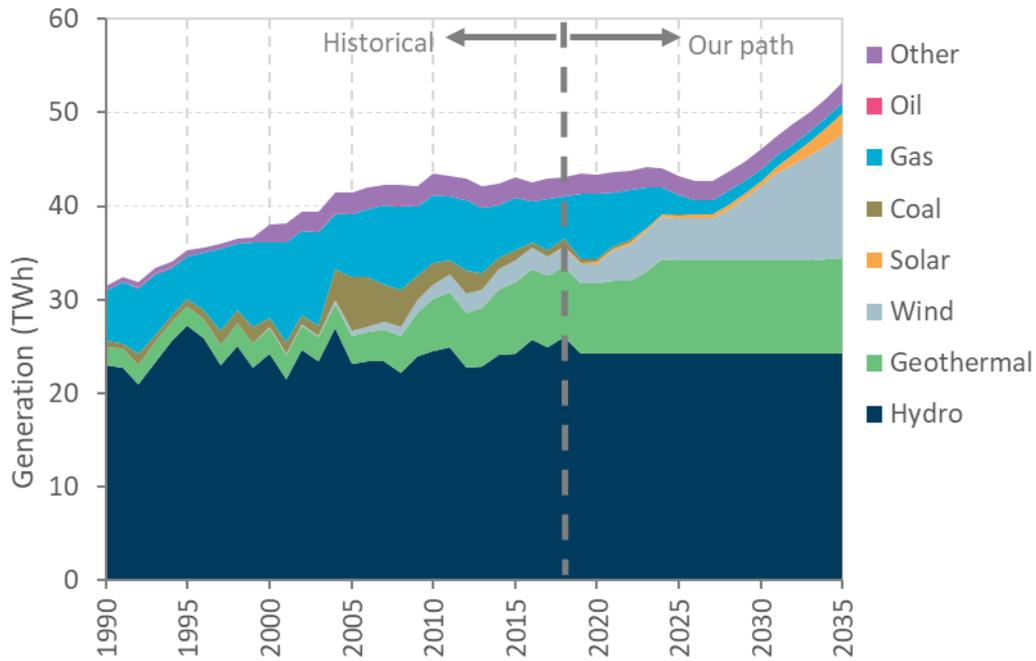


Figure 9.7: Electricity generation by fuel in our path.

Source: Commission analysis.

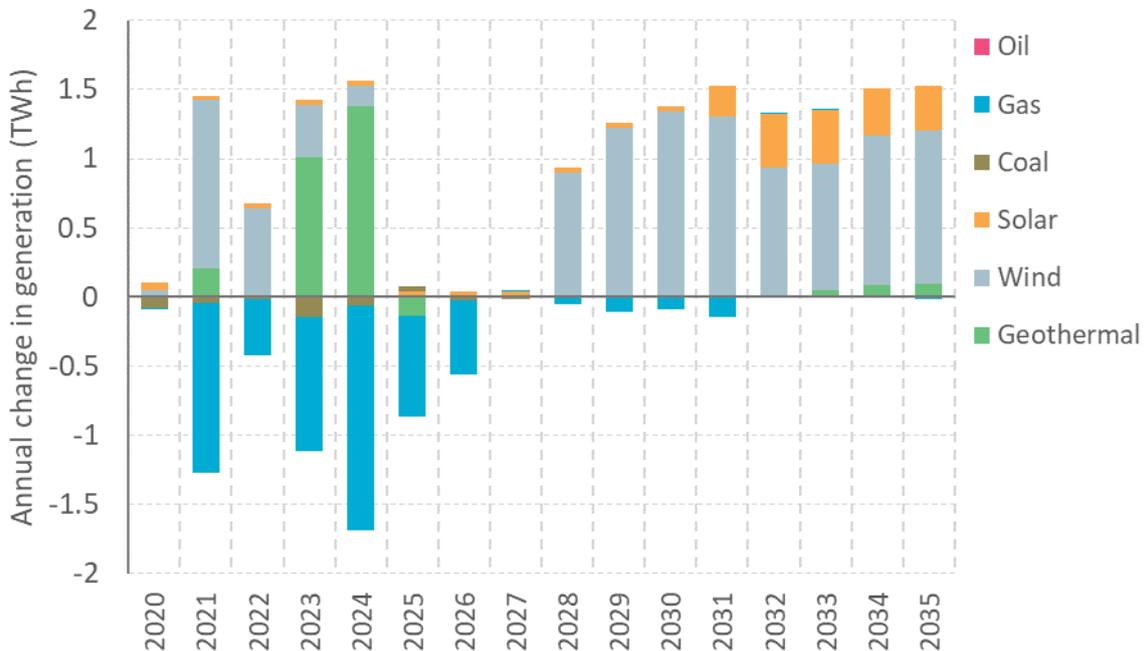


Figure 9.8: Annual increase (positive) or decrease (negative) in electricity generation compared to the previous year.

Source: Commission analysis.

Reducing emissions from geothermal

Some geothermal fields have high emissions from their geothermal fluid, with an equivalent emissions intensity as gas generation. In our path these high emitting geothermal fields would close before 2030 reducing geothermal emissions by around 25% while only reducing generation by 6%.

Solving the dry year challenge

There is also uncertainty around the solution to the dry year challenge – solutions for generating electricity in years when hydro lake levels are low. Multiple options are being considered under the NZ Battery project that could offer a fossil fuel free solution to providing electricity in dry years where hydro lake levels are low. There are questions over the technical and economic feasibility and public support of the proposals.

Gas generation provides flexibility to meet daily and seasonal peaks in demand and backs up renewable generation. While our path would see reductions in gas generation, some gas is still required to provide this flexibility until 2035 at least. In our path, coal fired generation at Huntly closes in the 2020s.

The challenge is delivering a timely, reliable and affordable build out of the electricity system, while managing the opposing risks of under or over-investing in the system. Continuing to build new electricity generation and transmission infrastructure throughout the 2020s would avoid construction bottlenecks and potential delays to wider decarbonisation in the 2030s.

