Chapter 17:

The direction of policy for Aotearoa

Transitioning to low emissions in Aotearoa requires changes across the whole economy and society. The Commission has been tasked to advise on the direction of policy for the emission reduction plan, which will outline the Government's approach to reducing emissions across all sectors.

This chapter focuses on policy that is needed to support emissions reductions in different sectors of the economy, policies that cut across sectors and measures to address the impacts of mitigation policies. In preparing our analysis and advice on the emissions reduction plan, we have drawn on modelling, analysis of emissions reduction measures, uptake barriers, potential impacts and pathways for meeting the 2050 target.

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17.1 Introduction

This chapter presents the Commission's advice on the **direction of policy** for the Government's emissions reduction plan. The material in this chapter draws on the analysis and modelling in previous chapters around the Current Policy Reference case, scenarios and the pathway for meeting the 2050 target, mitigation options, uptake barriers and impacts.

In accordance with the Climate Change Response Act (2002), we must: *"provide to the Minister advice on the direction of the policy required in the emissions reduction plan"* for the first emissions budget period.

The Government's first emissions reduction plan will focus on the first emissions budget period. However, it may also include policies and strategies to prepare for meeting subsequent emissions budgets, and to achieve and sustain the emissions reductions needed in the long term. This means the emissions reduction plan will need to identify areas where early action is needed to unlock potential for significant emissions reductions in the future.

In order to provide relevant information, the Commission has considered the factors the Minister must consider under the CCRA in preparing the emissions reduction plan. These include:

- a multi-sector strategy
- sector-specific policies, and
- a strategy to mitigate impacts of policies on Iwi and Māori, employees, employers, regions, and wider communities, including the funding for any mitigation action.

We have used these components of the emissions reduction plan to organise the material in the following chapter.

This advice aims to help clarify for the Government what its high-level strategy and priorities should be for tackling the substantial and complex task of driving the low emissions transition.

The Commission has focused its advice on identifying the goals and key interventions that government climate change mitigation policies need to deliver. The technology and economic pathways analysis undertaken for emissions budgets provides the foundation on which much of our advice on policy direction is built. This is particularly the case for the sector-specific policies.

This advice also aims to move beyond a techno-economic approach to consider the societal or system changes that are needed. This includes the role of different actors in the system (consumers, businesses, industry, central and local government), as well as issues of supply and demand, and cost and capability.

As identified in *Chapter 9: Which path could we take?* our analysis shows that some technologies, such as electric vehicles and a methane inhibitor or vaccine, have the potential to achieve significant emissions reductions. However, government policy should encourage a wider set of actions than

simply what is necessary to meet the emissions budgets, because it is uncertain how new technologies would develop and progress over time, and some policies and actions are likely to deliver less emissions reductions than expected.

In many instances, there would also be a lag time between implementing an ambitious policy and seeing significant results in the form of emissions reductions. For example, the slow turnover in the light vehicle fleet and industrial infrastructure means that ambitious policies would take some time to have a substantial impact on emissions.

As previously noted, it is also set out in the legislation that government must partner with iwi/Māori to develop approaches to meeting the emissions budgets. Approaches should balance different objectives and considerations, and align with the He Awa Waiora framework. Incorporating mātauranga and tikanga Māori into solutions and decision-making by partnering with whānau, hapū, iwi, and communities would create change and facilitate the transfer of knowledge and actions to and for future generations. The Government and iwi/Māori must work in partnership at all stages of the policy process.

17.2 Multi-sector strategy

This section focuses on identifying areas where action is needed, and which cut across all sectors.

The transformation of Aotearoa to a low emissions society and economy is one that requires the combined effort of government, businesses, iwi/Māori, communities and individuals. The Commission is providing advice on the direction of policy to government, who have levers to affect change both directly and indirectly throughout Aotearoa.

The following section sets out some of the options for influence which cut across sectors, such as the Emissions Trading Scheme, the work of agencies in partnership, government investment and accounting for emissions, innovation and research and development (R&D) spend, and information and behaviour change.

17.2.1 Strengthen market incentives to drive low emissions choices

As noted in *Chapter 16: Our approach to policy*, emissions pricing is a powerful tool and an essential component of an effective and efficient policy package for reducing emissions. In Aotearoa, the main emissions pricing instrument is the Emissions Trading Scheme (NZ ETS). The NZ ETS is a key multi-sector policy as it covers all major sources of gross emissions, except biogenic methane and nitrous oxide from agriculture. The NZ ETS also covers a significant share of forests in Aotearoa.

The NZ ETS will need to be adjusted on an ongoing basis to keep it fit for purpose. The NZ ETS has been in place since 2008, with limited success in reducing emissions. To a large extent this is due to flaws in how it was managed, which allowed the price of NZUs to drop to very low levels over 2012 – 2015. Since 2016, a series of reforms have been undertaken and the NZ ETS now has much of the architecture needed to be more effective. Further improvements are still needed, particularly with respect to NZ ETS unit volume and price control settings, and market governance.

The following sections discuss the main areas where further improvements to the NZ ETS are necessary to make it more fit for purpose.

Adjust NZ ETS unit volumes and price control settings to align with budgets

The NZ ETS reforms have enabled a cap on units in the NZ ETS as well as an auction reserve price and cost containment reserve to discourage NZU prices from reaching unacceptably high or low levels. These will be set on a five-year rolling basis, with an annual process for adding a further year of settings and potentially amending other years' settings. The first regulations establishing these settings for 2021-2025 have been finalised and will be implemented through auctioning from March 2021. As this had to be done prior to the Commission's advice on emissions budgets, the settings adopted by the Government were informed by a provisional emissions budget for 2021-2025, which reflected a straight-line trajectory to the 2050 target.

As expected, the modelling results developed by the Commission and the emissions budgets that it recommends differ from the provisional emissions budget (PEB). When the unit volume and price control settings are extended in 2021 to cover the 2022-2026 period, the Government has an opportunity to align them with the Commission's advice.

More broadly, the current framework for incentivising forests through the NZ ETS does not align with our recommended focus on driving gross emissions reductions and a change in the balance of exotic versus native afforestation as compared with the status quo.

Challenges

The most obvious area where NZ ETS settings need to change substantially is the price controls, with the existing settings being too low. The auction reserve price currently starts at $20 and rises to $21.65 in 2025. The cost containment reserve trigger price starts at $50 and increases to $54.12 in 2025. This is due to annual increases of 2% each year to reflect expected inflation. Continuing this approach would lead to an auction reserve price and cost containment reserve trigger of about $24 and $60 respectively in 2030.

Our modelling indicates that the pathways for meeting the 2050 target might require actions to reduce emissions in some sectors with cost of about $140 in 2030, and $250 by 2050. These modelled costs are not a forecast of the NZ ETS market price. Rather, they reflect the marginal cost of the measures that would need to be implemented to meet the relevant emission budget and get on the pathway for meeting the 2050 target.

The Government also has choices around the extent to which it relies on the NZ ETS or other policies to make these emission reductions happen. The more that non-ETS policies are used, the more likely it is that the NZU price in the NZ ETS can be lower while still achieving the same overall amount of emission reductions. This might not reduce the overall cost of reducing emissions – it would just mean that the cost of achieving some reductions was less visible in the emissions price, because it was not contributing to price formation in the NZ ETS market.

Approach / policies:

Increase the cost containment reserve and auction reserve price triggers. Whatever combination of policies the Government chooses to implement to meet the emissions budgets, our analysis indicates that the NZU auction price controls in the NZ ETS need to be significantly higher. Not increasing them from current levels would risk triggering the cost containment reserve to release more units at auction in particular. This would flow through to increasing the stockpile of surplus

units in the market and depressing the NZU price, which in turn would make it very difficult to meet emissions budgets as the NZ ETS would not be able to drive the necessary emissions reductions.

The auction reserve and cost containment reserve trigger prices are intended to act as safety valves to prevent unacceptably high or low NZU prices. They should not be set at levels at which they are likely to be triggered, rather they should provide a sufficiently wide corridor in which price discovery by the market can occur.

As noted earlier, the marginal abatement cost of $140 in 2030 arising from the Commission's modelling is not an NZU price forecast and the combination of policies the Government chooses to implement could cause the NZ ETS market price to be much lower. It does, however, indicate the level to aim for or exceed in 2030 for a cost containment reserve price that is unlikely to be triggered.

The auction reserve price needs to be set at a level that balances signalling that higher prices can be expected in future to support investor confidence, with managing the risk of creating opportunities to profit speculatively simply from holding units. Importantly for the former, process heat is a sector where the emissions price can be expected to play an important role in driving decarbonisation over the 2020s and beyond. Our evidence suggests that, other than efficiency measures, mitigation opportunities in this sector such as fuel switching only start from around $50 upwards.

There is a case to step the auction reserve price up to a level closer to recent market prices immediately, to protect investments made factoring in NZU prices over the past two-three years. Annual increases thereafter can be more moderate than increases to the cost containment reserve trigger price.

Increases to these price controls should also factor in inflation, to avoid their erosion in real terms.

Update unit volumes. The unit volumes will also need to be updated to reflect the first and second emissions budget, although there is less change in this respect between the Commission's recommended budget volumes and the provisional emissions budget. The NZ ETS unit volumes, for a range of reasons, will not exactly align with the emissions budget but there should be a clear logic to the relationship between the two. One reason why they will not exactly correspond is that the Government will need to continue to restrict auction volumes to reduce the unit stockpile.

Implement levers to manage forestry removals. The Government should also consider implementing a lever or levers into the NZ ETS to manage the amount of forestry removals that the scheme incentivises, in line with the pathway to meet emissions budgets (discussed in more detail below in the *Forestry and removals* section).

Improve NZ ETS market governance

Good governance of the NZ ETS market is important for the integrity and efficiency of market trading and to reduce the risks of misconduct, which could distort the NZU price and reduce confidence in the scheme.

Challenges

The regulatory framework governing conduct in the NZ ETS market is patchy and incomplete. The Government has recognised that this is a problem, identifying several risks to the functioning of the NZ ETS market. This includes risks of insider trading; market manipulation; false or misleading advice

to participants; potential lack of transparency and oversight of trades in the secondary market; money laundering; credit and counter-party risks; and conflicts of interest.

In response to these problems the Government has established a market governance work programme to develop both regulatory and non-regulatory options to address these risks.[1] This is an area where careful and detailed policy development is needed so it should not be unnecessarily rushed. However, progress on this work programme has been slower than would be ideal.

It is difficult to determine to what extent, if at all, these risks are occurring in the NZ ETS market now. Some of these risks have the potential to severely damage confidence in the market and its effectiveness to drive emission reductions. Increasing NZU prices are likely to heighten the risks. Confidence in the NZ ETS market is still rebuilding after events such as the extremely low prices experienced over 2012-2015 period.

Approach / policies:

The NZ ETS is a critical tool for the low emissions transition so it should be safeguarded by appropriate market regulation.

Internationally, most emissions trading schemes are regulated as financial markets. In these ETSs, the market participants can be generally categorised as wholesale. The NZ ETS market has special characteristics, including a large number of essentially retail-level participants such as small forest owners. This means that NZ ETS may need a bespoke regulatory regime, rather than full application of the Financial Markets Conduct Act (FMCA), although it may be appropriate to apply elements of the FMCA to the NZ ETS.

The market governance work programme would therefore benefit from strong involvement of agencies with expertise in the FMCA and market regulation, such as the Ministry for Business, Innovation and Employment (MBIE).

Address other NZ ETS-related issues

There are a range of other NZ ETS-related issues that should also be progressed, although they are not as critically important as the two highlighted above. They are briefly outlined below.

Determining use of auction proceeds: The Government has indicated it is considering options for recycling some or all the cash that would be generated from NZ ETS unit auctions.[2] Under current fiscal policy practices, this cash would be retained and allocated through Budget processes.

Auction proceeds could be used for a specific purpose,[3] which would provide an opportunity to boost public support for the ETS. For example, proceeds could be invested directly in emission-reduction activities and infrastructure, to support low-income households and communities through the transition and adjust to rising emissions prices, or for assisting communities and local authorities with the costs of adapting to the impacts of climate change.

Another option that needs to be considered is purchasing offshore mitigation to enable Aotearoa to meet its Nationally Determined Contribution (NDC).

[1] (Ministry for the Environment, 2019b, 2019a)
[2] (Cabinet Environment, Energy and Climate Committee, 2020)
[3] This is often termed revenue recycling

Future of industrial free allocation: The current approach in the NZ ETS to mitigate emissions leakage risk – output-based industrial free allocation – has some downsides. It limits demand-side emissions reduction, is not compatible with deep decarbonisation in the long term and uses taxpayer resources which then cannot be used for other purposes.

- A gradual phase-out of industrial free allocation was introduced through the recent NZ ETS reforms. The Government is also planning to undertake a first principles review of industrial free allocation policy, including looking at potentially updating the electricity allocation factor and allocative baselines. These are useful steps and should be pursued.
- There are alternative policy instruments that could be used to address the risk of emissions leakage such as product standards, consumption taxes and border carbon adjustments (BCAs). These choices should be explored, as over the longer term they may be a more compatible with the 2050 target and allow industrial free allocation to be reduced more quickly.

Reducing the uncertainty about adjustments to NZ ETS settings: As we outlined in our submission to the consultation on the proposed NZ ETS settings in February 2020,[4] it would be beneficial if the Government provided more information about how it intends to adjust unit volumes over time through the rolling five-year process for determining NZ ETS settings.

To build confidence in the market and support informed decision-making by market participants, the process for adjusting NZ ETS settings should be predictable and transparent. Specifically, it would be useful for the Government to outline how it intends to manage unit volumes in the NZ ETS in light of the split-gas 2050 target. One option the Government could consider would be to outline its approach to making adjustments over time in a published document or policy. This would help to reduce uncertainty about future unit supply, facilitate price discovery and better enable the NZ ETS to drive low emissions investment.

Voluntary action to reduce emissions and the voluntary emissions market: Some individuals and businesses wish to undertake voluntary action to contribute additional action towards or beyond meeting the emission-reduction targets. There is currently a lack of clarity about the role and avenues for voluntary emissions reductions in Aotearoa. This is due to the wide emissions coverage of the NZ ETS as well as the fact that negotiations about how trading in offshore mitigation will work in future have not concluded. There are also concerns within government that if a mechanism is enabled that allows the use of domestic emissions reductions for voluntary offsetting for carbon neutral claims, it would make achieving the emission reduction targets more costly overall. This lack of clarity means that desire for voluntary action in the private sector is not being leveraged for climate benefits, which is a missed opportunity.

The Government should clarify the types of claims that can be made about voluntary emissions reduction action that are possible in Aotearoa. This should consider how the NZ ETS and targets are accounted for – which is discussed in *Chapter 3: How to measure progress.*

[4] (Climate Change Commission, 2020)

Factor target-consistent long-term abatement cost values into policy and investment analysis

The Government's policy decisions or investments in long-lived assets must not lock Aotearoa into a high-emissions development future or one that increases exposure to the impacts of climate change.

A specific action that could have a powerful effect to help future-proof these decisions would be to require the incorporation of long-term abatement cost values consistent with climate change goals into the Government's cost-benefit or cost-effectiveness analysis. This is sometimes termed a 'shadow price' on emissions. It is common practice internationally; the World Bank and a range of countries such as the UK and France include a shadow price path in financial analysis of investment and policy decisions.

Challenges

Government agencies in Aotearoa currently use a range of different emissions cost values in analysis – there is no consistent approach.

The Productivity Commission's *Low-emissions economy* report recommended use of a shadow emissions price.

Work has progressed but an approach is still not widely bedded in within government. Our analysis also now provides new information and an opportunity for long-term abatement cost values consistent with the 2050 target to be adopted for this purpose.

Approach / policies:

The Government should adopt and implement, across government agencies, a centrally agreed path of abatement cost values for policy and investment analysis based on what is needed to meet the 2050 target. This will increase consistency and comparability in government investment decision-making, including in cost-benefit analyses. This shadow price path would also be useful for guiding local government and private sector decisions, to ensure that climate considerations are given appropriate weight and to avoid investments in assets that may later become stranded. Our analysis suggests that marginal abatement costs of around $140 in 2030 and $250 in 2050 in real prices are likely to be needed for Aotearoa to meet the proposed emissions budgets and the 2050 target. This information should inform the values used for policy and investment appraisal.

These long-term marginal abatement cost values are not a forecast of NZ ETS unit prices and is conceptually different from the market price in the ETS.

17.2.2 Integrate Government policy making across climate change and other domains

Transitioning Aotearoa to a low emissions economy requires a coherent and coordinated approach to climate change across government agencies, and across levels of government. A focus on coherent policy is important to ensure that households, business and communities receive clear and consistent signals about the transition to low emissions, and the nature and speed of change required. The fragmented nature of the government machinery poses a challenge in this regard.

