Chapter 16:

Households and communities

Contents

This chapter looks at what impacts the climate transition may have on households and communities in Aotearoa, specifically the health co-benefits, changes to household bills, access to transport and the impacts of land-use changes.

Our modelling suggests that most households would not see an increase in electricity bills and petrol costs over the course of the first three emissions budgets. Energy efficient electric appliances, improvements in fuel efficiency, a shift to electric vehicles (EVs) and more public transport, and walking and cycling will play an important role in meeting our proposed emissions budgets, while also saving people money.

Many of the policies to reduce emissions will also benefit health and wellbeing from improved air quality and warmer, drier homes.

However, not all New Zealanders will have the same access to low-emissions choices. Government needs to consider how to support some groups through the transition.

16.1 Introduction

In considering how people will experience the impact of the transition to a low-emissions economy, we must consider how the actions we take today will affect the wellbeing of current and future generations.

This chapter looks more closely at what impacts the climate transition may have on households and communities – particularly the health benefits, changes to household bills due to changing electricity and petrol prices, access to transport and the impacts of land-use change to forestry.

Many of the actions Aotearoa could take to address climate change would have broader health co-benefits and reduce the burden on the public health system, from better air quality to less noise and from more active local travel.

In terms of household costs, energy and petrol costs are key expenses for households. We analysed the potential impact of our proposed emissions budgets on household bills, access to transport and health. We found that our proposed emissions budgets would not increase bills for most households. Most households could see a reduction in electricity bills and transport costs, particularly if they switched to lower emissions heating and transport.

However, not all households would benefit equally. For example, low-income households could struggle to access these technologies, even though they would benefit the most from the cost savings and health co-benefits. Targeted assistance would be needed to ensure that low-income households can access new low-emissions technologies and are not disproportionately affected by the climate transition.

16.2 Impacts on different regions

While the cost to the Aotearoa economy of our recommended emissions budgets is expected to be small, these costs will be distributed differently from region to region. How communities in each region are impacted depends on the structure of the region's economy, its emissions profile, and its ability to adapt and plan for the transition to a low-emissions economy.

Some regions and communities in Aotearoa will be more affected by the climate transition than others. Communities that are reliant on high-emissions industries may see the closure of large businesses that provide significant employment for the community. This could have a big impact as major job losses at a local level can lead to entire communities being left vulnerable and dislocated. It is also important to consider how regions are connected, as an impact in one region could have flow on impacts in a neighbouring region.

Several of the key hard-to-abate sectors are located in specific regions of the country. For example, aluminium is manufactured in Southland, methanol in Taranaki, pulp and paper in the Bay of Plenty, and cement and oil refining in Northland.

The structure of a region's economy has a big impact on its emissions, and therefore its exposure to policies put in place to meet our recommended emissions budgets. Regions that are reliant on primary industries, such as Taranaki, Southland, Waikato and the West Coast, could be more exposed.

16.2.1 Regional employment

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. *Chapter 15: How we earn our way in the world* discusses the specific regional employment impacts.

The ability of a region to adjust to the transition will also depend on the size and structure of its economy. 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, but could also see greater changes as a result of the transition. For example, although Taranaki has a high regional GDP per capita, it could also see significant impacts as a result of changes in both the oil and gas, and dairy sectors. 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 could 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.

The regional impacts of our emissions budgets will interact with existing global and demographic trends, such as urbanisation, technological change, globalisation and an aging population. In some cases, this will create challenges for regional communities who are already struggling with slow economic growth, high unemployment and reduced population sizes.[1]

16.3 Impacts on health and wellbeing

Reducing global emissions is recognised as one of the most important global health interventions.[2] There is a large and growing body of evidence, both within Aotearoa and internationally, of the health benefits of reducing emissions. Climate health and wellbeing benefits include improved air

[1] (NZIER, 2014)
[2] (Chan Fung Fu-Chun, 2021)

quality, reduced cardiac diseases and improved fitness from active local travel. These impacts are often more immediate and localised, and benefit not only present generations, but also those in the future. Research supports taking early action as the sooner these policies are implemented, the greater the number of deaths avoided.[3] Taking actions now will also benefit future generations by reducing the health burden on current and future generations.

Health benefits are also likely to generate major cost-savings, in terms of reducing healthcare costs and improving productivity. Studies have shown that the health benefits of policies to reduce emissions can outweigh the mitigation costs, even without factoring in long-term health benefits.[4] In addition, global action to reduce emissions would also reduce the costs that would occur as a result of the changing climate, including costs on the health system from increased heat stress from warmer temperatures and temperature extremes, and changing patterns of infectious diseases. The health impacts of climate change would be unlikely to be spread evenly across the population, with more vulnerable groups being more exposed.[5]

The next section examines the health co-benefits of our actions to reduce emissions. Evidence from Aotearoa suggests that New Zealanders could benefit from improved health from warmer, drier homes,[6] reduced air pollution from moving away from fossil fuels[7], and moving to more active forms of transport.[8]

16.3.1 Health co-benefits from insulation and heating

Warmer, drier homes, improved house design and increased use of insulation in homes and building could generate significant health gains for New Zealanders.

While insulation has modest emissions reduction impacts, insulating homes makes them warmer and drier, creating better outcomes for more New Zealanders and reducing pressure on the health system. The Warm Up New Zealand programme, which ran from 2009 to 2013, was designed to retrofit insulation into 178,000 homes, of which 71,000 were low-income households. The programme covered 60% of the cost for low-income households and 33% for others. A conservative evaluation of the programme suggests that an investment of $332 million in insulation resulted in $23 million in energy savings, and $1.26 billion in saved health costs over 30 years. Lower-income households were also found to have received significantly larger health benefits.[9] This programme has continued in various forms since then, and there is potentially more benefit to be had, with the Building Research Association of New Zealand 2015 House Condition Survey showing that 830,000 houses in Aotearoa have sub-optimal roof and/or floor insulation.[10]

Low-income households may respond differently than higher-income households to changing prices and the installation of energy efficiency measures. Lower-income households have more to gain – particularly health-wise – from installing insulation, more efficient heating and other low-emissions

[3] (Hamilton et al., 2021)
[4] (Gao et al., 2018; Scovronick et al., 2019)
[5] (Royal Society Te Apārangi, 2017)
[6] (Grimes et al., 2012)
[7] (Kuschel et al., 2012)
[8] (Macmillan et al., 2014)
[9] (Grimes et al., 2012)
[10] (White & Jones, 2017)

options. This is because they are more likely to live in older, poorly insulated homes.[11] Lower-income households also spend a greater proportion of their total expenditure on electricity and petrol.

Evidence suggests that low-income households in Aotearoa do not tend to reduce their energy demand, and therefore energy bills, after making energy efficiency improvements such as installing insulation or more efficient heating. As such, low-income households may not benefit from reduced electricity bills as a result of the climate transition. Rather, they tend to warm their homes more and benefit from improved health as a result of warmer, drier homes.[12] These improved health benefits include increased comfort, reduced time off school or work, reduced number of GP visits, reduced hospital admissions for circulatory and respiratory illnesses, reduced pharmaceutical costs, and reduced mortality.[13]

Evidence from an evaluation of the Warm Up New Zealand programme found that low-income households received greater health benefits from installing insulation than higher-income households. The evaluation found that low-income households saved on average $818 each per year (95% confidence interval: $205 to $1272) after insulation was installed, compared to $227 (85% confidence interval: $11 to $388) for higher-income households.[14] These health benefits are greater than any potential energy bill savings (see *Section 16.4.2, Household electricity bills*).

Additionally, the evaluation found that there was little additional benefit of installing more efficient heating, which equated to health benefits of an additional $9 a year for low-income households.[15] The evaluation and other Aotearoa studies have found that the main health benefit is associated with insulation as it reduces exposure to very low temperatures and high humidity, as opposed to changes in average temperature and humidity.[16]

16.3.2 Health co-benefits from reduced air pollution

Road transport and residential burners contribute most of the particulate pollution in Aotearoa. Less vehicle pollution and use of coal and fossil gas will improve air quality, offering better health outcomes for New Zealanders. Studies in Aotearoa have shown an association between air pollution and mortality, which is in line with international trends.[17]

Moving to EVs from petrol and diesel reduces air pollution, and could have significant health co-benefits by reducing respiratory and cardiovascular illnesses. In total, air pollution is estimated to cost Aotearoa $4.28 billion every year. Of this, 22% is attributed to pollution from vehicles, equating to $940 million.[18]

There are health concerns on the effects of using fossil gas in buildings as it is a potential source of indoor pollution. Recent studies show there is evidence that fossil gas cooking can increase the

[11] (Telfar Barnard et al., 2011)
[12] (Telfar Barnard et al., 2011)
[13] (Telfar Barnard et al., 2011); (Howden-Chapman et al., 2007); (Motu Economic and Public Policy Research, 2017)
[14] The researchers considered that these benefits would be conservative as they did not include benefits from improved comfort. (Telfar Barnard et al., 2011)
[15] The researchers considered that these benefits would be conservative as they did not include benefits from improved comfort. (Telfar Barnard et al., 2011)
[16] (Telfar Barnard et al., 2011); (Howden-Chapman et al., 2007)
[17] (Kuschel et al., 2012)
[18] (Kuschel et al., 2012)

burden of childhood asthma.[19] Households can reduce these risks, but not eliminate these risks, through better ventilation and ensuring appliances are properly maintained. Indoor air pollution from fossil gas use can disproportionately impact lower-income households, who are more likely to use un-flued gas heaters, and live in rented accommodation which use older fossil gas appliances.[20]

For coal use, the air quality impacts, and therefore health impacts, of moving away from coal for industrial process heat will depend on what the coal is being used for. If coal was replaced with green hydrogen, this could result in localised air quality improvements. However, if coal was replaced with biomass, there might be relatively less improvement in localised air quality.