Over-investment could result in sunk assets or increase the delivered cost of electricity and disincentivise electrification. Underinvestment could delay progress on wider decarbonisation efforts in transport, industry and buildings.

Natural gas use

The total amount of natural gas used in Aotearoa needs to reduce in order to achieve the 2050 targets. Much of the natural gas currently used for process heat, heating and cooking in buildings, and electricity generation will need to convert to low emissions technologies.

Natural gas currently plays a significant role in the electricity system by backing up renewable generation, particularly in dry years when hydro lake levels are low. Using gas in this way supports the reliability and affordability of the country's electricity system.

There are options to eliminate the use of natural gas for electricity generation. However, these are likely to be expensive for the size of the emissions reductions they deliver. In addition, the transition away from gas across the economy would need to occur without compromising the affordability and security of the electricity supply or increasing total emissions.

There is a critical dependency between domestic gas supply and the company Methanex. Methanex produces methanol from natural gas and consumes around 40% of the total gas supply. Their demand incentivises natural gas producers to continue to invest to sustain production. Methanex has provided flexibility by reducing its demand when natural gas is constrained, benefitting all other gas users and reducing methanol production. Without continued exploration and development, the country's natural gas fields are likely to reach the end of their economic life. This will reduce the amount of gas available for all users. In the medium term, it may become uneconomic for Methanex to continue operating in Aotearoa in its current form. A reduction in gas used by Methanex could have flow on cost and supply implications for other gas users including electricity generation and domestic users of gas.

The impact on the electricity and gas system and the potential for large changes in supply and demand from industries exiting the market are discussed further in chapter 5 of our Advice report.

Industry and heat

There are proven options for decarbonising low and medium temperature process heat. These include switching fuel use from coal and natural gas to biomass and electricity. There are also opportunities to improve energy efficiency.

Biomass for Process heat

Some coal boilers in the the food processing sector are already being replaced with biomass or electricity. Our path assumes a steady, but reasonably rapid, rate of conversion to be on track to eliminate coal use for food processing by 2037 (Figure 9.9). This is roughly equivalent to converting one to two very large dairy processing plants away from coal each year or converting a larger number of smaller plants. Along with boiler conversion, our path assumes significant improvements in energy efficiency across the food processing sector.

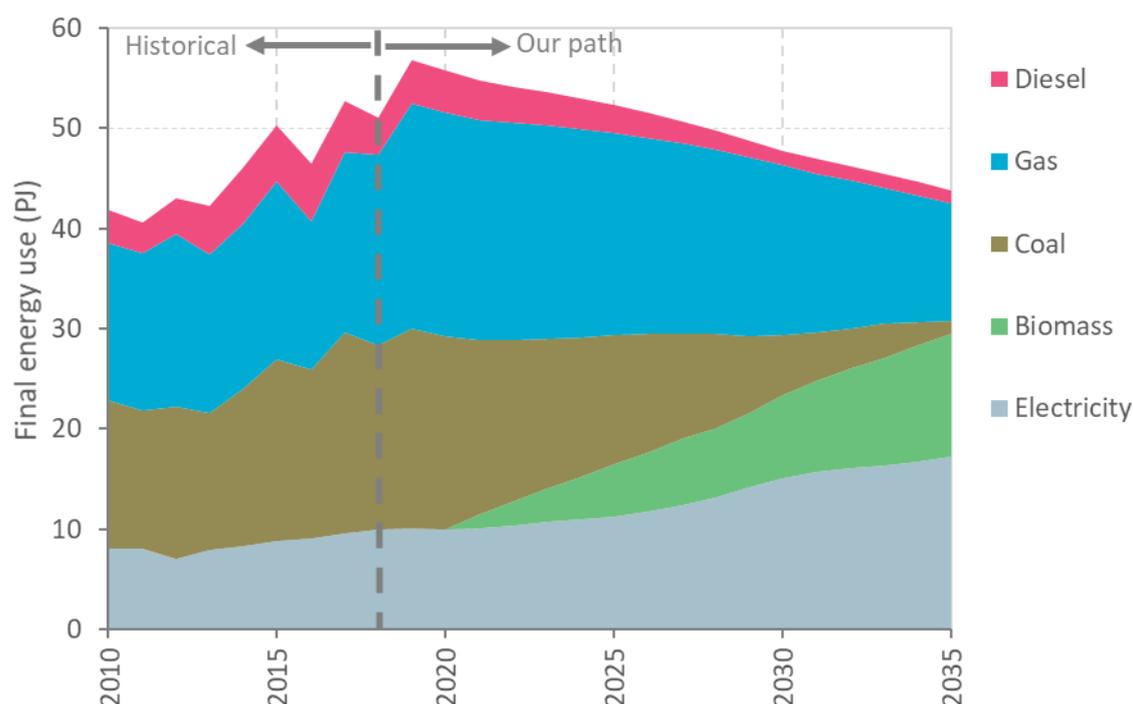


Figure 9.9: Food processing energy use in our path.

Source: Commission analysis.

Where available, biomass from forestry and wood processing residues are a low-cost fuel switching opportunity. There may be constraints on biomass supply in some regions where there is not significant forestry. In these regions, electric boilers will be needed, but at a significantly higher operational cost. Electrification of process heat will also require expansion of the electricity transmission and distribution grids. This will add to the total cost.

In our path, fuel switching to biomass also occurs in some other energy-intensive industries such as pulp and paper production.

Overall, our path takes advantage of the country's currently under-used biomass resource, moving towards a more circular economy. Achieving this uptake will require the development of supply chains for gathering and processing biomass along with the establishment of local markets.

Industry

In our path, we assume all of the country's heavy industries continue to produce at current levels, except aluminium and methanol production which are assumed to close in our Current Policy Reference case. High temperature process heat is more challenging to decarbonise and our path sees continued use of gas and coal in these sectors. While there is potential to further decarbonise a range of industrial processes through emerging technologies, we do not assume these are available for uptake before 2035.

