

# Chapter 15:

## How we earn our way in the world

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*The impact of emissions reductions on the country's economy will depend on the pace with which Aotearoa acts, the costs of reducing emissions and global action. Aotearoa needs strong, accelerated and predictable action so that businesses have predictability about where the country is headed, and to put us on a track where future generations inherit a thriving, climate-resilient and low-emissions economy.*

*This chapter looks at impacts on the economy; energy, food and fibre systems; businesses and workers; and the challenges and opportunities they would face from transitioning to a thriving, climate-resilient and low-emissions Aotearoa.*

## 15.1 Introduction

The transition to a thriving, climate-resilient and low-emissions Aotearoa provides both opportunities and challenges for sectors, businesses and workers. The shift to lower-emissions products, services and infrastructure would see low-emissions sectors do well and job growth in these sectors.

The transition would be harder for the more emissions-intensive sectors, particularly those that compete in international markets or have limited opportunities to reduce their emissions. There are concerns that climate policy in Aotearoa could increase costs and reduce the competitiveness of these industries, particularly if their overseas competitors do not face the same costs from their local climate policies.

There will be inevitable costs associated with meeting our recommended emissions budgets. Across the economy and society, businesses and individuals will need to look at their emissions and make changes to reduce them.

However, in many cases the investments made now will more than pay for themselves in the long term. Such investments include those in energy efficiency, electric vehicles (EVs), renewable electricity generation and improving on-farm efficiency.

Delaying these investments would result in greater cost to the economy and society. There is also an opportunity now for increased investment to stimulate the economy and support the post-COVID-19 recovery.

Signalling early the changes that are required would allow businesses the time to adapt and innovate. However, there would be situations where businesses would close as they are not sustainable in a lower-emissions economy. This would particularly impact the people who work in these businesses, and the local economy and community in which these businesses are located.

Overall, our analysis shows that the transition can be managed in a way that generates jobs, but in the short term, it would come with some job losses. How policy is designed and tailored to local circumstances would be critical in ensuring that workers' livelihoods are respected and that workers in industries going through change are empowered in the transition.

This section looks more closely at the impact on the economy, the energy and food and fibre systems, businesses and workers, and the challenges and opportunities they may face as Aotearoa

puts in place policy to reduce emissions. It then considers how these challenges can be managed and how workers can be supported throughout the transition.

The analysis in this section draws on modelling using our ENZ, Climate Policy Analysis (C-PLAN), and Distributional Impacts Microsimulation for Employment (DIM-E) models. There are differences in the structure and purpose of the ENZ and C-PLAN models, and therefore differences in the scenario runs. However, the modelling results of the Current Policy Reference case and demonstration path reported in this section have been aligned as closely as possible.

More detail on the ENZ model can be found in *Chapter 12: Long-term scenarios to meet the 2050 target*. More detail on the C-PLAN and DIM-E models can be found in Box 15.2 and Box 15.3, respectively, in this chapter.

## 15.2 Costs and savings from the energy transition

### 15.2.1 A decarbonised energy system can provide cost savings

We have assessed the costs and savings of some of the key actions that can be taken to decarbonise the energy system. These assessments are based on the rate of uptake of these actions in the demonstration path (outlined in more detail in the Climate Change Commission's (the Commission) advice, *Ināia Tonu Nei, Chapter 7: Demonstrating emissions budgets are achievable*).

This analysis looks at the costs of transition for Aotearoa across three key areas: road transport, space and water heating, and food processing. We have focused on these areas as they are large sources of current emissions in Aotearoa and are likely to require some of the most significant transitions from fossil to renewable energy. Together, these areas account for around three quarters of the reductions in long-lived greenhouse gas emissions by 2035 under the demonstration path.

Our analysis estimates the costs incurred in each year from capital investments in vehicles, boilers and appliances, use of fuel and electricity, maintenance, and other associated costs. We have compared these estimates against the Current Policy Reference case, where the uptake of these actions would occur more slowly. This allows us to show where there could be costs and where there could be savings from taking these actions over time.

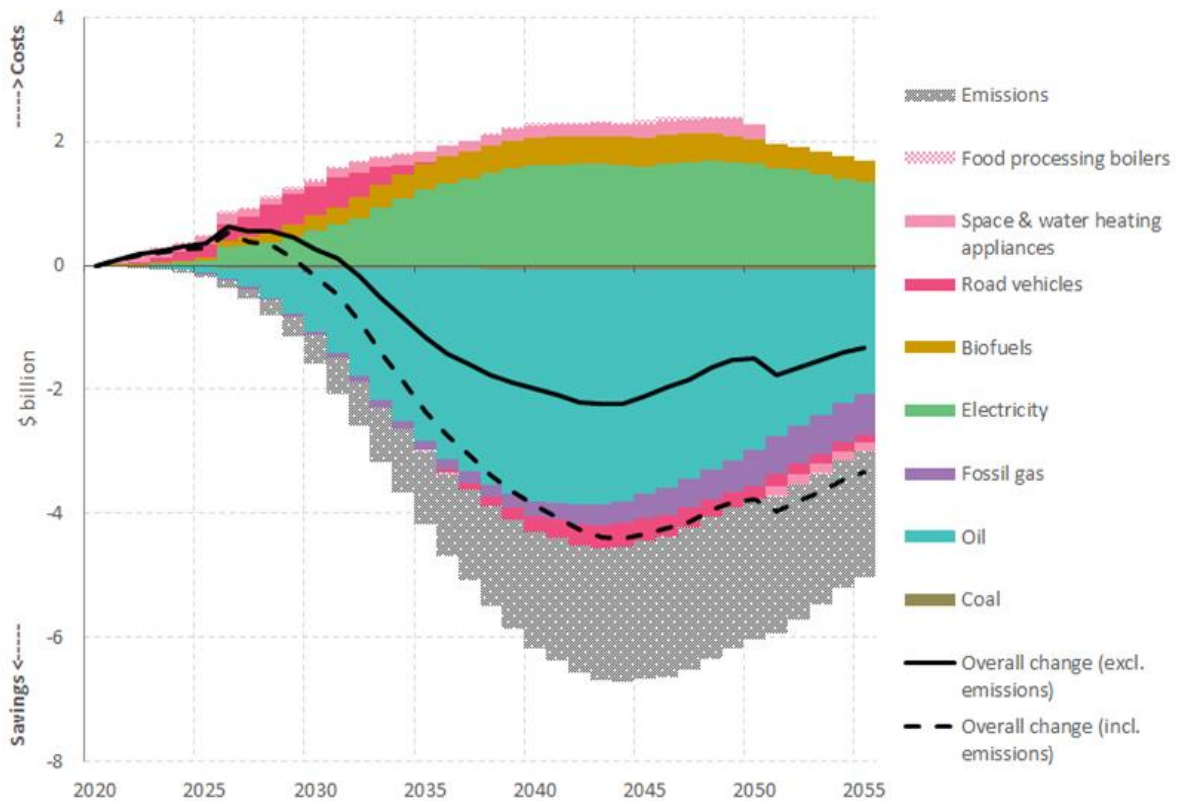
Overall, we find that substantial additional investment will be required over the coming decades, but this is likely to be outweighed by even larger future cost savings. This is demonstrated in Figure 15.1. There are costs over the next decade or so; beyond this, the savings outweigh the costs as avoided expenditure on fossil fuels outweighs the additional capital costs and expenditure on electricity and biofuels. By the 2040s, Aotearoa would be saving around \$2 billion each year (the solid black line in the figure).

The figures presented here consider only fuel-switching measures. They exclude the effects of energy efficiency improvements, mode shift and reduced travel demand in the demonstration path. We expect these to deliver further economic benefits, potentially more than doubling the net cost savings in the long term. However, a complete picture would need to consider wider implications such as transport infrastructure investment, which we have not been able to do.

The numbers above exclude the monetised value of emissions reductions. In Figure 15.1, the grey dotted area shows the avoided emissions costs if valued at the emissions values used in our modelling of the demonstration path (see the Commission's advice, *Ināia Tonu Nei, Chapter 7:*

*Demonstrating emissions budgets are achievable, Box 7.1: Emissions values for more information).* The black dashed line in the figure shows how the overall costs would change if avoided emissions costs were included.

The positive values (above the horizontal axis) in these figures (Figure 15.1, 15.2, 15.3, 15.4) indicate that the demonstration path would impose an additional cost above the Current Policy Reference case. Negative values (below the horizontal axis) indicate that the demonstration path would represent a cost saving relative to the Current Policy Reference case.



*Figure 15.1: Projected annual increase and decrease in costs from fuel switching across the road transport, buildings and food processing sectors in the demonstration path compared to the Current Policy Reference case. This excludes the effects of improved energy efficiency, mode shift and reduced travel demand. Positive values (above the horizontal axis) indicate that our demonstration path would impose an additional cost above the current policy reference. Negative values (below the horizontal axis) represent a cost saving relative to the current policy reference.*

Source: Commission ENZ modelling

## 15.2.2 Electrifying road transport could start to deliver cost savings within a decade

Our analysis indicates Aotearoa will save money if businesses and individuals decarbonise by electrifying transport. This accounts for most of the overall cost savings shown above in Figure 15.1.

Figure 15.2 shows a more detailed breakdown of the various cost elements for road transport under the demonstration path compared to the Current Policy Reference case. It shows the costs and savings from increasing the rate of electric and bio-fuelled vehicles from petrol-fuelled vehicles in

the transition. Again, this does not include the effect of reduced road travel from greater walking and cycling, use of public transport, use of rail and coastal shipping, working from home, or other changes to demand. These 'mode' shifts could lead to large additional cost savings, particularly through reducing the number of cars that Aotearoa imports, as well as health co-benefits from active transport.

Electrifying the vehicle fleet will require increased capital expenditure on vehicles, investment in electricity supply and distribution and charging infrastructure. However, our analysis indicates that these capital costs will be more than offset by savings in petrol and diesel use, along with lower EV maintenance costs. Our analysis suggests that annual cost savings will exceed the additional costs incurred by around 2030 under the demonstration path. Contributing to this is our assumption that the capital cost of electric vehicles will continue to fall, as the decline in battery costs makes EVs lower cost to purchase. Our analysis indicates that electric cars will become cheaper to own and operate than a petrol equivalent by 2031.

Unlike electrification, our analysis indicates that biofuels will remain more expensive than fossil fuels. This would lead to an increase in fuel costs – around \$300 million per year, but these costs would be small relative to the cost savings from electrification, which amount to at least \$1 billion per year from 2035.

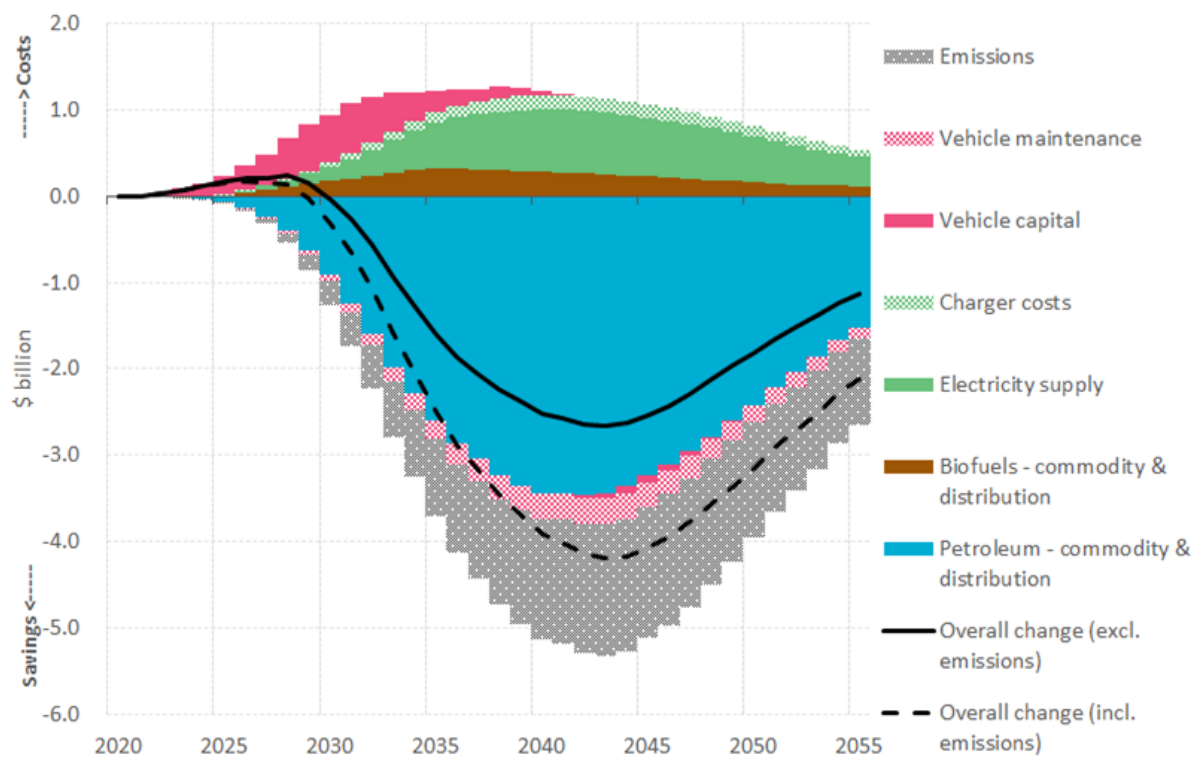


Figure 15.2: The projected increase and decrease in different elements of road transport costs in the demonstration path compared to the Current Policy Reference, excluding the effects of mode shift and reduced travel demand. Positive values (above the horizontal axis) indicate that our demonstration path would impose an additional cost above the Current Policy Reference. Negative values (below the horizontal axis) represent a cost saving relative to the Current Policy Reference.

Source: Commission ENZ modelling

The road transport cost savings decrease around 2040 and beyond. This is because the Current Policy Reference case still has a transition to electric vehicles, but the uptake is much faster in the demonstration path and so the savings are achieved earlier. The cost analysis includes both light and heavy vehicles classes which electrify at different rates.

Our analysis shows on balance the transition away from internal combustion engine (ICE) vehicles is projected to significantly reduce road transport costs in Aotearoa – even without taking account of the avoided cost of carbon emissions. Further, this evaluation also does not account for the avoided human health costs associated with ICE vehicle tailpipe emissions.

**Box 15.1 Explanatory notes & key assumptions for Figure 15.2**

- Vehicle maintenance is the net change in the road vehicle fleet maintenance costs. The value is negative in Figure 15.2 (i.e. a cost saving) as EVs are assumed to be cheaper to maintain than ICE vehicles.
- Charger costs is the cost of installing electric vehicle charging infrastructure at and away from home.
- Electricity supply is the cost of providing the electricity required for EVs – this includes the cost of generating the electricity, transmission and distribution.

### 15.2.3 Switching to electric space and water heating could deliver cost savings but there are transitional costs

In the demonstration path, fossil gas and LPG space and water heating systems are phased out and replaced with electricity by 2050. Our analysis finds that this would incur a net cost averaging around \$200 million per year out to 2050, excluding the emissions reduction benefits (Figure 15.3).

We estimate that electric heating systems are slightly cheaper than a fossil gas system today in new buildings, but the costs of converting an existing building to electric would be substantial. This is particularly due to ‘make-good’ costs for properties from removing fossil gas appliances and making repairs to the property. Another part of this cost relates to the opportunity cost of not replacing end-of-life fossil appliances with another fossil appliance and thereby missing out on the cheaper capital and installation costs associated with such a like-for-like replacement.

While substantial, these are one-off transitional costs. As Figure 15.3 shows, the cost of appliance transition (the pink area of Figure 15.3) occurs steadily through to 2050, at which point all residential and commercial consumers will have transitioned to electricity. After 2050, once all the conversions are completed, annual costs are lower and turn into savings as electricity appliances are slightly cheaper than fossil appliances in new-build and end-of-life asset replacement situations. We therefore find that similar to road transport, the transition to electric heating would ultimately lead to lower costs, but this point will take longer to arrive.

We have tested whether delaying the transition from fossil gas and LPG to electricity would reduce the economic costs to Aotearoa. However, our analysis indicates that this would end up costing Aotearoa more over the long term as the post-transition benefits are delayed.

The effects of energy efficiency improvements assumed in the demonstration path are not included here, but our analysis indicates there is potential for these to substantially offset the transitional costs.