Challenges

Responsibility for the development of climate policy is distributed across a number of different government agencies in Aotearoa.

While Ministry for the Environment (MfE) holds the lead in terms of the overall architecture of climate policy, the policy levers for the different sectors sit with other agencies. Ministry for Business, Innovation and Employment (MBIE), Ministry for Primary Industries (MPI), Ministry of Transport (MOT), Ministry of Foreign Affairs and Trade (MFAT), Treasury and the Environmental Protection Agency (EPA) all play different roles in terms of providing advice on mitigation, administrating mitigation policy (such as the ETS), or international climate related negotiations.[5] Agencies like Ministry of Housing and Urban Development (HUD), Inland Revenue (IRD), Department of Conservation (DOC), Ministry of Education (Education), Ministry of Defence and others also have policy remit and levers that can be used to achieve climate change outcomes. For agencies aside from MfE climate change is not their core business, and climate considerations are often crowded out by other priorities.

Currently climate change considerations are also not consistently 'mainstreamed' throughout all government policy and procedures, including understanding how government levers can be used as a mechanism to achieve climate change outcomes. Measures such as tax levers and structures, procurement procedures, and cost benefit and regulatory impact analysis (RIS) are all instruments that can be used to achieve outcomes, but this is not done systematically. This means that climate impacts are not reliably considered during the development of new policies, regulations or fiscal proposals – which can undermine climate change goals. Decisions being made by national (and local) agencies can be poorly aligned and lack policy coherence. Different agencies also give different weighting to various concerns in their decision making.

Factoring target-consistent long-term abatement cost values into policy and investment analysis (as discussed in the previous section) will help to expand capabilities and mainstream climate considerations, but other approaches are also important.

Some activities that take place across sectors, such as tourism, the food and fibre system and international education, have a significant impact on emissions. However, opportunities for reducing emissions from these activities are often not well understood due to their cross-cutting nature. The responsible government agencies do not have climate change as part of their core business, and therefore tend not to focus on low emissions objectives.

Approach / policies:

It is important to ensure that climate change objectives are given a high priority across government and factored into decision making. Ministerial focus on climate change goals and the use of connected Ministerial portfolios is helpful. Consistent signalling across investments, policy statements, direction to officials and internal policies and directives is also important to ensure that all regulatory and policy frameworks are aligned with low emissions objectives.

Ensuring government procurement policies include climate considerations, and leveraging government purchasing power to support low emissions products and practices could also help reduce emissions.

17.2.3 Support innovation to speed up the transition to low emissions

Innovation is the process of converting ideas and knowledge into new products, processes and ways of doing things. Transitioning Aotearoa to low emissions will require innovation right across the

[5] (New Zealand Productivity Commission, 2018)

economy, including energy and transport systems, buildings, industrial processes and how land is used. Innovation is an important driver of increased productivity and pushes out the boundaries of what is possible.

Innovation is not always about developing something completely new, it is also about adapting existing technologies and practices to new circumstances. Aotearoa is likely to be a technology taker in many areas, but innovation will still be needed to absorb, adapt and deploy new technologies and processes developed elsewhere.

Innovation results from investments in research, development and demonstration (RD&D), and from combining complementary ideas, skills and technologies in new ways.[6] Public and private investments in RD&D support both the development of new technologies, and the testing, adaptation and adoption of technologies that already exist. Innovation also depends on access to knowledge, skills and finance.

Challenges

While innovation can play a central role in supporting the transition to low emissions, there are currently several challenges that can hinder the innovation process. Innovation is costly and risky, and its impacts are often uncertain. Investing in climate related innovation can be hard for business to justify in the face of competing pressures. Businesses have limited access to the money, time and skills needed to carry out innovation or to invest in adopting low emissions technologies and processes.

The 'spillover benefits' from RD&D can also deter private companies from making investments. Spillover benefits occur when the development of new ideas or technologies benefit numerous businesses or people (including in the future) beyond those who pay for and develop them. Other businesses and individuals can copy the idea or practice, and so do not have to invest in research and innovation to create those benefits. Spillover benefits from low emissions innovation are good for the global climate, but it can act as a disincentive if the business or organization that created new technologies or processes cannot be sufficiently rewarded.

Existing product standards and specifications can also inhibit innovation, as they do not explicitly allow use of emerging low carbon products. This means new approaches can be perceived as risky or unproven, which can constrain demand. At the same time, the process of achieving product assurance and certification for new approaches is resource intensive.

Other factors that can inhibit innovation include lack of information about, or awareness of, the performance, cost and availability of low carbon products amongst trade professionals, suppliers, and end users. A lack of harmonisation across the supply chain can also limit awareness about opportunities to streamline engineering, procurement and construction in a way that increases energy and resource efficiency.

Incentivising innovation has the potential to speed up emission reductions and lower their costs. Emissions pricing is one key aspect of incentivising innovation but, given the risks and long timeframes, it provides an uncomplete incentive. Pricing therefore needs to be supported by other policies to help overcome some critical barriers.

[6] (New Zealand Productivity Commission, 2020)

Given the long timeframes associated with RD&D, incentives need to be in place early to drive the innovation needed to support a cost-effective path to meeting the 2050 target.

The Productivity Commission made several recommendations to improve the national innovation system and align it with climate change goals.[7] This included establishing the goal of transitioning to low emissions as a key priority within the national innovation ecosystem.

Approach / policies:

Aotearoa needs to ensure that it has well designed policies and support in place that enable researchers and industry to develop, adapt and deploy low emission technologies.

Effective emissions pricing will be an important part of incentivising innovation, but direct support for RD&D, and to support the development of necessary skills and capabilities will also be important. Measures could include, for example:

- Clearly signalling policy direction to incentivise innovation. This includes signalling policy changes and pathways to reaching the 2050 target well in advance;
- Government RD&D investments should also be targeted to areas where Aotearoa is likely to be a technology leader, and where the spillover benefits are likely to be greatest – including RD&D to reduce emissions from agriculture.
- Transitioning to a low emissions economy should be embedded as a key goal within programmes for supporting science and innovation, to ensure climate change objectives are prioritised – for example, through government-led schemes like Callaghan Innovation research and development grants, the Centres of Research Excellence, Crown Research Institutes, and the National Science Challenges.
- Introduce measures to de-risk innovation and early uptake of low emissions technologies and processes – for example, more direct public backing and funding support for innovation focused on lowering emissions.
- Increase industry, operator and consumer awareness and knowledge of low emissions products and practices, including through greater investments in pilots and demonstration projects.

17.2.3 Information and behaviour change

Transitioning the economy to low emissions will require some significant changes to behaviour. This is highlighted by our modelling. Behaviour change will need to be at both an organisational and business level, as well as an individual one.

There will need to be changes to the kinds of cars people drive, the way they travel, and how their homes are heated. These changes will need to be supported by infrastructure. Businesses, industry and investors will also need to make some different choices. Some businesses will need to switch to new processes and ways of doing things. Many farmers will need to change how they manage their land. All these things rely on changing behaviour, and frameworks that support that change.

Policies, comprehensive research and measures will need to be put in place to support consumers, businesses, investors and others to make the necessary changes. One important element of this is

[7] (New Zealand Productivity Commission, 2018)

ensuring firms and financial entities provide information on the extent of their climate risk exposure and identify how those risks are being managed. This transparency is important to ensure that investors, insurers, lenders, Boards of Directors and other stakeholders can make informed decisions concerning their investments.

Another important aspect is the need to undertake research to identify opportunities to change behaviour in a way that aligns with emissions reduction goals and create structures that support the pursuit of those opportunities.

Require entities with large investments to disclose climate-related risks

Climate change exposes the financial system to risk and instability. An understanding of exposure to climate-related risk is important to help firms and other entities manage and appropriately price those risks. It also is important to inform lending, investment and insurance underwriting decisions, and allow companies to make decisions that reflect their view of how the transition to low emissions will play out.

Firms or entities with large investments in fossil-fuel exploration, or in emissions-intensive infrastructure, are potentially exposed to considerable financial risk if those investments and assets lose value or become unusable as the world transitions to low emissions – known as *"transition risks"*. Many other firms without direct investments in fossil fuels might also be exposed to financial risk through reliance on emissions-intensive supply chains etc.

Some firms will also be exposed to the physical risks of climate change. For example, many airports and ports will be more exposed to sea level rise and storm surges given they are located at or close to sea level. Publicly owned infrastructure such as roads, wastewater and stormwater, and electricity lines may also be affected. The 20,000 to 30,000 farm businesses in Aotearoa may also be impacted by more extreme weather events.

Challenges

Climate change poses a material financial risk not only to individual companies and investors, but to the entire financial system. Without clear and transparent information about exposure to climate risk, firms, lenders, investors, insurers and other stakeholders may be left with unforeseen liabilities, or risky investments.

Climate-related financial risk disclosures require firms to provide information on the extent of their climate risk exposure and identify how those risks are being managed. Based on recommendations by the industry-led Task Force on Climate-Related Financial Disclosures (TCFD),[8] disclosures should include information about:

- the organisation's governance around climate related risk;
- the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning;
- the organisation's process for identifying, assessing and managing climate-related risks; and
- the metrics and targets used to assess and manage climate-related risks and opportunities.

[8] (Bloomberg, 2017)

Disclosing climate-related issues supports long-term resilience, benefitting not just firms, investors and markets, but also workers and society more broadly. It also allows Boards to take these issues into account when making short and long-term investment plans, expenditure, acquisition and reviewing corporate strategy.

The Government has recently committed to implementing a mandatory financial disclosures regime.[9] The proposal received strong support during consultation, including from three quarters of respondents that would be impacted by the proposed regime.[10]

The proposed mandatory financial disclosures regime would start no earlier than 2023. It would cover about 200 entities that manage about 90% assets in Aotearoa – including banks, credit unions, building societies, insurers, investment schemes, and Crown financial institutions that manage more than $1 billion in total assets, and all equity and debt issuers listed on NZX.[11]

Approach / policies:

The mandatory financial disclosures regime proposed by the government is an important step in ensuring investors, insurers, consumers and others have the necessary information to make informed choices and avoid exposure to climate risks. The ongoing review of this regime will be important to ensure that it remains fit for purpose in the future, and as knowledge about the nature of climate risks evolves.

The proposed regime is limited to institutions that manage more than $1 billion in total assets, and equity and debt issuers listed on NZX. While the cabinet paper noted that it is important for public entities to consider and disclose their long-term climate-related risks and opportunities, the regime will not capture public entities.[12] The Government could consider extending the proposed regime to cover public entities at the national and local level.

Undertake research to identify opportunities to change behaviour and create structures to support the pursuit of those opportunities

Understanding how to encourage long-term and sustainable behaviour change, and what levers to use (for example, education, policy) will require an evaluation of current and past programmes in Aotearoa and internationally, as well as a significant research programme to identify what tools to use and why.

This recognises that changing behaviour is complex and requires a collaborative, focused and multi-agency approach. In some cases, change may need to be driven at a hyper-local level, recognising the barriers to change within communities can be very different. Individuals within communities can be strong advocates and drivers of sustainable and authentic change. Stakeholders have told us that funding or recognising these community advocates could be one tactic that has had success for other complicated social issues, for example family violence.

[9] (Cabinet Economic Development Committee, 2020; Ministry for the Environment & Ministry of Business, Innovation & Employment, 2019; New Zealand Government, 2020)
[10] (Office of the Minister of Commerce and Consumer Affair & Office of the Minister for Climate Change, 2020)
[11] (Cabinet Economic Development Committee, 2020; New Zealand Government, 2020)
[12] (Office of the Minister of Commerce and Consumer Affair & Office of the Minister for Climate Change, 2020)

Sustainable behaviour change campaigns use a carefully planned, audience-driven approach. This creates environments that support desired behaviour, rather than just targeting individuals, are grounded in good research, and continually evaluated.[13]

Challenges

Supporting changes to corporate, group and individual behaviour in a way that aligns with transitioning the economy to low emissions will be important. Large scale behaviour change is required in every sector of the economy to meet the 2050 target.

Processes that are well known in behavioural science, such as group polarization and science denial, pose a significant challenge to climate policy.[14] There may well be other social, partisan or informational barriers that impede corporations, communities and individuals from making decisions and pursuing action that would lower emissions.

Little research has taken place, especially in the Aotearoa context, into what opportunities may exist to support changes to behaviour that support emissions reductions. The opportunities to change behaviour will be diverse and require very different approaches.

Approach/policies:

An example of a joined-up approach, involving multiple agencies was the adoption of the Safe System to drive the country's road safety strategy. The Safe System takes a system-wide view of road safety recognising that road safety is not the sole responsibility of the individual driver but depends on the entire road and transport system and the different levers and actors that make up the system. This includes legislation and enforcement, innovation, education and information, and leadership and capability.

Multiple agencies operating at the different levels of the transport system – including policy, enforcement and operations at local and national levels – committed to the approach. Funding is allocated through the Land Transport Fund which directs income from petrol taxes and road user charges into things that the government wants to achieve for the transport network. If income from the ETS were directed toward climate change initiatives, it could be used in a similar way.

Behaviour change in transport is directed by the NZ Transport Agency as the operations arm of the transport system. Work with local councils recognises that different communities have different needs and will respond to programmes that reflect this. There is no equivalent in climate, therefore a working group could be created across government to identify, scope, research and design sustainable and audience focused behaviour change initiatives.

Addressing identified gaps in evidence and data

The Commission's advice has relied heavily on the economic, social, cultural and environmental evidence and data that is available. Some sectors have a wealth of evidence and data available – for example transport. However, in other sectors the evidence and data available is old and inconsistent – for example land use classification data. There are some gaps in the evidence and data needed to properly analyse the impacts and co-benefits of climate change policy that need to be addressed.

[13] (NSMC, 2011)
[14] (van der Linden et al., 2020)

A key gap relates to the Māori economy, which is an enabler of Māori development and intergenerational sustainability and prosperity. The Māori asset base (estimated at $50 billion) makes up approximately 6% of the total asset base in Aotearoa. In comparison to the wider economy, the Māori economy has a lower asset base. However, the rate of growth exceeds the wider economy (5% compared with 2.7% in 2016).

Challenges

Examining historic disruptions to the ownership, utilisation, and management of Māori collectively-owned land raises the question of how the emissions budgets and efforts to reduce emissions can be equitable without a clear understanding of the current state of emissions from Māori-collectives or a Māori emissions profile.

A Māori emissions profile would enable Māori-collectives to have oversight of and manage emissions collaboratively across their takiwā. This would better enable balancing traditional concepts and practices of rangatiratanga/mana motuhake, e.g. resource preservation and management alongside contemporary cultural, social, and economic aspirations for iwi, hapū, and whānau intergenerational wellbeing and cultural vitality.

Approach/policies:

A crude attempt at estimating a Māori emissions profile by iwi takiwā could be achieved through Crown agencies (such as Te Puni Kōkiri, Ministry for the Environment, Ministry for Primary Industries, Manaaki Whenua, Te Tumu Paeroa and other Crown Research Institutes), giving effect to kotahitanga. By working collaboratively Crown agencies could build on existing data (e.g., Te Puni Kōkiri's Toku Whenua platform) and include additional data (e.g., stocking rates, plantation/forestry site coverage data, and iwi/takiwā boundaries) to then support iwi/Māori to stand up their own platform to effectively manage and monitor emissions within their takiwā, and incorporate this information in current and future planning and decision making.

Addressing this gap, and the associated information and capability enablement required, is consistent with giving effect to rangatiratanga and supporting more equitable outcomes for iwi/Māori. However, it is imperative that the enabling platform/mechanism ensures iwi/Māori-collectives maintain mana motuhake (control and autonomy) over their data and information.

A platform that enables iwi/Māori-collectives to maintain an emissions profile within their mana whenua area/takiwā will enhance current and future decision making, trade-off analysis, and enable iwi/Māori-collectives to better understand their current contribution to emissions reductions and removals. It will also support Māori-collectives to set realistic goals to manage emissions going forward.

Facilitating a platform/mechanism to enable iwi/Māori-collectives to measure and monitor their emissions profile, not only supports iwi/Māori-collectives to control their own emissions, but also to provide leadership locally and demonstrate impact in achieving climate positive goals.

17.3 Sector-specific policies

This section focuses on identifying areas where action is needed in each sector.

Meeting the emissions reduction targets will require action in every sector of the economy. However, the Commission's analysis indicates that greater gains can be expected in some sectors than in others, and that gains in each sector will be realised over varying timeframes. The Commission has identified what we consider to be the highest priority areas of action for each sector in the sections that follow.

17.3.1 Transport

The transition to a low emissions economy will depend heavily on reducing emissions from transport. Near complete decarbonisation of transport will be critical to meeting the 2050 net zero target. At this stage international aviation and shipping are not included in our budgets.