Agriculture

The two main agricultural greenhouse gases are biogenic methane and nitrous oxide. Biogenic methane has a different target to other gases, while nitrous oxide is included in the long-lived greenhouse gas target. The agriculture sector has focussed in recent years on making productivity improvements that have also decreased their emissions intensity. The sector is addressing water quality issues through actions that can also reduce emissions. These efforts need to increase to reach the 2030 and 2050 emissions targets.

On-farm practice changes

There are changes that farmers can make now to reduce emissions on their farms, if given sufficient support. These can improve animal performance while reducing stock numbers, reducing the number of breeding animals required, and moving to lower input farm systems. The Biological Emissions Reference Group found that, when successfully implemented, these changes could be made while not significantly reducing production and while maintaining or even improving profitability.

In setting our path and emissions budget levels, we have conservatively assumed that no new technologies to reduce methane emissions from agriculture are available before 2035. As a result, our path involves changes in farming practices that start pushing towards the limit of what we are confident can be delivered.

Overall, our path would see dairy and sheep and beef animal numbers each reduced by around 15% from 2018 levels by 2030. This compares with an 8-10% reduction projected under current policies. In this, we have included transforming a small amount of dairy land into horticulture, at a rate of 2,000 hectares per year from 2025. With these changes, the 2030 biogenic methane target could be met without relying on new technologies. If farmers can continue to achieve productivity improvements in line with historic trends, these outcomes could be achieved while maintaining total production at a similar level to today. This is illustrated in Figure 9.10 and Figure 9.11.

Methane reducing technologies

Selective breeding for lower emissions sheep is a proven option which is in the early stages of commercial deployment. Our path assumes that this can be progressively adopted, reducing total biogenic methane emissions from sheep and beef farming by 1.5% by 2030 and 3% by 2035. No adoption has been assumed for the first budget period. Breeding for low emissions cattle is a future possibility but the research is in an earlier stage. We have not assumed any contribution from this by 2035.

Methane inhibitors and vaccines are being researched. These could reduce the amount of methane that is released from cattle and sheep. While there has been progress on inhibitors, these are not yet commercially available. There is uncertainty around when inhibitors will be available, what their costs could be and how effectively they could reduce emissions. Therefore, as mentioned, our path

has been set so that the budgets can be achieved without the use of either methane inhibitors or vaccines.

However, if any of these technologies could be brought to market before 2035, they would provide additional options for meeting the emissions budgets. We will be reviewing progress on the developing these technologies and will consider changes to the emissions budgets if we believe they can be widely adopted in the future.

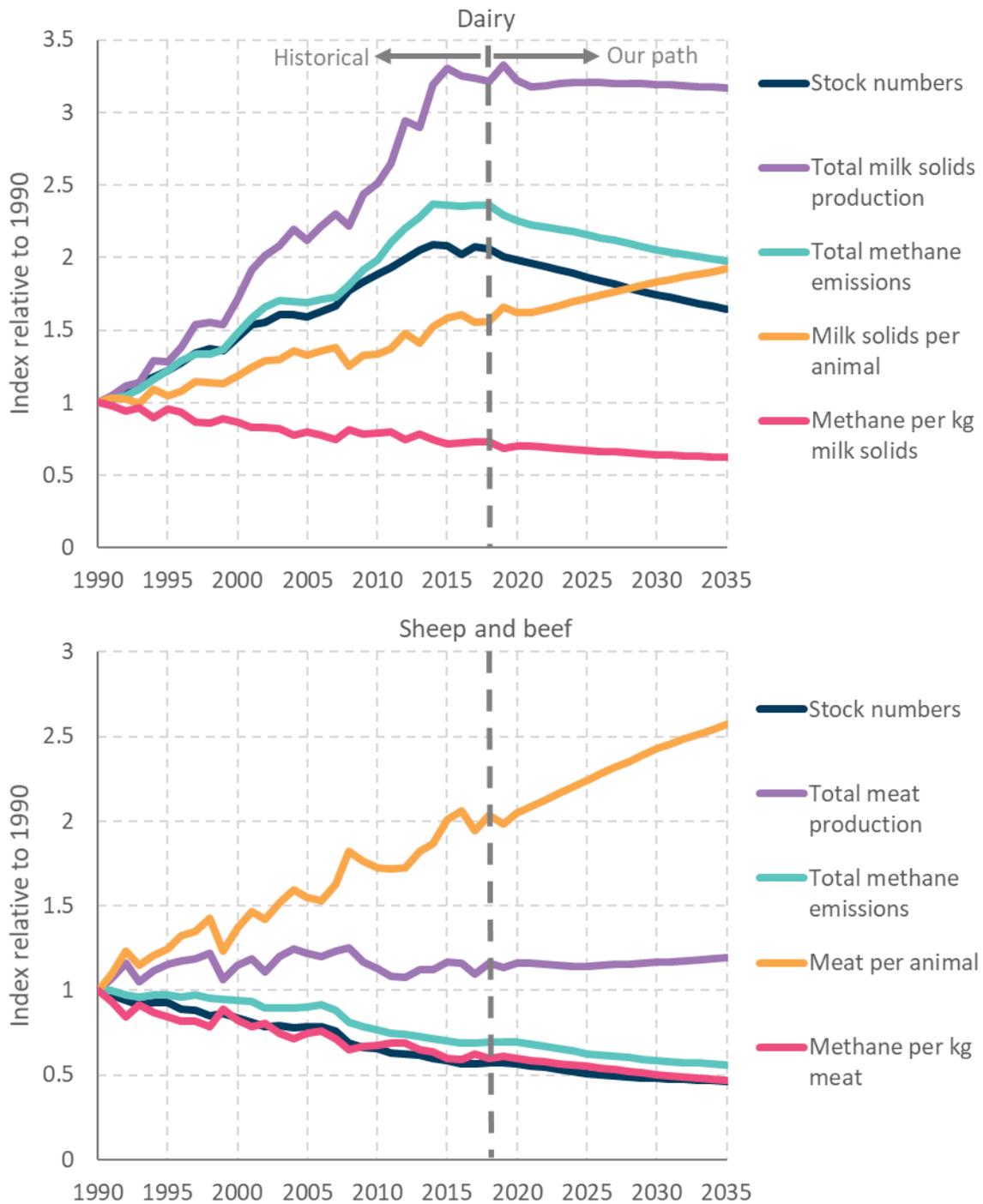


Figure 9.10: Changes in livestock numbers, production and emissions since 1990 and in our path for dairy farming (top) and sheep and beef farming (bottom).