Vehicle exhaust is a significant source of air pollution in Aotearoa, particularly in heavy transport areas. Vehicle exhaust emits a range of pollutants, including nitrogen oxides and fine particulate matter that is less than 2.5 micrometres wide. Fine particulate matter has worse health impacts than coarser particulate matter as it can get deeper into the lungs, causing respiratory issues.[21]

Moving to EVs from petrol and diesel vehicles will reduce air pollution, and in particular will reduce particulate matter that is less than 2.5 micrometres wide. EVs will continue to generate some air pollution as the weight of the vehicle wears down the road pavement, tyres and brake pads. However, these particulates tend to be coarser and have less health impact.[22]

Measurements show that vehicles in Aotearoa have become more emissions and fuel efficient over time, air pollutants concentrations have decreased.[23]

In addition, studies in Aotearoa[24] and internationally[25] on the lifecycle assessment of EVs found that they produce significantly less emissions than conventional petrol or diesel vehicles.

16.3.3 Health co-benefits from active transport

Shifting away from private vehicle use to active travel such as walking and cycling offers substantial health benefits for New Zealanders.[26] The majority of health benefits are due to increased physical activity, leading to less chronic diseases, and improved wellbeing, as well as cost savings.

Over the lifetime of the current population of Aotearoa, these health savings could be in the order of NZ$127 million if 25% of trips under 1 km were to switch to walking, or up to NZ$2.1 billion if all trips under 1 km were to switch to walking and all trips between 1 and 5 km were to switch to cycling.[27] Similarly, greater use of public transport and urban planning could facilitate more walking as people could walk or cycle to bus or train stations.

International studies show that walking and cycling is associated with a lower risk of cardiovascular diseases, cancer and mortality rates.[28]

[19] (Climate Council of Australia Limited, 2021)
[20] (Canterbury District Health Board, 2015; Climate Council of Australia Limited, 2021)
[21] (Ministry for the Environment & Statistics NZ, 2018)
[22] (Ministry for the Environment & Statistics NZ, 2018)
[23] (Bluett et al., 2016)
[24] (Life Cycle Strategies, 2015)
[25] (Elkind et al., 2020)
[26] (Bennett et al., 2014)
[27] (Mizdrak et al., 2019)
[28] (Patterson et al., 2020)

A simulation by researchers from Aotearoa found that segregating bike lanes from traffic on busy urban roads and slowing traffic on smaller local roads would encourage more commuter cycling, reduce greenhouse gas emissions by 26 $MtCO_2e$ and save the health system of Aotearoa $13 million by 2050.[29]

Improving the infrastructure for walking and cycling would encourage greater forms of active transport, especially for women, Māori, Pasifika and low-income New Zealanders, where lack of access and safety are barriers. Research in Aotearoa has found that providing safe and connected infrastructure could also attract more women to cycling.[30]

Reduced traffic congestion and shorter daily commutes also offers improved mental health and wellbeing.[31] Less noise pollution could help improve mental health and cardiovascular health, particularly for communities that live close to roads.[32]

Access to transport is a particular issue for Māori. Transport is hugely important for Māori to connect to their whānau, haukāinga, and tūrangawaewae. About a quarter of Māori in Aotearoa live in Auckland;[33] however many originate from outside of Auckland and may need to travel long distances to participate in activities and events.[34]

The design of our cities, underinvestment in public transport and walking and cycling, and incentives encouraging travel by car all contribute to New Zealanders limited transport options.[35] *The New Zealand Health Survey 2018/19* found that 2.8% of the adult population had an unmet need for GP services and 1% had an unmet need for after-hours healthcare due to lack of transport in the past 12 months.[36] Additionally, low-income households may also not be able to afford fast broadband, which limits virtual access to services.

16.3.4 Health effects of climate change

In addition to the health impacts of taking actions to reduce emissions, climate change can also affect the health and wellbeing of New Zealanders, particularly mental health. There is increasing evidence on how increased exposure to extreme weather events and climate impacts can have negative consequences on mental health and wellbeing.[37] These impacts range from increased stress, to serious clinical disorders such as anxiety, depression, and post-traumatic stress.

The health effects from the physical impacts of climate change are discussed in *Chapter 17: Impacts on environment, ecology, and the ability to adapt to climate change*.

[29] (Macmillan et al., 2014; Mandic et al., 2019)
[30] (Russell et al., 2021)
[31] (Mizdrak et al., 2019)
[32] (Hegewald et al., 2020; Sung et al., 2016)
[33] (Stats NZ, 2007)
[34] (Raerino et al., 2013)
[35] (Waka Kotahi (NZ Transport Agency), 2019)
[36] (Ministry of Health, 2019)
[37] (*Addressing the Mental Health Impacts of Natural Disasters and Climate Change-Related Weather Events | RANZCP*, n.d.; Royal Society Te Apārangi, 2017)

16.4 Impacts from changing electricity costs

Our analysis suggests that our recommended emissions budgets are unlikely to increase overall household electricity bills for heating, cooking and lighting.

However, exactly how household electricity bills could change is highly uncertain, and depends on both electricity prices and household electricity demand. The price that consumers pay for electricity covers the cost of generating the electricity as well as the lines and infrastructure that distributes it. There are also taxes, profit margins and other costs which contribute to an electricity bill (Figure 16.1).

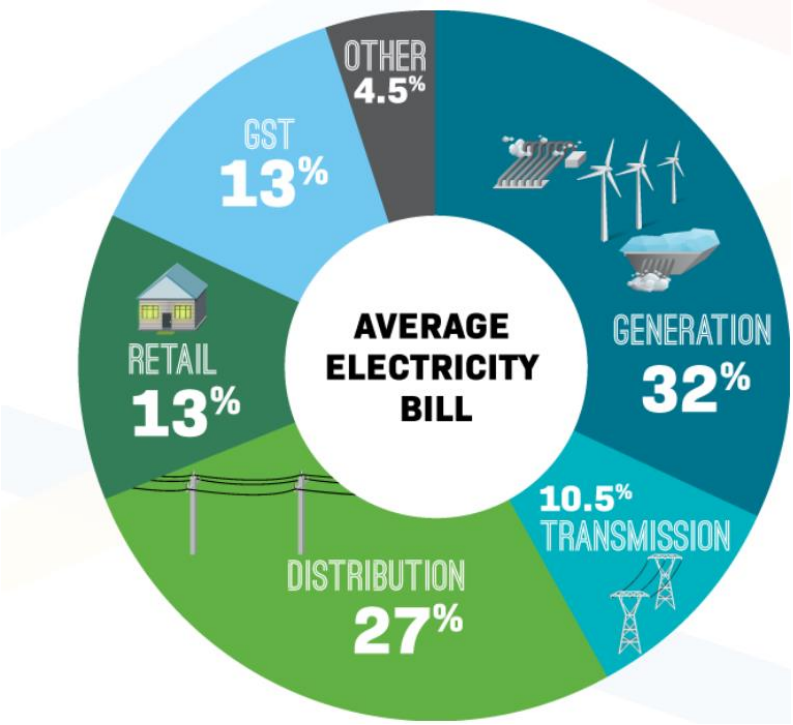


Figure 16.1: The typical cost components of an electricity bill today

Source: Electricity Authority[38]

Household electricity bills are also affected by changes in transmission and distribution costs. Figure 16.1 shows these make up a significant proportion of the bill for households, as well as for businesses and industrial consumers. Household bills could be significantly impacted by any changes in the cost of the transmission and distribution infrastructure and how those costs are allocated – for example, as a result of government changes to electricity pricing structures.

16.4.1 Wholesale electricity prices are expected to vary year to year

Electricity prices vary due to a range of factors beyond climate policy, such as a consumer demand, the weather, supply and demand of fossil gas, and pricing structures.