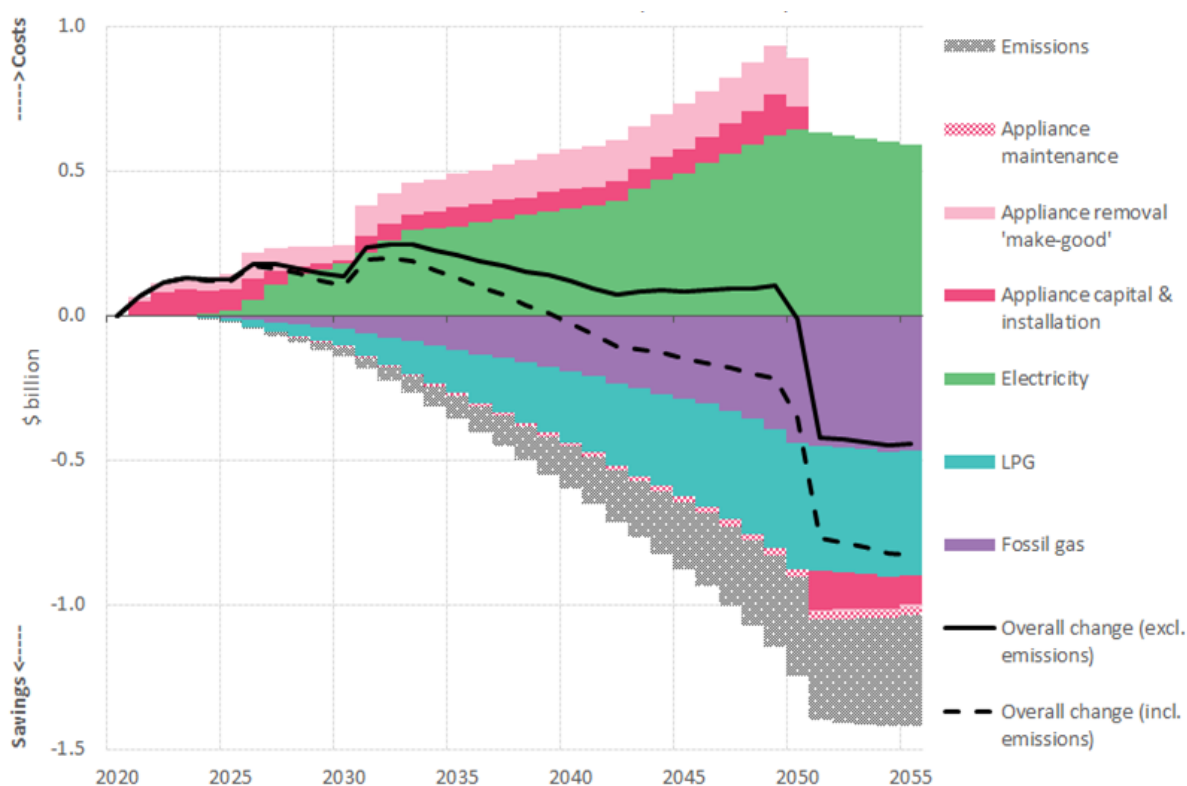


Figure 15.3: The projected increase and decrease in different elements of space and water heating costs for homes and businesses in the demonstration path compared to the Current Policy Reference, excluding energy efficiency improvements. Positive values (above the horizontal axis) indicate that our demonstration path would impose an additional cost above the Current Policy Reference. Negative values (below the horizontal axis) represent a cost saving relative to the Current Policy Reference.

Source: Commission ENZ modelling

### 15.2.4 Switching to biomass and electric heat in food processing will incur costs

The demonstration path sees a full transition away from using coal, fossil gas and diesel to generate heat in the food processing sector by 2050. Figure 15.4 shows that this leads to costs on the order of \$200 million per year by 2035, largely due to higher fuel costs. This is because, unlike for electric vehicles or space and water heating, conversion to a biomass or electrode boiler means using a more expensive fuel without any significant energy efficiency gain.

Again, this does not include the effect of further efficiency improvements assumed in the demonstration path, through measures such as improved heat recovery and heat pump integration. These would lead to significant fuel savings and could reduce overall costs, but there is uncertainty around the installation costs which are likely to be highly site-specific.

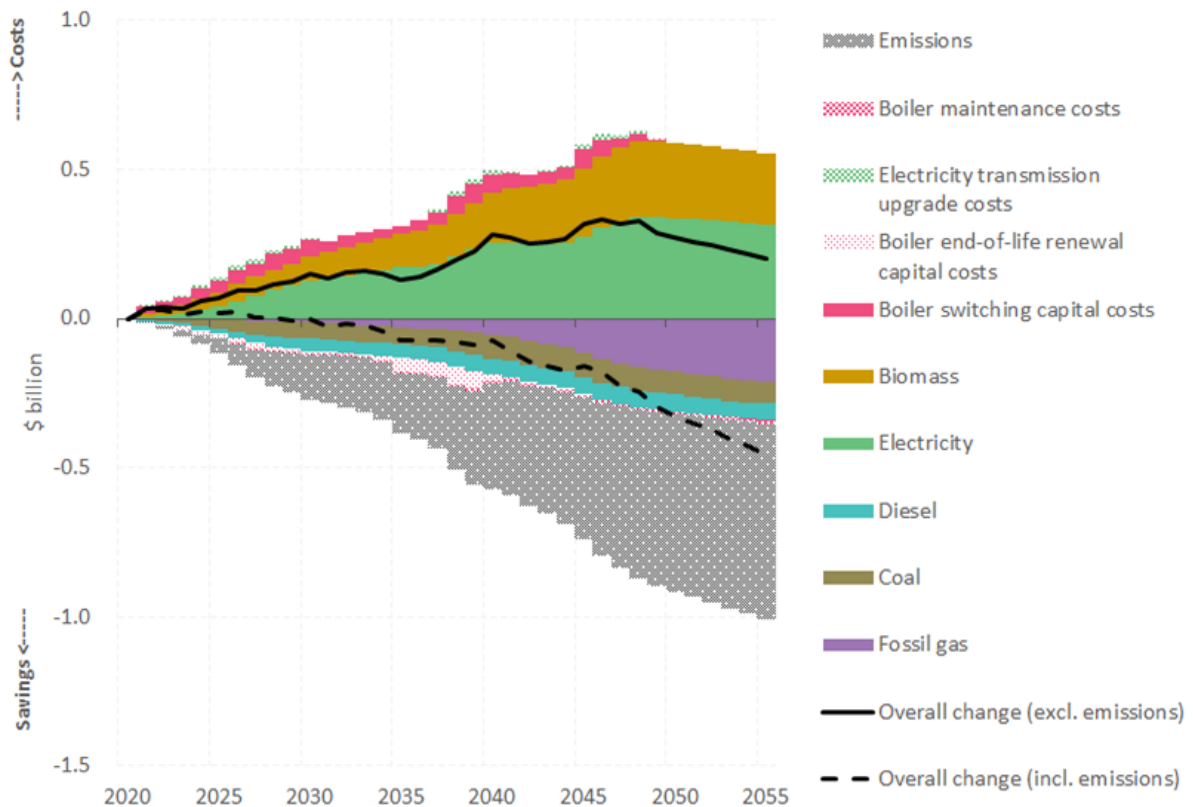


Figure 15.4: The projected increase and decrease in different elements of process heat costs for the food processing sector in the demonstration path compared to the Current Policy Reference, excluding the effects of improved energy efficiency. Positive values (above the horizontal axis) indicate that our demonstration path would impose an additional cost above the Current Policy Reference. Negative values (below the horizontal axis) represent a cost saving relative to the Current Policy Reference.

Source: Commission ENZ modelling

## 15.3 Economic growth

How the economy grows as Aotearoa transitions to a thriving, climate-resilient and low-emissions economy depends on the pace with which the country acts, the costs to businesses from reducing emissions, and the action the rest of the world takes. Global action to reduce emissions would reduce the increased severity of droughts, sea level rise and storms, and would reduce the cost to the economy of these impacts.

With the technologies and practice changes available to Aotearoa, our modelling suggests that what Aotearoa produces and exports for the most part would not need to change significantly to meet our recommended emissions budget levels. However, some sectors such as mining and fossil gas would reduce production significantly.

### **Box 15.2: How the Climate Policy Analysis (C-PLAN) model works**

C-PLAN is a type of economic model referred to by economists as a ‘recursive-dynamic multi-region computable general equilibrium’ (CGE) model. This means it models the whole world economy over time. We use it to simulate what happens to the economy every year out to 2050.<sup>1</sup>

C-PLAN assumes that if there is a change in one part of the economy, other parts of the economy would also change so that there is no excess supply or demand. Models like C-PLAN are good at showing how changes would flow through an economy, but usually cannot include a large amount of technological detail. For this reason, the Commission uses C-PLAN alongside the ENZ model, which provides a richer picture of technologies and practice changes for reducing emissions.

In C-PLAN, the world is divided into two regions – Aotearoa, and Rest of World. These regions have different climate policies to reduce emissions and may make things differently – for example, Aotearoa uses more land but less feed supplements to produce milk. However, both regions have the same sectors and can trade with each other where one region has a comparative advantage over the other.

Climate mitigation is modelled in C-PLAN primarily through abatement cost. The model splits out biogenic methane from livestock and waste from all other greenhouse gases, and models a separate abatement cost for each of these two types of emissions. The caps on emissions for each emissions type are imposed in the model for each year, and the model works out the cheapest way to meet them. C-PLAN has several ways that emissions caps can be met. These include specific technologies (methane vaccines and inhibitors, EVs, bioenergy for process heat, electrification of process heat), switching between energy sources, price-induced energy efficiency improvements, and reducing output. The Commission also assumes that energy efficiency and emissions intensity gradually improve over time.

The forestry sector is included in C-PLAN but does not respond to abatement cost (due to the technical difficulties of modelling this). Instead, emissions caps are inserted into the model on a net basis. Land used for forestry and agricultural sectors in each year is fixed, so land-use change does not respond to the abatement cost, but land use can vary across years and pathways. The effect of different levels of forestry is instead tested in the choices of target pathways.

C-PLAN is a new model, having been contracted for the Commission in late 2019. As with all models, C-PLAN will continue to be developed and refined over time. It is based on Massachusetts Institute of Technology’s Economics Projection and Policy Analysis (EPPA) model,<sup>2</sup> which was first developed over 20 years ago and continues to be refined, and the Vivid Economy-Wide (ViEW) model developed by Vivid Economics.

C-PLAN has some important differences from other CGE models that have been used in Aotearoa to inform climate mitigation policy. In particular, C-PLAN models emissions reducing in response to climate policy with little or no reduction in output, and so shows a smaller impact on GDP and abatement costs than other CGE models in Aotearoa.<sup>3</sup> This occurs because C-PLAN explicitly includes key emissions-reducing technologies that allow emissions to be reduced without reducing output (e.g. a methane vaccine), and also allows industries to switch the energy sources they are using. The scenarios and Current Policy Reference case that the Commission uses are also

<sup>1</sup> It uses base data from 2014.

<sup>2</sup> (Massachusetts Institute of Technology, 2017)

<sup>3</sup> (NZIER, 2018; Winchester, 2019)

different to previous modelling exercises, and so it is difficult to compare the results. In particular, the New Zealand Institute of Economic Research (NZIER) modelling for the Climate Change Response Amendment Act 2019 had more stringent targets for agriculture in some scenarios. The baseline scenario in C-PLAN also included a wider set of other policies that would reduce emissions, for example the new regulations for freshwater standards that the Government introduced in September 2020.

In our *2021 Draft Advice for Consultation*, we ran four scenarios, in addition to the Current Policy Reference case in C-PLAN. For this final advice, we also ran the demonstration path, which is based on the demonstration path in ENZ. There are some small differences between the demonstration path in ENZ and C-PLAN as these are different types of models (see our *advice, Ināia tonu nei* for more information on the ENZ demonstration path). We also updated the four scenarios runs from our *2021 Draft Advice for Consultation* and re-ran them to provide broad insights into the economy-wide cost implications of our recommendations. For this final advice, we are only presenting the results of the demonstration path.

The insights on the implications of reducing emissions from the C-PLAN model are in line with other international research, such as the modelling carried out by the European Commission and the United Kingdom Committee on Climate Change.<sup>4,5</sup>

*Table 15.1: The key assumptions used in each of the scenarios run in C-PLAN.*

	Forestry	Methane technology	Long-lived greenhouse gases	Biogenic methane
<b>Current Policy Reference case (CPR)</b>	MPI's current projections	None	Business as usual	Business as usual (from 2026)
<b>Transition Pathway 1 (TP1): More removals</b>	CPR exotic forestry (with additional native forests)	Low effectiveness and uptake only	Straight line path for gross emissions to net-zero in 2050	24% reduction in 2050
<b>Transition Pathway 2 (TP2): Methane technology</b>	CPR exotic forestry (with additional native forests)	Higher effectiveness and uptake (vaccine)	Straight line path for gross emissions to net-zero in 2050	47% reduction in 2050
<b>Transition Pathway 3: (TP3) Less removals</b>	About 2/3 of CPR exotic forestry (with additional native forests as in TP1)	Low effectiveness and uptake only	Straight line path for gross emissions to net-zero in 2050, accounting for forestry removals	24% reduction in 2050

<sup>4</sup> (European Commission, 2020)

<sup>5</sup> (Committee on Climate Change, 2019)

<b>Transition Pathway 4 (TP4): Faster reductions</b>	About 2/3 of CPR exotic forestry (with additional native forests as in TP1)	Low effectiveness and uptake only	36% reduction in gross emissions in 2030, net-zero in 2050	24% reduction in 2050
<b>Demonstration path</b>	As in ENZ demonstration path	No methane technology, but improved agricultural emissions efficiency	As in ENZ demonstration path, reaching net zero in 2040	As in ENZ demonstration path

### 15.3.1 GDP impact of meeting our recommended emissions budgets

We have modelled the potential overall impacts on the economy using a macroeconomic model built for the Commission, C-PLAN. This model is described in Box 15.2. This assessment looks only at the impact of meeting the domestic emissions budgets. It does not include the impact of meeting the Nationally Determined Contribution (NDC), which could include international purchases of offshore mitigation.

#### GDP impact from our 2021 Draft Advice for Consultation

In our *2021 Draft Advice for Consultation*, we considered four transition pathways that tested various combinations of methane technology, levels of forestry removals, and emissions paths for meeting our 2050 targets. After updating our Current Policy Reference, we assessed that the overall reduction to GDP, compared to a future without further policy action, would be 0.2-1.0% in 2035, and 0.3-0.7% in 2050.

*Table 15.2: GDP projections from the Commission's C-PLAN modelling (\$ billion)*

C-PLAN scenarios	2017	2025	2030	2035	2050
<b>Current Policy Reference</b>	270	318	357	388	487
<b>Transition Pathway 1 (TP1): More removals</b>	270	318	357	388	486
<b>Transition Pathway 2 (TP2): Methane technology</b>	270	318	357	387	486
<b>Transition Pathway 3: (TP3) Less removals</b>	270	318	357	387	484

<b>Transition Pathway 4 (TP4): Faster reductions</b>	270	317	353	384	484
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## Process for assessing the GDP impact of the demonstration path

Since our *2021 Draft Advice for Consultation* was prepared, we have modelled the GDP impact of the demonstration path that we used to calculate the levels of the emissions budgets. To do this, we updated the Current Policy Reference case used in the C-PLAN modelling to better align with the Current Policy Reference used in the ENZ modelling. The Current Policy Reference case now factors in the most recent updates from the Government projections, including GDP updates that take into account the effects of COVID-19, and updates from the Ministry for Primary Industries on land use and agricultural emissions intensity.

The demonstration path that we modelled in C-PLAN includes broadly the same technology and behaviour changes as the demonstration path we modelled in ENZ (see the Commission’s advice, *Ināia tonu nei* for more information on the ENZ demonstration path) for more detail on the demonstration path run through ENZ). The models have been aligned by using the same inputs where possible and by comparing emissions outcomes. However, the demonstration path in C-PLAN and ENZ is not exactly the same. This is because the two models are designed for different purposes. ENZ includes a more detailed breakdown of technology and behaviour changes than is possible in C-PLAN. C-PLAN is designed to tell us about the flow-on effects across the economy.

## GDP impact of the demonstration path

We have assessed, based on our modelling and other analysis, that our recommended emissions budgets are achievable at an overall reduction to the level of GDP in 2035 of around 0.5%. This considers only the mitigation costs associated with meeting the budgets and is not a cost-benefit analysis. It does not consider the significant co-benefits of action or the costs of delaying action (Section 15.2.3). GDP also does not measure the impacts on wellbeing.

Our economic modelling indicates the economy would continue to grow under our recommended emissions budgets. Under current policy settings, GDP is projected to grow to \$388 billion by 2035 and \$487 billion by 2050. Whereas meeting our recommended emissions budgets through the demonstration path would result in GDP growing to about \$386 billion by 2035 and put us on track for GDP to grow to \$481 billion by 2050.

Our modelling shows that meeting the target at a lower cost to the economy relies on the successful roll out of electric vehicles and improving the emissions efficiency of agricultural production so that production can be largely maintained. The overall impact to GDP would be higher – potentially reducing GDP by up to 1.0% in 2035 – if these key measures were not successfully rolled out.

Electric vehicle technology is available now, and policy can be designed to remove barriers and speed up their roll out. Opportunities to improve on-farm performance are also available now and achievable by farmers over time, with policy and programmes to address barriers.

Looking out to 2050 is more uncertain. There is more opportunity for currently emerging technologies, such as green hydrogen and methane inhibitors or vaccines, to play a role. We assess that the overall impact to GDP in 2050 would be around 1.2%. However, the overall impact to GDP in 2050 could be up to 2.3% if Aotearoa fails to deploy EVs and improve agricultural emissions efficiency at adequate rates.

Table 15.3: GDP projections from the Commission's C-PLAN modelling (\$ billion)

C-PLAN scenarios	2017	2025	2030	2035	2050
<b>Current Policy Reference case (CPR)</b>	270	318	357	388	487
<b>Demonstration Path</b>	270	318	357	386	481
<i>% difference in GDP compared to CPR</i>		0.0%	-0.2%	-0.5%	-1.2%
<b>Demonstration Path, with slower EV uptake</b>	270	318	357	385	477
<i>% difference in GDP compared to CPR</i>		0.0%	-0.2%	-0.9%	-2.1%
<b>Demonstration Path, with slower EV uptake and no extra improvement in agricultural emissions efficiency</b>	270	318	356	384	476
<i>% difference in GDP compared to CPR</i>		0.0%	-0.3%	-1.0%	-2.3%

### 15.3.2 How do our estimates of GDP impact compare to international studies?

Our finding that meeting the 2050 emissions target could impact GDP on the order of 1% is consistent with recent international studies of pathways to achieve net zero emissions. Table 15.4 below outlines how the transition pathways that would put Aotearoa on track to meet the 2050 targets compares to overseas estimates. Overall, these other studies estimated GDP impacts in 2050 for the region in question ranging from 1.3% lower to 3% higher relative to the baseline. These estimates all exclude the co-benefits of the transition, the costs of adapting to climate change and avoided climate damages.