Source: Commission analysis.

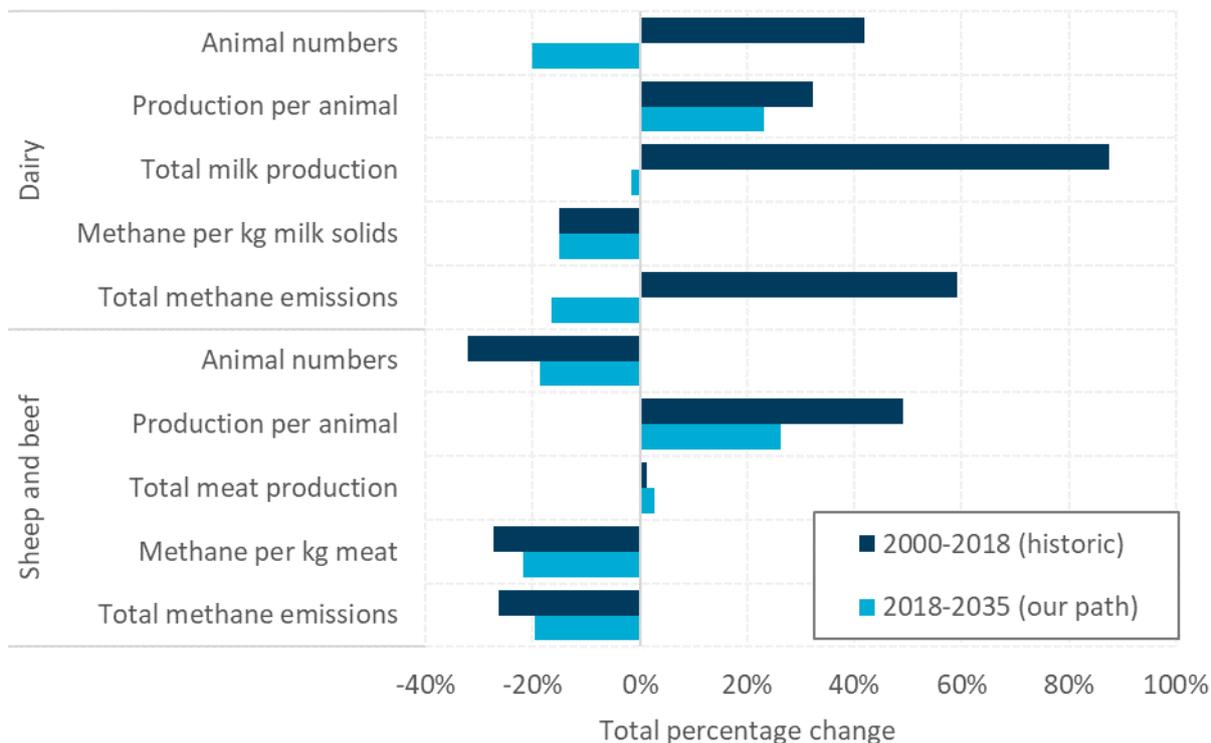


Figure 9.11: Changes in livestock numbers, production and emissions in our path to 2035 compared with changes from 2000-2018

Source: Commission analysis.

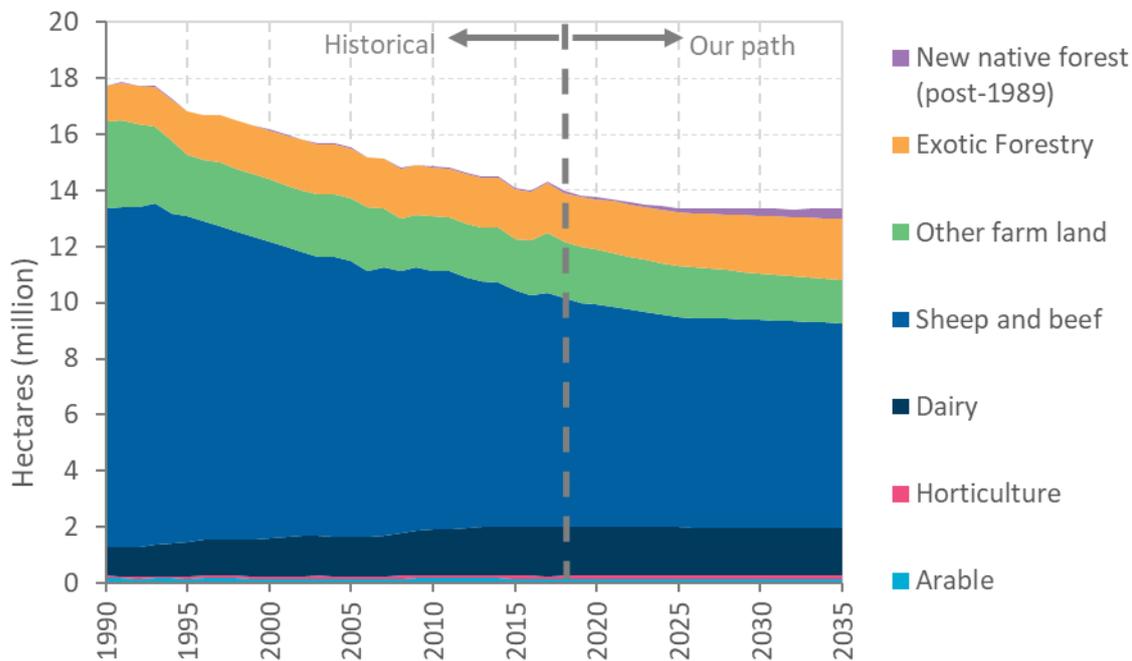


Figure 9.12: Land use for agriculture and forestry in our path

Source: Commission analysis.