We used the EMarket model to understand how wholesale prices might evolve under the demonstration path. The model electricity price reflects the balance of supply and demand, the cost

[38] (Electricity Authority, n.d.)

of operating existing generation and the new generation that needs to be built. This corresponds to the generation part of Figure 16.1 above – only one component of the household bill.

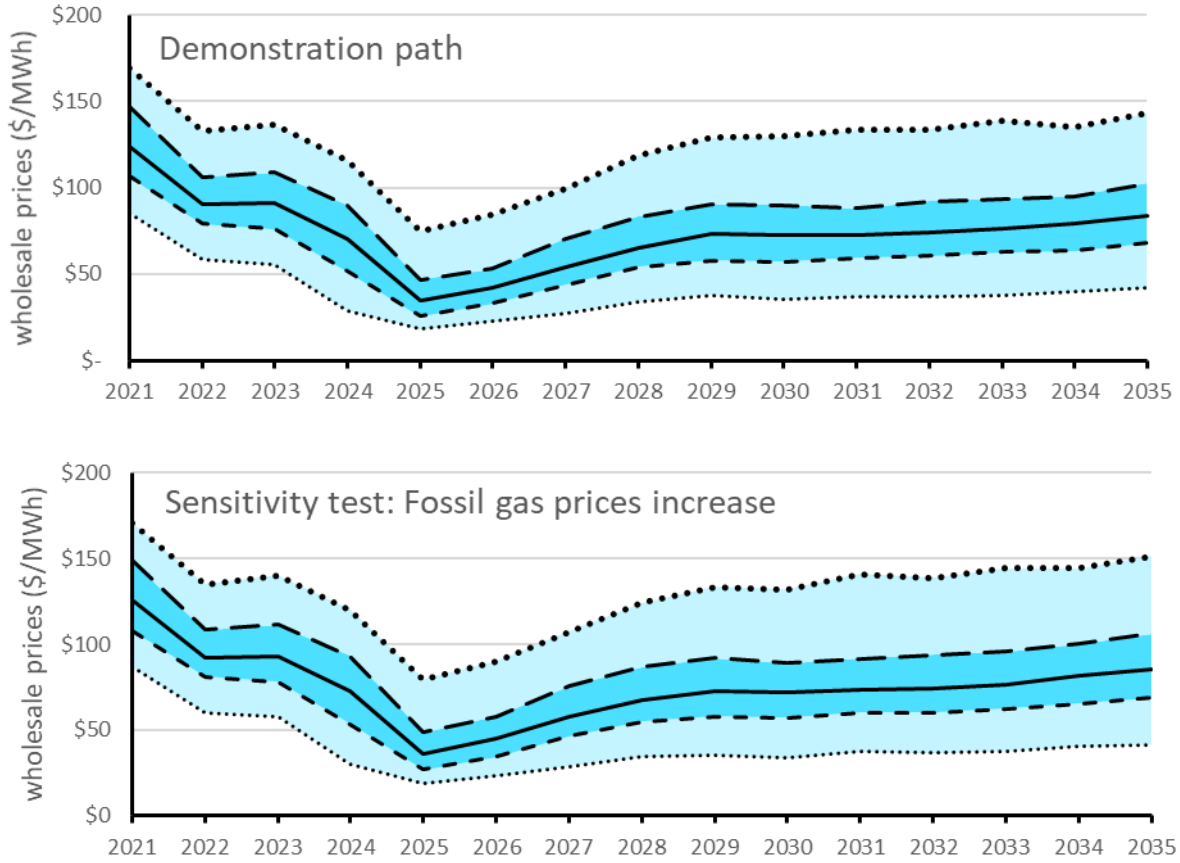
Our modelling suggests that, by taking action to meet our recommended emissions budgets, wholesale electricity prices across the country would continue to vary from year to year, depending on inflows into the hydro lakes. Prices start relatively higher, reflecting 2021 market conditions of low hydro storage and a shortage of fossil gas.

Over the next few years, the displacement of baseload fossil gas generation with lower cost wind and geothermal would reduce the average price. The assumed closure of the Tiwai Point Aluminium Smelter at the end of 2024 causes a further suppression of the price. The modelling suggests that the average wholesale price would eventually stabilise around $70-$80/MWh (Figure 16.2) – this price covers the costs of building new generation to match the growth in electricity demand.

We carried out sensitivity analysis to test the uncertainty in wholesale electricity prices. We tested a sensitivity where the Tiwai Point Aluminium Smelter remains open and one where fossil gas prices are higher.

Our modelling estimates that, if the smelter was to continue operating beyond 2024, the average wholesale price would be around $20/MWh higher from about 2025 to 2035 (Figure 16.2). The higher price would occur as more expensive renewable electricity generation would need to be built to meet the growth in demand.

In the fossil gas price sensitivity, we assumed that fossil gas prices increase by 20% by 2030. Our modelling suggests this would have a minimal effect on the wholesale electricity price (Figure 16.2). This is because much of the fossil gas generation that currently runs would have been displaced by renewable generation by 2025.



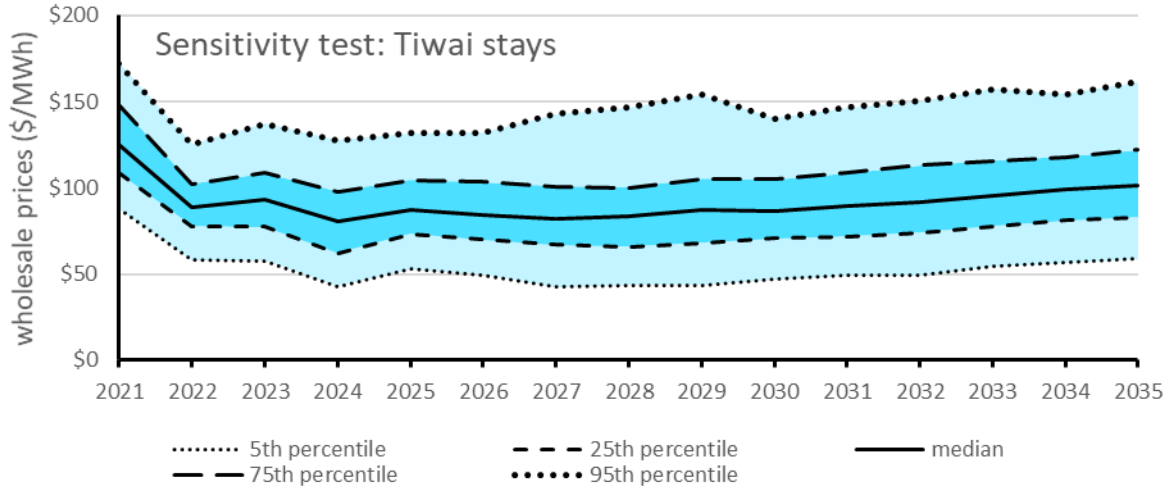


Figure 16.2: Modelled wholesale electricity prices in real dollars in the demonstration path and for two sensitivity tests. The annual variation shows the impact of inflows into the hydro lakes.

Source: Commission analysis.

Wholesale electricity prices are only one component of a household electricity bill. Electricity retailers would see these wholesale prices and determine how to pass these costs onto households – they often do this in a way that removes the day-to-day, month-to-month and year-to-year variability.

16.4.2 Making changes to reduce electricity bills

Although Aotearoa has relatively cheap electricity generation, household electricity bills can be costly. This is due to a range of factors, including regulatory settings and the poorly insulated housing stock in Aotearoa.

Households that are able to make energy efficiency improvements, for example by switching to heat pumps, or installing insulation or LED lightbulbs, should be able to reduce their household electricity bills.

Households electricity bills not only depend on residential electricity prices, but also on demand. Making energy efficiency improvements may be able to reduce household demand. There are a range of energy efficiency improvements that could reduce household demand and household bills. These include: replacing incandescent or halogen light bulbs with more efficient LED light bulbs, upgrading appliances with more energy efficient ones, or installing insulation, more efficient heating, curtains with thermal lining or double glazing would all help to improve a home's energy efficiency and therefore reduce how much energy that home uses to meet the same needs.[39]

Making energy efficiency improvements can also reduce energy use at peak times – in the mornings, evenings and in winter. Reducing demand at peak times helps the entire energy system as there is less need to upgrade electricity lines, avoiding potential additional costs for all households.[40] Reducing peak demand would require both the adoption of technologies for demand response and

[39] (Gen Less, 2017)
[40] (Transpower, 2020)

innovative business and pricing models. Electricity pricing incentives, such as low-cost night rates, combined with smart charging technology could be an effective way to address this issue.