Table 15.4: Cost estimates of achieving net zero emissions

Scope	Author	Estimation method	Cost or GDP impact in 2050
<b>Aotearoa</b>	The Commission/ Motu	Macroeconomic model (general equilibrium)	<b>Transition pathways</b> that align with our 2050 targets: 0.3-0.7% lower than Current Policy Reference case.  <b>Demonstration path:</b> 1.2% lower than Current Policy Reference case.

<b>United Kingdom</b>	Committee on Climate Change <sup>6</sup>	Resource cost assessment	Net cost less than 1% of projected GDP
		Macroeconomic model (macro-econometric)	GDP 3% higher relative to current policy baseline
<b>European Union</b>	European Commission <sup>7</sup>	Suite of three different macroeconomic models	GDP 1.3% lower to 2.2% higher relative to current policy baseline
<b>Global, 'hard-to-abate' sectors</b>	Energy Transitions Commission <sup>8</sup>	Resource cost assessment	Net cost 0.2–0.5% of projected GDP

The studies cited used different methods to quantify potential costs:

- *Resource cost* measures the net additional cost each year to deliver the same services with lower or zero emissions. This additional cost will not necessarily reduce economic output by an equivalent amount. For example, substituting imported fossil fuels with domestically produced renewable energy could boost GDP while increasing the cost of the energy system.
- *Macroeconomic models* provide estimates of how decarbonisation could affect GDP, employment and other economic metrics. These models simulate the flow-on effects of decarbonisation on how capital, labour and other resources are deployed throughout the economy.

The studies all support the conclusion that the overall impact of decarbonisation on the economy will be small relative to projected growth. However, different macroeconomic models disagree on whether the impact on GDP will be negative or positive. This disagreement centres on distinct model assumptions around market imperfections and whether the economy operates at full capacity.

General equilibrium models, like the Commission's C-PLAN model, assume that the economy is at an equilibrium usually without any unused resources. This means that, for instance, the additional investment required to decarbonise will necessarily reduce investment somewhere else in the economy. The European Commission's general equilibrium modelling results are similar to ours, with the net zero emissions pathway reducing GDP by 0.6-1.3% relative to the baseline in 2050.

Other models, such as the E3ME macro-econometric model used in both the UK and EU studies, do not assume equilibrium. This means that the economy has unused capacity and the additional investment in decarbonisation can provide a stimulus that boosts total economic output. These models found that a net zero emissions pathway could increase GDP above the baseline.

<sup>6</sup> (Committee on Climate Change, 2020). *The Sixth Carbon Budget: The UK's path to Net Zero*.

<sup>7</sup> (European Commission, 2018). In-depth analysis in support of the Commission Communication COM 773, *A Clean Planet for all: A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy*.

<sup>8</sup> (Energy Transitions Commission, 2020). *Making Mission Possible: Delivering a Net-Zero Economy*.

An important insight from these international studies is that spare capacity in the economy could see climate action boost economic growth. In the current context of economic activity being suppressed due to the COVID-19 pandemic, spare capacity is very likely. This highlights the opportunity for investment in the transition for Aotearoa to stimulate the economy and support the post-COVID-19 recovery.

### 15.3.3 How do our estimates of GDP impact compare to previous Aotearoa estimates?

Our estimates of the cost of meeting the 2050 target are substantially lower than suggested by economic modelling undertaken to support the Climate Change Response Amendment Act 2019. The modelling undertaken by NZIER for the Ministry for the Environment tested a range of scenarios for different target forms and levels. In the scenarios relied on in the Climate Change Response Amendment Act 2019's Regulatory Impact Statement, modelled GDP was 5-8% lower in 2050 relative to a baseline representing current policies.<sup>9</sup>

In contrast, our economic modelling indicates meeting the 2050 target could lead to a 0.3-0.7% reduction in GDP in 2050 compared to the Current Policy Reference case. Reaching net zero long-lived greenhouse gases in 2040 as in the demonstration path could lead to a 1.2% reduction in GDP in 2050 compared to the Current Policy Reference.

However, the impact on GDP would be greater if Aotearoa could not successfully roll out electric vehicles and improve the emissions efficiency of agricultural production so that production can be largely maintained. In this situation, reaching net zero long-lived greenhouse gases in 2040 as in the demonstration path could lead to a 2.3% reduction in GDP compared to the Current Policy Reference.

As climate policy and other factors have changed since the NZIER modelling was done in 2018, the NZIER baseline representing current policies has higher emissions than our current policy baseline, which is one factor making the costs appear larger. These differences are also discussed in Box 15.2 above.

### 15.3.4 Sensitivity of GDP results to key uncertainties

We have undertaken sensitivity analysis to test how key uncertainties could impact on the ability to meet the recommended emissions budgets. Figure 15.5 shows the modelled impact on GDP in 2035 and in 2050 for the five individual factors tested.

Holding all other assumptions constant, we have modelled how the demonstration path would be affected by:

- **Slower or faster rates of population and GDP growth.** We have tested population growth rates 0.4 percentage points faster or slower, and GDP growth rates 0.3 percentage points higher or lower, based on Government projections.

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<sup>9</sup> The NZIER report (NZIER, 2018, pp. 18, Table 7) uses the B-F-50 and B-F-75 scenarios, which are the same scenarios used in the Zero Carbon Bill's Regulatory Impact Statement (Ministry for the Environment, 2019b) (see the Addendum on p. 33, noting different terminology)

- **Higher or lower levels of global oil prices.** We have tested higher and lower values for oil price.
- **Higher or lower levels of global emissions price.** We have tested higher and lower values for emissions prices in the rest of the world. Lower emissions prices in the rest of the world would reflect a future where international climate action is much more limited and countries do not meet their stated commitments.
- **Continued operation of the New Zealand Aluminium Smelter.** We have tested what happens if the smelter continues to operate beyond 2024 with full certainty.
- **Potential closure of methanol production.** For illustrative purposes, we have tested the impact methanol production were to close completely by 2030.

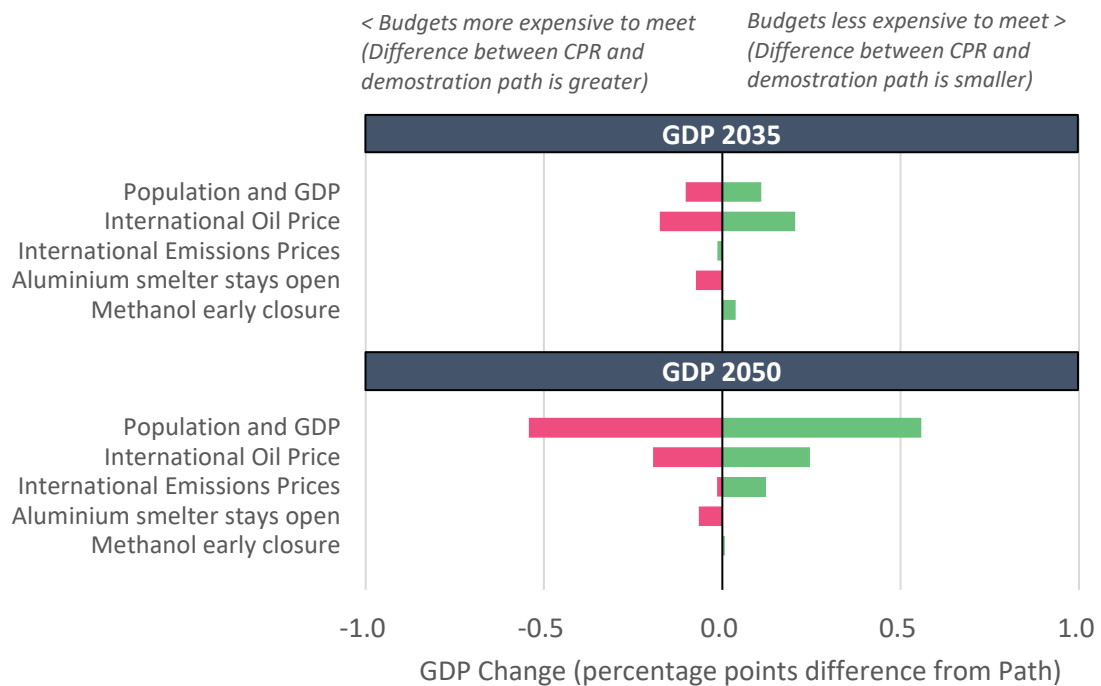


Figure 15.5: Sensitivity analysis of GDP results to selected factors or events

Table 15.5 below provides further detail on the assumed variations or sensitivity ranges tested in each case, compared with what is assumed in the demonstration path.

*Table 15.5: Assumptions used in sensitivity testing of the demonstration path*

Variable	Demonstration path value/setting	Sensitivity assumptions		Source/basis for sensitivity assumptions
		Low	High	
Population (average growth rate 2020-2035)	1.0%	0.5%	1.4%	Low and high cases used in 2020 Government emissions projections. Assumes:
GDP (average real growth rate 2020-2035)	2.4%	2.1%	2.7%	<ul style="list-style-type: none"> <li>10<sup>th</sup> / 90<sup>th</sup> percentile population projections from StatsNZ</li> <li>Labour productivity growth of 1.0% (base) / 0.6% (low) / 1.4% (high)</li> </ul>
Oil price	Increases from 40 USD/bbl in 2020 to 60 USD/bbl 2023, then constant	Decreases to 35 USD/bbl by 2030	Increases to 70 USD/bbl by 2023, then 90 USD/bbl by 2030	The Commission assumptions informed by IEA World Energy Outlook and other projections
International Emissions Price	Rises from US\$0/t CO <sub>2</sub> e in 2019 to US\$250/t CO <sub>2</sub> e	Rises from US\$0/t CO <sub>2</sub> e in 2019 to US\$125/t CO <sub>2</sub> e	Rises from US\$0/t CO <sub>2</sub> e in 2019 to US\$500/t CO <sub>2</sub> e	Illustrative
Aluminium production	Closure at end of 2024	N/A	Continues at full output (and electricity generation is updated to match)	Illustrative
Methanol production	Waitara Valley train closes end of 2021; Motunui train No. 2 closes end of 2029; all trains closed by end of 2039	Motonui train No. 2 closes end of 2028; all trains closed by end of 2029	N/A	Illustrative

## 15.4 The benefits and opportunities of meeting emissions budgets are significant

International and domestic research suggests there are significant co-benefits to reducing emissions in the more immediate term. Benefits to health and health equity, productivity and incomes all tip the balance further in favour of acting earlier to reduce emissions.<sup>10</sup> Health improvements from warmer, drier homes, less air pollution and from walking and cycling more reduce the burden on the health system.

There are also opportunities for businesses taking the lead in reducing emissions. Creating new low-emissions products and services could open up opportunities in new markets and could add value to our exports. The flipside is the risk of businesses losing access to international markets if Aotearoa does not take timely action to reduce emissions.

The pace the world acts to reduce emissions will also define how much climate change Aotearoa and other countries will need to adapt to. While there are estimates of the damages from more severe climate change, there is a growing body of research showing that these estimates significantly underestimate the true cost. This is because it is challenging to quantify many of the most serious consequences of climate change as they lie outside of human experience. However, these risks provide a compelling reason for the world to work together to reduce emissions.

Our assessment of the impact on GDP provides some useful insights but it does not include these benefits and opportunities, nor the costs related to not acting. It is difficult to fully quantify the benefits of action on the economy and society with any accuracy as there is significant uncertainty in how and when the benefits will be realised.

## 15.5 The impacts will not be evenly felt

The overall impact on GDP from meeting our recommended emissions budgets is small relative to the size of the whole economy. There will be significant benefits from the transition. However, opportunities, benefits, challenges, and inevitable costs will not be evenly felt across society. Some sectors of society will experience greater impacts, both positive and negative.

Distributional impacts can be managed if the government puts in place policies to support those most disadvantaged and least able to adjust, and to ensure a fair, inclusive and equitable transition.

The following sections look in more detail at how the benefits and costs may be distributed across different groups of people, and how we can ensure that costs do not fall disproportionately on the groups of people who are the most vulnerable and least able to adjust.

## 15.6 A gradual versus abrupt transition

A key challenge is judging how fast the country's transition needs to be. There is a question as to how to balance the urgency of preventing dangerous climate change and its associated costs, with

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<sup>10</sup> (Karlsson et al., 2020)

managing the impacts of disruptive economic transformation. There is also a question about our strategy as a nation – do we lead, which might come with higher costs, but also first-mover advantages, or be a follower, delaying action until others show us the way and costs come down?

Experience, including the country's own experience of reforms in the 1980s, has shown that rapid transformative change is socially and economically painful. This counts against very fast early action. It also counts against waiting until solutions have been found and fully proven elsewhere before rapid uptake and transformation at home.

Pursuing an early, steep decline in emissions is likely to come with higher adjustment costs. Even where low-emissions technology exists now, such as electric vehicles, there are short-run supply constraints. Time is needed to build capacity in these new markets, as well as to set standards and train the workforce to support them. There would also be greater risks that existing assets would have to be retired before the end of their expected lifespan, and of a political and social backlash that could stall progress.

Time is also needed to plan the transition and make sure affected businesses and workers are supported (see also *15.12 Impact on small businesses*, *15.13 Impact on employment, workers and skills* and *15.14 Ensuring an equitable transition for workers* sections below). An early and unplanned transition would make it harder to foresee other policy that could potentially compound the impacts on the same communities while also leaving less time to develop supportive policies for affected communities.

Delaying action would lead to a similar abrupt decline in emissions, but later. This also carries risks of increased costs, even though technology solutions may be cheaper. Continued investment in the wrong type of infrastructure, for example, could lock in emissions and cause stranded assets.<sup>11</sup> Delaying action would also increase the country's contribution to global emissions.

In contrast, early but consistent action would allow for a more gradual and steadier pace of change, with more scope for managing impacts. While there is uncertainty about the future pathway, the technologies for reaching emissions reduction targets in Aotearoa are mostly known. By adopting these technologies early rather than waiting for costs to come down, people can learn by 'doing', while steadily building up supporting infrastructure and services and helping overcome user barriers to reach critical mass.

Early signalling gives businesses time to adapt and innovate, find solutions that are both good for the climate and good for the bottom line, and replace assets and infrastructure with low-emissions options on as natural a cycle as possible.

Modelling carried out for Westpac in 2018 showed that taking planned action on climate change was more cost effective and could save Aotearoa \$30 billion in GDP by 2050, compared to delaying action until 2030.<sup>12</sup> Taking an early and well-paced pathway was also found to have fewer impacts on individuals and businesses, have less economic impact on emissions-intensive sectors, and be better for the economy as a whole.<sup>13</sup>

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<sup>11</sup> (OECD, 2019a)

<sup>12</sup> (Westpac, 2018)

<sup>13</sup> (OECD, 2019a; Westpac, 2018)

Conversely, delayed and more abrupt action would come at greater cost, could be more disruptive and could lock in emissions-intensive infrastructure that could later become stranded.<sup>14</sup>

## 15.7 Impact on taxation and Government revenue

There are likely to be fiscal impacts the Government would need to plan for, as a result of actions to reduce emissions and meet emissions budgets and the country's domestic targets for biogenic methane and all other gases. The extent of these impacts would depend on how policies such as road transport levies or the New Zealand Emissions Trading Scheme (NZ ETS) are set.

At the moment, land transport revenue comes from petrol excise duty, road user charges for all other vehicles, and motor vehicle registration and licensing fees, as well as from other sources. In 2018/2019, net revenue from petrol excise duty was slightly less than \$2.04 billion, from road user charges was \$1.73 billion, from motor vehicle registration was \$227 million.<sup>15</sup> This revenue is hypothecated, and along with a few other sources,<sup>16</sup> is used to fund the building, maintenance and operation of the land transport system.

Petrol and diesel consumption is likely to decrease over time as electric vehicles and other low-emissions transport modes become more popular and vehicle efficiency improves. While electric vehicles are currently exempt from road user charges, this exemption is set to expire on 31 December 2021.<sup>17</sup> Revenue from petrol excise duty, road user charges and vehicles registrations would change over time, and the Government would need to plan how to fund land transport given these changes.

The climate transition could also impact the Government's spending on social assistance for workers, families and health. The level of social assistance would depend on the transition strategy the Government puts in place and how well the transition is signalled and planned. The transition to a low-emissions economy could result in better health outcomes for New Zealanders – for example, from warmer, drier homes and reduced air pollution – reducing the burden on the health system. However, this could be counterbalanced by the health impacts from a changing climate, such as heat stress from more heat waves, and increased exposure to new vector-borne diseases and microbial contamination.<sup>18</sup>

There are also opportunities to benefit both the economy and climate. The Government's COVID-19 stimulus package can be used to both create jobs and stimulate the economy, and address climate change, and proceeds of the NZ ETS could also be leveraged in a similar way.

The NZ ETS can generate cash for the government by selling emissions units. The amount of cash that would be generated over time would depend on both the volume of units sold (which itself

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<sup>14</sup> (OECD, 2019a)

<sup>15</sup> The number of \$2.04 billion for petrol excise duty also includes a small amount of excise duty on liquid petroleum gas and compressed natural gas. (Office of the Minister of Transport, 2020)

<sup>16</sup> The other sources equated to about an additional \$700 million in 2018/2019. (Office of the Minister of Transport, 2020)

<sup>17</sup> Road User Charges (Exemption Period for Light Electric RUC Vehicles) Order 2012

<sup>18</sup> (Bolton, 2018; Royal Society Te Apārangi, 2017)

depends on free allocation, decisions about forestry accounting<sup>19</sup> and international unit and emissions budget volumes) as well as the market price for units. The amount of cash that can be generated by the NZ ETS over time would also depend on the policy mix Aotearoa uses to meet emissions budgets. For these reasons, it is not possible to draw firm conclusions from the Commission's pathways analysis about how NZ ETS proceeds would be affected by meeting emissions budgets and domestic targets for biogenic methane and other greenhouse gases.