Forestry

Native forests

Our path would see a significant increase in new native forests established on less productive land. The Ministry for Primary Industries forecasts that there will be around 12,000 hectares of new native forests established in 2021. Our path would see this ramp up to 25,000 hectares per year from 2030 (Figure 9.13). In total, close to 300,000 hectares of new native forests would be established by 2035 (Figure 9.12 above). The rate that we can plant or revert native forest would likely be limited by nursery capacity, pest control and fencing.

Estimates from recent studies suggest there is on the order of 1,150,000 to 1,400,000 hectares of marginal land that could be planted in forestry. As much of this land is steep and prone to erosion, we consider that it would be more suitable for permanent forests, particularly native forests.

Exotic forests

In our path, exotic afforestation would continue on the trajectory expected under current policies up until 2030, averaging around 25,000 hectares per year. From 2030 onwards, the rate of afforestation for carbon removals would reduce. In total, around 380,000 hectares of new exotic forestry would be established by 2035.

We have not assumed any change in the percentage of permanent exotic forest above Ministry for Primary Industries projections as this is not required to reach emissions targets.

As well as planting new forests our path would reduce deforestation, which is still a considerable source of emissions in Aotearoa. Our path assumes that no further native deforestation occurs after 2025.

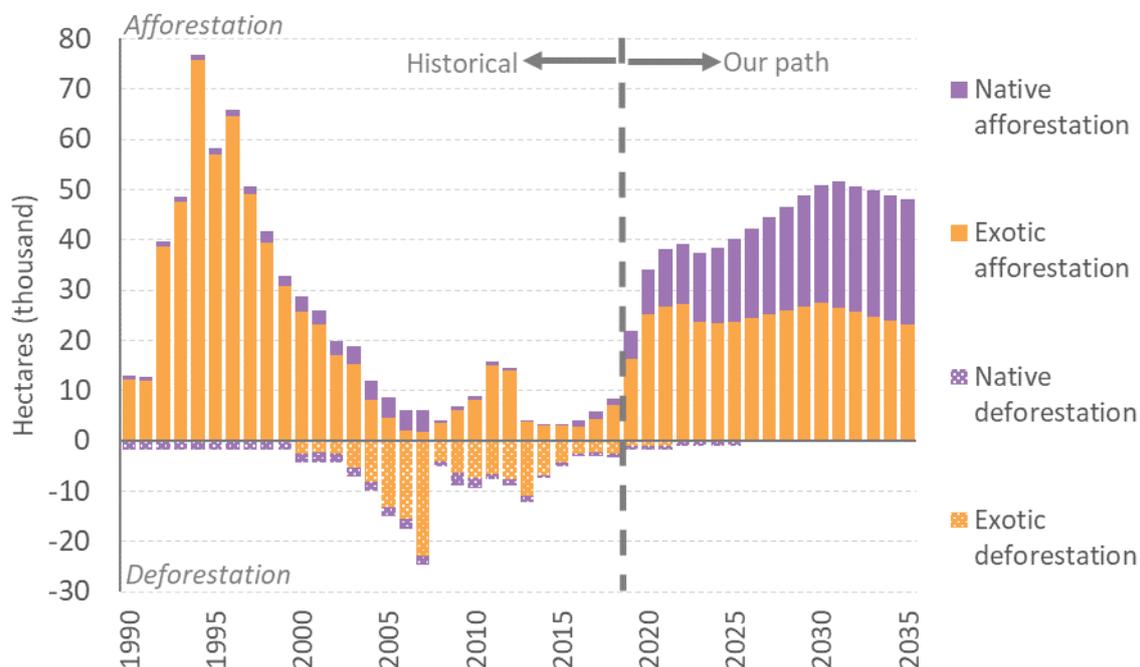


Figure 9.13: Afforestation and deforestation by year in our path.

Source: Commission analysis.

Bioenergy

Trees can help in the transition a low emissions Aotearoa in other ways.

Bioenergy offers a low-cost route for decarbonising some sectors, including process heat. Overall, there appears to be a large potential biomass supply from collecting and using waste from forestry and wood processing. However, the availability is likely to vary across the country due to regional mismatches in supply and demand of biomass, and the cost of transporting biomass. While the supply of biomass residues may appear to be abundant in some regions, trade-offs may also need to be made when deciding what parts of the economy to decarbonise using biomass first.

Timber can displace emissions intensive materials such as steel and cement in buildings. This reduces embodied emissions and can lock up carbon for several decades.

Waste

Reusing and recovering waste materials is a key part of a circular economy. Our path would see a reduction in the amount of waste generated and a focus on reducing the amount of organic waste, such as food, wood and paper, that go into landfills. We assume varying portions of the different organic waste streams can be diverted to recycling, anaerobic digestion, composting, and for use as boiler fuel.

Our path would see the total amount of organic waste going to landfills decrease by 23% from 2018 to 2030 (Figure 9.14). Of the different waste types, food and paper waste would see the greatest decrease, with the amount going to landfills reduced by around 40% by 2030 (Figure 9.15).

Waste emissions can also be reduced by increasing the amount of biogenic methane which is captured and destroyed from landfills, through either upgrading landfill gas capture systems, or diverting organic waste from sites without landfill gas capture to those with capture. In our path we assume minor improvements in capture efficiency at landfills with existing gas capture systems, and increased coverage to 10% of non-municipal landfills and other municipal landfills by 2030. These steps would reduce total methane emissions from waste by an additional 4% by 2030.