Household electricity bills could also increase if a household purchases an electric vehicle (EV). However, if that EV is replacing a petrol car, then overall household energy bills could decrease.

Figure 16.3 looks at the annual average cost to a household that relies on fossil gas for household energy (heating and cooking), and an internal-combustion engine (ICE) vehicle for transport ('Household 1') versus a household that uses electricity for household energy and owns an EV ('Household 2'). It shows that although the annual average costs for Household 2 are higher today, these costs will be lower in the future as EVs will become cheaper to buy. In 2035 Household 2 will be on average $2000 per year better off than Household 1. Household 1 may be able to reduce their future costs by converting to an EV and electric heating – although they may face one-off make-good costs from converting appliances.

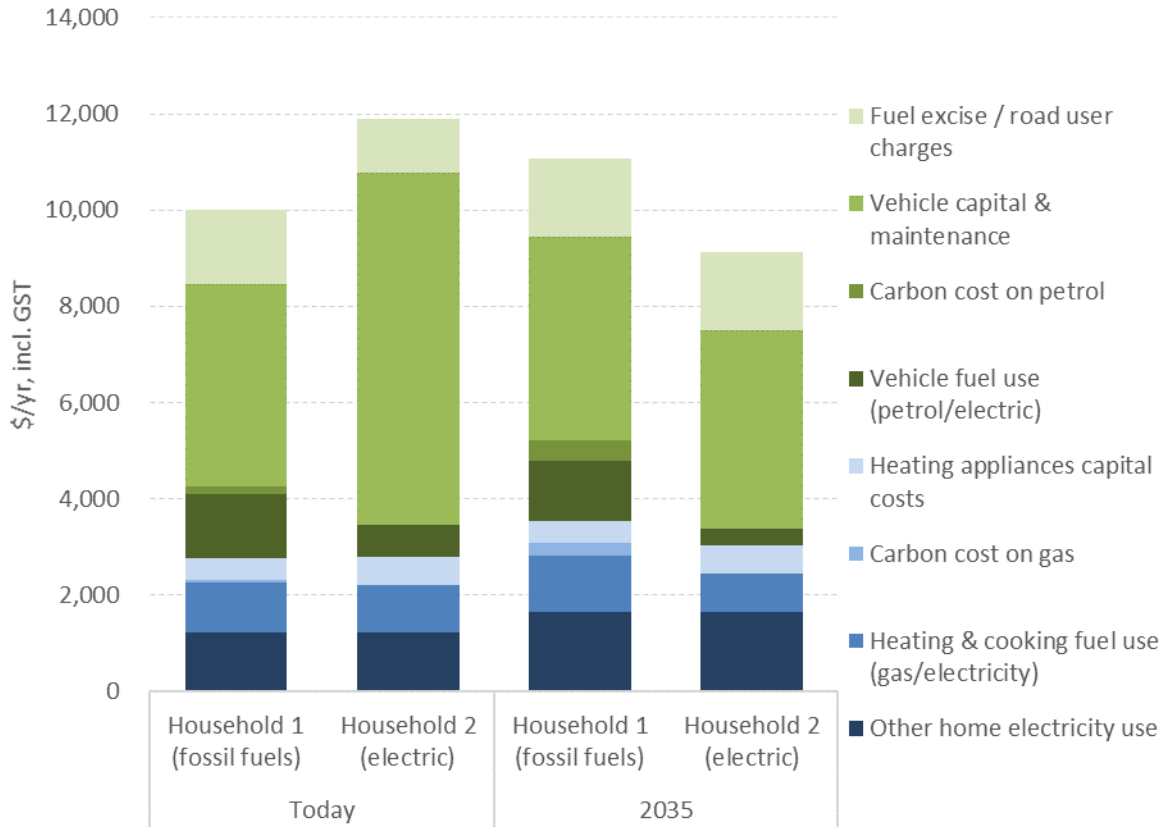


Figure 16.3: Household average annual vehicle, heating and cooking costs under the demonstration path today and in 2035. Household 1 has an ICE and uses gas for heating and cooking and Household 2 has an EV and uses electricity for heating and cooking.

Source: Commission analysis.

16.4.3 Impact on some socio-economic groups and communities

The impacts of our emissions budgets could disproportionately affect some population groups of New Zealanders. Some groups, such as Māori and Pacific communities, low-income New Zealanders and people with disabilities, already experience low-wellbeing outcomes across a number of measures. Targeted support is required to help these groups through the transition.

For example, consideration is needed for Māori households. Although Māori make up 16.5% of the population of Aotearoa,[41] a high proportion of the Māori population are in overrepresented in a number of low socio-economic groups compared to non-Māori. Māori are more likely to be on a low income, more likely to not have access to a motor vehicle and more likely to be renting.[42] Data from the *2018 Census* suggests that Māori households are also more likely than non-Māori to live in cold, damp homes. In particular, about half of Māori living in Northland and in some suburbs in Auckland are living in damp homes.[43]

Māori households are likely to be more affected to changes in electricity bills than non-Māori households. On average, Māori households spend more each week on electricity than other households – about $41.20 compared to $36.80 for non-Māori households – as well as spending more as a percentage of total expenditure. Māori households spend on average 3.6% of their total expenditure on electricity, compared to non-Māori households who spent on average spent 2.9% of their total expenditure on electricity.[44]

Similarly, Pasifika households tend to have more people than average, and overrepresented in low-income groups, meaning they may be relatively more exposed to climate-related changes in energy costs.[45]

Assisting some households and communities

Lower-income households, some Māori and Pasifika households, elderly and people with disabilities will benefit more from making energy efficiency improvements. These groups are more likely to live in older, poorly insulated homes[46] and would benefit from energy initiatives which also generate cost savings.

The impact on lower-income households can be managed through policy. Government could need to assist those on lower incomes with the upfront cost for energy efficiency improvements.

The Government's Warmer Kiwi Homes programme continues to provide funding to those on low incomes who own their own home to install insulation or more efficient heating. The Government has also introduced healthy home standards for rental homes that include standards for insulation and heating.

Continued intervention may be needed to ensure that lower-income households can access these benefits. The Government would need to assess whether the existing programmes are delivering at

[41] (Stats NZ, 2019)
[42] (Stats NZ, 2014)
[43] (Stats NZ, 2020)
[44] (Martin Jenkins, 2019)
[45] (Martin Jenkins, 2019)
[46] (Environmental Health Indicators New Zealand, 2020)

an appropriate pace and scale, and consider whether these programmes have broader impacts on rental prices and affordability.

16.4.4 Impact on regional electricity prices

Our recommended emissions budgets are unlikely to change regional electricity prices beyond the level of regional variation that already exists. However, there are numerous factors outside those in our emissions budgets that make future electricity prices highly uncertain.

Households' electricity bills vary from region to region, and even within regions. Different areas already face varying electricity prices. For example, electricity pricing surveys show that households in Kerikeri and the West Coast pay more for electricity than the national average. There can be as much as a 50% variation between regions.[47]

This reflects the cost of not only generating electricity, but also transmitting and distributing it. Smaller communities and communities further away from where electricity is generated often pay higher prices. Lines companies have fixed costs that they need to recover from their consumers. Having a smaller base of consumers to recover network costs from, like in Kerikeri and the West Coast, means these charges may be higher than more populous areas or areas with different pricing structures that incentivise consumers to reduce how much electricity they use at peak times.

Average household electricity demand varies across Aotearoa and depends on things like climatic conditions, personal choice about heating levels, and whether the household uses fossil gas, electricity or wood for heating. For example, the average household electricity consumption is twice as much in Queenstown as in Westport.

16.5 Impacts from changing fossil gas cost

Households that use fossil gas for heating and cooking are likely to see an increase in their fossil gas bills as a result of our recommended emissions budgets. Figure 16.4 shows the impact of our emissions budgets could increase the average household gas bill in 2035 by up to $300 a year for homes with reticulated fossil gas or liquified petroleum gas. Although today the average annual household heating and cooking costs are similar for both households, in the future these costs will be much lower for households that are on electricity.

[47] (MBIE, n.d.)