The Government has estimated that based on current NZ ETS settings, proceeds from auctioning units would provide at least \$3.1 billion over the next five years.<sup>20</sup> The adoption of emissions budgets and flow-on changes to NZ ETS settings over 2021-2022 could significantly alter this forecast.

Decisions have yet to be made on how the Government would use these proceeds. The Government made commitments in the 2021 Budget to explore options for using the revenue from the NZ ETS to fund the transition to a low-emissions economy.<sup>21</sup>

Options include using the funds to:<sup>22</sup>

- Reduce the overall cost of policies to reduce emissions in Aotearoa, such as targeting investments
- Adapt to the impacts of climate change
- Enable an equitable and inclusive transition, for example through policies to reduce the distributional impacts of climate policy
- Buying international units that may be needed for meeting our first NDC<sup>23</sup>

## 15.8 Impact on energy production

Energy is a vital part of New Zealanders' day-to-day lives – from the electricity that is used in homes, petrol and diesel to fuel vehicles, to the heat that industries use to produce goods used here in Aotearoa and sold around the world. Reducing emissions would require a transformation of the current energy system.

The Commission's economic modelling suggests that, under the Current Policy Reference case, coal and fossil gas use would reduce, while wind, solar and biomass would expand. This assumes that the costs of renewable technology would continue to decrease.

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<sup>19</sup> A significant proportion of post-1989 forests registered in the Emissions Trading Scheme are accounted for using the stock change approach. Decisions about whether and how to transition these forests onto averaging accounting may affect the amount of NZUs that the Government can auction into the scheme.

<sup>20</sup> (Office of the Minister for Climate Change, 2020b)

<sup>21</sup> (Office of the Minister for Climate Change, 2021)

<sup>22</sup> (Office of the Minister for Climate Change, 2020b)

<sup>23</sup> As discussed in the Commission's advice, *Ināia tonu nei, Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets*, meeting the NDC will require use of offshore mitigation. In future, it may be possible to devolve the purchasing the offshore mitigation to the private sector through the ETS. At present, however, the NZ ETS is being run as a domestic-only scheme. If this continues, the Government may have to purchase international units directly to ensure that the NDC is met. This is why funding the purchase of offshore mitigation is an important option to consider for use of NZ ETS auction proceeds.

Our modelling also suggests that a shift in climate policy, to reduce emissions and meet the country's domestic targets, would speed up these trends. Increased renewable electricity generation would be needed to power more industry and electric vehicles.

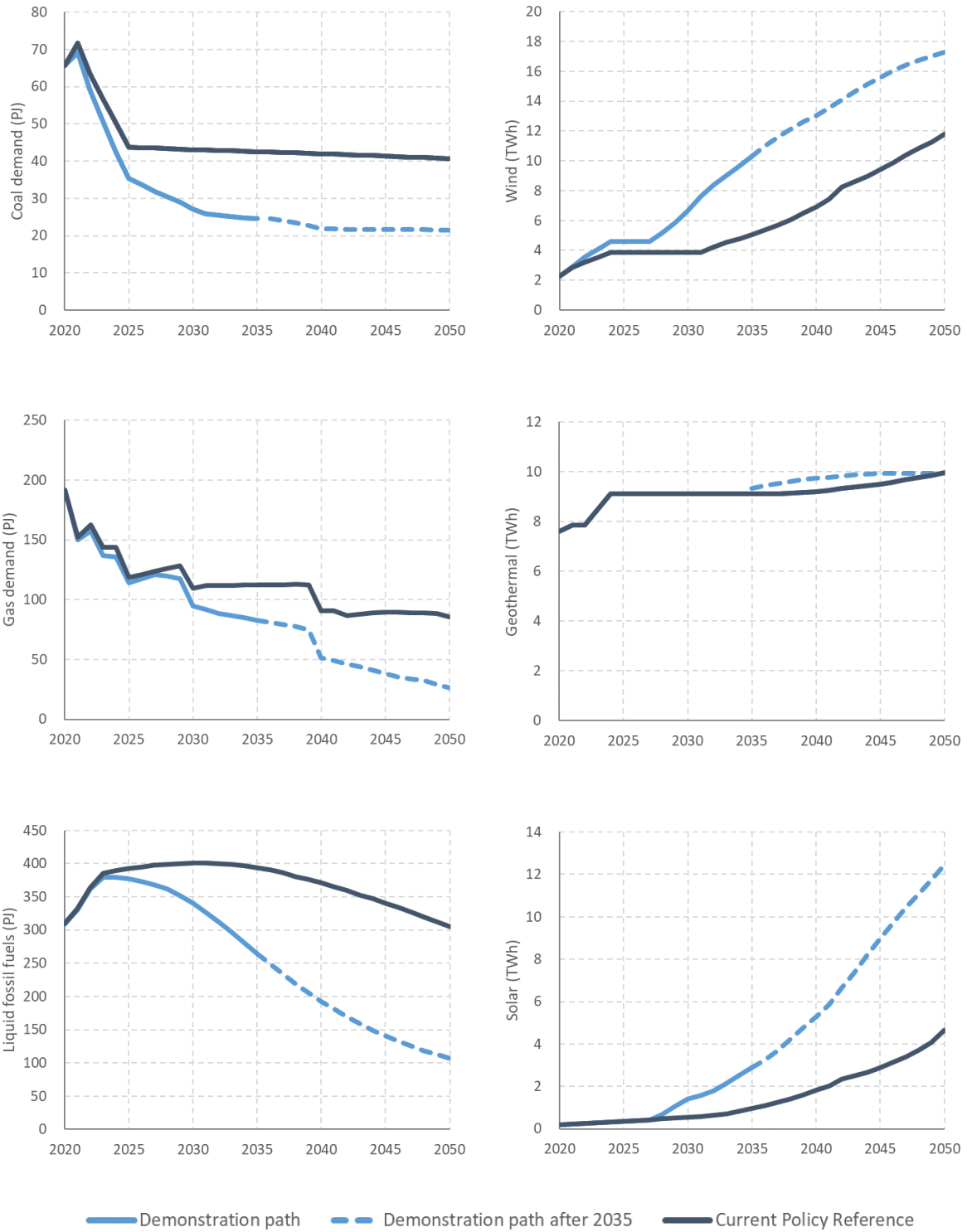


Figure 15.6: The changes in demand for coal, fossil gas and liquid fossil fuels (in PJ), and in geothermal, wind and solar generation (in TWh) that would occur in the demonstration path and the Current Policy Reference case from 2020 to 2050.

Source: Commission ENZ modelling.

## 15.8.1 Energy security

People and businesses also need to know they can meet their energy needs throughout the transition – they need energy security.<sup>24</sup> Reliability and resilience of energy supply is crucial for medically dependent or vulnerable New Zealanders and for businesses where unplanned supply disruptions are costly.<sup>25</sup>

As Aotearoa shifts away from fossil fuels and increases its dependency on electricity generation, it needs to ensure the electricity system can reliably generate sufficient supply. At the moment, fossil gas and coal provide this security of supply, particularly at peak times and in dry years when hydro lake levels are low. In addition, shifting energy reliance onto electricity to meet all transport, heating, cooking and industrial process needs carries risk in a nation exposed to natural hazards and other potential disruptions.

Aotearoa has a long, thin electricity grid that generally moves electricity from the South Island - where it is generated in large hydro schemes – to the major centres of demand in the North Island. However, there are ways to increase the resilience of the electricity grid and the system, such as building new generation in the North Island, reinforcing the transmission infrastructure, deploying new technologies such as batteries and diversifying into new fuels such as biofuels and hydrogen that boost energy security.

Aotearoa faces a specific challenge around the dry year risk. *Chapter 12: Long-term scenarios to meet the 2050 target* provides more detail on this.

Decarbonising the transport sector would result in Aotearoa relying less on imported oil. In 2018, the latest year available, Aotearoa spent \$11.2 billion on petroleum imports, the highest ever.<sup>26</sup> The dependence on imported oil exposes Aotearoa to oil price volatility and potentially insecure supply. Moving to domestic sources of energy for transport, such as renewable electricity or domestically produced biofuels, could reduce oil imports. This would improve the country's security of supply and provide opportunities for new businesses and jobs. The country's energy vulnerability could increase in the long term however, as we would rely more heavily on fewer sources. Careful planning and management would be needed.

## 15.8.2 Emissions leakage and competitiveness in industrial sectors

Climate policies could potentially increase costs for many Aotearoa businesses, reducing their competitiveness. This is a particular concern for industries with high emissions and who compete in international markets for relatively undifferentiated commodities, where overseas competitors do not face similar costs from climate policies. In these cases, there is a risk of emissions leakage, where domestic climate policy inadvertently increases global emissions and so negates some of its intended

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<sup>24</sup> The World Energy Council defines energy security as “a nation’s capacity to meet current and future energy demand reliably, withstand and bounce back quickly from system shocks with minimal disruption to supplies.” (World Energy Council, 2019)

<sup>25</sup> For example, the 2018 unplanned outage at the Pohokura gas field event contributed to decreased production of methanol by approximately 0.3 million tonnes compared to the previous year. (Methanex Corporation, 2018)

<sup>26</sup> (Statistics NZ, n.d.)

effect. There are also possible impacts on employment when firms fail to stay internationally competitive.

This provides a particular challenge in Aotearoa due to the small nature of its industries, where there are a number of industries that are made up of only one firm.

In our modelling, we assume that the Tiwai Point aluminium smelter closes by the end of 2024 based on Rio Tinto's recent signalling, and that domestic methanol production closes down in a staged way with the last production train closing in 2040. We have conservatively assumed that domestic steel making, cement and lime production continue to operate at current levels of production and do not achieve efficiency improvements.

Climate policy is one of many factors that can influence the competitiveness of businesses, and its impacts need to be considered in this broader context. For example, in the United Kingdom, the key drivers of competitiveness in the steel, aluminium and cement industry were reduced demand, low global prices, a strong pound sterling and high fossil fuel energy costs, with climate policy also contributing, but to a relatively small extent.<sup>27</sup>

How and to what extent industrial or energy-intensive businesses would be impacted by climate policies would depend not just on the direct cost of those policies, but also on the businesses' ability to adapt and innovate as well as the other pressures they face, such as the price of key inputs.

Climate policy would incentivise businesses to innovate, which can both reduce emissions and improve productivity. International evidence suggests that pricing greenhouse gas emissions stimulates innovation in existing low-emissions technologies, increasingly so at higher emissions prices. By pricing emissions, businesses are incentivised to find lower-emissions ways to produce their product or service. This means businesses become more efficient, they innovate, and they invest in low-emissions technologies that become more attractive due to the emissions price. In turn, increased deployment and diffusion of these technologies results in a larger and more competitive market, further lowering technology prices, accelerating learning and attracting investment.<sup>28</sup> While emissions pricing encourages the development, diffusion and deployment of new and existing practices and technologies, it does not provide a full incentive for low-emissions innovation, taking into account positive spill over effects.

Some businesses may find it hard to invest in reducing emissions or climate-related innovation as they already are facing other pressures. For example, putting aside the emissions price or other costs related to climate policies, the cost of energy itself is a significant influence on many industrial businesses' operating margins. This may affect their ability to compete against global counterparts who may have lower energy costs or whose energy costs are a smaller proportion of their total production costs. A number of Aotearoa firms in energy-intensive sectors have recently carried out or announced strategic reviews, although none have cited costs from climate policy as a major driver of their current competitive situation.

If these industries were to close or lose market share due to climate policies imposed in Aotearoa, there are risks that production could shift offshore to countries with less stringent controls on

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<sup>27</sup> (Cambridge Econometrics, 2017)

<sup>28</sup> (Eden et al., 2018)

emissions, causing global emissions to increase – known as emissions leakage. How likely emissions leakage is to occur depends on where production is likely to shift to and how emissions intensive that production is.<sup>29</sup>

While climate policy has not been cited as a major factor in Rio Tinto’s announcement that it intends to close the Tiwai Point Aluminium Smelter, the smelter’s planned exit illustrates that understanding the risk of emissions leakage is not straightforward. Commentators have held various views on the implications of the smelter’s closure on global emissions. Some suggested that aluminium production could move to smelters in China that are powered by coal, while others suggested that it could move to low-emissions plants in Canada.

Analysis by Sense Partners in 2018 suggested that there was no perceptible evidence of reduced competitiveness in Aotearoa from climate policy in place at that time. However, they noted that this could change in the future if climate policies continued to be unevenly applied globally.<sup>30</sup>

There are options for mitigating the risks of reduced competitiveness and emissions leakage. So far competitiveness and emissions leakage concerns are managed in Aotearoa by providing potentially exposed businesses with output-based free allocation under the NZ ETS.<sup>31</sup> This is similar to approaches taken in other jurisdictions with emissions pricing. Firms undertaking emissions-intensive and trade-exposed activities receive free emissions units under the government’s Industrial Allocation policy. Activities that are highly emissions intensive receive 90% free allocation while moderately emissions intensive activities receive 60% free allocation.<sup>32</sup> This reduces the cost of the NZ ETS on these firms.

In 2019, there were 85 companies that received free allocations from the government. In total, over 8 million units were allocated which, assuming an emissions price of \$35 per unit, represents a value of almost \$290 million. This is a cost to the government because if it did not provide these units for free, it would be able to sell them by auction.

Over half of the unit allocations were received by three companies, comprising of about five million units. Most unit allocations were relatively small – more than 75% of unit allocations were less than 20,000 units. Most of the recipient companies of these smaller levels of allocation are small horticultural producers, such as fresh cucumber, capsicum and tomato growers who do not participate in the NZ ETS, but receive free allocations because of the pass-through costs from their electricity or fuel use.<sup>33</sup>

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<sup>29</sup> (Sense Partners, 2018)

<sup>30</sup> (Sense Partners, 2018)

<sup>31</sup> (Ministry for the Environment, 2018)

<sup>32</sup> The purpose of Industrial Allocation is to reduce the risk of emissions leakage from production moving offshore to places with lower emissions pricing. There are currently 26 activities that are eligible to receive Industrial Allocation. Three firms receive 60% of total industrial allocation volume: New Zealand Steel near Auckland, New Zealand Aluminium Smelter in Southland, and Methanex in Taranaki collectively employing approximately 5,400 people. It is important to note that EITE firms will still face some incentive to reduce emissions as long as their allocation corresponds to less than 100% of their ETS costs, i.e. an ETS cost exists on a proportion of their emissions. By reducing their emissions, they can also benefit from selling the units that were allocated to them.

<sup>33</sup> (EPA, 2019)

Free allocation can effectively mitigate emissions leakage risk, but it comes with downsides. Output-based free allocation reduces downstream incentives for demand-side emissions reductions, such as resource efficiency and driving substitution of emissions-intensive goods, which can distort low-emissions investment. This means that some cost-effective emissions reductions would not be taken up and, as a result, the emissions price in the NZ ETS would be higher than it would be if there were no free allocation. Providing free allocation to some firms can therefore put the burden of reducing emissions on others.

For these reasons, it is important to make sure that the allocation regime is not overly generous. There is concern that currently the Government may be over-compensating firms in some industrial activities, by providing more units than are necessary to address emissions leakage risk.<sup>34</sup> The Government is looking to undertake a first principles review of industrial allocation policy to address this concern.

Over time, other options for providing leakage protection should also be explored – such as product standards, consumption charges or border carbon adjustments. These alternatives all come with their own, not insignificant, implementation challenges, particularly in relation to trade policy and political economy concerns, so are likely to be options for the longer term.

The impact of increased emissions prices on emissions-intensive and trade-exposed businesses depends on the industrial allocation policy in the short to medium term, as well as the climate policies put in place internationally. Nonetheless, it would be important to monitor global markets and actions by competitors to ensure that domestic climate policy contributes to global environmental benefits. This would be an important task for the Commission, with a new function of advising on the industrial allocation phase-out rates, which includes assessing emissions leakage risk.

Emissions budgets should also be set with a mind to such risks and uncertainties. We need to assure ourselves the emissions budgets can be met in multiple ways, to make sure they are resilient. The work we are doing to narrow down on emissions budget numbers is looking to ensure that the emissions budgets can be met in multiple ways.

## 15.9 Impact on food and fibre production

Many New Zealanders work in the food and fibre sector – from farmers, farm workers and foresters to those transporting food and fibre around the country, working in processing plants, and exporting food and fibre products. This income also supports broader rural communities and is an important export earner for the nation.