Across the transport sector, there are a range of solutions to support the shift to low emissions. This includes electrification of all forms of transport, use of low carbon fuels, reducing travel or shifting to active forms of transport like walking or cycling, and shifting freight off roads and onto rail or coastal shipping.

Develop an integrated national transport network to reduce travel by private vehicles and increase the proportion of clean public or shared transport and walking and cycling

Increasing the use of low emissions public transport, shared transport and active types of transport is one way to reduce kilometres travelled by light vehicles. The Commission's modelling assumes that a shift towards these ways of travelling could reduce emissions, though there are challenges.

The Commission's pathway sees annual household vehicle travel per person decreasing by around 1% each year after 2025, although the long lead times for investment in infrastructure for walking, cycling, and public transport would mean that light vehicle travel per person grows to 2025 before peaking. The pathway assumes no new public transport buses with internal combustion engines from around 2030-2035. Public transport ferries are highly amenable to electrification, and our preferred path is consistent with assuming that most new public transport ferries will be electric beginning almost immediately.

The COVID-19 experience has demonstrated that productive remote working is feasible for many people, and this option will only become more attractive as technology continues to improve. Analysis for the Commission suggests that about 30% of the labour force in Aotearoa could work from home, at least some of the time.

Challenges

In many parts of the country there is not frequent, reliable, and affordable and connected public or shared transport choices. In many places there is also inadequate cycling and walking infrastructure, with cities and towns designed to prioritise cars. Unless walking, cycling and using public transport is safe, affordable, convenient and accessible, New Zealanders are likely to remain attached to private vehicles.

Decades of under-investment in infrastructure and services for public transport, walking and cycling have often made these travel choices slower, less reliable, more dangerous and ultimately less

attractive than travelling by private vehicle. This under-investment was compounded in the 1990s and early 2000s by the deregulation of public transport, which made integrated network planning difficult, and undermined the delivery of quality services.

Transport planning and funding is largely centered around private vehicle use, though this is starting to change. Of the approximately $4 billion spent on land transport in 2017, more than $3 billion is spent on roads. In comparison, about $600 million was spent on public transport and less than $100 million was spent on walking and cycling.[15] This looks to improve going forward as directed by the new Government Policy Statement on Land Transport 2021 (GPS).

Cities and regions in Aotearoa also tend to be structured in a way that encourages people to travel by car. They are generally characterised by low-density, dispersed and uncoordinated development, meaning that:

- trips are often long (making walking and cycling unattractive);
- urban planning and street design guides generally prioritise private vehicles over other types; and
- poor integration between land use and transport decision-making has often led to mismatches between where growth happens, and where travel choices are better

These factors, together with rising incomes, have contributed to the high rates of car ownership and high rates of travel per person in Aotearoa.

Access to transport choices is a key enabler for Māori. Transport plays an important role enabling Māori to realise various social, cultural, environmental, and economic aspirations including connecting to their whānau, supporting the haukāinga, and returning to their tūrangawaewae. About a quarter of Māori in Aotearoa live in Auckland;[16] however, many have strong whakapapa connections outside of Auckland, and may need to travel long distances, often with large families,to participate in cultural activities and events.[17]

Access to transport choices is also a challenge for people with disabilities. Public transport may be impractical and expensive. 24% of New Zealanders have a disability and Māori have a proportionately higher disability rate which, if combined with a low-income household, could have a compounding effect on transportability.

Whether it is possible for someone to avoid travel to and from work and work from home will depend on their occupation, access to a digital connection, and suitability of their home environment. Some households and geographic areas are not fully covered by high-speed broadband internet or 4G mobile communications, restricting the ability to work from home or access other virtual services. Some jobs or tasks are unable to be performed remotely. Some households are unsuitable for working from home, such as having insufficient space or other occupants, including young children.

[15] (NZTA, 2020)
[16] (Stats NZ, 2007)
[17] (Raerino et al., 2013)

Approaches / policies

One of the main ways to increase the share of clean public, shared and active types of transport is to develop and implement compact urban design policies. This requires a stronger and more deliberate relationship between urban planning, design and transport. Ensuring this happens at planning stage is more effective than retrofitting transport needs.

An integrated approach to transport planning is vital. For example, nationally and locally, operations, such as trains, buses and coaches, should be coordinated to function together, with combined booking services and improved infrastructure. Developing a national public transport network is important to make a system that is accessible for people and to facilitate the scale of mobility shift that is required.

Ensuring public and active transport receives appropriate planning and funding priority is also important as better infrastructure drives demand. Effective strategies in these areas could include strengthening the direction of the Government Policy Statement (GPS) on Land Transport to include specific and time bound targets to increase the proportion of low emissions public and shared transport, walking and cycling, and integrate low emissions transport options. Encouraging public transport uptake locally and nationally by reducing fares for targeted groups (such as for those under 25 years of age), and improving quality of service is a complementary approach.

Such changes to the GPS can be effectively supported by supplementary policies to reduce car use. Potential measures include introducing congestion charging and increasing parking prices, zero emissions zones and pedestrian priority areas in cities. Government could also take the lead in supporting the establishment and roll out of car sharing schemes or encouraging e-bikes.

End-to-end integrated solutions, including "first and last kilometre" solutions,[18] and including park and ride options are further considerations, as well as mobility as a service as opposed to conventional public transport. This is particularly relevant in smaller urban centres and rural communities without easy access to public transport, or where the community is not concentrated enough to make public transport feasible.

Targeted measures that are co-created with the disability community would be important to contribute to an equitable, accessible transport system.

Regarding increased working from home, approaches include:

- Continue activities to create 100% access to high-speed broadband internet and facilitate the nation-wide roll out of 5G mobile broadband.
- Consider funding high-speed broadband access for lower socio-economic groups.
- Government can lead by example by more strongly encouraging and facilitating optional working from home for roles where this can be done.

[18] The 'first and last-kilometre' is a term that describes the beginning and end of an individual's public transport journey. Usually, after traveling on public transport, we need to walk, or take a second type of travel to reach our final destination. This gap from public transit to destination is seen as counterintuitive to establishing a truly connected city.

- Government provision of incentives for employers who create and enact policies allowing optional working from home. The tax-free allowance for employees working from home introduced could be maintained permanently, for example.

Box 17.1: Case study

Experience overseas has shown that significant shift in ways of travel can be achieved with effective strategies. For example, in 2008 Vancouver set a target for half of all trips to be made by public transport, walking or cycling by 2020. This goal was met two years ahead of schedule and the city is now aiming for two thirds all trips by foot, bicycle and public transport by 2040. To achieve this change, Vancouver focused on providing people with travel choice, through investing heavily in walking, cycling and public transport improvements. Land use policies have also been a major part of Vancouver's success.

More recently the Republic of Ireland has announced that it will be spending 20% of its national transport budget on walking and cycling. The commitment will deliver a five-year programme linked with a specific target of new separated cycling and walking infrastructure that will be delivered or under construction by end 2024. The intention is to enable a step change in the number of people taking daily journeys by foot and bicycle which will help improve quality of life and air quality.[19]

Prioritise the accelerated electrification of light vehicles (cars, vans, SUVs)

While there are many choices to reduce transport emissions, electrification of road transport will play a critical role in meeting the net zero target. The Commission's modelling indicates that to decarbonise road transport by 2050, internal combustion engine light vehicle imports will need to be phased out by 2030-2035.

Rapid replacement of the current conventional fleet is needed to ensure transport emissions fall by the third emissions budget period. Electric vehicle uptake is currently not happening fast enough for this to happen. EV ownership in Aotearoa is increasing but remains low, with nearly all vehicles running on petrol or diesel.[20] Immediate action is required to rapidly increase the electric vehicle market in Aotearoa – from around 2% of new light vehicle registrations in 2020 to around 15% by 2025.

Challenges

At present, the upfront cost for a new electric vehicle is considerably higher than for a comparable fossil fuel vehicle. This cost difference acts as a disincentive, dissuading people from purchasing an electric vehicle. Upfront purchase price has been identified by consumers as the most important reason for not buying an electric vehicle.[21]

High upfront costs mean that low- and middle-income households may find it harder to access electric transport compared to wealthier households. This is likely to be more of a barrier for people

[19] (Government of Ireland, 2020)

[20] As of October 2020, roughly 23,000 EVs were registered across light and heavy vehicles. Although this represents only about 0.4% of the total fleet the number of EVs in Aotearoa has almost tripled in the past two years. However, the small proportion of the fleet made up of EVs means that the shift has not materially decreased transport emissions.

[21] As shown by a consumer survey run by EECA. (New Zealand Productivity Commission, 2018)

who are disproportionately represented in low-income neighbourhoods, and in rental accommodation.

Ability to access charging infrastructure is an additional limitation. About 85% of New Zealanders have access to off street parking,[22] and the vast majority of electric vehicle charging is done at home. Electric vehicle charging infrastructure is relatively well developed for the number of electric vehicles currently on the road. However, apartment dwellers and those in rental accommodation face more difficulty in charging electric vehicle at home. Increased numbers of community charging stations will be required to ensure people who do not have access to home charging have access.

Charging infrastructure will also need to keep pace with the projected rapid uptake of electric vehicles to ensure high amounts of coverage. Multiple chargers at key locations will be required, with rapid chargers that are able to charge cars more quickly, which will enable more vehicles to pass through the charging station. Measures to overcome practical barriers to the roll out of charging infrastructure may also be required, such as facilitating access to finance for charging infrastructure companies until such time as there is a high enough volume of electric vehicles for them to become more profitable.

There is also the need for proactive action to build the technical and social infrastructure for reuse, recycling and responsible disposal solutions for batteries. Otherwise Aotearoa runs the risk of unintended environmental consequences, as current lithium-ion electric vehicle batteries can be highly polluting and pose a fire risk if not disposed of properly.

Another challenge is the lack of choice of electric vehicles in Aotearoa, particularly for utes and people movers (7-9 seat) – which New Zealanders often favour over smaller vehicles.[23] In particular, people in rural areas may not have access to an electric vehicle that fits their needs. Aotearoa accounts for a very small proportion of global vehicle sales, and electric models available in other countries are frequently not offered here. Some models are also offered at a significant price premium compared to the same model in other countries.[24]

There is also a lack of supply volume of electric vehicles from second-hand markets that Aotearoa depends on. Most of the EVs brought into the Aotearoa fleet are used cars, predominantly from Japan, and sourcing used electric vehicles will depend on the availability of electric vehicles there. According to the data in our ENZ model, the average age of a used light vehicle entering Aotearoa is 8.3 years. So, the used vehicles we will be importing in any given year will have been made 8 years earlier, for example, the vehicles we import in 2030 will be made in 2022 if this current trend continues. However, in 2019, there were only about 38,000 electric vehicles (BEV and PHEV) sold in Japan.[25] This compares to over 160,000 used light vehicles imported into New Zealand in 2018 (MoT Vehicle Fleet Statistics).

Aotearoa increasingly competes with other countries for low emission used Japanese vehicles. This dependence also makes Aotearoa consumer choice for electric vehicles dependent on what

[22] (New Zealand Productivity Commission, 2018)

[23] The trend in NZ is that consumers are increasingly buying heavier new vehicles with higher emissions. In 2011 small vehicles were 16.6% of new vehicle sales. By 2019 their share of sales halved to 8.5%. (Ministry of Transport, 2019b)

[24] (New Zealand Productivity Commission, 2018)

[25] (Statista, 2020)

Japanese manufacturers, governments and consumers choose five years (or more) prior to entering the Aotearoa market.

This lack of choice is compounded by a lack of leverage in accessing future supply of new electric vehicles. Aotearoa is a small distant market, in need of right-hand drive vehicles. Automakers are expected to prioritise their passenger electric vehicle efforts on the markets with the most stringent regulations (such as China and Europe) for the next 10 years.[26] This means Aotearoa may face restricted access to supply, particularly in the absence of any regulations or incentives to drive greater uptake.

A challenge that needs to be carefully managed is that a large uptake of electric vehicle could add significant load to local electricity networks if they are all charged during peak periods – such as in the evening when everyone comes home from work. The additional electricity load at peak times could put pressure on the existing network and require large investments to provide more capacity.[27] As electric vehicle numbers increase, measures would need to be implemented to help manage this risk – such as cost reflective pricing of electricity.[28]

Finally, there are some specific policy settings that may also be hampering efforts to increase the efficiency of the vehicle fleet – for example how the Fringe Benefit Tax (FBT) is calculated on light vehicles, and a lack of enforcement regarding FBT claimed against utes available for personal use. [29]

It is worth noting that a shift towards electric vehicles and reduction in vehicle use will reduce government revenue from some current sources, such as road user charges and petrol excise duty, which are currently used to fund the building, operation and maintenance of the land transport system (including building roads and funding public transport). This is discussed in more detail in *Chapter 12: How we earn our way in the world,* and the Government will need to plan how best to restructure land transport funding in light of these changes.

Approach / policies:

A policy package to accelerate EV uptake must address demand side barriers as well as the supply side barriers. International experience shows that vehicle efficiency standards (discussed below) combined with fiscal incentives can achieve large emission reductions. Setting an ambitious policy package is important to ensure Aotearoa does not lose further ground with other countries that are already implementing policies to accelerate the electrification of their fleets. Without this we risk becoming a dumping ground as manufacturers send the cars they cannot sell in those markets to Aotearoa.

Experience internationally shows that policies to reduce the up-front cost of efficient vehicles have the strongest impact on purchase decisions.[30] Fiscal incentives like subsidies or "feebates" can help

[26] (*Electric Vehicle Outlook 2020 - Executive Summary*, 2020)
[27] (New Zealand Productivity Commission, 2018)
[28] Most customers pay a fixed price for their electricity no matter when in the day they use it.
[29]The FBT is payable on light vehicles where they are available for an employee's personal use. For simplicity, the rate of FBT is calculated based on the capital costs of the vehicle instead of capital and operating costs. Because EVs have higher capital costs and lower running costs, this puts them at a disadvantage because they are currently more expensive than ICE vehicles with similar specs. FBT should be applied to utes available for personal use, however lack of enforcement and widespread misunderstanding of FBT rules have resulted in many employers not paying the tax on utes available for employee use.
[30] (German et al., 2018)

to overcome barriers to consumer demand,[31] encouraging the uptake of low emissions vehicles and discouraging the purchase of high emitting ones.

Under a feebate scheme, all vehicles (new and used) are assessed for their greenhouse gas emissions potential. Higher-emissions vehicles incur a fee, while low emissions vehicles receive a rebate. The rebates could be funded via the fees paid for high emitting vehicles. The fees could also be used to fund the scheme's costs and make it a fiscally neutral initiative.

Another approach to addressing the higher pricing of electric vehicles is through the introduction of a fuel efficiency standard. This requires importers/manufacturers to reduce the average collective carbon dioxide emissions of all the vehicles they sell to meet a certain level over time, or they will pay a penalty. In order to meet the standard, vehicle importers can price electric vehicles at a level at which they sell in sufficient volumes to meet the standard for their whole range. Without a lower price, electric vehicles would be unlikely to sell in sufficient volumes to meet the standard. This policy is discussed further below under the priority of improving the emissions intensity of the light vehicle fleet.

Other approaches include:

- Restricting or banning the import of new and/or used fossil-fuelled vehicles after a certain date. More and more countries are taking the course of action, with the UK bringing forward its date from 2040 to 2030.[32]
- Government leadership in the electric vehicle uptake of its own fleets (including ensuring appropriate Budget allocation for agencies) will be critical in ensuring EVs enter the second-hand market.
- Government and/or the private sector bulk procure and ensure the supply of electric vehicles, or underwrite the risk of sale.
- Introduce battery refurbishment, replacement and recycling schemes.
- Piloting leasing schemes, particularly in low income areas, to remove the upfront and ongoing running costs of owning a vehicle.
- Facilitating the provision of public charging infrastructure.
- Direct subsidies or support for low-income households or support for car sharing schemes will be important to ensure electric vehicles are accessible for everyone.
- Encouraging business to buy electric vehicles, by reducing or removing the fringe benefit tax for corporate fleets.
- Introducing Zero Emissions Zones in city centres that can only be accessed by electric vehicles
- In use benefits for electric vehicles, such as low or reduced parking charges, or in the future low or reduced congestion charging fees.

Because fleet turnover is slow, policies need to be put in place as soon as to get us on track to meet the third budget period and 2050 target.

[31] (German et al., 2018)
[32] (Ambrose, 2020)

Box 17.2: Case study

The Clean Vehicle Rebate Project in California promotes clean vehicle adoption by offering rebates of up to $7,000 for the purchase or lease of new, eligible zero-emissions vehicles, including electric, plug-in hybrid and fuel cell vehicles.