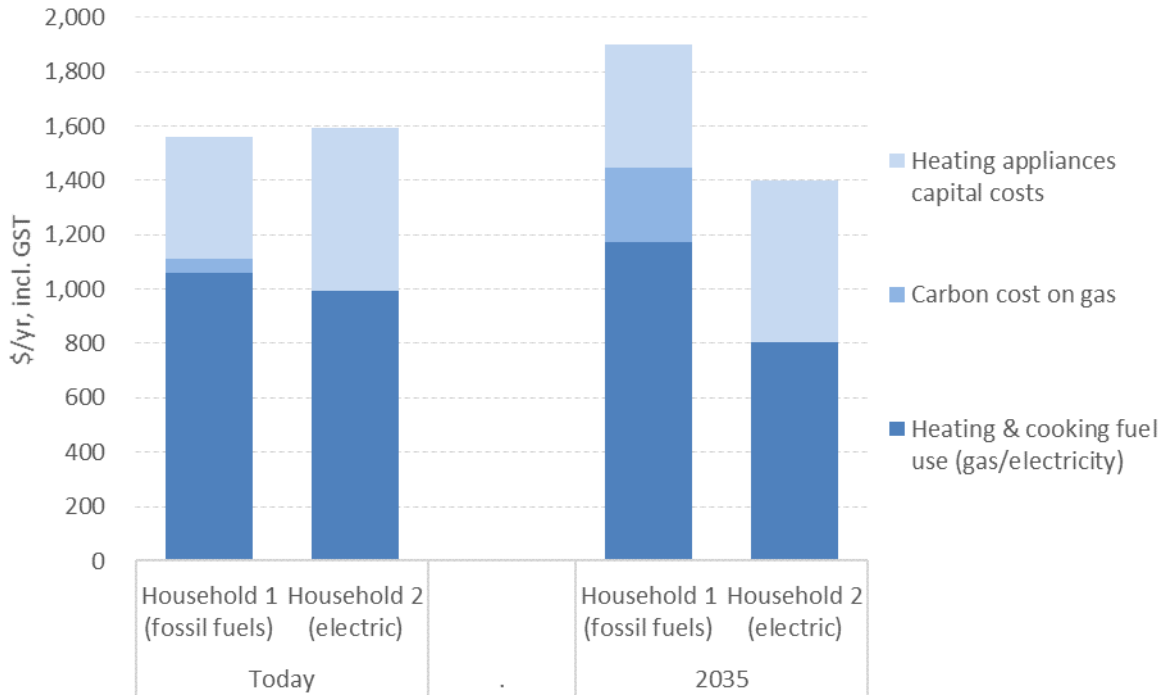


Figure 16.4: Average annual household heating and cooking costs under the demonstration path today and in 2035. Household 1 uses fossil gas heaters and appliances, household 2 is electric.

Source: Commission analysis.

Future fossil gas prices are uncertain and there are a number of complex dynamics that are difficult to predict. The transition away from fossil gas may mean that, over time, many households would benefit from replacing fossil gas appliances. The main cost would come if households were to replace fossil gas appliances before the end of their useful life. There are also other costs associated with removing fossil gas pipelines from a home, additional wiring or changes to electricity meter boards, and the associated building work.

Households could reduce costs by not installing new fossil gas appliances, and by replacing existing fossil gas appliances with low-emissions alternatives when the appliance comes to the end of its life. We have specifically factored replacing appliances at the end of their useful life into our analysis of emissions budgets to avoid unnecessary cost.

16.5.1 Some households may need support

The impact on households of increasing fossil gas bills could be managed through the pace of the transition away from gas and through policy.

Analysis for the *Electricity Price Review* shows that those on higher incomes are more likely to use fossil gas.[48] However, in policy design, the Government will need to pay particular attention to low-income households that use fossil gas, and may not have the money for the upfront conversion cost, or may rent homes with fossil gas appliances or heating.

Landlords who own properties with fossil gas appliances may not have any incentive to replace them with lower-emissions, low-cost options, as they would not benefit from the savings in running costs.

[48] (Ministry of Business, Innovation & Employment, 2020)

There may be some efficiencies and cost savings from replacing old fossil gas heating systems with modern electric systems.

Portable fossil gas heaters are still used by some households in Aotearoa. They are used proportionately more in the North Island, particularly in Gisborne and Northland.[49] These heaters tend to be used by lower-income households due to the low upfront cost and the ease of budgeting for heating bills.

Portable fossil gas heaters contribute to mouldy homes and cause health problems.[50] Although the number of these heaters is decreasing, replacing them with more efficient low-emissions options will take continued government support. However, this should flow through to healthier households and less burden on the health system.

16.6 Petrol bills and access to transport

Transport is crucial to New Zealanders' livelihoods, wellbeing, and the economy. It is important for people to connect to families, for allowing people to participate in wider society and for ensuring access to work or education, healthcare, supermarkets, banks, and local activities.

Our current system tends to prioritise travel by car, disadvantaging those who do not have easy access to vehicles. This particularly impacts young, elderly, disabled, and economically disadvantaged communities. The design of cities, underinvestment in public transport, walking, and cycling, and incentives encouraging travel by car all contribute to this challenge.[51] *The New Zealand Health Survey 2018/19* found that 2.8% of the adult population had an unmet need for GP services and 1% had an unmet need for after-hours healthcare due to lack of transport in the past 12 months.[52] Additionally, low-income households may also not be able to afford fast broadband, which limits virtual access to services.

16.6.1 Petrol and diesel costs are likely to increase

Improving fuel efficiency, a shift to EVs, and more public transport, walking, and cycling will all be important parts of meeting our recommended emissions budgets.

Our modelling indicates petrol and diesel prices could increase by up to 30 cents per litre in 2035 as a result of our recommended emissions budgets. The average household may expect to see transport costs increase, including increases in the cost of petrol and vehicle maintenance, if they are not able to replace their vehicle with a more fuel-efficient vehicle.

16.6.2 Increasing transport bills can be offset

There are ways to offset this increase. Households could purchase more fuel-efficient cars, or walk, cycle, use public transport, and work from home more. However, those on lower incomes, or those with less access to public or shared transport would have less ability make some of these changes, and could be left facing higher costs. Intervention would be needed to support these households.

In 2035, our modelling indicates that households which replace an ICE car with an EV could save more than $1,300 a year. This is because EVs are already cheaper to run, and will become cheaper to

[49] (Stats NZ, 2018)
[50] (Canterbury District Health Board, 2015)
[51] (Waka Kotahi (NZ Transport Agency), 2019)
[52] (Ministry of Health, 2019)

buy than an ICE vehicle in the future. Although electricity bills will increase, the total household energy bill will decrease for households with EVs. However, wealthier and urban households would benefit from EVs earlier than lower-income and rural households. The total private vehicle and energy costs for households with and without an EV now and in 2035 are shown in Figure 16.5.

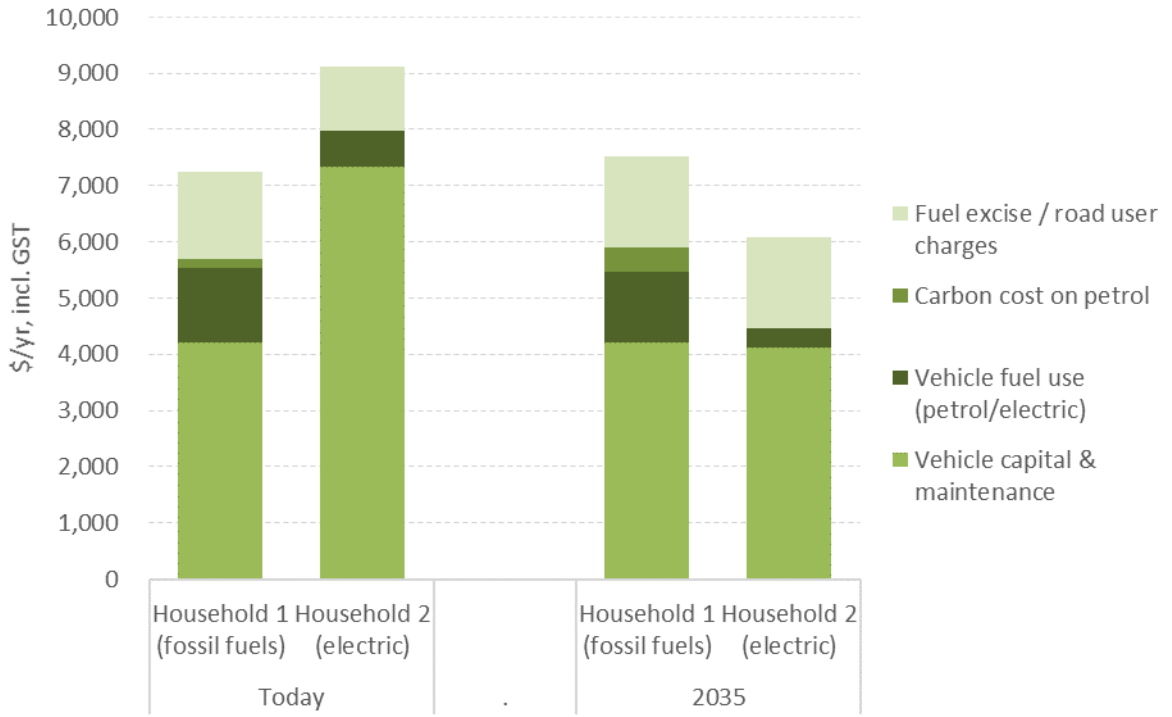


Figure 16.5: Average annual vehicle and fuels costs for demonstration path. Household 1 has an ICE and household 2 has an EV.