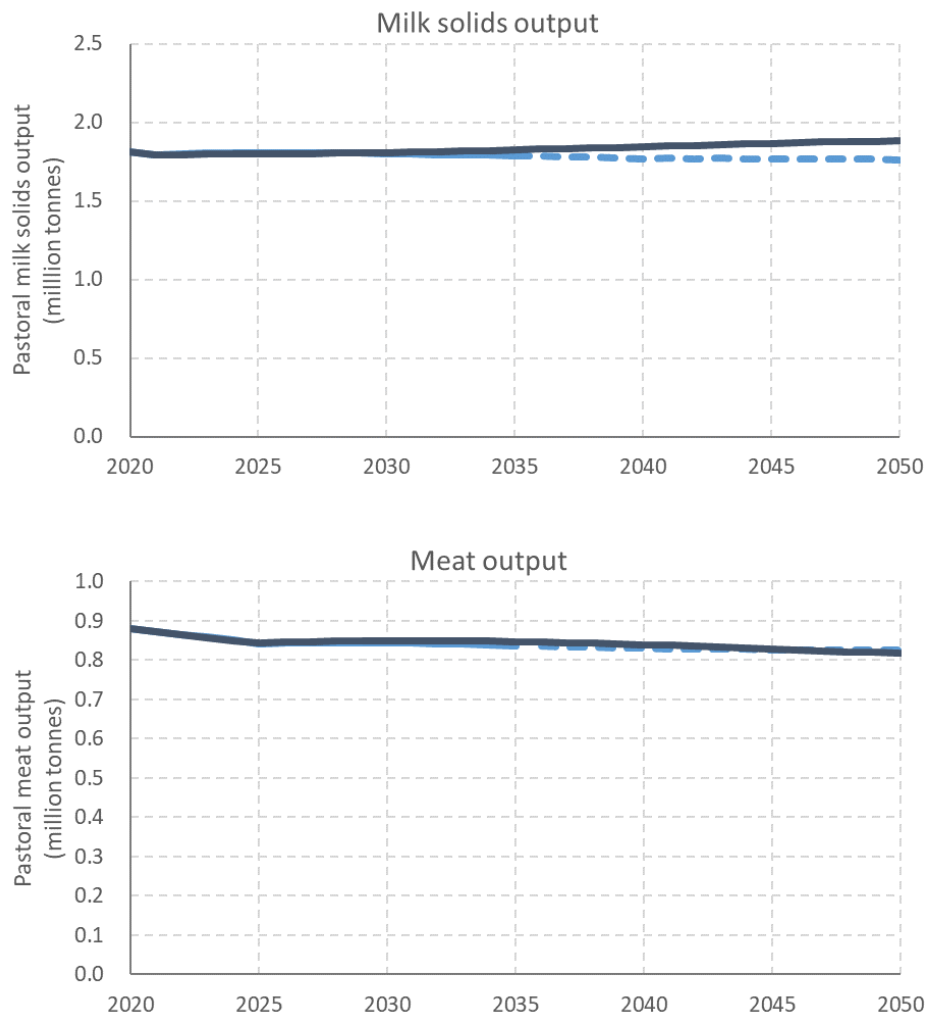
As shown in Figure 15.7, our ENZ modelling suggests that in the Current Policy Reference case, production of milk solids would remain relatively stable over the first three emissions budget periods, and increase slightly by 2050. In the demonstration path, milk solids output would reduce slightly.

In comparison, meat production would stay relatively stable over the first two emissions budget periods, and then increase slightly looking out to 2050 under the Current Policy Reference case. The demonstration path would follow a similar trend.

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<sup>34</sup> (Office of the Minister for Climate Change, 2020a)

For forestry, the total harvestable volume would fall in the second emissions budget, but then increase in the third emissions budget and out to 2050. The demonstration path would result in the same total harvestable volume by 2050 as the Current Policy Reference case. This reflects the long-term nature of forestry. Due to the long harvest cycles for pine forests, new planting will not make a difference to harvest volumes until around 2050. The variations up until 2050 are due to the age profile of trees already in the ground. Over time, we are assuming increasing harvest yield from new vintages due to improvements in genetics and silvicultural practices.



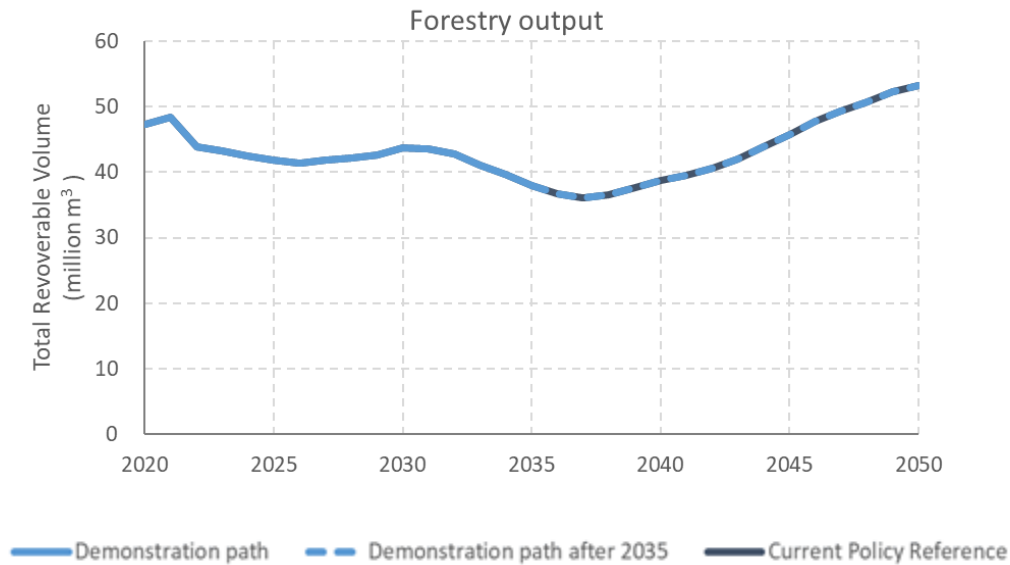


Figure 15.7: The change in output of milk solids, sheep and beef meat and forestry that would occur in the Current Policy Reference case and the demonstration path over the first three emissions budgets and out to 2050

Source: Commission ENZ modelling

### 15.9.1 Food security

As a food producing and exporting nation that is estimated to contribute to feeding over 40 million people,<sup>35</sup> Aotearoa must consider the potential effects that climate policies could have on the country’s agricultural production, and domestic and global food security. Food security not only depends on food production and availability, but also on nutritional content, and the ability to acquire affordable food, in which well-functioning markets play an important role.

#### Global food security

The Paris Agreement highlights the importance of food production and food security, recognising *“the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change”*. Article 2 outlines that *“This Agreement [...] aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: [...] (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.”*<sup>36</sup>

The Paris Agreement is focused on efforts to adapt to the effects of climate change, in a way that helps to end hunger and poverty. Climate change is likely to exacerbate food insecurity globally, as rising temperatures increase crop failures, lower livestock production and heighten the risk of

<sup>35</sup> KPMG (2017)

<sup>36</sup> (United Nations, 2015)

disease, pests and extreme weather events in these regions.<sup>37</sup> The Intergovernmental Panel on Climate Change has found that low-income consumers are particularly at risk from the impacts of future climate change.<sup>38</sup>

Hunger and poverty are issues experienced more in developing countries. Therefore, safeguarding food security is to a large extent about ensuring access to basic food requirements, particularly for the 750 million people largely located in sub-Saharan Africa and South Asia classified as ‘severely food insecure’.<sup>39</sup>

The role of Aotearoa in helping to address global food security challenges is likely to be limited. This is because the country’s food production is focused on the premium value chain,<sup>40</sup> and feeding the world’s growing middle-class and high-end consumers.<sup>41</sup> In 2018, only 3.4% of food exports from Aotearoa went to the low-income food-deficit countries as classified by the Food and Agriculture Organization of the United Nations.<sup>42</sup> Consumers of exports in these countries are also unlikely to be the rural poor and food insecure due to the relatively premium nature of Aotearoa products. In low-income, food-deficit countries, 62% of dietary energy comes from cereals, roots, and tubers.<sup>43</sup> This highlights that food security concerns primarily centres around the supply and cost of grains rather than the more premium products exported by Aotearoa.

Aotearoa does, however, make important contributions to global food security through trade policy, research, and development assistance. Aotearoa has long been a champion for a fair, open and rules-based trading regime and has played an important role in negotiating agreements which reduce distortions in global food trade. As the Organisation for Economic Cooperation and Development (OECD) has pointed out, food and nutritional security is dependent on production and trade, necessitating open and well-functioning supply chains to ensure food reaches markets where it is needed. Existing agricultural trade distortions tend to undermine food producers in food insecure countries.<sup>44</sup>

Research and technical assistance in Aotearoa on animal productivity and farm efficiency could also enhance global food security and the resilience of agricultural systems. This could be achieved through improving livestock productivity in food insecure countries. The government’s role in founding and funding the Global Research Alliance on Agricultural Greenhouse Gases is a key example. Its ability to credibly lead such initiatives is enabled and underpinned by the country’s innovative ecosystem of farmers, researchers, and agriculture experts. Support for food production is also a key priority in the government’s spend on foreign aid.

Finally, one of the most important contributions Aotearoa could make would be to reduce emissions. Playing a role in mitigation and building momentum for an effective global effort to limit temperature increases would help to reduce the worst impacts of climate change on food security.

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<sup>37</sup> FAO (2018)

<sup>38</sup> IPCC (2019, p. 439)

<sup>39</sup> FAO (2020c). The exact number is difficult to pinpoint because of variation in diets and the way Aotearoa export products are consumed.

<sup>40</sup> Primary Sector Council (2020); B+LNZ (2020)

<sup>41</sup> Productivity Commission (2018a, p. 317)

<sup>42</sup> FAO (2020a); (Stats NZ, 2020b)

<sup>43</sup> (FAO, 2020b)

<sup>44</sup> OECD (2020)

## Domestic food security

Despite Aotearoa producing much more food than we consume, some disadvantaged communities find it challenging to access nutritious food. The Child Poverty Action Group notes that 160,000 children in Aotearoa live in households without sufficient access to healthy food. While the overall cost of food rose by 4% in the last five years, the cost of fruit and vegetables rose by 9%.<sup>45</sup>

These domestic food security problems are driven primarily by low incomes rather than a lack of food supply. Given the export orientation of most food production in Aotearoa, it is likely that international markets would affect domestic food prices to a greater extent than changes in production due to climate change policies. The possible exception to this is if production of items grown primarily for domestic consumption (such as some fresh vegetables) contracts, as this could drive prices up and exacerbate existing food and nutrition access for some vulnerable groups. However, in both the Current Policy Reference case and scenarios modelled in *Chapter 11: Where are we currently heading?* and *Chapter 12: Long-term scenarios to meet the 2050 target*, horticultural area, and therefore production, increases in the years to 2050.

In 2015/16, it was estimated that 39% of children in food insecure households were Māori.<sup>46</sup> If food price increases do occur, they are likely to have a disproportionate effect on Māori. Strategies relevant to food security or correlated policy issues, should prioritise equitable outcomes for Māori households, particularly Māori children, who may be impacted by increases to food prices.

However, given the high levels of food production in Aotearoa, and that horticulture production is unlikely to contract, reducing emissions to meet targets for biogenic methane and all other greenhouse gases is unlikely to exacerbate food insecurity domestically. Solutions to domestic food security problems likely lie in addressing poverty and other barriers to nutritional access rather than in climate policy.

### 15.9.2 Emissions leakage and competitiveness in the food and fibre sector

As with emissions-intensive and trade-exposed industrial businesses, there are risks that climate policy could reduce the competitiveness of the food and fibre sector and result in emissions leakage.

The Interim Climate Change Committee (ICCC) noted that it was difficult to assess any potential reduction in competitiveness of the food and fibre sector from climate policy as compared to other factors that affect the overall competitiveness of Aotearoa in international markets. It noted that producer costs in all markets would continue to evolve through changes in labour markets, production systems, food safety requirements and health and safety regulations.<sup>47</sup>

The risk of emissions leakage is difficult to quantify precisely for the food and fibre sector. However, looking at some of the factors which contribute to emissions leakage, ICCC found that the risk of emissions leakage from reducing agricultural emissions in Aotearoa was unlikely to be high in the short-term. Any decrease in dairy production would likely be made up by an increase in production

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<sup>45</sup> Child Poverty Action Group (2019a)

<sup>46</sup> Child Poverty Action Group (2019b)

<sup>47</sup> (Interim Climate Change Committee, 2019b)

in Western Europe or North America. Those locations have dairy emissions footprints similar to Aotearoa, have economy-wide emissions caps, and their farm businesses also face environmental regulations on nitrate, ammonia and phosphorous pollution which would constrain production.<sup>48</sup>

The risk of emissions leakage from reduced meat and wool production is likely to be greater than for dairy. This is because not all competitor countries are advanced economies with economy-wide emissions reduction targets. However, Aotearoa producers' increasing efforts to differentiate their products on quality, environmental credentials and provenance may moderate this risk.<sup>49</sup>

Under current legislation, agricultural emissions are set to be priced from 2025.<sup>50</sup> At the same time, farm businesses would receive free allocation, which can be provided in a way to reduce emissions leakage risk.<sup>51</sup>

As with emissions-intensive and trade-exposed industrial businesses, it would be important to monitor global markets and actions by competitors to ensure that domestic climate policy contributes to global environmental benefits. This would be an important part of our future advice on what allocation should be given to participants in the alternative pricing system for farm-level agriculture emissions.<sup>52</sup>

## 15.10 Impact on Māori economy

Released in 2021, the BERL report 'Te Ōhanga Māori 2018: The Māori Economy 2018' values the Māori asset base at \$69 billion of which \$24 billion is in agriculture, forestry and fishing, 60% of this is held by Māori-collectives.<sup>53</sup> Other asset classes include property, private equity, financial assets, tourism, geothermal, technology and innovation.<sup>54</sup>

Driven by cultural values, some Māori-collectives are already identifying and/or moving into innovative low emissions industries (e.g., hemp, medicinal cannabis and koura, or investing in technology to drive innovations in nutraceuticals, fashion and tourism).

The Māori economy is like a developing economy within a developed economy and is fast growing. Value added (GDP) by Māori enterprises in total grew 9.2% between 2013 and 2018, compared to 6% in non-Māori enterprises. It is "*expected that Māori will invest approximately NZ\$1.5-\$2 billion annually over the next 10 to 15 years.*"<sup>55</sup> This model of integrated and sustainable growth makes Māori-collectives well placed to demonstrate an alternative model of leadership as Aotearoa looks to progress emissions reducing initiatives.

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<sup>48</sup> (Interim Climate Change Committee, 2019b)

<sup>49</sup> (Interim Climate Change Committee, 2019b)

<sup>50</sup> (Climate Change Response Act 2002 (as at 01 December 2020), 2020, sec. 219)

<sup>51</sup> (Interim Climate Change Committee, 2019a)

<sup>52</sup> Before preparing a report on the system to price agricultural activities as an alternative to the ETS in 2022, the Ministers of Climate Change and Agriculture must request and consider advice from the Commission on "what assistance, if any, should be given to participants" (see section 215(4) of the Climate Change Response Act).

<sup>53</sup> (BERL, 2021)

<sup>54</sup> (TBD Advisory, 2019)

<sup>55</sup> (NZTE, 2017)

Although Māori freehold land is estimated to comprise about 1.4 million hectares in Aotearoa, nearly 80% of all Māori land is of a less versatile land class (class 6, 7 and 8) and many parcels of Māori land are small and fragmented.<sup>56</sup> Different structures and priorities have led to significant areas of Iwi/Māori owned land being under-utilised for agricultural activities. The Ministry for Business, Innovation and Employment estimates that one-third of Māori land has potential for development or increased utility.<sup>57</sup> Māori enterprises have different structures and priorities. Collective ownership structures result in lengthier decision-making processes to obtain agreement from all shareholders. Collective ownership, and concepts such as taonga tuku iho, also make it difficult to use land as security when seeking finance for development.

Māori economic development also tends to have a long-term outlook and is typically progressed alongside Māori cultural, social, and environmental development strategies as a holistic approach to intergenerational wellbeing. 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. Māori-collectives typically have a conservative risk appetite to ensure the protection of their cultural assets, and values-based decision-making is considerably more complex for Iwi/Māori.<sup>58</sup>

It is important to note that different Iwi, hapū, marae and whānau have diverse views and their own specific challenges. These differences affect the ability of many Iwi/Māori landowners to respond to policy in a timely way, to minimise risk and maximise strategic opportunities.

In addition to Māori-collectives and businesses, Māori workers also face particular challenges. This is considered in the employment and workers section, *15.6 Employment and workers*.

For more information on the impacts to Iwi/Māori, see *Chapter 10: Perspectives from Tangata Whenua: considering impacts of emissions reductions and removals for Iwi/Māori*.

## 15.11 Impact on trade

International trade is critical for the economy, jobs and society of Aotearoa. Currently, about 60% of economic activity in Aotearoa is from trade.<sup>59</sup> The food and fibre sector is a major employer and exporter with about 85% of its meat,<sup>60</sup> and 95% of its milk exported each year.<sup>61</sup> Tourism and commercial services are also significant export earners for Aotearoa, with tourism having been particularly impacted by the COVID-19 pandemic. Trade is also beneficial for the Māori economy and offers opportunities for Māori exporters to gain access to new markets.<sup>62</sup>

Trading activity of Aotearoa affects its foreign exchange and balance of trade. Exporting products and services allows Aotearoa to pay for imported goods and services. Imports reduce costs and make more goods and services available to New Zealanders. Aotearoa imports a large range of goods, including crude oil and diesel, motor vehicles, clothing, computers, mobile phones and other

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<sup>56</sup> (Nana, 2019); (Harmsworth et al., 2012)

<sup>57</sup> (Ministry for Business, Innovation and Employment, 2017a)

<sup>58</sup> (Whetu Consultancy Group, 2019); (BERL & FOMA, 2019); (Funk, 2009)

<sup>59</sup> (New Zealand Ministry of Foreign Affairs and Trade, 2018)

<sup>60</sup> (Meat Industry Association, 2020)

<sup>61</sup> (DCANZ, 2020)

<sup>62</sup> (Ministry for Business, Innovation and Employment, 2017a)

electrical goods.<sup>63</sup> While the move to electric vehicles may see Aotearoa import less petrol in the future, New Zealanders would continue to rely on imports from other countries for a range of products and technologies.

Figure 15.8 and Figure 15.9 show modelling results for exports and imports under the Current Policy Reference case and target-aligned scenarios from our Climate Policy Analysis (C-PLAN) model. These results have been calculated from the more-conservative model run where EV uptake is lower and so the impact on GDP is greater. Despite this, the target-aligned scenarios and our demonstration path still show very little difference to the Current Policy Reference case. Our economic modelling suggests that under the Current Policy Reference case, both exports and imports would increase by 2050. In particular, services and manufacturing exports would increase, while more manufacturing products would also be imported.