Incentives are based on household income. High income households do not get anything, and low-income households get a bigger EV incentive than middle income households.[33]

Improve the efficiency of the light vehicle fleet

Vehicles that enter the fleet today will be driven until they are on average almost 20 years old. This means that if Aotearoa is to achieve a low emissions fleet by 2050, nearly all the vehicles entering the fleet need to be low emissions by 2030.

If the share of EVs in Aotearoa steadily increases, the overall fleet can become more efficient. Although EVs make the biggest difference, increasing the number of EVs, plug in hybrids, hybrids, and more efficient petrol and diesel cars can all contribute to improved emissions intensity of the light vehicle fleet. The fleet can also become more efficient by consumers choosing smaller vehicles.

Challenges

Over the next five years, more than 1.2 million light vehicles will likely enter the vehicle fleet. If powered by fossil fuels, these vehicles will lock in up to 50 Mt of carbon dioxide emissions over the next two decades. That is the equivalent of over half of the annual gross emissions in Aotearoa.[34]

The light vehicles imported into Aotearoa today are among the most fuel inefficient of any OECD country. Vehicles driven in Aotearoa produce more emissions and cost significantly more to run over the vehicles' lifetime than in other countries. One of the key reasons for this is that Aotearoa has no regulations or restrictions to influence the fuel efficiency of light vehicles entering the fleet. Aotearoa is an outlier in this respect – one of only three OECD countries without vehicle fuel efficiency standards.[35]

The average light vehicle entering the Aotearoa vehicle fleet in 2018 produced about 180 grams of carbon dioxide per kilometre, compared to 120 grams of carbon dioxide per kilometre in the EU. Roughly half of the vehicles that come into Aotearoa each year are used imports. The average age of these vehicles at the time of import is around 8 years. Generally, for the same vehicle model, newer versions tend to be more energy efficient and thus have lower emissions.

However, even new vehicles coming into Aotearoa are model variants that are less efficient and cheaper to manufacture than those supplied in countries with fuel efficiency standards.[36] This

[33] (California Clean Vehicle Rebate Project, 2016)
[34] (New Zealand Productivity Commission, 2018)
[35] (New Zealand Productivity Commission, 2018)
[36] In 2017, the most efficient vehicle models on our market had, on average, 21% higher emissions than their counterpart models in the United Kingdom. (Ministry of Transport, 2019a)

means that vehicles in Aotearoa emit more carbon dioxide and cost more to run. Because these less efficient vehicles move into the second-hand market this disproportionately affects lower income households who spend more on transport.

Without clear guidance from the Government on EV targets and emissions standards, Aotearoa risks becoming a 'dumping ground' for cheap petrol/diesel from the UK and Japan as they move to electric vehicles.[37]

The turnover of vehicles in the Aotearoa fleet is slow. The average vehicle is driven until it's around 19 years old, and the age at which vehicles are scrapped is gradually increasing.[38] This means that the carbon intensive vehicles arriving into the country remain in the fleet for a long time.

Approach/policies

A fuel efficiency or carbon dioxide standard would increase the supply of low emitting vehicles in the Aotearoa fleet. These regulations all require suppliers to meet an overall average fuel economy or carbon dioxide emissions level, weighted across new and used-import vehicle sales within the country where the standard applies. Internationally carbon dioxide standards, have been effective in driving emission reductions in light vehicles.[39] There is a range of different international examples of how a standard could be designed.

If such a standard were in place, suppliers would need to stock and sell more fuel-efficient conventional vehicles, more petrol hybrids and more EVs to meet carbon dioxide fleet targets or pay a penalty. Such a policy would work in tandem with other measures described above to increase EVs.

Other approaches include:

- Setting limits on the age of used imports to encourage vehicles with newer, more energy efficient technology
- Introducing measures to shorten the lifespan of the vehicles in the fleet, such as scrappage schemes
- Targets for increased fuel efficiency
- Introducing measures to shift New Zealanders preferences away from larger, heavier vehicles through behavioural based actions; and
- Differential registration and use fees for vehicles with lower emissions.

[37] (Drive Electric, 2020)
[38] (Ministry of Transport, 2019a, p. 8)
[39] For example, a 2015 evaluation of the European Union's vehicle fuel efficiency standard for new light vehicles, found that it is likely to have accounted for 65–85% of the reductions that occurred in tailpipe emissions over 2009–2014. The standard achieved an estimated rate of annual improvement of 3.4 to 4.8 gCO_2/km. This compared to the annual rate of improvement of 1.1 to 1.9 gCO_2/km previously experienced under a voluntary industry standard.

Increase the use of low carbon fuels for trains, ships, heavy trucks and planes

Low carbon fuels offer an alternative to conventional fossil fuels (e.g. petrol and diesel) to power vehicles. This section is focused on three low carbon fuel options – electricity, green hydrogen and biofuels.

The Commission's modelling shows that low carbon fuels will play an important role in decarbonising transport by 2050. Even if the light vehicle fleet rapidly converts to EVs, low carbon fuels, such as biofuels or hydrogen are likely to be needed over the longer term for aircraft and long-distance trucks. These heavy vehicles are more difficult to electrify, so the transition is likely to take longer.

Our preferred pathway shows that 6% of liquid fuels for domestic use are low carbon fuels by 2035, this is approximately 140 million litres per year. This would require building about another 7 equivalent sized plants similar in capacity to Z Energy's existing Wiri plant, which has a capacity of 20 million litres per year.

Challenges

Low carbon liquid fuels are currently more expensive than fossil fuels. Unlike other countries, Aotearoa does not have incentives or regulations in place to support low emission fuels to become more competitive, or to encourage their uptake.

The costs to produce green hydrogen and biofuels are currently more expensive than fossil fuel production. Green hydrogen is more expensive than more direct uses of electricity, in part due to inefficiencies involved in producing hydrogen from electricity. Biofuels also cost more to produce than fossil fuels, and as a result are sold only as a premium product in Aotearoa.[40]

A lack of production facilities in Aotearoa also contributes to the higher cost of low emission fuels. Aotearoa does not currently have a commercial supply of green hydrogen, or a nationally available supply of biofuels – although there is ample supply of electricity generation and feedstock potential for making both.

Work is currently underway across the private sector to build hydrogen plants and develop a hydrogen refueling network in Aotearoa. The cost of creating this infrastructure is significant, and has required government funding to de-risk private sector investment. Aotearoa currently produces a small amount of conventional biofuels at commercial scale. This is blended in low percentages with fossil fuel. However, this is not sufficient to supply the entire heavy vehicle fleet.[41]

Bioenergy offers a decarbonisation solution for transport, as well as for industrial users of heat. However, there is a limited supply. For example, the Commission's modelling shows that Aotearoa would need to look beyond using woody biomass as a feedstock if the country were to rely on bioenergy to decarbonise the heavy transport fleet. Competing land uses, particularly food production, also limit the amount of bioenergy available.

[40] (New Zealand Productivity Commission, 2018)
[41] (Ministry of Transport, 2020)

There are challenges associated with battery-electric heavy trucks due to the size, weight, and cost of the batteries, and time required to recharge them. These challenges are less of an issue for medium trucks typically used for local deliveries and other short-haul duties with lighter loads.

Aviation is particularly challenging to decarbonise, as electric aircraft are not yet a proven commercial technology.[42] Currently, there is no commercially viable sustainable aviation fuel (SAF) supply in Aotearoa. This is largely due to the lack of supportive policy. In offshore ports where SAF is being produced, its use has been supported by market by public funding and policy.

Emissions from rail are small, as rail is an efficient way to move freight and proportions of the main trunk lines are already electrified. With significant potential to shift freight from road to rail, there is greater potential from decarbonising rail by further overhead electrification or use of battery-hybrid or low carbon fuel locomotives. However, the high cost of electrification is a significant barrier, particularly on less busy routes. Low emissions locomotives are not currently commercially available, though it is likely that alternatives to overhead line electrification will need to be implemented to achieve Kiwirail's net zero carbon by 2050 objective. Significant parts of the freight rail network have been facing a state of managed decline due to lack of long-term investment and inadequate planning and funding frameworks. The Draft New Zealand Rail Plan sets out a remedial investment programme and a new planning and funding framework to maintain freight rail and provide a platform for future investments for growth. However, the Plan does not establish clear targets, or an investment strategy to increase the mode share of rail.

Approaches / policies

As with support for vehicle electrification, it is important that a policy package for low emission fuels addresses the supply and demand side barriers. Policies must also pay attention to the particular challenges associated with aviation.

On the **supply** side, policy and investment support is required to help establish plants and close the commercial gap with traditional fossil fuel. Funding to support the production of low carbon liquid fuels, such as biofuel or hydrogen, could take the form of measures such as grants or tax credits.

On the **demand** side, adjusting regulatory settings to support long-term demand is critical. Measures such as low carbon fuel standards or biofuel blend mandates can encourage and increase the sale of low carbon fuels.

Regarding SAF, mandates requiring the ratcheting up of blending are emerging throughout Europe. For example, in Norway a 0.5% blend mandate is in effect from 1 January 2020. Norway's ultimate target is for a 30% share of SAF in the aviation sector by 2030.[43] The Swedish Government announced on 11 September 2020, a greenhouse gas reduction mandate for aviation fuel sold in Sweden in 2021. The reduction level is expected to be 0.8% in 2021, and gradually increase to 27% in 2030.[44]

The Draft New Zealand Rail Plan sets out a remedial investment programme and a new planning and funding framework to maintain freight rail and provide a platform for future investments for growth.

[42] Electric aircraft are, however, a fast-developing technology, with several manufacturers planning to offer small commercial aircraft within the next few years.
[43] (Norway Ministry of Climate and Environment, 2019)
[44] (Neste.com, 2020)

However, the Plan does not establish clear targets, or an investment strategy to increase the mode share of rail. There is also potential to shift freight from road to coastal shipping.

Box 17.3: Low carbon fuel standards

Several overseas jurisdictions have adopted low carbon fuel standards (LCFS) to reduce their transport emissions. LCFS take different forms. California sets a limit on the carbon intensity – the amount of GHGs emitted per megajoule of energy produced – of fuels across the vehicle market. The limit falls gradually each year. This forces fuel companies to source lower-emission alternatives to fossil fuels to meet their target (or purchase credits from suppliers who overachieved their target).

Alternatively, the UK scheme requires fuel companies to supply renewable fuels as a set proportion of their sales. This scheme is similar to the previous Biofuel Sales Obligation.[45]

17.3.2 Heat, industry and power

The heat, industry and power sector is broad, encompassing a wide range of sub-sectors and emissions sources. Reductions are likely to take place at varying rates across these different sources.

The Commission's modelling shows that emissions reductions from process heat and electricity production in the early budget periods will be important to help Aotearoa meet the 2050 target. Due to technological challenges and the slow turnover of infrastructure, emissions reductions in other parts of this sector, such as heavy industry, are likely to take place in later budget periods.

The key opportunities over the first emissions budget period include maximising the use of electricity, scaling up provision of other low emissions energy sources, and using less energy through efficiency measures. Action is also needed to ensure new long-lived fossil fuel assets are not developed, and support is needed for innovation in hard to abate industrial processes, which will be required to decarbonise longer term – see *Support innovation to reduce emissions from industrial processes* section below.

This section relates to the policy direction of energy supply and use, and therefore has direct implications for the transport sector (discussed above) so should be considered in parallel.

Decarbonise energy

In Aotearoa, total energy supply is 40% renewable, with the remaining 60% coming from fossil fuels. This energy is used across the economy in transport, electricity generation, for heating buildings, and for manufacturing products in industry. Energy is a necessity in the modern world as a critical input into every good and service in the economy.

The Commission's analysis shows that achieving the 2050 target of net zero long-lived gases depends on transitioning away from fossil fuels to renewables in transport, heat, and electricity generation. This will require a significant expansion of the electricity system, including the national grid, and scaling up the production of low emission fuels such as biomass and hydrogen. It will also require considerable effort and investment to move to using low emissions energy in transport, industry and to heat buildings. Continually improving energy efficiency, encouraging system innovation and new

[45] (New Zealand Productivity Commission, 2018)

business models, and the deployment of storage technologies will all be important for ensuring the energy system remains affordable and reliable as it decarbonizes.

Challenges

The transition to a low emissions energy system will require action by individuals, communities, business and the Government, to both mitigate the risks of the transition as well as capturing opportunities and co-benefits it presents.

As noted in MBIE's discussion document *Accelerating Renewable Energy and Energy Efficiency*:[46]

> *"The package of policies that will enable the energy transition will affect technologies, natural resources, infrastructure, markets and institutions. There is no 'one-size-fits-all' policy solution suitable for the energy sector as it cuts across the entire economy. We must consider the different ways that energy is used in sectors of the economy and the relevant opportunities available in each case. Regional and geographic differences will influence the use and availability of low emissions energy sources, including wind, solar, biomass and geothermal. Effective change may require unique transition pathways and different timing and sequencing of changes across different sectors."*

The impact of these actions will need to be carefully managed in partnership with industry and communities (see time-critical necessary action 1 – An equitable, inclusive and well-planned transition). As fossil fuel industries phase down and energy systems and uses transform, there may be both anticipated and unanticipated effects, including on industries and communities, which could work against the transition to low emissions economy.

Having a coordinated, long-term vision that looks across not just energy, but economic development, infrastructure and equitable transitions and other government objectives, may help to manage the transition and ensure good outcomes for Aotearoa.

Building energy infrastructure, scaling up provision of low emissions fuels, and developing skills and capabilities for a low emissions energy system requires a long lead time. Coordination across the whole energy system will be necessary to manage a timely transition away from fossil fuels to low emissions alternatives. Policy action will be required to drive change across the energy system to achieve the pathway to 2050.

At present, the Government is pursuing an uncoordinated approach to supporting the development and deployment of different low emission technologies, fuels and industries. Developments are happening without an overarching and clear set of objectives and outcomes for the energy system as a whole. Keeping costs to a minimum and ensuring security of supply requires an understanding of these objectives against a long-term set of goals.

While the Government has made progress in setting out its vison for the electricity system, there is no clear and coordinated approach to planning the transformation of the wider energy system over the coming decades. The Government's 100% renewable electricity target is a part of a bigger energy picture, which also encompasses transport fuels and heat amongst other things. Furthermore, transport and heat emissions both represent a larger share of the total energy emissions (about 50% and 22% respectively) than electricity (about 13%).[47]

[46] (Ministry of Business, Innovation and Employment, 2019)
[47] (The Ministry for the Environment, 2020)

Approach/policies

The Government could provide industry with greater certainty by clearly signalling the timing and direction for the decarbonisation of the energy system, including transport, process heat, electricity generation, and buildings, so that industry, communities and households are better able to plan for the energy transition.

Setting a broad, system-wide target for renewable energy could be a way to signal the required emissions reductions across the whole energy system and to encourage investment at a pace that aligns with the pathway to 2050. eveloping a coherent National Energy Strategy would be an effective way to do this.

The development of a national energy strategy, with decarbonisation of the energy system at its center, could set direction for the different sectors of the energy system. A National Energy Strategy could consider future energy developments, infrastructure, equitable industry transitions, as well as regional and economic development planning needed to support the transition of the energy system, in a coherent way in Aotearoa. The objective of such a strategy would be to ensure that the phase down of fossil fuels, and scale up of new low emissions fuels, is smooth and appropriately sequenced.

There will be some nationally significant forks in the road as the energy system decarbonises; choices will need to be made.

For example, choices will need to be made about whether Aotearoa should keep its gas pipeline infrastructure long term as an option for low emissions gases, or whether a low emissions steel industry is critical for security of supply for the construction industry. Also, decisions will need to be made about whether the skills of those who work in the oil and gas sector should be actively retained in Aotearoa for new low emissions industries. Beginning conversations on these significant issues in a National Energy Strategy, and setting early direction, will be important for mitigating potential impacts on communities and industry, and for exploring the opportunities alternative options may offer.

A National Energy Strategy could set out an overarching and clear set of objectives and outcomes for the energy system as a whole. A package of policies and sector specific strategies or roadmaps to drive emissions reductions would underpin the National Energy Strategy. An overarching strategy could help in aligning policies across the different sectors of the energy system and managing their interdependencies. The potential direction of this policy package is discussed in the rest of this section.

Maximise the use of electricity as a low emissions fuel

Aotearoa has one of the lowest emission electricity systems globally. This advantage can be better leveraged to reduce emissions.

To electrify transport and heat, the electricity system will need to grow substantially in the 2030s. Increased electricity demands will need to be met by new renewable electricity generation, new transmission and distribution connections, and upgrades of existing transmission and distribution capacity. It will be important to reduce the emissions from the electricity system as it grows.