Source: Commission analysis.

16.6.3 Ensuring New Zealanders have access to transport

Lower-income households may be less able to afford an EV than wealthier households due to the upfront costs. Currently the cheapest second-hand EVs still cost over $10,000.[53]

It may also be challenging for those who cannot charge an EV at home, for example people living in apartments. We have heard throughout our engagement and consultation that the range of EVs available, high upfront cost, and lack of charging facilities is particularly relevant for people with disabilities who often rely on a vehicle to get around, and for some Māori households who are disproportionately represented among those with low incomes.

Access to transport is a particular issue for some Māori. Transport is hugely important for Māori to connect to their whānau, haukāinga and tūrangawaewae. About a quarter of Māori in Aotearoa live in Auckland, however, many have whakapapa connections outside of Auckland and may need to travel long distances to participate in Iwi, hapū and whānau activities and events. Some Māori households are large or intergenerational and require larger vehicles. Transport, particularly utes, can also be a key enabler for the haukāinga to collect resources and provide services to the marae.[54]

[53] (Stuff, 2020)
[54] (Raerino et al., 2013)

Some people and businesses have specific transport needs that the transition would have to address. Farmers, contractors, and others in rural communities need vehicles that can carry heavy loads or access rugged or remote locations, such as a single- or double-cab utes. Farm bikes and quad bikes are also an essential part of farming and rural landscapes. For these needs, there are cost-effective solutions available now, or in the next few years.

Public transport might not be feasible in smaller towns and rural areas, or for people with disabilities. In some smaller towns, mobility as a service may be a better option. For example, Timaru is trialling a new system called MyWay by Metro in place of the usual bus service. Through this system, people can request a vehicle directly through a smartphone app or call-centre. The technology identifies a 'virtual bus stop' within a short walking distance, allowing for shared trips without fixed routes or schedules. This system was developed because the previous bus service was not well used. Rather than reducing services or removing public transport altogether, on demand services were developed as an alternative. A low-floor vehicle can be requested when booking for passengers with mobility aids, service animals, and for parents with pushchairs. MyWay also offers enhanced mobility services at a fixed fee that is driveway-to-driveway in off-peak hours, enhancing accessibility.[55]

16.6.4 Some households may need support

The Government will need to provide proactive, targeted support to ensure that New Zealanders have access to transport. This will help address the barriers that lower-income, rural households, and people with disabilities have with accessing transport options, such as EVs. Policies that help to generate a second-hand EV market, encourage car sharing, and assist with purchasing an EV or electric bike could help. For example, California's 'Enhanced Fleet Modernization Program Plus-Up' provides support to scrap old ICE vehicles, and provides vouchers to purchase a replacement vehicle, or for public transport and car-sharing services. The value of the vouchers varies depending on income.[56] Some countries are also considering schemes that would allow people to trade in their existing petrol or diesel vehicle for an electric bike.[57]

More public transport, walking, and cycling will have a positive impact, particularly on those who live in cities and larger urban areas. Central and local government will need to provide more and better transport options to increase access to transport for people with disabilities, on low incomes, or with large families. Currently, public transport is not always a realistic option for people with disabilities and many therefore rely on cars. Good policy and planning will be needed to ensure that transport systems are integrated and accessible.

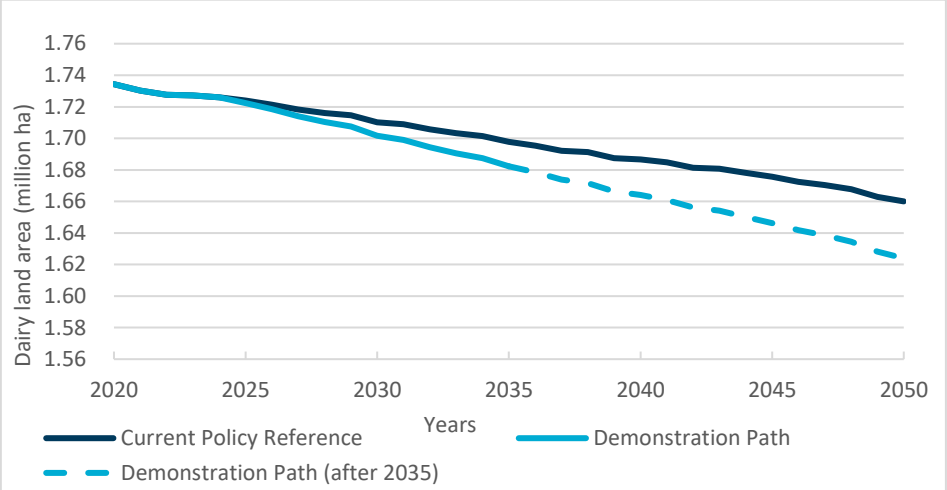
16.7 Potential impacts from land-use change

Our economic modelling suggests that in our Current Policy Reference case, the land area in dairy and sheep and beef would decrease, and the land area in exotic and native forestry would increase over the course of the first three emissions budgets and out to 2050 (See Figure 16.6).

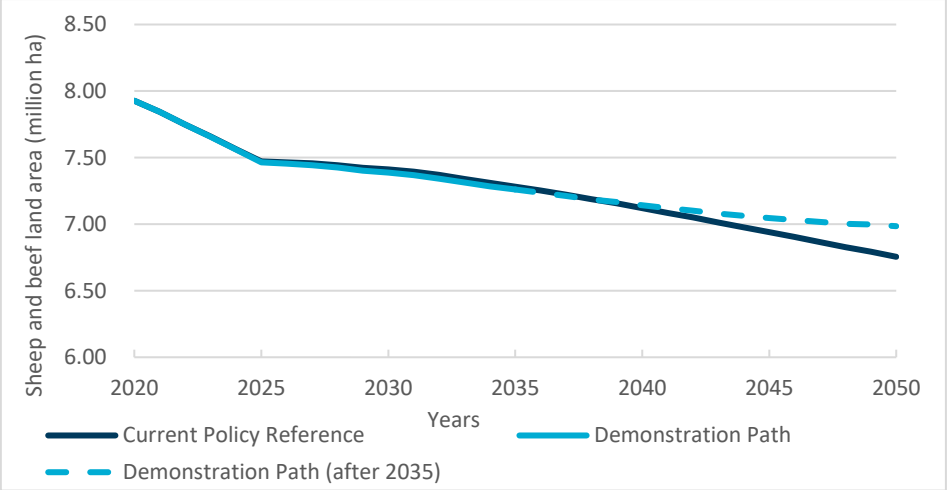
Our demonstration path would see a reduction in dairy land area, but less reduction of the area in sheep and beef farming out to 2050 relative to the Current Policy Reference case. Our path would also see comparatively less exotic forestry and more native forestry compared to the Current Policy

[55] (MyWay by Metro, 2020)
[56] (The Greenlining Institute, 2016)
[57] (*Trading Clunkers for Electric Bikes*, 2021)

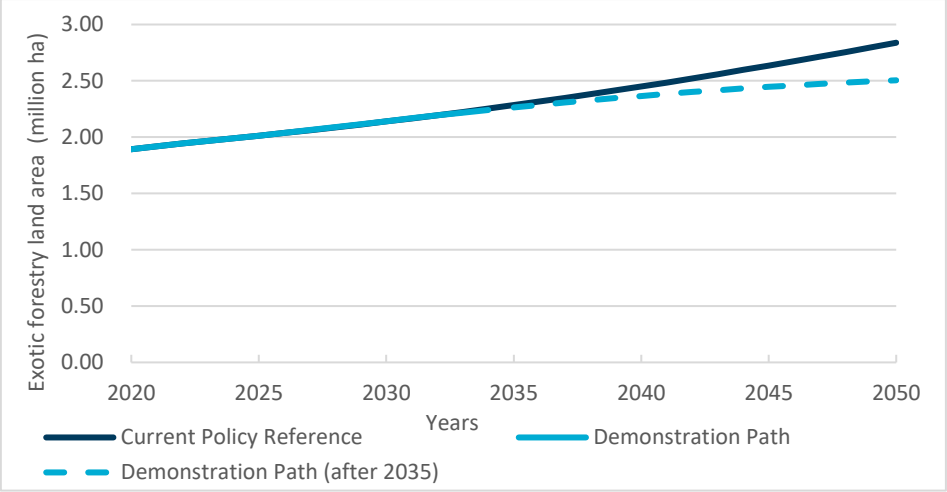
Reference case out to 2050. This is because our demonstration path places less reliance on forestry removals and more reliance on gross emissions reductions. It is also because our demonstration path assumes a greater proportion of native forestry, reflecting the greater co-benefits of native forests.