These modelling results suggest that taking actions to meet emissions budgets and the country's domestic targets for biogenic methane and all other greenhouse gases would not result in significant changes to exports and imports. However, this would depend on how Aotearoa transitions compared to its trade partners and competitors.

Depending on the transition pathway Aotearoa takes, New Zealanders could see significant land-use change from pastoral agriculture to forestry. We have commissioned Infometrics to analyse the implications of land-use change on the balance of payments. The provisional analysis of this study suggests that under some circumstances the income from the resulting timber exports would likely be greater than the lost earnings from pastoral agriculture.<sup>64</sup>

Aside from climate policy, other factors may play a role in the country's trade flows. International markets would change over time as consumers' preferences change, trade rules evolve, demographics change and other economic factors such as labour costs, education and innovation alter countries' comparative advantages. The physical impacts of climate change would also affect trade.

For Aotearoa, there are also economic opportunities in international markets for differentiating products for being low emissions, and risks to losing access to markets or to capital from not acting to reduce emissions.<sup>65</sup> Globally, consumers are increasingly demanding products that meet specific environmental standards,<sup>66</sup> and financial institutions are increasingly factoring climate risk into their decisions.<sup>67</sup> Companies manufacturing or selling high value goods are turning to their supply chains and selecting inputs based on their environmental credentials.<sup>68</sup> For example, the food company Danone has committed to becoming carbon neutral across their full supply chain by 2050 and

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<sup>63</sup> (Stats NZ, 2019)

<sup>64</sup> (Infometrics, forthcoming)

<sup>65</sup> (Interim Climate Change Committee, 2019a)

<sup>66</sup> (Unilever, 2017)

<sup>67</sup> (Investor Group on Climate Change, 2020); (Eceiza et al., 2020)

<sup>68</sup> For example, 115 global companies with US\$3.3 trillion in procurement spend have signed up for CDP's global environmental disclosure system. Of these companies, 43% are selecting or deselecting suppliers based on their environmental credentials. A further 30% are looking to follow this lead in the near future. (CDP, 2019)

require that their suppliers support this.<sup>69</sup> Benefitting from these opportunities would require Aotearoa businesses to move ahead of other businesses.

The physical impacts of climate change are also likely to affect production, trade routes and infrastructure. Agricultural production may be affected by more frequent droughts. Higher sea levels and more frequent storms could result in more frequent port closures. How these changes affect trade flows in Aotearoa would depend largely on the relative impacts on its trading partners and competitors.<sup>70</sup>

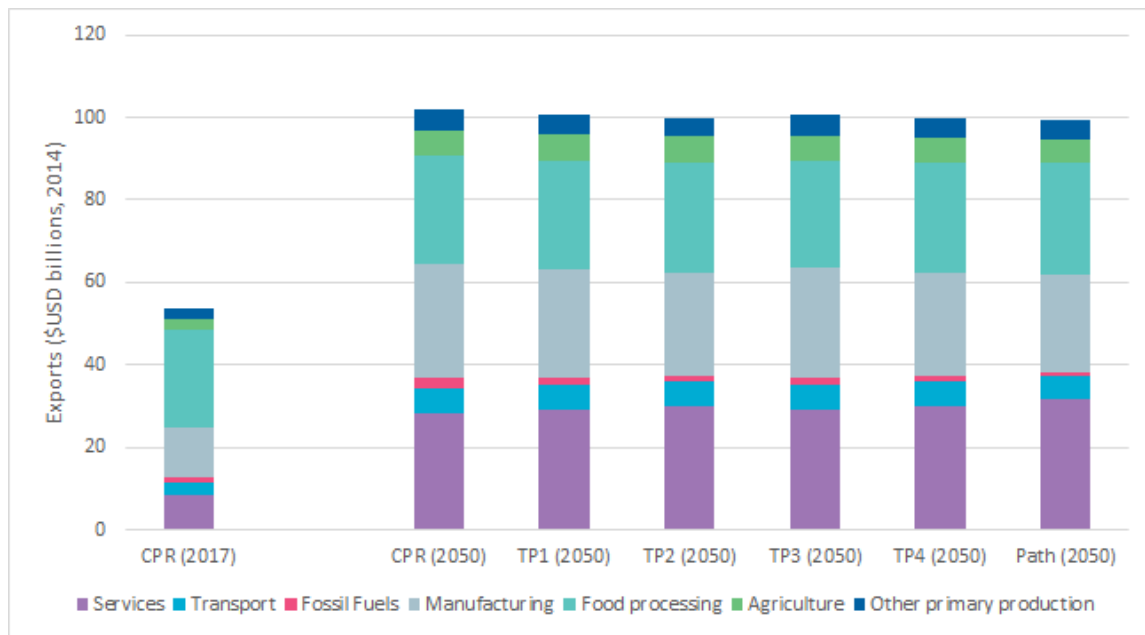


Figure 15.8: Economic modelling of how the exports would be impacted by 2050 under the Current Policy Reference case (CPR), the different Transition Pathways (TP1, TP1, TP3 and TP4) and the Demonstration Path (Path).

Source: Commission C-PLAN modelling

<sup>69</sup> (Danone, 2019)

<sup>70</sup> (Dellink et al., 2017)

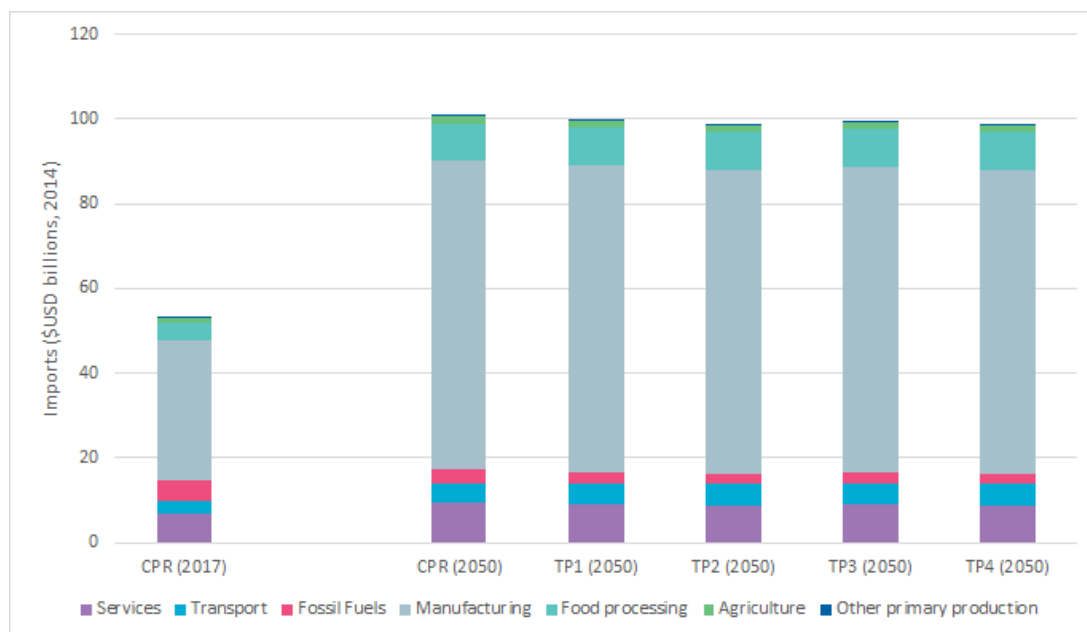


Figure 15.9: Economic modelling of how Aotearoa imports would be impacted by 2050 under the Current Policy Reference case (CPR), the different Transition Pathways (TP1, TP1, TP3 and TP4).

Source: Commission C-PLAN modelling

## 15.12 Impact on small businesses

Aotearoa small businesses – those with fewer than 20 employees – make up about 97% of Aotearoa businesses and contribute about 30% of employment and over 25% of GDP.<sup>71</sup> They include farm businesses, tradespeople and construction businesses, retail, hospitality and tourism.<sup>72</sup> They play a crucial role in the economy, especially in supply chains and larger exporting businesses. Many of these businesses have been particularly affected by lockdowns due to the COVID-19 pandemic.

Small businesses are diverse and would be impacted in different ways by the transition to reduce emissions, meet emissions budgets and eventually the country's domestic targets.

All small businesses would be exposed to the climate transition and emissions budgets in some way. Most would be exposed through their electricity and transport usage. However, this exposure is likely to be minor over the course of the first three emissions budgets as electricity prices are modelled to remain stable or decrease, and vehicles become more fuel efficient. Small businesses could reduce costs further by improving their energy efficiency or switching to EVs for transport. Small supermarkets and local dairies would also be exposed through the use of hydrofluorocarbons as refrigerants.

There could also be opportunities for small businesses that have a heavy reliance on vehicles. Taxi drivers, couriers, builders and tradespeople that move to electric cars or vans would not only reduce their transport emissions, but also reduce ongoing running and maintenance costs. EVs are currently more expensive than conventional petrol and diesel vehicles, but our modelling expects that they

<sup>71</sup> (Ministry for Business, Innovation and Employment, 2020)

<sup>72</sup> (Ministry for Business, Innovation and Employment, 2017b)

would reach price parity in the late 2020s. There are also examples of larger companies helping their independent contractors purchase EVs. For example, recognising the upfront cost is preventing uptake, NZ Post is contributing a minimum of 50% of the price difference between an EV and its petrol/diesel equivalent to help its CourierPost, Pace, Rural Post and Provincial Delivery contractors purchase an EV.<sup>73</sup>

Some small businesses work with more emissions-intensive products and technologies in their businesses than others - for example, builders who use cement or steel in construction or mechanics who maintain vehicles with internal combustion engines. These businesses may need to start working with newer low-emissions products and technologies and upskill to be able to do so. There would also be opportunities for new small businesses in developing and supplying these low-emissions products and technologies.

Some small businesses would face greater challenges and be more impacted by the move to a lower-emissions society than others. Some businesses would be more directly impacted because their core business is no longer viable and would need to adapt. Some small businesses which depend on local industries, either directly (e.g. through supply chains) or indirectly (e.g. supporting coffee shops or mechanics) would also be exposed if those industries were to close down. This could be especially the case for small businesses that provide support services for emissions-intensive industries or are located in communities where an emissions-intensive industry is a large employer.

Approximately 20,000 to 30,000 farm businesses in Aotearoa would be impacted by climate policy. These businesses would need to make practice changes and take up new technology as it becomes available to reduce biogenic methane and nitrous oxide. It may be more challenging for them to pass on any costs they incur from these changes as they supply milk, meat and wool into international markets. In addition, the need to reduce emissions on farms sits within a broader context for farm businesses, which are also responding to water quality, biodiversity and biosecurity regulation.

For vegetable growers who heat their greenhouses, it would be costly to replace a coal boiler with a lower-emissions option earlier than would otherwise be needed. Boilers are 20 to 30 year investments, and retiring them early comes at significant cost.<sup>74</sup>

Small businesses generally have less resources to dedicate to measuring their businesses' emissions footprint, understanding where their emissions come from and assessing the options for reducing them. A 2019 survey of 707 farmers found that 50% of farmers had little or no understanding of the actions they could take to reduce their on-farm emissions, while only 14% had quantified their emissions in the last two years.<sup>75</sup>

The ability for small businesses to respond, adapt and innovate would depend on information, skills and capability, access to capital, and how early the necessary changes are signalled. In addition to ensuring that the workforce has the skillsets to respond, the government would also need to play an important role in working with small businesses, for example through extension programmes, to ensure they have the information and support to respond to climate policy.

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<sup>73</sup> (NZ Post, 2020)

<sup>74</sup> (Horticulture New Zealand, 2020)

<sup>75</sup> (The Nielsen Company, 2019)

## 15.13 Impact on employment, workers and skills

There will be inevitable changes to employment and jobs as Aotearoa moves towards a low-emissions society. This will flow through to the skillsets that are needed.

There will be more jobs available in some areas and fewer jobs in others as a result of our emissions budgets. In the early years, this may result in job losses. For later emissions budgets, there will be less job loss as young workers entering the workforce go into different occupations.

Much of the change will occur gradually over the next 15 years. Some of the workers in these industries will retire over this time. However, there will be workers that may need support to transition into new areas of work.

Some regions and communities of Aotearoa will be more affected by the climate transition than others. Some communities may see the closure of large businesses that provide significant employment for the community. This would have a big impact as major job losses at a local level can lead to entire communities being left vulnerable and dislocated. Some affected workers may have the mobility and means to acquire new jobs in other industries and regions, while others may not. Affected communities can end up 'stranded', where workers with particular skills and expertise are no longer in demand.

Aotearoa has already seen Rio Tinto announce the Tiwai Point aluminium smelter will close. Other emissions-intensive industries and large employers have also announced strategic reviews. There are many reasons for such industry closures besides climate change policy, with Rio Tinto citing energy costs and a challenging aluminium outlook. Closure of these industries has an impact on those who work there.

There are also a number of people that work in jobs that use emissions-intensive goods or services. Many of the industries these people work in will be able to switch to lower-emissions goods and services without too much displacement. For example, this could include people who work in construction as engineers, buildings, plumbers and electricians.

There will also be industries that grow and new industries that emerge as part of the transition. There will be more opportunities for jobs in the circular economy and bioeconomy, in new industries such as hydrogen, in renewable electricity as transport and process heat are electrified, in energy efficiency and home energy audits, and advisory services for managing emissions on farm.

Given the aging population in Aotearoa, there may be particular challenges ensuring that the new industries that emerge as a result of the transition can get enough workers with the necessary skillsets.

In addition, there will be further disruption to the way we work, as we see more use of data science, digitalisation, automation, robotics, artificial intelligence, and machine learning.

The following sections consider how employment could change in different sectors, and for different population groups. It also outlines at a high level the types of skillsets that will be needed in the jobs that emerge as part of the transition.

In response to feedback from consultation, we have carried out additional analysis on jobs, particularly the jobs that could be gained as a result of climate action. This analysis draws on results from modelling, as well as analysis by others.

We commissioned a new model called the Distributional Impacts Microsimulation for Employment (DIM-E) to provide information on the jobs that could be gained and lost as a result of the climate transition. Box 15.3 below provides a description of the DIM-E modelling. The DIM-E model can only tell us about sectors already existing, however new sectors will emerge as part of the transition.

We also draw on analysis from the results of ENZ modelling. The ENZ model provides more technological and sectoral detail than the C-PLAN and DIM-E models, including on some emerging sectors. A more detailed description of what is included in the ENZ model and the model results can be found in *Chapters 4-9, 11 and 12 in 2021 Supporting Evidence*.

**Box 15.3: The Distributional Impacts Microsimulation for Employment modelling<sup>76</sup>**

The Distributional Impacts Microsimulation for Employment (DIM-E) model takes the results of the C-PLAN model and combines them with granular data from Stats NZ (particularly the Integrated Data Infrastructure IDI and the Longitudinal Business Databases LBD). Using information on job characteristics by industry and demographic information for workers like age, ethnicity, education level, and location, the DIM-E can take the percentage changes in industry employment provided by C-PLAN and show which groups of people are most likely to be affected by the changes to the economy, as well as the size of those effects. For example, a 1% change in a large industry could mean more jobs being affected than a 5% change in a small industry. Moreover, instead of reducing their work force, employers may adjust employment by reducing the hours or earnings of the employees they have. Similarly, businesses may respond to increases in production by increasing the number of hours worked by their existing employees. For this reason, we think of jobs being affected in terms of ‘job-equivalents’.

Hence, DIM-E allows us to estimate the number of job-equivalents expected to be gained and lost across the economy based on the expected expansion and contraction of different industries. By comparing the characteristics of jobs potentially being lost to those being gained, we can then get a sense of whether the people who are expected to lose jobs due to changes in the economy would be able to find similar jobs in industries that are growing.

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<sup>76</sup> Disclaimer for output produced from Stats NZ surveys or Census data: Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers.

Disclaimer for output produced from the IDI and/or LBD: These results are not official statistics. They have been created for research purposes from the [Integrated Data Infrastructure (IDI) and/or Longitudinal Business Database (LBD)] which is carefully managed by Stats NZ. For more information, please visit <https://www.stats.govt.nz/integrated-data/>.

Disclaimer for Inland Revenue tax data: The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data’s ability to support Inland Revenue’s core operational requirements.

This model cannot tell us about the aggregate effect on jobs in Aotearoa but provides insights on the flow of work across Aotearoa. This is because the DIM-E modelling draws on the results of C-PLAN modelling. The C-PLAN model (described in Box 15.2) assumes ‘full employment’ – that creating jobs in one sector means that jobs decline in another sector.

However, the ‘full employment’ assumption in C-PLAN does assume some unemployment. The long-term unemployment rate in the model is 4.25% of the labour force. We consider that the assumption of ‘full employment’ is reasonable as the government is likely to work to keep the unemployment rate low and any unemployment is likely to be smoothed over the long timeframe. The population projections in the model draws on the 50<sup>th</sup> percentile projections from Stats NZ. These population estimates include migration.

In our *2021 Draft Advice for Consultation*, we ran four scenarios through this model. For this final advice, we are only presenting the results from the demonstration path. As there will be natural changes in jobs over time due to other factors, the results for each scenario are presented relative to how jobs would change under current policies (the Current Policy Reference case).

It is important to note that the demonstration path run through the DIM-E model can provide more employment in certain sectors by resulting in more job gains in industries that are expanding, but also by resulting in fewer job losses in industries that are contracting relative to the Current Policy Reference case. Conversely the demonstration path can provide less employment by resulting in either fewer job gains in industries that are expanding or more job losses in industries that are contracting relative to the Current Policy Reference case.

### 15.13.1 Impacts on jobs by sector

The actions taken to meet the country’s emissions targets will increase the demand for low-emissions goods, services and skills. In contrast, the demand for higher-emissions goods and services will fall. This section looks at the employment changes that could occur in various sectors as a result of emissions budgets and the climate transition.