As noted above in the transport section, action is required to rapidly increase the electric vehicle market in Aotearoa – from around 2% of new light vehicle registrations in 2020 to around 15% by 2025. The Commission's pathway also requires the steady reduction of process heat emissions out

to 2050. In early years we expect biomass to play a significant role in achieving this, while the electrification of industry is likely to ramp up in the 2030s. In the electricity system, the Commission's pathway assumes that coal fired electricity generation is phased out by 2025, while gas use is significantly reduced and no longer used for baseload generation. Gas generation in the pathway reduces to around 3.0 TWh in 2025 and 1.5 TWh in 2030.[48]

Challenges

One of the key challenges the electricity sector will face is the rapid expansion in generation, transmission and distribution assets that will be required to deliver the widespread electrification of transport and industry in the 2030s. Another challenge is ensuring that the delivered price of electricity remains affordable, and the system is reliable and resilient, throughout this period.

The future of electricity demand and the sequencing of the build out of the electricity system in Aotearoa is uncertain. This due to a range of factors including a lack of government policy to incentivise the adoption of EVs, the expected future exit of the aluminium smelter, and the potential arrival of new dry-year storage solutions in the market. While some of these factors may lead to the closure of some fossil fired generation, they may also act to disincentivise investment in new renewable generation. Continuing to build new renewable electricity generation and transmission infrastructure throughout the 2020s would help to avoid potential construction bottlenecks that would delay the electrification of transport and industry in the 2030s.

Increasing the use and provision of electricity will also require the timely and efficient development of transmission and distribution infrastructure. It will be important to manage the opposing risks of under and over-investing in the national grid to ensure the cost and reliability of electricity does not impede the role it can play in reducing emissions.

The lead times for major new and upgraded transmission assets are also long compared to lead times required for new generation or demand. Issues with cost allocation and the risk of stranded assets associated with building transmission lines may slow or hold up new renewable electricity generation or the electrification of an industrial site, and risk delaying decarbonisation.

The capacity and capability of local distribution networks to develop their networks to manage the disruption caused by emerging technologies, like EVs and household solar and batteries, could also be a challenge. Aotearoa currently has 29 electricity distribution businesses across the regions, with varying structures and capabilities.[49] Like transmission, distribution networks need to be built to meet peak demand and need to manage a balance between over and underinvesting in their assets.

Moving away from using fossil fuels in the electricity system will also create a challenge when considering dry-year risk. The Commission's pathway assumes that gas continues to provide flexibility in the electricity system. The Government is currently undertaking work focused on potential energy storage solutions to address the country's dry year electricity problem, through the NZ Battery Project. The project will add important knowledge and evidence to the understanding of the future electricity system. Aotearoa will likely need to solve the dry year problem at some point.

[49] As local monopolies, 17 distributors are under the Commerce Commissions price-quality regulation, the other 12 are consumer-owned and exempt from the regulation as the Government considers that their consumers have enough input into how the business is run.

However, while a solution would enable Aotearoa to reach 100% renewable electricity, it could cost taxpayers billions of dollars.

As previously noted, reducing emissions from the electricity system is part of a broader energy transition. Consideration should also be given to alternative options for reducing emissions, as it is likely that other actions would have a larger impact for the same cost. Arriving at 100% renewable electricity is consistent with the aim of net zero emissions in 2050, but the timing and sequencing of the transition should be carefully considered as part of the decarbonisation of the wider energy system.

Finally, the regulatory regime will need to quickly adapt and respond to new developments, to facilitate changing electricity market functions that will be driven by the electrification of transport and industry, and the adoption of distributed energy resources. This includes ensuring it can deliver the services needed such as demand response. The capacity and capability of electricity distribution businesses will be an important consideration. The Electricity Pricing Review and others have called for more innovation to be led by these businesses.

Approach/policies

There are several approaches that could enable greater use of electricity as a low emissions fuel. For information on the specific barriers and policies relating to EVs see the *Prioritise the accelerated electrification of light vehicles (cars, vans, SUVs)* section above, for process heat conversion see the *Reduce process heat emissions* section below. The reforms to the NZ ETS mentioned in the *Multi-sector strategy* above will also impact the case for switching to electricity, particularly as it affects the relative costs for fuels.

A range of choices have been canvassed that could support a reduction in emissions from the generation of electricity in the first emissions budget period. These choices are set out in the work done by the Interim Climate Change Committee (ICCC),[50] and in the consultation undertaken by MBIE and stakeholders in responding as part of the *Accelerating renewable energy and energy efficiency* discussion paper. However, since then, there have been some significant contextual changes – for example, COVID-19 and the Government's response, the signalled aluminium smelter exit, multiple industry-initiated strategic reviews of the nation's heavy industries, creation of the NZ Battery project, proposed changes to freshwater policy, and announced changes to the RMA.

Measures that increase demand for electricity as an energy source will help to maximise its use and should be considered by both government and industry. The Major Electricity Users Group power purchase agreement (Renewable Electricity Generation Project)[51] is an example of industry innovation in this area. This type of collaboration should be supported and encouraged. In terms of government support, choices include removing regulatory barriers, and creating legislative frameworks that send a strong signal about policy direction, including clear trigger mechanisms.

Maximising the use of electricity as a low carbon fuel requires an electricity market that functions effectively and delivers affordable electricity in a reliable way. Keeping peak demand growth lower than overall electricity demand growth will be key to reducing emissions in a way that keeps the costs of the system down and effectively manages the increased volatility of a system with more

[50] (Interim Climate Change Committee, 2019a)
[51] (Major Electricity Users' Group, 2020)

EVs, and more renewables. Encouraging greater cooperation between the 29 electricity distribution businesses, or aggregating them, could potentially support improved efficiencies and resilience.

Smart grids, more distributed generation, and time of use pricing are examples of changes that could create opportunities for distribution businesses to manage peak demand. It will be important to understand and enable opportunities to optimise the building of transmission and distribution infrastructure alongside increases in electricity demand and new renewable generation, as this will help to ensure a smooth transition.

Technology has the potential to change the way New Zealanders generate, store and consume electricity. It will affect how the electricity market functions, and create greater potential for independent and distributed generation, micro-grids and demand response. Innovations like peer-to-peer trading are also emerging. These disruptions offer solutions for Māori-collectives, remote and rural communities and others.

In order to reduce emissions from electricity generation, policy interventions that give greater certainty to the market should be considered. This includes certainty about timing for the retirement of generation assets, as well as measures to deter the build of new fossil fuelled generation. Measures that could help to provide certainty include announcement of a backstop date by which fossil fuelled generation assets must be retired, a disclosure regime for the market exit of generation assets, and/or a target for emissions from electricity generation.

The retirement of fossil fuelled generation also presents a challenge to the sector with respect to its role in providing dry year security. This could prove a barrier to the exit of some infrastructure from the system. The Government can assist in overcoming this challenge by making evidence-based decisions about how and when to address the challenge of dry years. Some choices for addressing dry year challenge are very costly, and there may be more cost-effective ways to achieve larger emissions reductions elsewhere in the economy. It will be important, when making decisions about how to address difficult challenges like dry years, that costs and impacts of investments are carefully considered. The dry year challenge could be considered as part of a national energy strategy for Aotearoa.

Scale up the provision of low emissions energy sources

Having a diversity of energy sources will be important in order to retain choices along the pathway to reaching the 2050 target, and beyond. It could also be useful to retain some energy sources that can be stored and transported in ways that do not rely on electricity and transmission lines. The Commission's modelling identifies bioenergy and hydrogen as alternative fuel sources to displace emissions and provide diversity in the energy mix in Aotearoa – and both can be domestically produced.

To support a diversity of energy sources, Aotearoa needs to increase its production of low emission fuels. Increased production of low emission fuels will need to be complemented with the development of supporting infrastructure and supply chains, and workforce capabilities.

The Commission's modelling highlights an opportunity to make better use of available bioenergy resources, such as forestry residue and pulp logs, in the years 2020-2030 to displace emissions. In the first three emissions budgets the Commission's modelling indicates that there is little to no constraint on available resource. Deployment of biofuels out to 2050 may be constrained by the

desire to avoid the use of dedicated energy crops, particularly if Aotearoa undertakes to produce biofuels for international aviation and shipping. Other constraints may also exist, such as the speed at which supply chains can be created and the approach to emissions from bioenergy. Bioenergy should be considered in the broader framework of the bioeconomy.

Hydrogen can be produced via number of routes, but will need to be low emissions if it is to have a place in a future Aotearoa economy. It is an energy-dense fuel that is versatile in how it can be used and where it can be produced. This means it could be helpful in providing energy security and meeting the needs of certain industries – for example, high temperature heat processes.

The Commission's modelling highlights an opportunity to use hydrogen for meeting the needs of one of the hard to abate industries. In its modelling the Commission has chosen steel as a representative, though it could be used for others, such as in the manufacture of ammonia-urea fertiliser, or to meet the needs of a new industry. In the modelling low carbon liquid fuels, which could be hydrogen or liquid biofuels, also support the long-term decarbonisation of some of aviation and heavy transport.

Challenges

Both hydrogen and bioenergy are generally more expensive than the fossil fuel alternatives under current policy settings.[52] The rising NZ ETS price will help to reduce this cost difference, as will technology improvements that reduce the cost of production of these low emissions fuels. However, for hydrogen, the trajectory for cost reductions mean that it is unlikely to be available beyond niche applications until later emissions budgets. Aotearoa is a technology taker for hydrogen electrolysers but has more control over the cost of bioenergy. The relatively small domestic market and high input costs can make it difficult to support new at-scale production facilities in Aotearoa.

Scarce bioenergy resources and potential competing land uses, such as for food production, can create uncertainty along the supply chain and impede increased production of biofuels. In the absence of long-term demand certainty and policy or financial support, it may be difficult to develop the business case for investment to scale up the production of low emissions fuels. Transportation distance and effort of recovery would likely determine the extent to which biomass can be used economically in Aotearoa. Developing supply chains for collecting and processing bioenergy resources can be challenging, as the resource is dispersed across the whole of Aotearoa. Regional mismatches in supply and demand, coupled with differences in cost to transport biomass between regions, can result in areas with oversupply and areas of scarcity.[53] Wide regional variation means that not all the potential biomass supply could be used.

Hydrogen also faces challenges with respect to production and transport. A significant increase in renewable electricity generation and development of transmission infrastructure would be crucial. While the natural gas network could be utilised for a blended hydrogen and gas fuel, moving entirely to a hydrogen system would require new distribution and storage infrastructure.

Incomplete information about future direction of government policy, emissions pricing and energy prices can affect investment decisions. The lack of a government plan regarding the optimal use of scarce bioenergy resources or the role of hydrogen in the economy can also hinder companies from

[52] Using biomass to generate heat is cost competitive with coal in some regions at present.
[53] (Hall & Alcaraz, 2017)

investing in new production facilities. Insufficient information on feedstock availability and price trajectories can also create uncertainty and hinder investment decisions.

A national conversation about the role of these fuels will also be important. Both bioenergy and hydrogen have opportunities, risks and implications that have not yet been fully explored and understood in the Aotearoa context.

Approaches/policies:

There are several ways to help ensure that companies have the consistent signals they need to enable long term decisions. The reforms to the NZ ETS (set out in the *Multi-sector strategy* section above) will be key.

Policy support will be needed during the first emissions budget to ensure that the provision of low emissions fuels can be scaled up to meet the emissions reductions required in later budgets. Measures that create demand for these fuels would help to build a market and reduce costs in the first emissions budget period. This is particularly the case for bioenergy, where the Commission's modelling indicates an opportunity in the first and second emissions budget to make better use of existing bioenergy resources.

As part of a long-term national energy strategy, Aotearoa could undertake some exploratory research into the development and deployment of bioenergy and hydrogen as low emissions fuels. This would increase understanding of the role they should play in the future. Policy effort should focus on the high value displacement of emissions in sectors where electrification is unsuitable or significantly to expensive. This could be the aviation industry, medium and high temperature process heat, or the heavy vehicle fleet. Well-targeted research and development incentives, enabling infrastructure through capital and finance offerings, and choices which reduce or share the risk of enterprises are all levers available to government to help develop an industry ecosystem.

For bioenergy, the development of a coherent long-term plan towards a bioeconomy would be beneficial, as there is a clear role for government in providing direction and coordination. This could be considered as part of, or alongside, the Government's Forestry Strategy, or as part of the proposed National Energy Strategy. A long-term plan for a bioeconomy should look across areas of land use, waste, transport, energy, buildings, domestic wood processing and industry, as each has role in the bioeconomy. The plan should also assess the potential for perverse outcomes and the likelihood that bioenergy resources could be constrained beyond 2035. It should also be focused on managing the resource in a way that targets it towards the highest value use, in terms of displacing emissions, and coordinating how the bioeconomy could develop across multiple sectors. iwi/Māori, not only as a Treaty Partner, but as tangata whenua and kaitiaki with significant interests in assets that will contribute to a bioeconomy. The strategy supporting the plan would benefit from tikanga based values that emphasise intergenerational wellbeing.

For hydrogen, the Government needs to assess hydrogen's place in a National Energy Strategy. This includes, for example, considering the energy demand and infrastructure requirements of producing green hydrogen at-scale, evaluating the trade-offs of using hydrogen against other low emissions fuels, and identifying the potential value and role of hydrogen across the economy. Further work is required to investigate whether blue hydrogen is compatible with emissions reductions targets, and

whether it could be politically and socially acceptable as part of the transition.[54] The Commission has heard mixed views from stakeholders.

Beginning a process of providing suppliers and consumers with more information will assist the expansion or growth of low emissions fuel production. This includes information about the availability of fuel feedstocks – such as pulp logs – over time, the size of the market, expected price trajectory, and engineering solutions that would be required. This will also support the development of the supply chains and workforce required to scale up both production and use of low emissions fuels.

Reduce process heat emissions

The pathway to the 2050 target relies on major reductions in emissions from process heat. In the first three emissions budgets, reductions would be needed from low and medium temperature uses – as this is where technology is available. Avoiding the lock-in of new fossil fuel process heat assets and continued energy efficiency improvements will also be critical.

The Commission's pathway sees a steady pace of fossil fuel boiler plant conversions beginning immediately, in order to be on track for a complete transition by 2050. The pathway sees the phase out of coal use for low and medium temperature heat requirements by 2035, an immediate reduction of gas use through efficiency measures, and no new fossil fuel boiler installations. Continued reduction in gas use begins towards 2030 with the conversion of existing gas boilers. The pathway is dependent on scaling up the provision of low emissions energy sources, such as biomass and electricity.

Challenges

Manufacturing plants are often built to certain specifications and infrastructure is sized to fit existing coal and natural gas assets, and existing energy loads. In addition, because of the way some plants are configured, switching fuels may have an impact on related manufacturing processes. There may be practical engineering constraints around fuel switching and implementation of low emissions technologies. As such, the opportunities to reduce emissions are diverse and often site-specific, even across sites that produce similar goods – for example, milk powder.

There are significant existing capital-intensive assets across industrial sectors in Aotearoa. Converting these assets in line with our pathway would require the retirement of some assets before the end of their economic life. This could have significant impact on a business' accounts and ability to access further capital at attractive rates. Further there is variation in businesses' capital allocation methods, risk appetites and debt thresholds.

For example, there are currently an estimated 100 boilers across 60 different sites in the food manufacturing sector, using about 20PJ of coal per year. However, 75% of the coal use is concentrated in 10 large processing sites with around 25 boilers.[55] Converting these large processing sites by 2035 through a combination of electrode and biomass boilers would have a capital cost of approximately $440 million plus additional costs associated with upgrades or connections to the

[54] Blue hydrogen is hydrogen produced from gas with carbon capture and storage

[55] Data sourced from EECA and MBIE heat plant and boiler databases, plus information provided by Fonterra. Analysis undertaken internally with the incorporation of Transpower and Powerco transmission and distribution cost data.

electricity grid. These additional costs are highly site specific but can be significant. This would also result in an increase in operating costs, particularly for sites which electrify.

The rate at which plant conversion can happen will be limited by several factors, including fuel availability, the time required to convert plants, establish or expand fuel supply chains, and the time it takes to upgrade grid infrastructure and build new renewable electricity generation. It will also be limited by the availability of skills and expertise to undertake plant conversions and implement other emissions reduction options. Specific knowledge and skills are often required to undertake the appropriate site-specific analysis to support the business case for new technologies, and for their installation, operation and maintenance.

Fuel switching decisions are long-term, involve high capital costs, and are highly dependent on the relative capital and fuel costs of different energy sources and technologies. At present, coal and gas are the cheapest forms of energy to supply process heat for many applications.[56] Boilers are enduring assets with life cycles of up to 40 years, but can be extended indefinitely if it is maintained and repaired. This generally requires less upfront capital than replacing it.

There are challenges to increasing fuel switching to both bioenergy and electricity. Uncertainty regarding long-term biomass supply may impede decision-making and investment in process heat conversions. For electrification, a key challenge is the cost and time associated with distribution and/or transmission grid connections. For large industrial users, connection costs can make up a larger proportion of a project's cost than the equipment itself. In addition, it can take significantly longer to complete a new transmission line or interconnection upgrade than it does to develop and build a new processing plant – including planning, consenting and construction.