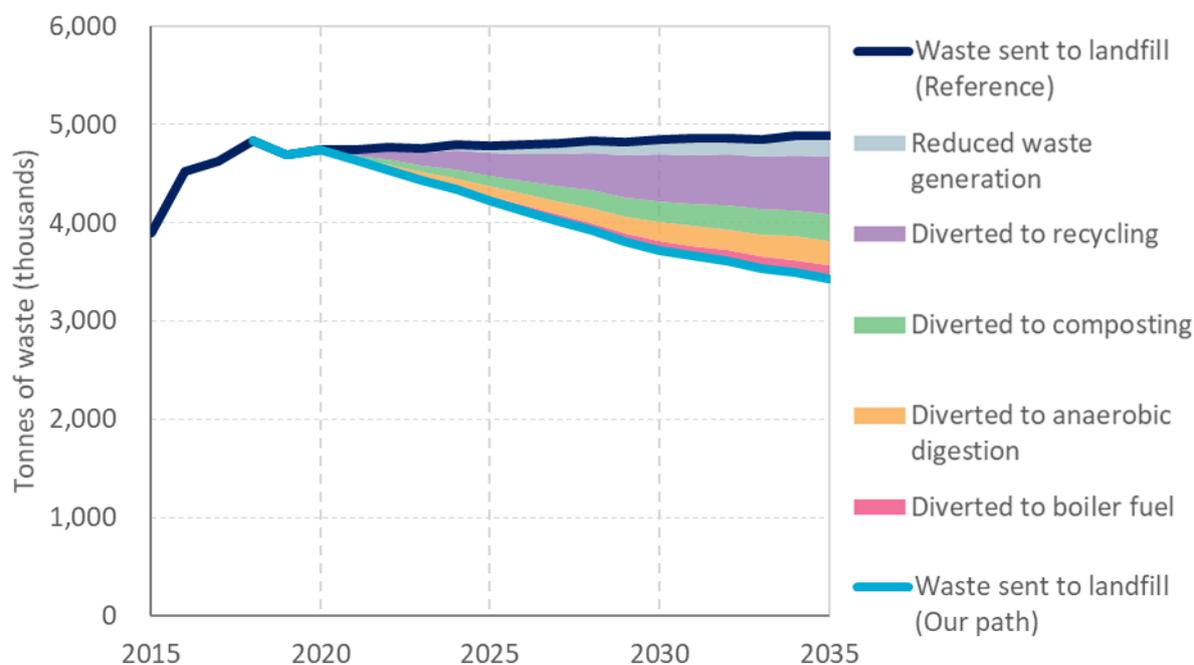


Figure 9.14: Total organic waste sent to landfill in our path.

Source: Commission analysis.

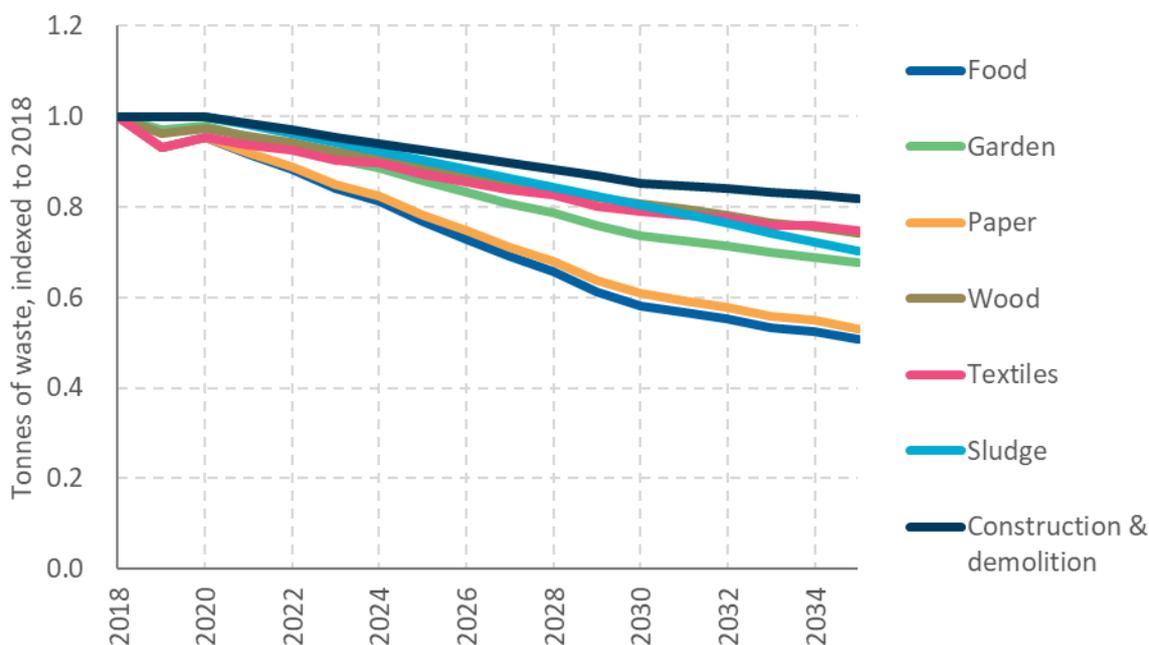


Figure 9.15: Tonnes of waste sent to landfill, indexed to 2018 values

Source: Commission analysis.

F-gases

Fluorinated gases, including hydrofluorocarbons (HFCs), are greenhouse gases that are primarily used as refrigerants in fridges, freezers and air conditioning systems. Our path assumes emissions from HFCs reduce by at least 18% by 2030 and 33% by 2035 in line with the actions Aotearoa takes under the Kigali amendment to the Montreal Protocol. This can be achieved through reducing the import of HFCs in second-hand products, reducing equipment leakage, and increasing end-of-life recovery of products that contain these gases.

9.2.3 There is flexibility in how our recommended budgets can be achieved

We have tested the proposed emissions budgets to ensure that they can be met across a range of future circumstances. These tests have examined the flexibility to meet the emissions budgets with different mixes of actions.

We have developed two illustrative alternative paths to examine distinct variations to our main path which could meet the same budget levels via different mixes of measures. The alternative paths also achieve broadly the same balance of long-lived gases and biogenic methane within the budgets.