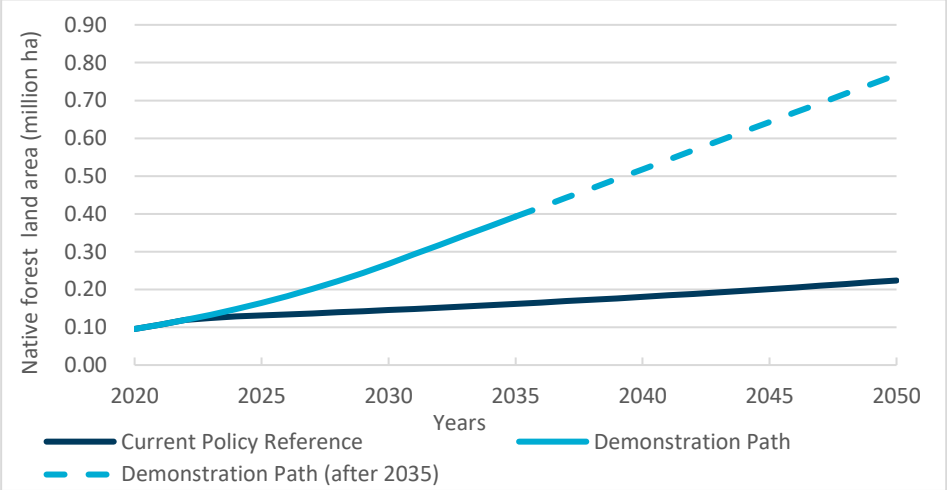
Dairy land area (million ha)



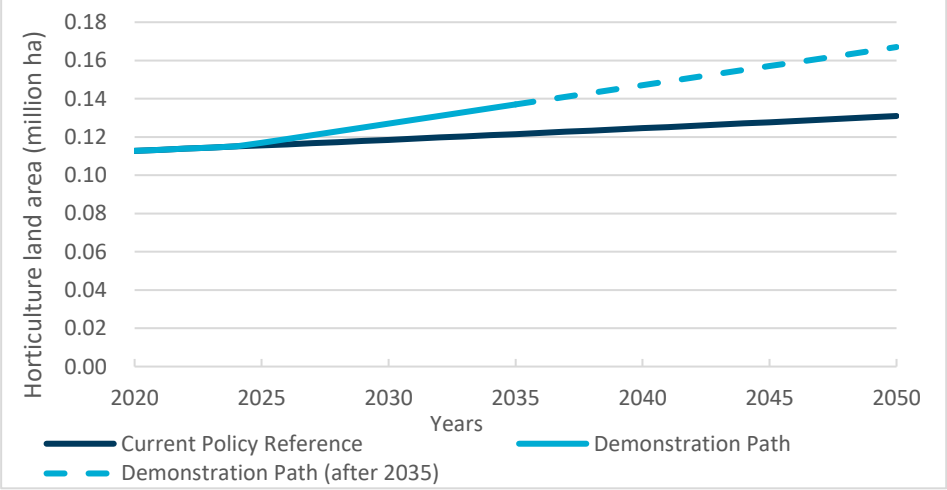
Sheep and beef land area (million ha)



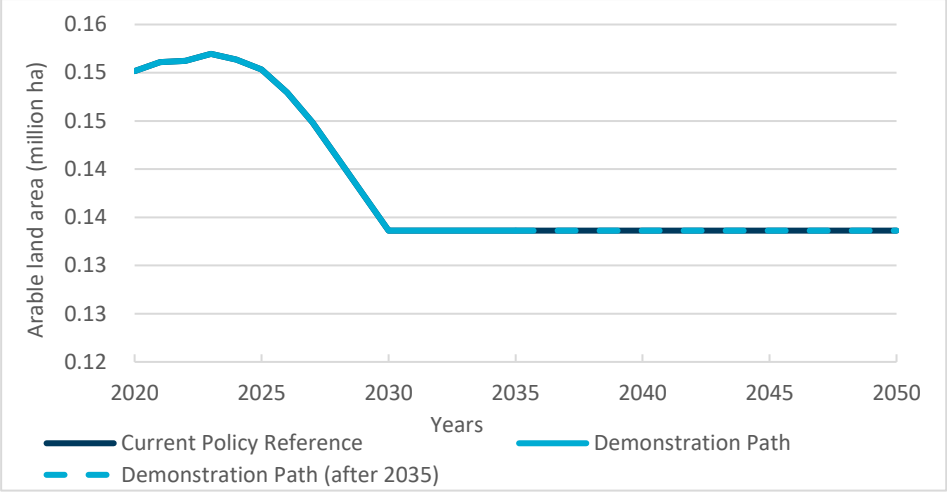
Exotic forestry land area (million ha)



Native forest land area (million ha)



Horticulture land area (million ha)



Arable land area (million ha)

Figure 16.6: The land area of the dairy, sheep and beef, exotic forestry, native forestry, horticulture and arable sectors under the Current Policy Reference case and our demonstration path.

Source: Commission analysis.

16.7.1 Afforestation

Under our emissions budgets, afforestation could play a role in helping achieve our emissions budgets and emissions reduction targets. However, we heard though consultation that there are some concerns that the speed and potential extent of afforestation could have significant impacts on communities. This could impact both rural communities and provincial centres that are reliant on the food and fibre industry for work.

Rural communities are particularly reliant on the primary sector for employment. The food and fibre produced in rural communities also supports the wider communities and the broader food system, including many of our towns, providing work in transporting and processing primary products. Impacts on rural communities can therefore have flow on effects to urban and provincial centres.

Rural communities and the workers living there also face other pressures, for example from automation. Automation of jobs is expected to impact rural communities more than urban centres.[58]

These concerns reflect the experience of rural communities in the late 1980s when economic restructuring, including the reduction of state services and removal of agricultural subsidies, led to wholesale and rapid land-use change. This negatively impacted some rural communities through reduced employment and population. The closure and consolidation of food and timber processing plants had dramatic effects on small towns previously dependent on them. These shifts drove demographic changes and affected key social institutions such as schools, libraries, and sports clubs.[59]

Some rural communities are concerned that significant afforestation could occur on sheep and beef land, with associated employment impacts and flow-on effects. The impacts of any afforestation

[58] (Infometrics, 2018)
[59] (Taylor, 2019)

would depend on the scale, pace and species of trees that are grown, the purpose for which the trees are grown, and the type of land that is afforested.

Our modelling in ENZ does not determine the location of this afforestation, but recent research suggests the north-eastern North Island is where the largest afforestation would likely occur.[60] This could also significantly intersect with collectively owned Māori land.

Many sheep and beef farms have areas of land that are considered unproductive, due to steepness and susceptibility to erosion, and which could be afforested without a significant impact on farming productivity or employment. There are a range of estimates as to how much land falls into this category. Recent studies put the potential area at 1.2 to 1.4 million hectares,[61] while the Biological Emissions Reference Group estimated that approximately 6% of hill country sheep and beef farms could be afforested without negatively affecting production, equating to approximately 250,000 hectares.[62] However, the characteristics of some of this land also make it uneconomical or highly environmentally risky to harvest forests on it, meaning permanent forest may be the more suitable land use.[63]

The bigger concern for many is that entire farms could be converted into forestry, thereby entirely displacing sheep and beef operations, with resulting economic and employment impacts. There are a number of studies that have looked at these potential impacts, discussed below.

Significant land-use change from pastoral agriculture to forestry would lower export earnings until the forests are first harvested – typically after 25-30 years for *Pinus radiata*. 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.[64]

Jobs offered by forestry and sheep and beef farming vary by time and location, and depend on the type of forestry. PwC carried out analysis of the number of jobs at the national level across the value chain for both production forestry and sheep and beef. Their analysis suggests that production forestry generates, on average, 38 full time equivalent jobs (FTEs) per 1,000 hectares across the whole value chain, from site to export, while the figure for the sheep and beef value chain is 17 FTEs. Plantation forestry integrated into sheep and beef farming, and permanent carbon forestry were associated with 20 and 1 to 2 value chain FTEs per 1,000 hectares, respectively.[65] These FTE numbers include direct jobs such as shepherding, logging, and food and wood processing, as well as indirect and induced jobs in areas such as transport, consulting, retail and hospitality.[66]

At a more local level, consultants looked at the direct jobs in Wairoa from sheep and beef farming compared to forestry, where direct jobs were considered to mean working 48 weeks a year for 40

[60] (West et al., 2020)
[61] (Manley, 2019; Mason & Morgenroth, 2017; Ministry for Primary Industries, 2018)
[62] (Reisinger et al., 2018)
[63] For example, some land may be physically difficult to access for cutting, or far from processing facilities, making it too costly to harvest. Other land may be too steep or close to sensitive waterways, meaning the risks of erosion and sedimentation are unacceptably high.
[64] (Infometrics, Forthcoming)
[65] The PwC analysis for permanent carbon forestry included radiata pine, exotic forests and indigenous forests using MPI look up tables. The value of 2 FTEs per 1,000 ha corresponds to radiata pine. The other two types of forest result in 1 FTE per 1,000 ha each (PwC, 2020).
[66] (PwC, 2020)

hours per week at at least $25/hour.[67,68] This study found that sheep and beef farming created 7.4 direct jobs each year per 1,000 hectares. Up until the harvest period, forestry created 2.2 direct jobs per 1000 hectares each year for the first 29 years. It also found that there were fewer direct local forestry jobs for most of the rotation period before growing rapidly for a temporary period during harvest.[69] However, the study found that the seasonal nature of forestry jobs could be controlled by managing harvesting patterns and ensuring that the forest estate is a mixed age class.