Lack of government support and clear direction on the value and role of low emissions fuels across the economy can impede the development of robust supply chains and infrastructure needed to scale up the production and use of bioenergy and electricity to displace emissions. Coherent government leadership is required to provide businesses with the certainty needed to enable long-term investment decisions.

Approaches / policies:

Early action and government support will be necessary to phase out the use of coal in low and medium temperature heat in industry by 2035. Regulation should be introduced to immediately deter investment in new coal boilers. Efficiency gains and emission reductions from existing plants could potentially be outweighed by continued development of new fossil fuel heat plants. Government could provide additional certainty to industry by signalling milestones towards 2035 for the phase out of coal use in existing boilers.

Continued energy efficiency improvements could unlock fuel switching opportunities at lower operating costs by reducing the quantity of low emission fuels needed to replace fossil fuels. This could also ease constraints on transmission or distribution capacity, limiting costly upgrades or connections, and reduce demand pressure on scarce bioenergy resources. Energy efficiency

[56] Electric technologies can be more affordable than coal for some low temperature applications and biomass can be more affordable than coal in some regions.

measures include optimising process design and the deployment of high efficiency electric technologies like mechanical vapour recompression technology.[57]

Demand-side measures should be introduced to reduce barriers to the uptake of low emissions technologies and develop infrastructure upgrades. This includes, for example, boiler conversions, new fuel handling and storage facilities, or grid infrastructure upgrades to distribution and transmission lines or substations. Demand-side measures could include facilitating access to finance or capital, increasing support for the identification of site-specific emission reduction opportunities and costs, and improving the relative cost of low emissions fuels to fossil fuels.

Supply-side measures should also be considered as part of a bioeconomy plan and national energy strategy, to support fuel switching. Such measures could include fostering industry capability, supporting development of robust low emissions fuel supply chains, scaling up production of low emissions fuels, and timely build out of the renewable. See also the *Decarbonise Energy* and *Scale up provision of low emissions energy sources* sections above.

Efficiently use energy in buildings

The most cost-effective way to reduce emissions from the sector is to reduce the amount of energy consumed. Energy efficiency in Aotearoa generally improves at the rate of 1% per year.[58] If less energy is being used to achieve the same outcome, productivity improves. Energy consumption and GDP have traditionally been closely linked – growing the economy has led to growth in energy consumption and associated emissions. Some countries have managed to break this link, but Aotearoa has not yet managed to achieve this.

Improving energy efficiency means households and businesses can spend less on energy bills. Improving energy efficiency will be critical in maintaining the affordability of energy in a low emissions system. It also means that where gas boilers are being used to heat water for homes, or where coal is being used to run an industrial plant, less fossil-fuel resource would be required to achieve the same outcome. This means that the total emissions would also reduce.

The Commission's analysis indicates that the greatest emissions reduction opportunity in buildings is switching from gas and LPG to low emission fuels. The Commission's pathway shows an immediate reduction in the use of gas in new buildings due to restrictions on new gas connections and new gas heating systems after 2025. Across all buildings, gas use declines steadily towards 2050, falling by around 18% by 2030 and 35% by 3035. Continued energy efficiency improvements through higher building standards and voluntary action improves energy intensity by roughly 1% per year.

Challenges

Energy efficiency is well understood, as are the co-benefits associated with efficiency improvements. This includes improved health outcomes from warmer drier homes.

Although Aotearoa has a predominantly renewable electricity system, there are still emissions benefits from reducing electricity consumption through energy efficiency. This is particularly the case if efficiency improvements can reduce peak demand. Alongside hydrogeneration, gas fired

[57] Mechanical vapour recompression (MVR) is already widely used by New Zealand's dairy sector as it is a very efficient way of evaporating water from milk. The opportunity is to deploy more advanced MVR to further increase its use in the dairy industry, and other industries that need to evaporate water.
[58] Across sectors including but not limited to buildings.

power stations are used to meet peak demand. Therefore, if peak demand can be lowered, less fossil-based generation would be required. However, some of the opportunities to make homes or businesses more efficient can be costly, and they are often not considered to be a necessary expenditure. This can be a hurdle to adoption, and one that can be compounded in businesses by the need for rapid payback on capital investments.

Energy efficiency investments may be considered too small for banks to lend for, so raising finance may also be difficult. There can also be limited access to necessary expertise for understanding how to improve the efficiency of certain businesses or processes.

There may also be a split incentive problem with energy efficiency investments. A common scenario is where the property owner bears the costs of undertaking the efficiency measure, but a tenant would benefit – for example in the form of lower energy bills or improved comfort. This can lead to no action being taken. See also section on *Transport, buildings and urban form* below.

The complexity of the retail electricity market can also disincentivise consumers from making changes that could save them money and reduce emissions. Many consumers have limited understanding of their energy use patterns, and limited time to invest in choosing and switching price plans (or adopting new technologies) that would allow them to take advantage of opportunities to be more efficient, and of market competition to secure lower electricity prices. Consumers may perceive the potential cost savings as too small to be worth the effort, given other priorities.

Approach / policies:

Electricity will increasingly be used as the principal energy source in Aotearoa, and emissions from the electricity system will continue to reduce. However, even as these improvements continue there remains good rationale to continue to pursue efficiency improvements because they support consumer savings, household health benefits and improvements to the standard of the housing stock.

There is a range of measures that can be used to support and accelerate energy efficiency. This includes continuing to amend legislation to improve energy efficiency standards for all buildings, both new and existing, through measures like improving insulation requirements, and introducing mandatory measures to improve the operational energy performance of commercial and public buildings. Government could also introduce a date after which no new natural gas connections or new natural gas heating systems can be installed. This would prevent emissions lock-in of long-lived assets. However, any measures introduced by government should also ensure lower income households have support in understanding and accessing low emissions heating options.

As is proposed in the Taskforce for Financial Disclosures, mandating greater board level involvement and oversight of emissions information would enable greater understanding, and may encourage further action. See the sections on *Strengthen market incentives to drive low emissions choices* and *Information and behaviour change* for further suggestions in this space.

The Energy Efficiency and Conservation Agency (EECA) has remit to assist companies through funding support and provision of information in order to encourage investing in energy efficiency projects.

Support innovation to reduce emissions from industrial processes

Aotearoa has several single company industries with industrial processes unique to this country. The emissions associated with these processes can be hard to abate. Transforming these processes to low emissions processes, for example shifting from coal-based steelmaking to a hydrogen-based process, is currently technically and economically challenging.

Most of the hard to abate industries manufacture products that currently have a critical role in the economy, like cement, steel and iron. If government deems it critical to maintain existing domestic heavy industry, or to grow a new manufacturing base, they would need to work alongside industry to ensure it happens in a way that is aligned with the climate change targets. There are other options; Aotearoa could import products from overseas,[59] offset emissions from current processes through forestry or other mechanisms, or support innovation and adoption of new industrial processes that require new feedstocks or reactants. This would also require the scale up in the provision of these new feedstocks or reactants.

The timing of the transition for these hard to abate emissions is an important issue. Under the Commission's pathway, many emissions intensive and trade exposed industries would continue to operate to 2050 at current production levels – though the aluminium smelter and methanol production both cease operations in the 2020s. In some modelling scenarios, steel production converts to hydrogen in the late 2040s.[60]

The products manufactured compete with internationally produced products. Therefore, these activities (production processes) are classified as 'emissions-intensive and trade-exposed' for the purposes of the NZ ETS and receive a free allocation of units. The free allocation of units will gradually phase down towards 2050. Emissions leakage is a concern. [61] At the same time, if production ceases in Aotearoa and is replaced by production elsewhere that does not increase global emissions there is not a concern from an emissions perspective, but there would be economic consequences.

Challenges

Currently, there are a limited number of commercially mature alternatives to fossil fuels for industrial processes. Decarbonisation of industrial processes through electrification is technically and economically challenging given the tightly integrated use of fossil fuels for high temperature process heat and as a feedstock or reductant. Aotearoa is generally a technology taker, and solutions that emerge internationally may not work for domestically unique processes (e.g. hydrogen steelmaking with iron sand) or may not make economic sense to adopt. Adopting new industrial processes would require significant investment in research, development and innovation.

Industrial plants may need to be modernised and retrofitted with new technologies and equipment to utilise alternative feedstocks and different chemical reactions. Given the age of the integrated

[59] In which case embodied emissions of imports and the potential for emissions leakage should be considered.
[60] This is not a specific recommendation from the Commission but is rather an example of a plausible step on the transition pathway. Green steel production is considered in the Tailwinds and Further Technology scenario.
[61] Emissions leakage is where production reduces in Aotearoa, leading to an increase to higher emissions production elsewhere in the world, in a way that increases global emissions. Globally this is a poor outcome.

manufacturing plants in Aotearoa, retrofitting may require significant capital investment on a scale similar to the cost of constructing a new plant.

Currently, alternative feedstocks and reductants like green hydrogen are significantly more expensive than coal or gas. As noted in the *Multi-sector strategy* section, RD&D funding is not always well targeted or coordinated with broader government objectives, and greater levels of industry and international partnerships are needed to foster innovation in key areas.

Increased competition for certain feedstocks over time can increase their cost, create supply uncertainty, and hinder long-term investment in transitioning industrial processes. This is the case with materials added to concrete, for example. There is currently an insufficient supply of alternative feedstocks domestically, though they can be sourced internationally. As the world decarbonises, these alternative materials may become increasingly constrained.

Aotearoa is unlikely to be the technology leader when it comes to the R&D focused on reducing emissions from industrial processes. However, as processes for some of these industries are currently bespoke and are based on a specific resource found in Aotearoa – for example the type of coal or iron sands found here, Aotearoa will need to adapt technologies developed elsewhere to local circumstances. Many industries have already proved resourceful at doing this. Globally, hard to abate sectors, such as cement, will need to eventually transition as countries undertake action to limit the global average temperature increase to 1.5°C above pre-industrial levels. Some sectors may consolidate into certain regions that are able to undertake the process with lowest emissions – as a distant but renewable-abundant nation, Aotearoa may or may not be well placed to continue when this happens.

Approach / policies:

Aotearoa needs to begin a joint conversation with employers in these hard to abate sectors. These sectors are often large regional employers, and several are undertaking strategic reviews. There is a risk that, due to economic reasons, some of these industries may close. Whilst this would reduce emissions it would also lead to concentrated job losses, and some of these industries might be considered strategically important for the country.

A clear government plan (along the lines of the UK's Clean Growth Strategy) for the future of hard to abate sectors to bring economic strategy together with emission reduction goals could be helpful. This plan should be developed alongside the National Energy Strategy and could be done as part of the Just Transitions programme – see also the *Localised transition planning* section below. A focus on long term outcomes is important to ensure that investments align with policy goals.

An assessment of the need to expand support for RD&D into new decarbonisation technologies focused on the hard to abate industries should be undertaken, based on the long-term outcomes within the plan – for example, into new technologies to make use of alternative feedstocks and new chemical processes and adapting them to local circumstances. Support for demonstration projects and small-scale pilots could also be useful.

17.3.3 Transport, buildings and urban form

Urban form, transport and buildings are an important consideration for achieving the emissions reductions targets. Aotearoa has a predominately urban population which is projected to increase. [62] The number of buildings in Aotearoa will need to increase to meet the needs of a growing population and economy. How the cities, communities, and buildings we live, work and play in are designed, constructed and operated will have an impact on emissions.

Demand for transport and urban form are closely inter-linked. Population density, transport infrastructure, layout and land use are key drivers of emissions in urban areas. Low-density residential development – or urban sprawl – is associated with higher transport emissions. Cities with a lower average population density are less compact and their economic hubs (employment, education facilities, residences, shopping centres) are located farther from each other. These longer travel distances and higher transport demand are likely to be met by greater use of privately owned passenger cars. This results in an increase in vehicle kilometres and emissions. Equally so, high density cities that are not well designed and are congested can also lead to higher transport emissions.

As cities grow they require more housing supply. Cities can 'grow out' (enabling construction at the edge of the city), 'grow up' (permitting more intensive development within established areas), or both. The Productivity Commisison found that cities in Aotearoa tend to grow out rather than up. As growth occurs at the urban boundary rather than the urban centre, this results in populations being farther from the city centre.[63]

There is limited opportunity to rapidly change urban form. The potential for emissions reduction and co-benefits through a shift towards compact urban form is high but the timeframes to realising these opportunities are slow due to the path dependencies created by the existing infrastructure. However, the decisions Aotearoa makes today can influence the type of buildings, communities and cities in the future and prevent emissions lock-in as transport systems, buildings and other infrastructure are long-lived assets.

As urban areas densify and transport electrifies, it will be important to ensure that energy, water, and fibre infrastructure can accommodate more people living in the same area. It will also be important to develop connectivity across communities to facilitate shifting to different types of transport and to ensure accessibility for all New Zealanders. The Commission has, to date, had limited resource to focus on developing recommendations for how cities and towns can be planned and designed to reduce emissions. This is an area where further work in future could be beneficial.

In the Commission's pathway, existing commercial and institutional buildings reduce operational energy intensity by 30% across a 30-year retrofit cycle. All new buildings also have improving operational energy standards and reduce energy intensity at a rate of 1% per year. Existing residential buildings are assumed to reduce gas use by 35% by 2035 through transitioning to low emissions fuels and improved energy efficiency. The pathway assumes no new gas connections for new buildings by 2025.

[62] Around 84% of New Zealanders live in an urban area (Stats NZ, 2020)
[63] (Productivity Commission, 2017, p. 80)

Challenges

It is currently unclear exactly the emissions reduction impact of urban planning and form, and there are numerous studies claiming different measures and magnitudes of emissions reduction potential from urban planning and design interventions. For example, the Productivity Commission notes that higher density urban centres can reduce vehicle kilometres travelled per capita by 5-12%.[64] A study by the Stockholm Environment Institute highlights that urban planning for compact urban form can reduce emissions by 5% by 2030 and 6% by 2050.[65] NZTA has identified potential for increased public transport and alternative modes from compact urban form.[66] The global Coalition for Urban Transitions supports the notion that compact and mixed-use design of cities can reduce passenger car travel demand and encourage mode shift towards more sustainable transport means, such as walking, cycling and low emissions public transport (e.g. electric trains and buses).[67]

There is potential that widespread uptake of electric vehicles could fundamentally change the relationship between urban form and transport emissions – particularly in Aotearoa where there is access to renewable electricity. Under this scenario, urban planning and design would have less impact on reducing transport emissions (as transport fuel would be largely emissions free), although would continue to have co-benefits such as reduced congestion and energy efficiency (energy required for distance travelled).

The planning of new communities or suburbs, and the redesign of shopping areas, affects transport choices, and therefore emissions from transport. Compact urban design can reduce emissions. As discussed below, location and amenities are often prioritised over energy use and potential emissions reduction for buildings. The intersection of waste, transport and energy emissions in relation to buildings and urban form can make it difficult to ensure accountability and joined-up government planning and decision-making towards clear outcomes. This is an area where further work to understand the opportunities and potential policy interventions to reduce emissions would be beneficial.

The way a building is constructed determines its embodied emissions, and its design affects ongoing emissions from energy use. Construction, renovation and demolition over the life of a building generates waste and can therefore impact waste emissions. However, there is generally little or no coordination between the different companies involved in life cycle stages of a building.

Designing and constructing high-performance, resilient buildings that exceed the minimum Building Code requirements is perceived as costly. There are mismatches between those bearing the cost of building beyond the minimum Building Code requirements and adopting low emissions technologies, and those accruing the benefits over time. There is also the risk that the cost of building beyond the Code will impact housing affordability if developers and property owners seek to pass on costs.

There are significant remaining opportunities to improve energy efficiency and to switch to low emissions fuels across the built environment. However, it may be difficult for building designers, operators, occupants and trades professionals to obtain, understand and analyse information to assess options best suited to them. Additionally, the capital cost of technologies is often prioritised

[64] (New Zealand Productivity Commission, 2018, p. 493)
[65] (Erickson & Tempest, 2014)
[66] (Waka Kotahi, 2019)
[67] (Gouldson et al., 2018)

over its whole-of-life costs and benefits. Other factors are also prioritised over energy savings and emissions reduction such as seismic ratings, location and proximity to amenities.

Reducing emissions from transport, buildings and urban form requires coherent long-term thinking, because choices made in the next five years will have emissions consequences for the next 50.

Approach / policies

The Government could develop a consistent approach to estimate the long-term emissions impacts of urban development decisions and continually improve the way emissions consequences are integrated into decision making on land-use, transport and infrastructure investments.

It could ensure a coordinated approach to decision making is used across Government agencies and local councils to embed a strong relationship between urban planning, design, and transport so that communities are well designed, supported by integrated, accessible transport options, including safe cycleways between home, work and education.