Alternative path A tests how our proposed emissions budgets could still be met with a slower uptake of electric vehicles and with less emissions reduction achieved through changes in farm management practices. In this case, the emissions budgets could be met through:

- further reducing travel or shifting to lower emissions travel modes

- further land use change from livestock agriculture into horticulture, exotic forestry and other uses
- further reducing the amount of organic waste sent to landfill
- phasing out F-gas refrigerants faster
- an earlier switch away from gas use in the wood processing sector.

Alternative path B tests how our proposed emissions budgets could still be met with less change from current behaviours. In this case, the emissions budgets could be met through:

- further accelerating uptake of electric vehicles so that all new light vehicles entering the fleet are electric by 2030
- a methane inhibitor being widely adopted on dairy farms, reducing methane emissions from dairy cattle by around 5% in 2030 and 15% by 2035
- further increases in landfill gas capture.

The specific variations in alternative paths A and B compared with our path are set out in Table 9.2 below. Other actions common to all three paths are as described in the previous section above.

Table 9.3 shows the emissions and removals for each path over the three budget periods. The alternative paths would meet the overall emission budgets defined by our path to within 1 Mt CO₂e, and with a similar balance of greenhouse gases and removals.

Table 9.2: Actions that differ between our path and alternate paths A and B

	Our path	Alternative path A	Alternative path B
<i>EV share of light vehicle registrations</i>	50% by 2028 100% by 2032	50% by 2030 100% by 2035	50% by 2027 100% by 2030
<i>Household light vehicle travel</i>	34 billion vehicle-km in 2035 (1% reduction from 2018)	32 billion vehicle-km in 2035 (6% decrease from 2018)	36 billion vehicle-km in 2035 (6% increase from 2018)
<i>Low carbon liquid fuels</i>	140 million litres per year by 2035		None
<i>Electric air travel</i>	None		5% of domestic air passenger-km electric by 2035
<i>Kinleith pulp mill conversion</i>	2030	2025	2030
<i>Farm management changes</i>	Reduce average emissions per hectare by 13% for dairy and 7% for sheep and beef by 2035	Reduce average emissions per hectare by 8% for dairy and 3% for sheep and beef by 2035	
<i>Methane inhibitors and vaccine</i>	None		Reduces dairy enteric methane by 5% by 2030 and 15% by 2035

<i>Nitrification inhibitor</i>	Reduces dairy nitrous oxide emissions by 5% by 2035	None	Same as our path
<i>Exotic afforestation</i>	Average of 25,000 hectares per year to 2030	Additional 5,000 hectares per year from 2025-2029	Same as our path
<i>Dairy to horticulture conversion</i>	2,000 hectares per year converted from 2025 (additional to MPI baseline)	3,500 hectares per year converted from 2021	None
<i>Sheep and beef land retirement</i>	~500,000 hectares by 2025 then no further retirement (per MPI baseline)	Further 500,000 hectares retired by 2035	Same as our path
<i>Waste recovery/diversion</i>	Reduce total organic waste to landfill by 23% by 2030	Reduce total organic waste to landfill by 39% by 2030	Same as our path
<i>Landfill gas capture</i>	By 2035: Municipal landfill capture efficiency increased to 73% Capture systems at 20% of non-municipal landfill sites		Municipal landfill capture efficiency increased to 80%; Capture systems at 70% of non-municipal landfill sites
<i>HFCs</i>	33% emissions reduction by 2035	45% emissions reduction by 2035	Same as our path

Table 9.3: Emissions and removals by budget period in our path and alternative paths A and B, in CO₂e

		<i>Biogenic methane (Mt CO₂e)</i>	<i>Long-lived gas emissions (Mt CO₂e)</i>	<i>Removals (Mt CO₂e)</i>	<i>Net total (Mt CO₂e)</i>
Budget 1 (2022-2025)	Our path	123	174	26	271
	Alt. path A	124	172	26	270
	Alt. path B	124	174	26	272
Budget 2 (2026-2030)	Our path	146	190	49	286
	Alt. path A	147	189	49	286
	Alt. path B	146	190	49	287
Budget 3 (2031-2035)	Our path	138	153	68	223
	Alt. path A	138	157	72	224
	Alt. path B	135	153	68	220

These illustrative alternative paths show that there are a range of ways in which the recommended budgets could be achieved through different combinations of measures. However, the ambition level of the proposed budgets means there is limited flexibility in the rate of adoption of key

measures. For example, the proposed budgets would be unlikely to be achieved without electric vehicles reaching 100% of new light vehicle imports by 2035 at the latest. Achieving this sooner would give greater flexibility in how the budgets could be met.

The potential emissions reductions from methane technologies such as inhibitors and vaccines are large. When these technologies become available, we will expect that the budgets are set at a level which would encourage their adoption. While we currently do not have sufficient confidence to set budgets which would require the use of these technologies, when they are proven and available, we expect to reassess the recommended budgets to take this into account.

9.2.4 Meeting the budgets

Our analysis above shows that the proposed emissions budgets are achievable under a range of circumstances. Our path is one way the budgets could be met. However, there will be many other ways to meet the budgets.

We consider that our path would be a good starting point for the Government's consideration of the actions required under the emissions reduction plan to meet the budgets. Our path would enable a portfolio of measures to be developed which would provide flexibility in how the budgets are met. In addition, it would enable a basis for a wider range of measures for the Government to use to meet the later budgets. In this way our path does not just seek to keep open the option of deploying some measures, but to actively encourage the development of new options.

Using budgets to achieve both components of the 2050 target

The Act specifies that the budgets are the total emissions across all gases, both biogenic methane and long-lived gases, expressed as a net quantity of carbon dioxide equivalent.