When harvest is included (accounting for cartage and roading), this increases to 5.1 direct jobs per 1000ha, averaged over 30 years. Therefore, harvest time creates 89.4 jobs in one year (assuming all harvest is completed in one year). These jobs include labour such as logging and trucking, as well as services such as mechanics.

Additional analysis shows that carbon farming created 0.6 local jobs per 1000ha which were predominantly planting trees, and once the forests were planted the jobs would cease. The limited long-term work opportunities include measuring growth and filing emissions returns, however, this work does not necessarily need to be done by local people. Both the PwC and BakerAg reports agreed on the low-economic value and low employment created by permanent carbon farming.

Analysis suggests that sheep and beef farms can generate a wide variety of job types across labour and services.[70] In 2019, 980 direct jobs came from sheep and beef farms, which equated to 30% of the people in paid employment in Wairoa. This generates flow-on employment in other sectors in Wairoa including education, health, retail, and entertainment. As many of the jobs in forestry occur during harvest time, the industry's contribution to the wider community fluctuates in line with harvesting.

These numbers suggest that, on average, forestry could provide more jobs across the value chain, but that wholesale or large conversions of sheep and beef farmland to forestry might reduce employment in the immediate area. This aligns with earlier work assessing the impact of increased forestry in the 1980s and 1990s, which found forestry provided slightly more jobs than pastoral agriculture overall, but these were more concentrated in larger rural towns, particularly those involved in processing.[71]

Forestry and pastoral farming vary not just in terms of the number and location of jobs, but also in terms of wages and skills required.

In the past, the development of forestry boom towns was associated with higher Māori populations and comparative ethnic diversity.[72] Māori workers made up 22% of the forestry workforce in 2017,[73] while the average share of Māori in agriculture, forestry and fishing employment in 2013 was 11%.[74]

Initial analysis being carried out for the Commission by Motu, based on census and other Stats NZ data, identified that although employment in dairy and in sheep and beef is predicted to decline

[67] (BakerAg, 2019)
[68] This definition of 'jobs' is therefore weightier than FTEs used in the PwC report, which partly accounts for the lower number.
[69] (Bruce & Harrison, 2019)
[70] (BakerAg, 2019)
[71] (Fairweather et al., 2000)
[72] (Taylor, 2019)
[73] (Te Uru Rākau et al., 2020)
[74] (BERL & FOMA, 2019)

between 2020 and 2050 based on land-use changes, these declines are expected to be offset by employment gains in forestry and horticulture.[75] This may not be an easy transition for workers and businesses, therefore it is important to understand the worker characteristics in order to understand their mobility to switch into other sectors. The forestry and agriculture industry workers and jobs have different characteristics. Motu found that forestry and logging workers were more likely to be male, full-time, permanent, and Māori relative to pastoral farming. Forestry and logging roles generally paid more are more likely than those in pastoral farming to only have one job, especially if they work full-time.

A shift in where workers live would have wider implications for the social structure of rural communities, potentially leading to declines in school rolls and spending in local businesses. This could affect all rural communities but will potentially have important ramifications for Māori who have already suffered displacement and disconnection from their whenua.

Relying on forestry removals to reduce the effects of climate change would also create risks associated with the physical impacts of climate change, and could also divert action away from reducing gross emissions in other sectors. Fires, high winds and other physical impacts that are exacerbated as a result of climate change would pose an increasing risk to forests.

The scale of afforestation that is expected to occur would in large part be driven by the emissions price in the New Zealand Emissions Trading Scheme (NZ ETS) and other financial incentives such as the One Billion Trees programme, in addition to export prices. Current policy settings and sector infrastructure heavily favour the planting of exotic *Pinus radiata* over other species. Increasing emissions prices would also incentivise greater shares of permanent exotic carbon forestry.

Constraining this price incentive for afforestation through the NZ ETS could help limit its overall scale. However, it would not necessarily address the issue of wholesale farm conversions, which is what likely has the greatest effect on rural communities. Limiting this would likely require a regulatory approach, through the Resource Management Act or alternative intervention, that places restrictions on land-use change.

Capacity building and extension services for landowners focused on integrating trees or forestry onto farms as diversification rather than wholescale farm change could limit the impacts of afforestation. Developing carbon monitoring systems that allow for tracking, and rewarding sequestration from smaller or dispersed areas of trees could also facilitate this.

Changing the balance of incentives in exotic versus native afforestation would also alter the impact on rural communities. Native afforestation might generate less value chain jobs than exotic forestry if it is not all planted and harvested. However, it could be suitable for areas of less-productive land. It would, therefore, not come at the expense of other economic activity. Mechanisms to incentivise native afforestation could come by extending grant schemes such as One Billion Trees or by developing ecosystem services payment schemes that could reward the other environmental benefits of native forests.

Efforts could also be made to promote a native forestry industry. This could be particularly relevant for Iwi/Māori. Efforts to increase domestic timber demand by changing building policies could also stimulate the wood processing industry and increase the value chain employment of forestry.

[75] Characterising Rural Employment, MOTU, *Pending publication*

16.7.2 Land-use change to horticulture and other uses

Diversifying land and switching some land currently in pastoral agriculture to horticulture, arable crops, and other livestock such as pigs and poultry produces considerably lower biological greenhouse gas emissions per hectare.[76] However, horticulture and arable systems often involve higher fossil fuel consumption.[77]

The combined area of land in horticulture and arable crops in Aotearoa is currently about 1% of total land use. More than 1.5 million hectares of land currently in livestock farming would be suitable for horticulture or arable cropping.[78]

However, there has not been significant diversification to horticulture despite it being more profitable per hectare than dairy or livestock farming. This indicates that there are barriers to shifting land use in this way. Barriers include:

- Labour shortages for seasonal workers
- High capital investment of converting and lack of access to capital[79]
- Lack of infrastructure and supply chains[80]
- Challenges with market access and non-tariff barriers[81]
- Tightly managed markets to maintain premium prices[82]

Workers require adequate housing, transportation and access to facilities and services. Hence, labour shortages in horticulture and agriculture in general are a more complex issue than merely a lack of capacity or skills. COVID-19 and the close of our borders has exacerbated existing labour shortages of the industry.

Aotearoa citizens and permanent residents make up about 65%-75% of the horticultural labour force, with the remainder being workers on temporary visas.[83] About 33% of the seasonal labour in 2019 were part of the Recognised Seasonal Employer scheme, and most workers for the apple and pear sub-sector come from the Pacific.[84]

Globally, automation in horticulture is likely to accelerate in the packhouse and the fields within the next 5 years. Opportunities may open in data science, technology, and information and communications technology related to the industry.[85]

Hence, in the long term, the industry will need to attract people who can work with machines, through apprenticeships, and science, technology and mathematics education for the whole food and agriculture sector. This will require collaboration across agricultural sectors as well.[86]

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[76] (Interim Climate Change Committee, 2019)
[77] (Reisinger et al., 2017, p. 61)
[78] (Reisinger et al., 2017, p. 8). For example, apples, kiwifruit, grapes, vegetables and pulses.
[79] Productive orchards sell for about NZ$350,000/ha for Green and NZ$500,000/ha for Zespri Gold, severely limiting new entrants to the industry. (Cradock-Henry, 2017)
[80] (Clothier et al., 2017)
[81] (Horticulture New Zealand, 2019; Journeaux et al., 2017; Westpac, 2016)
[82] (ANZ, 2018)
[83] Includes viticulture, seasonal and off-season (NZIER, 2019)
[84] (New Zealand Kiwifruit Growers Incorporated (NZKGI), 2020)
[85] (Higgins et al., 2020)
[86] (Higgins et al., 2020)

Some Aotearoa companies are testing and using robotics for fruit picking and sorting.[87] Automation would be constrained by access to capital.

[87] (Good Fruit & Vegetables, 2019; Jee, 2019; Robotic Plus, 2019)

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