The Government plans to make large investments in state housing over the first emissions budget period. Government should leverage this investment to maximise opportunities for emissions reductions, to avoid lock in and prevent stranded assets, and to drive growth in industry capability and readiness. Additionally, this investment can be leveraged to support a just transition by addressing energy affordability and ensuring equitable access to low emissions options, for example, in transitioning from portable LPG heaters to heat pumps.

Government should use its significant procurement power to foster integration between building designers and builders, to accelerate capacity building and upskilling, and to build demand for lower emissions materials and practices across the construction industry. This would ensure an improvement in the emissions performance of future infrastructure, and current and future state housing, with benefits realised across the private sector. Upskilling across the construction industry should be backed by ongoing legislative reform, for example through the Building Code and reform of the resource management system. There also needs to be more co-design of urban form and transport planning with communities to ensure that communities, particularly lower income communities, are not developed in areas most at-risk to changes in future climatic conditions.

Ongoing operational emissions from buildings are mostly from energy use – for example, from gas, coal or electricity. The Commission's modelling indicates that the biggest opportunity to reduce emissions associated with operating buildings is by reducing the use of fossil fuels, especially gas. Over time, fossil fuel use would need to be replaced by low emissions fuels such as electricity. For existing buildings, continued improvements in energy efficiency is essential, particularly in large commercial buildings and institutional buildings.

The *Heat, Industry and Power* section of this chapter contains additional suggestions of ways to reduce emissions from buildings. This includes maximising the use of electricity as a fuel in buildings and increasing energy efficiency.

The recommendations in the *Waste* section of this report are also relevant, such as the suggestion to increase waste recovery and improve the circularity of the economy.

17.3.4 Agriculture

Under a Current Policy Reference case, emissions from agriculture are expected to fall, although agricultural output is maintained. Reductions in emissions are due largely to strengthened freshwater policy leading to a reduction in stock numbers, the NZ ETS incentivising land-use change to forestry, as well as continued efficiency improvements. However, more action will be needed to reduce emissions in line with meeting the 2050 methane target. See *Chapter 7: Where are we currently heading?* for more detail.

The focus of climate policy for agriculture in the short term should be on supporting the widespread uptake of low emissions technologies and management practices that are commercially available. Significant gains could be made at a national level if all farms were brought up to the standard of the current best performers.

Increased and continued investment in research to bring new technologies, such as methane inhibitors and vaccines, to fruition would also be important. However, there remains considerable uncertainty around when and if these technologies would become available to farmers. Even if such technologies are successfully brought to market, incentives or measures would still be needed to ensure that they are widely adopted by farmers as and when they become available.

Many farmers have expressed a desire to be able to incorporate all sources and sinks of emissions within their farm systems into emissions calculations, and potentially see them integrated into any future emissions pricing system. This should drive investigation into the scale and feasibility of emissions and removals from trees and vegetation on farms that do not meet the definition of a forest. Further consideration is required about whether to include these in any scheme for pricing agricultural emissions – this issue is discussed in the *Forestry and Removals* section below.

Support farmers' adoption of best practices for low emissions pastoral farming

Most emissions from the agriculture sector come from livestock farming, and the methane and nitrous oxide emitted are the result of complex biological processes. Methane emissions are largely a function of the amount of feed an animal eats. Nitrous oxide emissions are largely a function of the amount of nitrogen added to the land through urine, dung and fertiliser.

Reducing on-farm agricultural emissions therefore relies largely on changes to farm management practices that reduce total feed being produced and consumed, and nitrogen being deposited onto land. Adjusting stocking rate, supplementary feed and nitrogen inputs for emissions efficiency, and use of low-nitrogen feeds, can all help to reduce on-farm emissions.

The Commission's analysis shows that changing on-farm management with current practices will be enough alone to achieve the 2030 biogenic methane target.

Challenges

While making changes to the way farms are managed can reduce emissions, there are challenges to doing so. The interactions between the different aspects of the farm system are complex, and changing one aspect of a system would have knock-on effects in others. Soil quality, plant cover, climate and stocking rates, as well as what animals are fed and how they are housed, would all impact a farm's emissions profile. The opportunity for gains will vary widely between individual farms, and between regions.

There is also some uncertainty about the impact of many on-farm mitigation options. Actual methane and nitrous oxide emissions on-farm cannot be measured directly so need to be calculated/estimated. This can be done in different ways that involve varying levels of complexity. Using relatively simple stock number and production data can recognise changes in emissions from production rate or stock level changes, but they are too blunt to be able to recognise emission reductions that might result from adjustments in the way farms are managed. Farm models that also consider farm-specific data around animal and diet characteristics can give a more accurate picture of changes to farm emissions, but require the collection of a lot more data, and are more expensive to implement. Estimating emissions at a farm level requires a balance between capturing as much farm-specific information as possible, and availability and cost of that data. No estimate will be able to completely capture and account for the complexities of different farm systems.

The complexity of farm systems also means that achieving emission reductions of any scale relies on highly skilled farm management, as well as high quality data to support farmer decision making. Currently, many farmers, farm advisers and other professionals that farmers rely on do not have a good understanding of emission mitigation practices, or of how different approaches would work within different farm systems or contexts.

Farmers are often faced with large amounts of advice that can be time-consuming to navigate, and from sources with a variety of interests. Building the knowledge and skills needed to ensure that measures are well understood, and can be well implemented, would be important – access to technology like rural broadband would help support better access to the information, advice and tools farmers need.

Regenerative agriculture is an outcomes-focused approach that uses practices to improve soil quality, promote biodiversity, sequester carbon and increase resilience to the impacts of a changing climate. This approach can include practices like no/minimal tilling, use of cover crops, crop rotation and agro-forestry. Regenerative agriculture is relatively undeveloped in Aotearoa, with limited efforts to evaluate its impact on emissions to date. More investigation is required to understand the potential of approaches like regenerative agriculture to reduce emissions.

There are changes farmers can make now to how their farms are managed that would help to adjust farm systems to achieve lower emissions but doing so in a way that maintains profitability is challenging. Many farmers hold high levels of debt, which can be a barrier to investing in new technologies, approaches or changes in land use that could reduce emissions. Measures that affect production would affect farmers' ability to drive a return on capital they have already invested and could potentially lead to stranded assets.

For changes to farm management to have a significant impact nationally, there would need to be widespread adoption of these kinds of practices. A combination of support, market incentives and direct regulation are likely to be required to drive the scale of change needed.

Incentivising farmers to adopt and implement best practices and technologies for low emissions pastoral farming is a matter of urgency. Measures to incentivise best practices will also be important when (and if) new technologies are developed – such as a methane vaccine. Such technologies would only have an impact on methane emissions if they are widely adopted by farmers.

Approaches / policies:

Meeting the 2030 methane target and the 2050 targets would require measures to incentivise more farmers to take action to lower methane and nitrous oxide emissions from pastoral farming. The Interim Climate Change Committee made a series of recommendations in their *Action on Agriculture* report.[68] Some, but not all, of these have been implemented.

The Interim Climate Change Committee (ICCC) concluded that the best way to reduce livestock emissions is to price them through a farm-level levy/rebate scheme.[69] Therefore, ensuring that methane and nitrous oxide from agriculture face an emissions price should form a key part of the Governments' approach in this sector. The Government should continue to advance implementation of the He Waka Eke Noa programme, which is tasked to develop a farmgate emissions pricing mechanism by 2025. Alternatively, agricultural emissions could be priced from 2025 through the NZ ETS.[70]

Alongside pricing, farmers also need better information and support to develop the skills needed to manage farms in a way consistent with low emissions. Some of these are already being progressed through the He Waka Eke Noa partnership and should continue to be supported. To support the development of skilled and effective low emissions farming, the Government should:

- Develop accessible, trusted, information hubs on emissions reduction measures for farmers. Such hubs can provide farmers with tools and resources to help them measure and manage emissions, as well as support services to implement changes.
- Co-develop with farmers training and farm extension services that provide opportunities for farmers to share knowledge and experience. This should include specific training and extension services co-developed with and for iwi/Māori landowners.
- Provide technical and financial support for the development of training and accreditation schemes to ensure farmers have access to advice from credible, impartial advisers and rural professionals who understand how emissions mitigation practices work in different farm contexts.
- Accelerate and provide further resource to support the development of farm environment plans that consider greenhouse gas emissions on-farm alongside other environmental outcomes, and traditional business outcomes.
- Continue to invest in farm system modelling to support good decision-making.

There are some other potential ways to support and incentivise farmers to adopt best practices and technologies which the Government should consider. These include:

- Providing, facilitating or supporting the provision of concessional farm finance for investments that lead to emissions reductions;
- Investing in demonstration projects to experiment with novel technologies, practices and land uses to reduce emissions (eg, using Pāmu farms for demonstration projects).

[68] (Interim Climate Change Committee, 2019b)
[69] (Interim Climate Change Committee, 2019b)
[70] Agricultural emissions from different sources could also be priced through different mechanisms. For example, livestock emissions could be priced at the farm level through a rebate/levy with fertiliser emissions priced at the processor level in the NZ ETS.

- Supporting the rapid rollout of rural broadband, to ensure farmers have access to data to support decision making and the ability to practice precision agriculture.

Diversify agricultural production to reduce emissions

Pastoral agriculture dominates the Aotearoa landscape, accounting for about 40% of total land area. The area of land in horticulture has increased in some places in recent years, including on iwi/Māori farms, but remains very small in terms of total percentage of Aotearoa land use – horticulture and arable combined account for only around 1% of total land use.

Diversifying landscapes and switching some land currently in livestock agriculture to lower emission uses like horticulture or arable cropping could reduce emissions. Most expansion of horticulture or arable is likely to happen on land currently used for dairy.

However, horticulture and arable are already very profitable land uses. This indicates that barriers to changing land use are likely to be significant.

Challenges

These are currently several barriers to shifting land use from pastoral farming to lower emissions activities. One of the main barriers is market access. Aotearoa fruit is mostly exported, and while it tends to achieve a premium price internationally due to its high quality, gaining access to new markets for fresh horticultural produce is a slow process, linked to the negotiation of international agreements.[71] Expanding international export of produce would be likely to take considerable time and effort.

Lack of experience, skills, support and infrastructure can also act as barriers to land use change. For example, the horticulture sector currently experiences seasonal labour shortages, and this has been exacerbated by COVID-19. Expansion of horticulture and arable farming would require access to high quality soils and water storage, as well as appropriate climatic and land characteristics. There is also currently a lack of high-quality information and data about potential land uses in different parts of the country, now and in the future. A lack of processing facilities, infrastructure and supply chains for lower emissions products can also act as a barrier to diversifying land use away from pastoral agriculture.

As with pastoral farming, access to capital can also act as a barrier to landowners who want to diversify. Changing land use to horticulture or arable can require high capital investment. Existing dairy farms (typically the land most suitable for horticulture or arable) often have high levels of debt, and the need to drive a return on existing capital investments is a barrier to land use change that could reduce emissions.

Some of the land potentially suitable for horticulture and arable would also be in fragmented pockets which may not be sufficiently large to be standalone horticultural enterprises.

Approaches / policies:

Currently disjointed policy objectives and siloed governance structures mean environmental issues, and issues associated with different land uses, are dealt with in isolation. To begin to overcome this, a national conversation about the future of land use across Aotearoa would be important. Different

[71] (Horticulture New Zealand, 2019)

land uses have opportunities, risks and implications that have not yet been fully explored and understood in the context of the transition to low emissions.

Measures are also needed to support landowners who want to diversify some of their land to lower emissions activities. Government measures should focus on overcoming the barriers that currently prevent the shift to more profitable and lower emissions land uses.

This includes:

- Undertaking detailed and targeted analysis to better understand the nature of current barriers to shifting to already profitable lower emissions land uses;
- Ensuring that farmers have access to high quality, trusted information on changing or diversifying land use to lower emissions activities. This should include access to an evidence base to identify what can be grown where, now and in the future, as well as information regarding cultivation practices and markets. Improving access to rural broadband can support this outcome;
- Encouraging cross-sectoral thinking and collaboration by government agencies and sector bodies, or the development of pan-sector governance structures for the primary industries;
- Investing in market development and infrastructure for new and emerging low emissions agricultural products.
- Verification of the emissions footprint and broader sustainability of products, including through approaches like certification and product labelling, can help to support market access for low emissions food products.

Provide increased and sustained funding to support R&D for technologies to reduce emissions from agriculture

Investigating and developing new technologies has been a major focus of the Government's approach to reducing greenhouse gas emissions from agriculture, and the focus of considerable research effort over recent years.

The Government invests about $20 million each year into research focused on reducing greenhouse gas emissions from agriculture, and farmer extension programmes. The country plays an international role in research in this area, particularly to reduce methane emissions, including through the Global Research Alliance on Agricultural Greenhouse Gases. A wide range of industry actors also support a lot of scientific work in this area, including Fonterra, Beef + Lamb, DairyNZ, the Fertiliser Association, Deer Research and others.

Investments into agriculture emissions research has already identified practical solutions, and there are a range of new technologies under development with considerable potential. Measures currently being investigated and developed that offer promise include a methane vaccine and a methane inhibitor that would be compatible with the pastoral farming system in Aotearoa.

Continued investment in research to bring these (and other) new technologies to fruition is important. If these technologies are successfully developed, they could lead to substantial emissions reductions and give Aotearoa a wider range of potential paths to meeting the 2050 methane target. However, there is considerable uncertainty around when and if new technologies to reduce emissions would become available to farmers.

A key challenge for any future technology would be to ensure that it is able to be widely deployed in the pastoral farming system, and that once developed farmers are incentivised to use it.

Challenges

Future measures to reduce emissions currently being researched and developed hold a lot of potential. However, any technology that is not easily integrated into the pastoral farm system would be unlikely to be adopted on the scale needed to shift the dial on biological emissions.

As noted in the multi-sector strategy section above, investments in RD&D are needed to support the development of new technologies (such as a methane vaccine), as well as the testing, adaptation and adoption of technologies that already exist (such as a methane inhibitor that is compatible with the pastoral system in Aotearoa).

To date, the collective global effort to mitigate emissions in the agricultural sector has been weak[72], and Aotearoa has the potential to be a global leader in this area. If successful, significant emissions reductions could be achieved in Aotearoa, which would give greater flexibility in terms of how the pathway to the 2050 target could be met.

Breakthroughs in developing new technologies to reduce emissions from agriculture could also provide Aotearoa with an opportunity to export knowledge and technology that could have an impact on agricultural emissions globally. Given the long timeframes needed for investments in RD&D to produce technologies and innovations that can be adopted on-farm, the need for additional funding to support this research is urgent.

Experience has shown it can take a long time to get products through the regulatory process (e.g. putting products on the Agricultural Compounds and Veterinary Medicines (ACVM) register) so that it can be used on farms. It is also not clear whether existing natural products, such as seaweed, need to be included on the ACVM register if they are advertised as reducing emissions.

Approaches / policies:

Reducing emission from agriculture is an issue of great importance to Aotearoa – much more so than for many other countries that have a much smaller share of their emissions from agriculture. This means that there is a strong reason for Aotearoa to invest in RD&D and innovation. Promising solutions are under development, but their success relies on continued investment by both the Government and the private sector.

As highlighted by the ICCC, the Government needs to carefully balance research priorities, between current market potential and opening up new opportunities.[73] As part of its approach to continued investment, the Government should:

- Provide ongoing and increased support for RD&D and innovation to reduce emissions from agriculture, with particular focus on the development of a methane inhibitor suitable for use in the pastoral system, or of a methane vaccine.
- Identify and address regulatory and market barriers to the early adoption of new methane reduction technologies, so they can be widely adopted when commercially available. This

[72] (OECD, 2019a)
[73] (Interim Climate Change Committee, 2019b)

should include streamlining the regulatory process for novel products to reduce emissions and making this process clear for companies to bring products to market.

17.3.5 Forestry and removals

Because trees remove carbon dioxide from the atmosphere as they grow, they offer the opportunity to 'offset' or compensate for some of the emissions from other sources and help to reduce net emissions. However, relying too heavily on emissions removals by forestry could divert action away from reducing gross emissions in other sectors. It could also pose risks because forests are not a guaranteed permanent removal of carbon from the atmosphere – the carbon stored in forests could be re-released back into the atmosphere if forests are destroyed or damaged.

There are options to design policies to manage these risks, for example the NZ ETS includes mechanisms to safeguard permanence and there are also other options such as establishing a buffer of removals as a sort of insurance against the destruction of forests. However, the greater the reliance on forestry, the more challenging it becomes to mitigate these risks.

To help ensure emissions reductions occur in other sectors, the Commission has provided clear advice on the proportion of emissions reductions and removals that should comprise achieving the emissions budgets. The Commission sees forestry playing a role in helping Aotearoa to meet its emissions reduction targets that is nuanced in terms of scale and type. The role the Commission sees for forestry is informed by a consideration of the environmental, social, and economic impacts that forestry can have.