#### Oil and gas, and coal mining

The coal mining and oil and gas sectors, and the services that support them, will be impacted by the transition away from fossil fuels. This would particularly affect Taranaki and the West Coast where the majority of these jobs are located. These sectors are already declining in current policy settings. In the Current Policy Reference case, production of fossil gas and oil could reduce by about 40% by 2035 compared to 2018/2019. Under the demonstration path, production could reduce by about 60% by 2035 (for more details, see the dataset of modelling results).

Under current policy settings, our DIM-E modelling indicates that Aotearoa would see about 500 fewer jobs in these fossil fuel sectors between 2022 and 2035. However, taking action to meet our recommended emissions budgets would result in about 1400 fewer jobs in these sectors by 2035 – an additional 1,000 fewer jobs compared to under current policy settings (see Figure 15.10).

This does not include the approximately 270 workers at Methanex. Like most businesses, Methanex will consider a variety of factors when making decisions about the future of their production facilities. Methanex recently announced that they would mothball one of their three methanol

production facilities due to insecure gas supply. This would result in 75 permanent workers losing their jobs. In our modelling, we assume that Methanex closes down in a staged way with the last production train coming to a close in 2040.

Many of the workers in the oil and gas sector are highly skilled and therefore have high paying jobs. Their skillsets include engineering, earth sciences, surveying and logistics. These skillsets could be valuable in other sectors, including sectors emerging as part of the transition to a low-emissions economy.

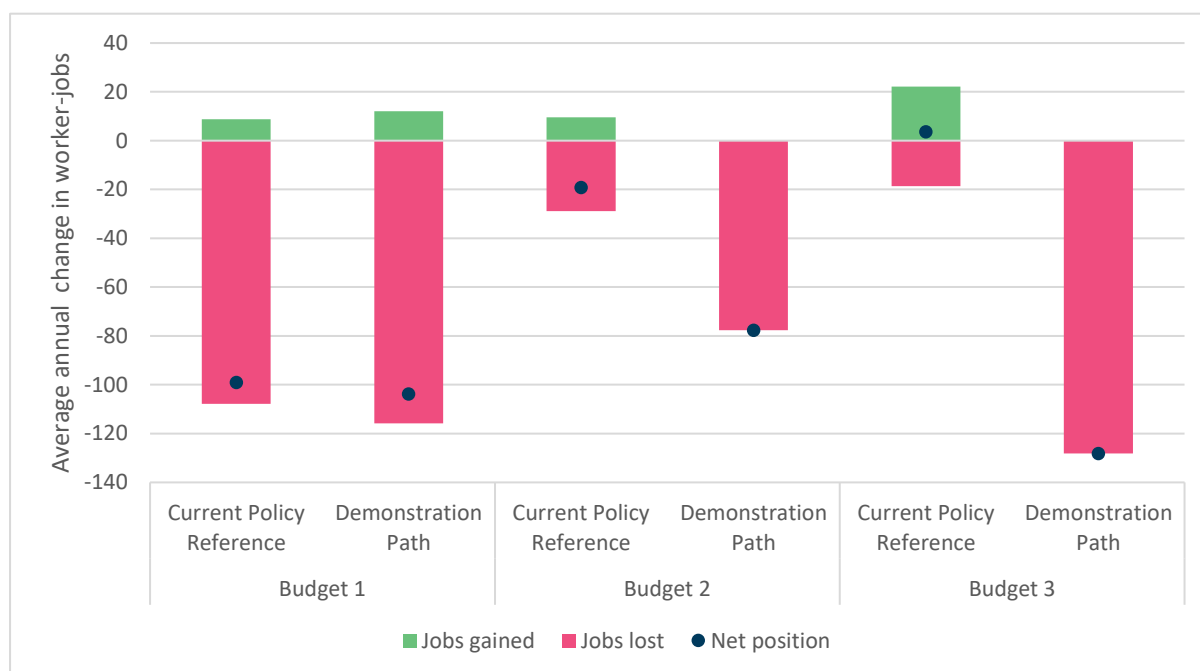


Figure 15.10: Simulation results of the average annual change in employment in the fossil fuel sectors (ANZSIC codes B060, B070, B109, C170, D270) in each emissions budget period under the Current Policy Reference case and demonstration path.

Source: DIM-E simulation results

## Gasfitting

Changes in how we use fossil gas will also flow through to those working in gasfitting. In 2019/2020, there were 5701 licensed gasfitters in Aotearoa. Most gasfitters also work in plumbing, so the number of jobs that could be impacted by the climate transition is difficult to predict.

While the use of fossil gas needs to reduce over time, gasfitting skillsets would be important for maintaining and decommissioning the existing gas infrastructure, and for building up low-emissions hydrogen and biogas industries. There is a risk that the skillsets to do this could disappear if the number of people entering gasfitting apprenticeships reduces.

Gasfitting apprenticeships are five years. New training and certification would need to be developed for new low-emissions gases, particularly for hydrogen given its different chemical properties. Before developing any training on new low-emissions gases, the gasfitting industry would need more certainty about the technologies coming along and what those technologies would be used for.

## Car maintenance

Motor mechanics will also be impacted by changes in the transport sector, including the uptake of electric vehicles and the shift to more walking, cycling and public transport. Electric vehicles require less maintenance as they have fewer parts, and do not need oil changes or spark plugs to be replaced. They also have less wear on brakes due to regenerative braking, but have relatively more wear on tyres as they are heavier.

In 2018, there were 17,700 motor mechanics across Aotearoa.<sup>77</sup> These mechanics were maintaining around 3.9 million light internal combustion engine vehicles and around 12,000 light electric vehicles.

If Aotearoa were to continue under current policy settings, our ENZ modelling suggests the number of light internal combustion engine vehicles would increase to about 4.2 million and light electric vehicles to 570,000 by 2035. Assuming that electric vehicles require 40% to 60% less maintenance than internal combustion engine vehicles,<sup>78</sup> the number of motor mechanics in Aotearoa would need to increase to between 20,300 and 20,800 by 2035.

Under the demonstration path, the number of light internal combustion engine vehicles would decrease to about 2.8 million and light electric vehicles would increase to 1.6 million by 2035. With the same assumption that electric vehicles require 40% to 60% less maintenance than internal combustion engine vehicles, the number of motor mechanics in Aotearoa would decrease to 15,400 to 16,800 by 2035. That equates to 900 to 2,300 fewer motor mechanics in 2035 compared to in 2018.

While these numbers help to provide some indication of magnitude, there are a number of things that are not factored in. For example, this does not factor in the potential impact of disruptive technologies such as self-driving cars, which could reduce the size of the fleet in Aotearoa.

Mechanics are already upskilling as cars are increasingly becoming more complex, incorporating new technologies, computers and software. Mechanics will need further upskilling for maintaining and repairing electric vehicles given the electrical systems and different drivetrain.

Beyond car maintenance, there are also likely to be new jobs in refurbishing and recycling batteries. There is unlikely to be any change in the number of jobs in car manufacturing as Aotearoa tends to import vehicles. Depending on where the market goes, there may be a new market retrofitting existing vehicles with electric drivetrains.

## Renewable electricity

New jobs will be created in renewable electricity. Renewable electricity generation will need to increase to meet our recommended emissions budgets. This could include a build of about 13 TWh of new renewable electricity generation to replace fossil generation and meet the increased demand from electrifying transport and process heat. Transpower and lines companies would also need to invest to transmit and distribute more electricity around the country.

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<sup>77</sup> (Stats NZ, 2020a)

<sup>78</sup> (Hummel et al., 2017; Logtenberg et al., 2018)

More than 8,000 New Zealanders currently work in electricity generation, transmission, and distribution. These New Zealanders are highly skilled workers with specialised skills in areas such as electrical engineering, energy trading, pricing, sales, system design, demand management, network operations, maintenance, and regulatory compliance. The industry is facing challenges as the current workforce is aging.

Transpower estimates that thousands more highly skilled workers will be needed in the electricity sector by 2035 to meet increasing electricity demand. Part of this will be from increased demand as transport and process heat are electrified. These jobs would be over and above replacing workers that retire in the coming years. As technology advances, the sector will increasingly need workers with skills in technological and digital innovation, automation, data science and artificial intelligence.<sup>79</sup>

Many of these jobs will be located around the country, particularly in building new generation and building lines to distribute it.

## Energy efficiency

New jobs could also be generated in energy efficiency. This was an area that was identified by the Government for stimulus spending as part of COVID-19 economic response.

The Green Building Council estimates that more than 1,000 jobs could be generated by bringing 120,000 Aotearoa homes up to healthy standards – by installing insulation and more efficient heating.<sup>80</sup> According to the 2018 Census, there are more than 1.8 million homes in Aotearoa. The *BRANZ 2015 House Condition Survey* estimates that 830,000 houses in Aotearoa have sub-optimal roof and/or floor insulation,<sup>81</sup> so the potential is significant.

In addition to creating new jobs, improving insulation and heating in homes, particularly in the homes of those on low incomes, can deliver immediate health benefits and reduce health inequities (see *Chapter 16: Households and communities*).

There are opportunities in energy efficiency beyond retrofitting insulation and installing more efficient heating in homes. There are opportunities in commercial buildings and in improving the efficiency of appliances.

## Waste

Meeting our recommended emissions budgets requires us to reduce, reuse and recycle our waste.

New jobs could be created by reusing and recovering waste materials that would otherwise go to landfill. For every job in landfilling, two to four jobs could be created in resource recovery.<sup>82</sup>

An assessment of the impacts of amendments to the waste levy in Aotearoa found that increasing the levy and expanding it to cover additional waste streams would create new jobs. Diverting about

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<sup>79</sup> (Transpower, 2020)

<sup>80</sup> (New Zealand Green Building Council, 2020)

<sup>81</sup> (White & Jones, 2017)

<sup>82</sup> (Ministry for the Environment, 2019a)

513,000 tonnes of waste away from landfill between 2020 and 2023 could result in 230 to 345 new jobs.<sup>83</sup> These jobs would be created around the country.

## Food and fibre

Our recommended emissions budgets are likely to see some changes to the types of jobs in the food and fibre sector.

Farmers will need to change their farm management practices to improve efficiency while maintaining production to meet our recommended emissions budgets. As a result, farmers may reduce stocking rates, meaning that less labour may be needed on farm and there may be less need for vets.

However, there will be new jobs in advising farmers on how to change farm management practices in a way that optimises business, climate and other environmental outcomes. Making such changes are complex. These would be highly skilled jobs and the number of people working as farm advisers would need to be increased quickly.

There would also be new jobs in producing, distributing and administering methane inhibitors or vaccines if they are commercially developed.

The number of jobs in meat and milk processing would be unlikely to change significantly given that our recommended emissions budgets could be met while maintaining milk and meat production.

## Land use change

In our ENZ modelling of potential transition pathways to 2050, we assume that there is less afforestation than would occur under current policy settings. This is because although relying heavily on sequestering carbon through forestry might help Aotearoa meet its 2050 targets, it would make maintaining net zero long-lived emissions beyond 2050 more difficult.

There were about 19,000 people employed in sheep, beef and grain farming in 2014 – the base year for our DIM-E modelling. Under current policy settings, our modelling estimates there could be about 3,000 fewer jobs in sheep, beef and grain farming by 2035. However, taking actions to meet our recommended emissions budgets could result in 2,600 fewer jobs in the sector by 2035 – 400 fewer job losses than would occur under current policy settings (Figure 15.11).

Of the afforestation that does occur, we have weighted the balance towards native afforestation. Permanent native forests absorb carbon more slowly but will continue to do so for centuries until they reach maturity. Because of this, carbon removals from new permanent native forests have a role to offset the remaining long-lived greenhouse gas emissions in sectors with limited opportunities to reduce emissions from 2050. For instance, this could include offsetting nitrous oxide emissions from agriculture and residual industrial process emissions.

The potential for land-use change from pastoral farming to horticulture and arable is small. Land use change to horticulture could increase the number of available jobs as horticulture is more intensive and generally requires more workers per hectare. However, many horticultural jobs are seasonal

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<sup>83</sup> (Ministry for the Environment, 2019a)

and as a result the sector experiences labour shortages. There are also opportunities for new jobs in food processing, for example in the proposed oat milk plant in Southland.

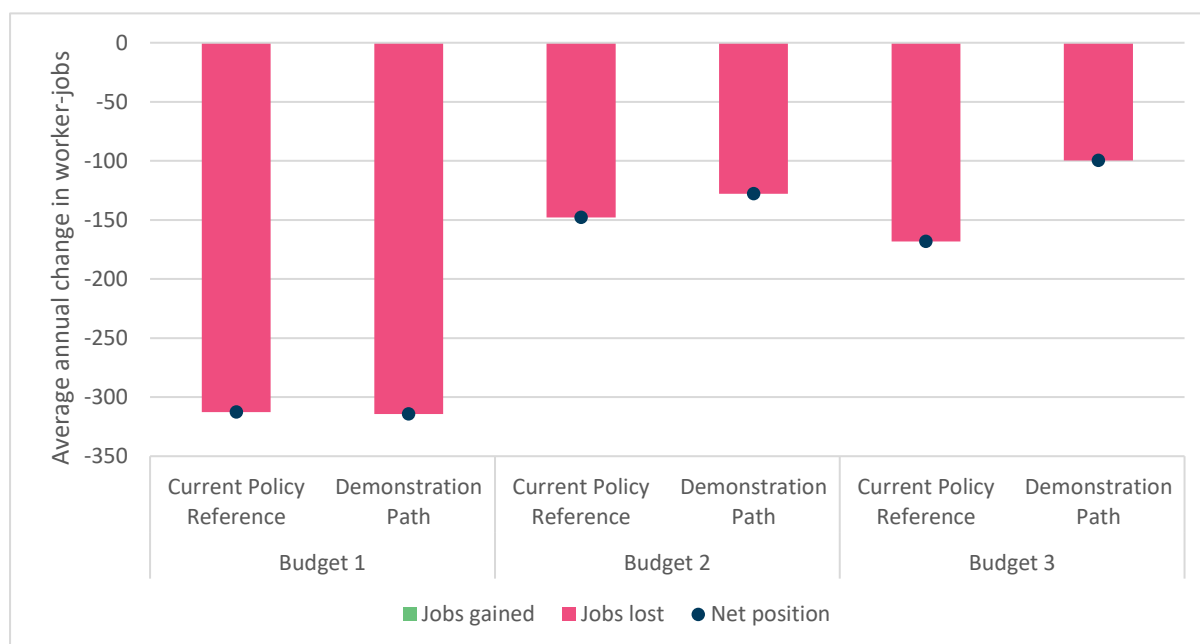


Figure 15.11: Simulation results of the average annual change in employment in the ANZSIC sector A014: Grain, Sheep and Beef Cattle Farming in each emissions budget period under the Current Policy Reference case and demonstration path.

Source: DIM-E simulation results

## Native afforestation

Native afforestation will be needed to meet our recommended emissions budgets. Native forests absorb carbon more slowly than exotic forests, but will continue to do so for centuries until they reach maturity. As a result, carbon removals from new permanent native forests can be used to offset long-lived greenhouse gas emissions in sectors with limited opportunities to reduce emissions from 2050. For instance, this could include offsetting nitrous oxide emissions from agriculture and residual industrial process emissions.

There is an opportunity to develop a native forestry industry in Aotearoa. Meeting our recommended emissions budgets could see close to 300,000 hectares of land afforested in natives by 2035. This would generate jobs throughout the country, particularly in nurseries to supply seedlings, labour for planting, fencing, pest control, and support and technical advice. Establishing and managing native forests tends to be more labour intensive than radiata pine forests. Native forests also create opportunities for jobs in honey, recreation and ecotourism, and forest-based pharmaceuticals.

## Bioenergy and bioeconomy

Bioenergy will play an important role in meeting our recommended emissions budgets – both in the form of biomass and biofuels. To ensure the increase in bioenergy is feasible, we considered how much wood waste would be available in Aotearoa and could be used. However, other feedstocks, such as tallow for biofuels, and imported bioenergy could also be used.

Producing energy from biomass is much more labour intensive than conventional fuels. Much of the work is in growing the feedstock – work that is already happening in Aotearoa given we are considering using only existing wood waste. However, there would be new jobs in recovering wood waste, transporting it and processing it ready to be used.

Much of the wood grown in Aotearoa is exported as raw logs. There are also opportunities to add value by processing wood in Aotearoa, which would also create jobs.

### Hard-to-abate industrial sectors

Some industries face particular challenges when it comes to reducing emissions, such as cement and steel. These industries are large employers in the regions and are fundamental to the economy, but solutions for decarbonising these industries are further off. Some of these industries have announced strategic reviews, citing many reasons besides climate policy. There are key strategic decisions that need to be made about the future of these industries. The outcome of these decisions will impact jobs.

In our ENZ modelling, we assume that Tiwai Point Aluminium Smelter closes all potlines by the end of 2024 in line with their recent announcements. The smelter's closure would see about 1,000 direct job losses between now and the end of 2024.

For other hard-to-abate sectors, it is hard to predict. In our ENZ modelling, we assume that steel and cement production is unchanged. However, these industries may face other challenges outside of addressing climate change. As of September 2020, New Zealand Steel employed about 1,400 workers, but they announced there could be 150 – 200 job losses after a strategic review.

Methanex, wood, dairy and meat processing are discussed in earlier sections of this chapter.

### Hydrogen industry

Hydrogen is an emerging industry. It is highly uncertain what role hydrogen will play and therefore how many jobs could be created in the hydrogen industry. The number of jobs, skillsets needed and where those jobs are located will depend on how big the industry becomes, how hydrogen is used, and the role hydrogen plays compared to other fuels including electricity. There is potential for the hydrogen industry to need mechanical skillsets if hydrogen was used in heavy trucks, engineering skillsets if hydrogen boilers were installed, and gas fitting if hydrogen was blended into pipelines.