While the Commission advises on the expected amounts of biogenic methane and other gases, the budgets can be met through any mix of the two. Because of the different warming impacts of different greenhouse gases, the balance between the two components of the 2050 target makes a difference both to our contribution to long term global temperature increases, and to the feasibility of meeting the 2050 target. For instance, achieving the recommended budgets through greater than envisaged reductions in biogenic methane could increase the risks of not being on track to meet the net zero long-lived gas component of the 2050 target.

Planning to meet the budgets through significantly more reliance on exotic forest removals we have advised on would result in delaying taking actions that reduce emissions. This could mean faster more costly actions are required later to keep on track to achieve net zero long-lived gas emissions by 2050. Greater reliance on exotic forest removals would also expose Aotearoa to increased risk from future climate changes such as forest fires, droughts and pests, reducing the stock of carbon in the forest.

Therefore, we consider that in setting actions and policies to meet the recommended budgets, the Government should aim as far as possible to achieve broadly the same mix of long-lived gas and biogenic methane as set out in our advice. It is appropriate for there to be some flexibility to meet budgets through different combinations of long-lived gases and biogenic methane. This flexibility is useful in managing uncertainty in how effective the portfolio of policies will be. However, in its response to budgets we suggest that the Government plan to meet budgets as if the two components of the 2050 target were to be separately achieved.

Taking such an approach would also be more likely to ensure that our emissions reductions are in line with the IPCC path that limit warming to 1.5°C.

The Government should aim to overachieve the budgets

Under the Act, the Minister must ensure that the emissions over the specified budget period do not exceed the budget level. This suggests that, in planning to meet the budgets, the Government should aim to overachieve the budgets in order to have high confidence that emissions will be below budget level.

There is a delay of up to 2.5 years between emissions occurring and their reporting in the Greenhouse Gas Inventory. Therefore, it will be difficult for Government to monitor emissions in real time and to make adjustments to its policies to ensure that it is on track to meet the budgets. One strategy to provide greater flexibility would be for the Government to put in place a wide range of policies that mutually reinforce each other which would give it more options for making adjustments to help meet the emissions budgets. This strategy would also help to avoid the risk that some actions fail to deliver the expected emissions reductions for whatever reason.

We believe it would be prudent for the Government to set out plans which aim to overachieve the budgets, to ensure that there is high confidence that the budgets can be met. While the Act provides some limited ability to meet budgets by borrowing against future budgets, the Government should not plan on using this flexibility in setting its policy and because it will increase the risks and costs to future generations and create inequities.

Domestic flexibilities to meet the budget

There are a number of flexibility mechanisms under the Act that allow for a budget to be met domestically. These include:

- *Setting emissions budgets so that they are resilient to uncertainty:* the risks and uncertainties about future opportunities to reduce emissions can be factored in upfront. This makes it more feasible to still meet the emissions budgets domestically, even if some policies or actions do not deliver the expected quantity of reductions. This is the approach we have taken to recommending the first three emissions budgets.
- *Revising emissions budgets:* emissions budgets that have already been notified can be revised when a further emission budget is being put in place. For example, in 2024 the fourth emissions budget is due to be set. At this time, the second and third emissions budget can also be revised, if there has been a significant change in circumstances since those emissions budgets were set.
- *Borrowing:* at the end of an emissions budget, a small amount (1%) of the volume from the next emissions budget can be brought forward to help meet the current emissions budget.

Our view is that in planning to meet the emissions budgets, the Government should not intend to rely on borrowing to meet the budgets. Borrowing should only be used when the Government finds itself in a position where there is not sufficient time in the budget period to adjust policies to ensure emissions are below the budget level.

Emissions removals from exotic forest can also be used as a flexibility mechanism to help ensure that the budgets are achieved. Additional removals from exotic forests, above what is set out in our path, could have a useful role to provide some headroom to ensure budgets are always met.

Because of the time taken for forests to sequester substantial carbon, advance planning to encourage this additional planting could be a useful flexibility mechanism for the Government. These removals could form a reserve which the Government could call on in case other actions fail to deliver the expected emissions reductions.

9.2.5 Offshore mitigation

The Minister must set emissions budgets that Aotearoa can reach using our own domestic emissions reductions and removals. Emissions budgets must also be met as far as possible through domestic emissions reductions and removals. It is possible, however, to resort to the use of offshore mitigation to meet an emissions budget under certain circumstances.

“Offshore mitigation” refers to units or emissions reductions and removals bought from overseas. We must advise on the circumstances that would justify the use of offshore mitigation as well as a limit on how much offshore mitigation should be used for meeting an emissions budget.

Circumstances justifying the use of offshore mitigation

Offshore mitigation gives the government flexibility to meet emissions budgets if reducing emissions domestically turns out to be more difficult than expected. It is not the only flexibility that is available.

We have identified two categories of circumstances that might arise that could make it difficult for Aotearoa to meet its emissions budgets:

- *Known unknowns*: these are risks and conditions that are known but somewhat uncertain or difficult to quantify. Examples include the cost and uptake rates of electric vehicles, or exactly when the Tiwai Point aluminium smelter or the Huntly power plant close. The government may also be able to influence these factors to some extent through policy.
- *Unknown unknowns*: these are unexpected situations that cannot be foreseen or quantified in advance. These could be characterised as exceptional circumstances or force majeure events which are unpredictable, outside the control of the Government, unpreventable and which cause a large one-off increase in emissions. Examples would be natural disasters such as earthquakes or volcanic eruptions, or a (not reasonably preventable) fire that affects the HVDC inter-island link connecting the electricity networks of the North and South Islands.

When it comes to known unknowns, we think the three domestic options outlined above give the Government enough flexibility. At this early stage of our decarbonisation journey, our analysis shows that there is a range of options and path available for meeting the emissions budgets. This approach also aligns with the purpose of emissions budgets and the 2050 target to drive domestic emissions reductions and the transformation of our economy.

If events in the “unknown unknowns” category occur, the timing and scale of the emissions increase may be so large that it cannot be made up for domestically. We consider that only these circumstances would justify using offshore mitigation for the first three emissions budgets. Domestic options should be exhausted first, however, as offshore mitigation should be the last resort.