#### 15.13.2 Impacts on jobs by region

Regions like Taranaki and the West Coast will be affected by the transition away from coal, oil and fossil gas. Other regions could be affected by the closure of hard-to-abate industries, such as the closure of Tiwai Point Aluminium Smelter in Southland. This will have particular impacts on employment.

We used our DIM-E model to examine the expected regional employment effects of our recommended emissions budgets. This models where job change could occur with net job change being the difference between job growth and job decline. Job decline does not necessarily mean that individuals would lose their jobs, as some of the change can occur through natural attrition.

Overall, our DIM-E modelling estimates that most regions would experience net job gain over the three emissions budget periods compared to what would occur under current policy settings.

However, Taranaki and the West Coast would experience net job loss over the three emissions budget periods (Figure 15.12). This is likely driven by the concentration of jobs in oil and fossil gas, and mining sectors in these two regions (see Oil and gas, and coal mining in *Section 15.13.1 Impacts on jobs by sector*). However, the extent of net job loss for the region would be less than for these sectors because the model estimates that there will be job growth in other sectors in these regions.

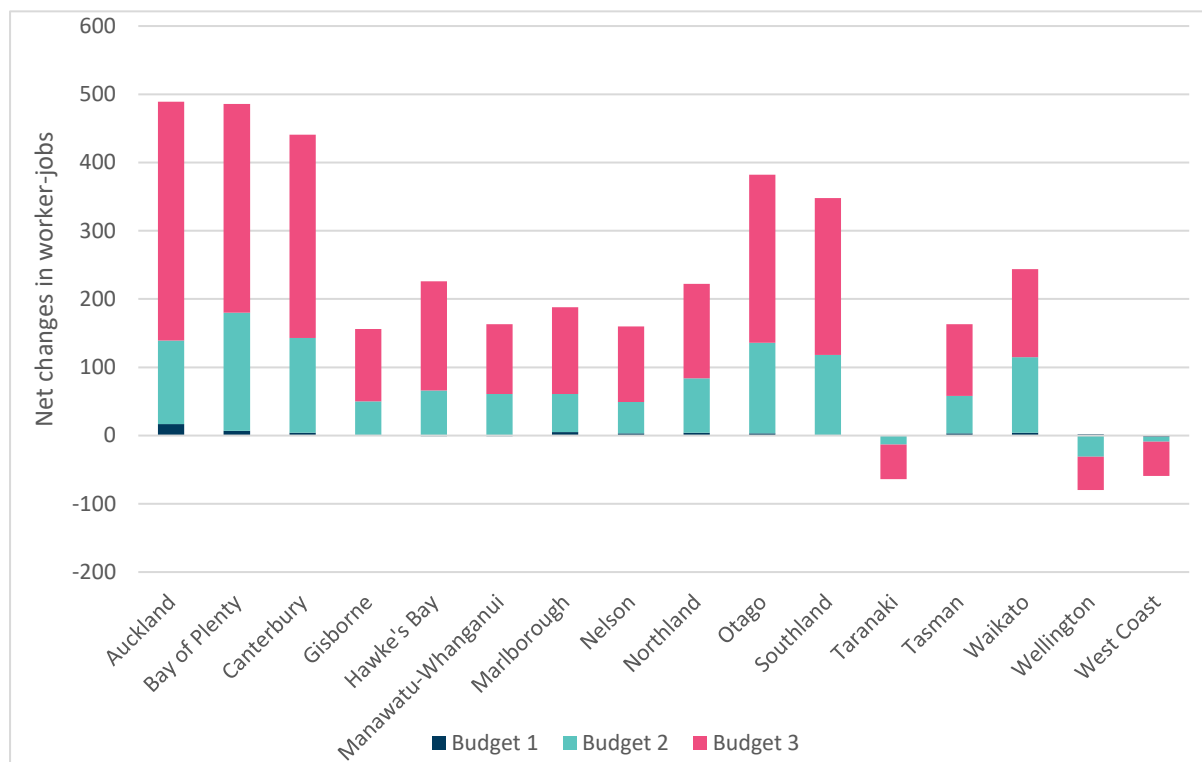


Figure 15.12: The overall net change in jobs (the job gains minus job losses) that our modelling estimates could occur in each region as a result of our recommended emissions budgets from 2021-2035

Source: DIM-E simulation results

### Regions ability to transition

The size and structure of a region’s economy also indicates how able it is to adjust to the transition. Some regions will have more ability to adjust than others. Larger and wealthier regions are likely to have more resources to plan for the transition. Other regions may need more support.

Localised transition planning will be needed in areas where there is significant employment in emissions intensive sectors. Transition planning should support regional economic diversification and could look to create new industries, based on the skills, resources and aspirations of the local community and Iwi/hapū.

### 15.13.3 How different population groups are impacted by job change

Some population groups will experience more employment impacts than others from our recommended emissions budgets. The exact impacts will depend on how the government chooses to meet our recommended emissions budgets and the policies they put in place.

We are able to look at some of this impact using the DIM-E model. However, we must also consider existing inequities in employment for different population groups. For example, some population groups already experience higher unemployment rates than others (Table 15.5).

Table 15.5: Key labour market indicators in Aotearoa in 2019/2020

	All young people (aged 15-24 years) (%) *	50 and over (%) *	Māori (%) *	Pacific peoples (%) *	Women (%) *	Disabled people (%) **	National average (%)*
<b>Employment rate</b>	55.8	54.8	62.7	60.2	62.4	39.0	<b>67.3</b>
<b>Not in education, employment or training (NEET) rate</b>	12.3	NA	19.1	18.0	13.3	43.2	<b>12.3</b>
<b>Unemployment rate</b>	12.0	2.3	8.3	8.2	4.7	10.0	<b>4.4</b>
<b>Underutilisation rate</b>	29.5 <sup>^</sup>	8.2 <sup>^</sup>	18.3	16.2	13.8	22.7	<b>11.4</b>
<b>2020 Median weekly wages (\$) ***</b>	575	978	999	954	924	400	<b>1040</b>

\* Annual average quarterly data from Households Labour Force Survey, Stats NZ

\*\* Labour market statistics (disability), December 2020 quarter

\*\*\* Based on Labour Market Statistics (Income) 2020 NZ Stats

<sup>^</sup> Values obtained from Households Labour Force Survey, March 2021 quarter. 50 and over is for 55+ age bracket.

## Māori

Some Māori individuals in the workforce could experience greater changes. In 2018, Māori in the workforce held about 16% of jobs. Our modelling suggests that Māori make up about 20% of those who gain jobs and about 13% of those who lose jobs across the first three emissions budget periods.

BERL has estimated that the current income gap for Māori is \$2.6 billion per year, equating to \$140 less income per person per week for the working age Māori population. Over half of the working Māori population are in lower skilled jobs, and almost half are in jobs that have a high risk of being replaced by automation.<sup>84</sup> Research indicates that current education and training providers are not serving Māori well and have low levels of engagement from Māori.<sup>85</sup> Māori who need to retrain or update their skillsets as employment changes could therefore be disproportionately impacted. Education and training developed by Māori for Māori would be important for reducing existing inequities and in ensuring an equitable transition.

These barriers would need to be addressed to enable Māori to fully participate in climate action and ensure that Māori workers are not disadvantaged.

<sup>84</sup> (BERL, 2017)

<sup>85</sup> (Whetu Consultancy Group, 2019)

Our analysis does not allow us to distinguish the specific effects on Māori incomes. However, the Crown–Māori Economic Development Strategy, He kai kei aku ringa, also has a goal of growing the future Māori workforce into higher-wage, higher-skilled jobs.<sup>86</sup>

## Pacific peoples

Pacific peoples currently disproportionately face higher unemployment, underutilisation and earn less than the national average (Table 15.5).

Our modelling suggests that Pacific peoples could disproportionately experience greater job change as a result of our emissions budgets. Our analysis suggests that Pacific peoples make up about 8% of those who gain jobs from the transition and about 7% of those who lose jobs from the transition. Overall, there are more job gains than job losses for Pacific peoples across all three emissions budget periods.

## Age groups

Our modelling suggests young people would see net job gain as a result of our recommended emissions budgets. People aged between 15-24 make up about 18% of job gains over the three emissions budget periods. Older workers, particularly over the age of 45 would be disproportionately impacted by job change.

## Women

Our modelling of employment flows from our recommended emissions budgets indicates that men may be more affected by the transition than women. This is because the industries that are most affected by the transition tend to employ more men. However, both women and men are likely to experience a net gain in jobs by 2050 compared to what they may experience under current policy settings.

In Aotearoa, women are disproportionately underutilised and earn less (Table 15.5). Historically, there is evidence showing that women are more negatively affected during economic change.

Our modelling also does not capture the dynamics that could occur as employment changes. For example, the flow-on impacts to women as men move out of high-emissions industries and seek new work. This was a problem in the UK in the 1980s and 1990s – many women were displaced from manufacturing jobs as men who lost jobs in coal sought out new work. Additionally, women often had to take on the ‘double burden’ of paid work as well as unpaid care work.<sup>87</sup>

## People with disabilities

Our modelling does not address the impact of employment changes on disabled people. However, any changes to jobs could have disproportionate impacts on disabled people. This is because disabled people are more likely to face poor employment outcomes, as they are less likely to be in work or education, and are more likely to be unemployed, underutilised and earn less than non-disabled people (Table 15.5).

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<sup>86</sup> (Māori Economic Development Panel, 2012)

<sup>87</sup> (Piggot et al., 2019)

## Jobs by highest qualification

The modelling suggests that most people who gain jobs in the transition will have a secondary education or higher, but that people that have Bachelor's and Post-graduate education could see a net job loss over the emissions budget period. This is likely due to the impact on the oil and gas and mining sectors, where a higher proportion of workers hold Bachelor's or Postgraduate degrees.

### 15.14 Ensuring an equitable transition for workers

The previous sections outline that, while overall the impact of the climate transition on businesses and jobs is likely to be manageable, some workers, industries and communities could be more severely impacted.

This section considers how workers can be supported through the transition, particularly by investing in education and retraining to help prepare displaced workers for the new job opportunities that would emerge from the transition to a low-emissions and climate-resilient economy and society.

Productivity, skills and innovation are important for ensuring an equitable transition where workers have the skills to move into new jobs, and businesses have the skills and capability to innovate, adopt new technologies and commercialise new ideas.

Localised transitions planning would also be needed, particularly in communities that rely heavily on one or two industries for employment.

#### 15.14.1 Productivity, skills and innovation

Productivity refers to how well businesses, people or organisations convert inputs – like capital and labour – into the output of goods and services. By improving productivity, a certain amount of output can be created using fewer resources, or more or better outputs can be created from the same amount of resource.<sup>88</sup> Productivity growth is a major driver of income growth and living standards.<sup>89</sup> Policy that addresses both productivity growth and the low-emissions transition can help to ensure more innovation, more inclusive economic growth, the creation of higher paying jobs, and contribute to higher living standards.

However, despite having high labour market performance relative to other OECD countries, Aotearoa has relatively weak labour productivity and earnings quality – a measure of how the level of wages contribute to living standards and wellbeing, and the distribution of wages across the workforce.<sup>90</sup> Research by the Productivity Commission suggests that the country's low productivity growth is due to weak technology diffusion from leading edge global businesses to the country's leading businesses, low technology and knowledge spill over from domestic leading businesses to

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<sup>88</sup> (New Zealand Productivity Commission, 2020)

<sup>89</sup> (Gurría, 2015). In Aotearoa, wages increase at a faster rate when there is strong growth in labour productivity. (Conway et al., 2015)

<sup>90</sup> (OECD, 2018)

less productive businesses, and resources being concentrated in small unproductive businesses and not reallocating to more productive businesses.<sup>91</sup>

The decisions business owners make affect how well the productivity-enhancing processes of innovation, technology diffusion and resource allocation happen. Those decisions are in turn affected by government policy.

Leading edge businesses develop and make smart use of new technologies and processes to improve their operations. They adopt innovative management practices, and flexible approaches to delivering their goods or services. These technologies and processes then diffuse to other firms in the economy, which can adapt them to improve their own productivity. In this way, these leading firms help to lift the productivity of the whole economy. Government policies that support these productivity-enhancing processes would be an important part of an equitable transition to low emissions.<sup>92</sup>

The education, and science and innovation systems are critical for ensuring low-emissions economic growth.<sup>93</sup> The Productivity Commission suggests productivity growth in Aotearoa can be improved by strengthening international connections and integrating with high-value global value chains, improving the science and innovation system, and ensuring that New Zealanders have the skills that are needed for where the labour market is heading.<sup>94</sup>

A good skills and education system benefits workers, businesses and societies.<sup>95</sup> For a worker, skills are important for allowing an individual to pursue their interests, for improving employability and wages, for empowering individuals and allowing autonomy in the workplace, and improving overall wellbeing.<sup>96</sup>

For businesses, skills and capability allow them to innovate, adopt new technologies or commercialise new ideas. Ensuring skills match what is needed in the labour market is important for enabling businesses can do this.<sup>97</sup> Increased rates of innovation would also help to soften competitiveness impacts from strong climate action. Being an early mover in researching new technologies and adopting existing technologies could benefit Aotearoa, particularly in sectors where Aotearoa has shown innovation such as agriculture. This could lead to new sectors, new business opportunities and new jobs.<sup>98</sup>

For societies, skills and innovation help to create new opportunities for transforming the economy, creating new jobs, and more inclusive sustainable growth.<sup>99</sup>

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<sup>91</sup> (New Zealand Productivity Commission, 2016)

<sup>92</sup> The Productivity Commission has completed its inquiry into “frontier firms”, and how the Government can support the processes of innovation, diffusion and reallocation to improve productivity. The final report was released in April 2021. (New Zealand Productivity Commission, 2020).

<sup>93</sup> (OECD, 2017a)

<sup>94</sup> (New Zealand Productivity Commission, 2016)

<sup>95</sup> (The Global Deal for Decent Work and Inclusive Growth et al., 2020)

<sup>96</sup> (The Global Deal for Decent Work and Inclusive Growth et al., 2020)

<sup>97</sup> (New Zealand Productivity Commission, 2016, 2019)

<sup>98</sup> (Ministry for the Environment, 2018)

<sup>99</sup> (The Global Deal for Decent Work and Inclusive Growth et al., 2020)

The education and training system would need to focus not just on learning at the start of an individual's career, but lifelong learning, as well as ensuring individuals are provided with the skills that would be needed in the future labour market. Long-term skills development would need to include pre-employment and life skills training, secondary and tertiary education, vocational training and apprenticeships, ongoing training in the workplace, and training and retraining for those seeking work or new careers.<sup>100</sup>

Policy intervention would also need to focus on the skill requirements of those who work in industries where more change would be needed as part of the climate transition, and on those who would have the most difficulty gaining new employment. The education system would need to be more flexible, and address barriers that restrict all New Zealanders from participating in education and training, with particular focus on the challenges Māori face in accessing education and training.<sup>101</sup>

### 15.14.2 Localised transition planning

Some regions and communities of Aotearoa would be more affected by the climate transition than others. In particular, some communities may see the closure of large businesses that provide significant employment for the community. Such a closure can have a big impact, not just on employees, but also on businesses and workers in the wider community.

Significant job losses at a local level can potentially lead to entire communities being left vulnerable and dislocated. Some affected workers may have the mobility and means to acquire new jobs in other industries and regions, while others may not. Affected communities may therefore end up 'stranded', leaving some workers with skills and expertise that are no longer in demand.<sup>102</sup>

Already disadvantaged groups, such as those on lower incomes, youth, elderly, Māori and Pacific Peoples, are more likely to be more vulnerable to climate hazards.<sup>103</sup> Furthermore, some coastal communities may need to relocate due to sea level rise and flooding, dislocating both the communities that remain and those resettling elsewhere.<sup>104</sup>

In such situations, localised transitions planning would be needed where central government works together with local businesses, workers, Iwi/Māori, community and local interest groups, and local government to develop a long-term vision and strategies for affected regions.

The OECD emphasises that localised transition planning would help to ensure climate change policies are tailored to regional and local circumstances, and address the needs and aspirations of different groups within the community.<sup>105</sup>

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<sup>100</sup> (The Global Deal for Decent Work and Inclusive Growth et al., 2020)

<sup>101</sup> (New Zealand Productivity Commission, 2019; Whetu Consultancy Group, 2019)

<sup>102</sup> (OECD, 2017b)

<sup>103</sup> (Ministry for the Environment, 2020); (Islam & Winkel, 2017)

<sup>104</sup> (Ministry for the Environment, 2020)

<sup>105</sup> (OECD, 2017b)

Localised planning is also important for achieving successful and enduring transition outcomes, and aligning government and business investment priorities.<sup>106</sup> In some situations, businesses would only invest if they know that complementary investments, such as to infrastructure, are being made.<sup>107</sup>

Transparent and inclusive processes, and active social dialogue regarding the transition, would be key to achieving a transition that is accepted and enduring.<sup>108</sup>

There are several international examples of different approaches to inclusive transition planning. Research suggests that important elements of existing initiatives aimed at supporting an equitable transition include ensuring affected workers, businesses and communities are active and empowered participants in transition planning. The provision of targeted financial and capacity building support is also important.

In Spain, for example, ‘just transition agreements’ have been required since 2018 between the government, unions, and businesses in all regions that are affected by climate transitions. Local civil society groups and the general public can also participate in the development of the agreements, which are designed to support strategies to reduce the negative impacts of the transition, and to finance green projects. The first such agreement was reached in October 2018 for regions impacted by coal mine closures.<sup>109</sup>

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<sup>106</sup> (New Zealand Productivity Commission, 2018b)

<sup>107</sup> (New Zealand Productivity Commission, 2018b)

<sup>108</sup> (OECD, 2019b)

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