Policies should be put in place to ensure that the pathway to meeting the 2050 target strikes the recommended balance between emissions reductions and removals, leveraging the varied contributions of different kinds of forests.

Increase amount of permanent native forest that provides a long-term carbon sink

The rate at which native forest sequesters carbon is slower than for exotic planted forest, but a hectare of permanent native forest will continue to sequester carbon for hundreds of years. These forests would also offer other benefits, such as improving biodiversity and recreational benefits. If high rates of native afforestation can be sustained to 2050, there is potential to build an enduring carbon sink.

Challenges

We see a significant role for permanent native forest in providing an enduring carbon-sink to help Aotearoa to meet its 2050 target. The Commission's pathway requires at least 16,000 ha of new native forests per year by 2025, and 25,000 ha per year by 2030 until at least 2050. Policy will be needed to support this.

There is an estimated 1.15 to 1.4 million ha of erosion prone land, much of which would not be suitable for production forestry but could be suitable for converting to permanent forest. However, there is currently a lack of incentive for landowners to let less-productive farmland revert to permanent native forests. This is particularly the case for small or fragmented areas of trees that are of a scale not eligible for inclusion in the NZ ETS, but which still offer carbon benefits (as well as biodiversity and erosion control benefits).

Look-up tables are used, for NZ ETS purposes, to calculate average forest carbon stocks in forests of less than 100 ha for a given year. For native forest, a default table applies to all native species across all regions for up to 50 years. While the amount of carbon sequestered by different types of native forest in different regions is likely to vary considerably, this is not reflected as current lookup tables are based on regenerating indigenous shrublands (mainly mānuka and kānuka).[74] Nor do they reflect that many native species have long growth cycles.

Establishing new permanent forests also comes at a cost for landowners – building and maintaining fences is expensive, and some land would be lost to grazing. Planting seedlings would be required in some places where there is not a natural seed source, which would be an additional cost.

Some Māori-collectives that own large tracts of land may face challenges transitioning land use. The Crown needs to work in partnership with Māori-collectives to understand their aspirations for land use – forestry in particular. There are likely to be some specific barriers preventing Māori-collectives from afforesting their land in line with their aspirations – including, for example constraints and challenges associated with the management of collectively-owned iwi/Māori land under Te Ture Whenua Māori Act 1993, or considerations in line with kaitiaki and tikanga values.

Large existing areas of permanent native forest already store and sequester a large amount of carbon in Aotearoa. Most does not count towards the targets, because it is forest that existed pre-1990. Controlling pests that damage foliage, seedlings and affect tree health would help maintain carbon stocks, and may help to increase carbon stocks on this land. However, there is no incentive for landowners to undertake pest management or other measures to increase carbon stocks. Currently, it is difficult to detect the effects that management practices have on carbon stocks and so they are not reflected in national estimates of carbon sequestration by these forests.

Many farms contain small areas of trees and other vegetation on-farm, including riparian plantings, shelter belts, and small pockets of native bush or exotic plantings. The carbon sequestered in these trees does not currently contribute to emissions budgets or targets, because they do not meet the rules around what can be counted as a carbon sink towards the emissions reduction targets. *Chapter 3: How to measure progress* discusses these accounting rules in more detail. Many farmers and other stakeholders have expressed a desire to be able to count all the carbon sequestered in trees and other vegetation on-farm. Some have expressed a sense of unfairness that all on-farm emissions sources should incur an obligation, while not all sinks are rewarded. However, there is currently a lack of robust data about the amount of carbon sequestered in small areas of trees or vegetation, and the costs of measuring and monitoring carbon sequestration could be considerable.

Policies / approaches:

There are a number of potential approaches to encourage the establishment and ongoing management of permanent native forests on marginal and erosion prone land. This includes:

- Develop carbon monitoring systems that enable tracking of sequestration from different types of vegetation, smaller blocks or dispersed areas of trees, and develop mechanisms to reward this either inside or outside of the NZ ETS;
- Establish and provide ongoing funding for pest control activities to ensure the carbon stocks in permanent forests are preserved;

[74] (Ministry for Primary Industries, 2017)

- Provide financial incentives or subsidies to help reduce the costs of establishing and maintaining native plantings. This could include, for example:
    - Extending grant schemes such as One Billion Trees, or providing targeted grants for native planting, fencing and predator control to facilitate reversion;
    - Results based finance for native afforestation (e.g. nature forest bond scheme);
    - Develop ways to recognise wider ecosystem services, which could reward the other environmental benefits of native forests (e.g. biodiversity).
- Update the NZ ETS lookup tables for a wider range of native species;
- Ensure the Crown works in partnership with iwi and other relevant Māori-collectives to understand their aspirations for land use, and understand specific barriers to afforestation that iwi/Māori landowners face.
- Develop management plans for large permanent forests to protect and enhance carbon stocks and other benefits of these forests, and reduce the risks they are exposed to such as pests, disease and climate change impacts. The plan should also consider the community impacts of these forests.

Define a clear role for production forests in the transition to low emissions

Most commercial forests in Aotearoa are radiata pine, which can sequester a lot of carbon quickly. Other exotic and to a lesser extent, native species, are established for production, sometimes using alternative forest management systems. This allows them to help us reduce net emissions in the short term and offer flexibility for meeting budgets and targets in the future. However, once an area of production forest land has been afforested and the trees have reached their long-term average carbon stock, no further removals contribute to meeting the targets.

Maintaining established forests is important but is primarily about preventing loss of carbon stocks already accumulated. Production forests are helpful for providing removals over the short to medium term to reduce the climate impact of Aotearoa over the time needed to reduce gross emissions, but they are not a long-term solution.

Challenges

Relying too heavily on emissions removals by exotic forestry could divert action away from reducing gross emissions in other sectors. Heavy reliance on removals from exotic forestry to meet the 2050 target is also likely to make maintaining net zero emissions after that date challenging, and dependent on significant further conversion of land to forestry into the future. Current NZ ETS settings may incentivise more large-scale pine plantations than is desired to meet 2050 targets.

Large-scale change from livestock farming to plantation forestry would also represent an economic transformation that would inevitably affect some communities in terms of the local workforce and culture. Some rural communities are concerned that afforestation could occur on sheep and beef land, with associated employment impacts and flow-on effects. The impacts of any afforestation would depend on the scale, the species of trees that are grown, the type of land that is afforested, and how much other sectors are able to reduce gross emissions. If adverse impacts of afforestation on rural communities are judged to be likely or come to pass, they would need to be managed.

Approaches / policies:

A key priority for government policy must be to align emissions removals by forests with emissions budgets. This may need to be achieved through a combination of ETS changes and other policies.

There are several potential ways to alter the incentive for afforestation from the ETS, examples include:

- Introduce a limit on the amount of forestry units that non-forestry NZ ETS participants can surrender.
- Alter the amount or rate at which forestry units are allocated -for plantation forestry in the NZ ETS so that they earn less overall.

These options would need to be carefully explored and analysed, including with those who may be affected by the changes, to understand the implications and avoid unintended consequences. This is because different options would have different effects in terms of the relative price of forestry NZUs compared to other NZUs, and on the prevailing NZ ETS market price.

Limits on either the earning or the use of forestry units in the NZ ETS would reduce the returns to forest owners but would do so by different mechanisms. Introducing a quantity limit in the NZ ETS would reduce the value of forestry units relative to other NZUs, while the second example above would not affect the price of forestry NZUs in that way, but the forest owner would earn less of them and so overall would still get a lower return.

While amending the NZ ETS could provide a lever to limit the overall amount of afforestation that is incentivised, it would not be able to limit the amount of afforestation that occurs in specific places. Some stakeholders in the agriculture sector have expressed concern about whole farm conversions to forests or the scale of afforestation in certain regions having adverse impacts on rural communities. Addressing these concerns would likely require other approaches, such as rules about land use implemented under planning legislation.

Non-ETS policies the Government could consider to support diverse and resilient production forests include:

- Use resource management instruments or reforms to manage land use conversion to forestry – for example, restrict extensive land use change in some regions, and remove existing limits in others to allow forestry. This option would help to control the amount of forestry that happens in a particular location, and could be used to address concerns about the impacts of whole farm conversion to forestry or impacts on rural communities in some regions.
- Capacity building and extension services for landowners focused on integrating trees or forestry onto farms as diversification rather than wholescale farm change, to limit the impacts of afforestation on rural communities.
- Investigate approaches for promoting a native forest industry.
- Introduce measures to increase domestic timber demand, for example by changing building policies to stimulate the wood processing industry and increase the value chain employment of forestry.

Consider alternative options for permanent emissions removals

As noted above, relying heavily on emissions removals by forestry could pose risks for our climate change goals. Forests are not a guaranteed permanent removal of carbon from the atmosphere –

the carbon they store could be re-released back into the atmosphere if forests are destroyed or damaged. Furthermore, production forests offer only short to medium term removals. To improve resilience and provide on-going options for removals, diversifying options for long term emissions removals beyond forests may be beneficial.

Higher cost alternative options for emissions removals already exist. These have been discussed in *Chapter 5: Removing carbon from our atmosphere* and includes Carbon Capture and Storage (CCS) and bioenergy combined with CCS (BECCS). Such approaches could play a role in the latter half of the century to help Aotearoa meet its contribution to global efforts to limit warming to 1.5°C above pre-industrial levels.

Challenges

There are a range of existing regulatory mechanisms and carbon accounting rules which do not currently incentivise the development of CCS, and do not fully account for the environmental, health and safety, access to land, and mineral and property rights associated with the process. For example, the Resource Management Act does not address long-term liability for CCS operations after closure and does not facilitate the ongoing regulatory supervision of CCS projects over a very long timeframe. Additionally, the likelihood of a person developing CCS without a surrender obligation under the NZ ETS is low.

CCS and CCS-based technologies like BECCS are largely a developing or emerging technology with highly variable, site-specific costs and long development timelines. In Aotearoa, CCS has not progressed beyond the research and concept stage.

Approaches / policies:

There are three priority actions the Government could advance that would maintain optionality in this area:

- Uphold its obligations under the Te Tiriti o Waitangi and initiate a broad process to understand iwi/Māori perspectives on CCS and BECCS.
- Take action to develop a better understanding on the geophysical potential and suitability of CCS and BECCS approaches in Aotearoa. This could include:
    - Staying informed of global developments in CCS technologies and applications, and broadly assessing their relevance and applicability to Aotearoa;
    - Investigating the potential and suitability of depleted or producing oil and gas fields in the Taranaki region for carbon storage; and
    - Researching the nature of skills, capabilities and workforce required to support the development and implementation of CCS and BECCS approaches, such as those in forestry, oil and gas, and geothermal energy.

17.3.6 Waste

There are many emissions reduction opportunities in waste, most of which would generate co-benefits, synergies and spill overs for the economy, society and environment. Biological methane from waste does not make up a large proportion of total greenhouse gas emissions. Yet, compared

to other sectors, reducing emissions from waste is less reliant on technology and can generally use proven reduction options that have been tried and tested overseas.[75]

While waste emissions may look like a small fraction of total greenhouse gas emissions,[76] there are embodied emissions associated with the production and transportation of things that ultimately end up in landfill. This is a major area with potential to reduce overall emissions footprint and impact on the climate in Aotearoa.

The preferred opportunity to reduce emissions from waste is by reducing the amount of waste generated in the first place. Other opportunities include recovering waste before it goes to landfill, and ensuring modern, efficient disposal sites.

The Commission's modelling indicates that there are a range of possible paths to achieving the 2050 methane target. While waste is only around 10% of overall biogenic methane emissions,[77] it can play a substantial role in achieving this target as the ability to reduce emissions from waste is not reliant on the development of technology.

Reduce waste at source

Preventing waste from being created is a crucial step in avoiding emissions from waste. Most waste in Aotearoa is generated by commercial and industrial activity, with a smaller proportion from households. Improving industrial processes and removing barriers to help change behaviour can help to minimise the amount of waste generated.

Challenges

With a large proportion of goods being imported Aotearoa has limited direct control over how much waste goods produce. There is also a lack of knowledge among businesses and households about how to reduce waste and a lack of market incentives for doing so.

To enable consumer behaviour to shift, removing barriers that prevent consumers from pursuing choices and approaches that lower emissions would be important – for example, by addressing gaps in knowledge by providing information and support. For example, The Love Food Hate Waste Campaign that was run in London successfully reduced avoidable food waste by 14%, with every £1 spent on the campaign generating up to £8 in savings.[78] This provides a good example of how consumers can be supported to shift behaviour, and in doing so can both reduce emissions and save money.

Approaches / Policies:

To achieve reduce waste generation at source, interventions need to be aimed at industry and businesses, as well as individual consumers. Possible approaches include:

- Develop information and support materials for producers and consumers on how to reduce waste at source, for example through targeted campaigns around the impact of waste.
- Encourage innovation in technology and processes through investment in designing out waste and resource efficiency.

[75] (New Zealand Productivity Commission, 2018)
[76] (Ministry for the Environment, 2020)
[77] (Ministry for the Environment, 2020)
[78] (Waste & Resources Action Programme, 2013)

- Remove structural barriers that prevent waste reduction at source for example by mandating the repairability of goods and machinery.

Increase resource recovery from waste

Waste that cannot be avoided in the first place can be recovered instead of going to landfills in order to reduce the emissions they would otherwise create. Recovering organic waste from landfills can prevent emissions from being released as organic materials decay. Recycling and re-use can prevent other forms of waste from going landfill and can help to reduce emissions in other sectors. Many forms of waste can be converted to energy.

Challenges

There is currently a lack of collection and processing infrastructure which means that opportunities to divert and recover waste are inconsistent and limited.[79] There is also uncertainty about the ability to access appropriate feedstock for producing recycled or reused products, uncertainty about markets for recovered or recycled products, and a lack of skills and knowledge about how to go about waste recovery – which adds to the challenge. The current lack of market incentives to invest in resource recovery from waste mean that it is often cheaper to dispose of waste in landfills, and to use virgin materials rather than recycled materials to make new products.

For example, in rural areas of Aotearoa where there is a lack of collection infrastructure, many farmers are burdened with having to manage their own waste. Farmers often dispose of waste with a combination of burning or burying, both of which generate emissions. Setting up a nationwide network of collection points (similar to those set up by AgRecovery) can reduce emissions from farm waste, and find use for organic wastes. For example, wood waste can be upcycled into furniture, or used as a compost ingredient or as a fuel.

Approach / policies:

There are a range of measures that could be introduced to increase resource recovery from waste. These could include, for example:

- Develop a coordinated national strategy and timeline for increasing resource recovery with the aim of increasing the waste recovery rate in Aotearoa.
- Increase investment in the resource recovery sector – including infrastructure, knowledge base, technology to ensure Aotearoa has a fully modern resource recovery sector from collection to sorting to processing to recovery.
- Shift the burden of resource recovery away from communities and nature to manufacturers, importers and retailers through increasing the use of regulated product stewardship schemes.
- Ensure that pricing of waste encourages resource recovery, for example by increasing the waste levy and ensuring it applies at all landfill sites, and by ensuring the NZ ETS applies to all disposal sites.
- Encourage the use of recovered material to create demand for products, for example by using financial incentives or regulation to support the use of waste compost on farms.

[79] (WasteMINZ, 2020)

- Ensure consistent access to appropriate feedstock to enable resource recovery sector. This could be done, for example, by mandating recovery targets from landfill and introducing measures to encourage source separation to reduce contamination.

Box 17.4: Case study example: Living Earth Facility in Christchurch

The Living Earth Facility in Christchurch, owned by Waste Management recovers 50,000 tonnes out of 65,000 mixed green and food waste from landfill annually. They turn this waste to compost and supply several nearby farms, with the compost having the beneficial impact of adding to the nutrient loads of the soil, without generating any harmful nitrogen run-off as would be the case if the farms were using synthetic nitrogen fertiliser.

This is possible because of several factors that are unique in Christchurch:

- The Christchurch City Council has a separate waste collection for food and garden waste
- Living Earth is owned by Waste Management, which means that they have access to a large pool of capital and funding from a larger organisation
- The "Gate fees" of landfill in Christchurch has landfill costs equivalent to the cost of living earth, so it's price competitive for Living Earth to compete with landfill options.

Ensure modern, low emissions landfills

For waste that cannot be avoided or recovered, it is important that it be disposed of in modern landfills that minimise emissions. Modern, low emission landfills capture a portion of emissions generated from organic waste as it decays and can reuse it to generate energy.

Challenges

While many municipal landfills in Aotearoa are modern sites which have high rates of gas capture, there are some operational municipal sites which are not required to capture gas as the waste volumes are too low. In addition, there are also non-municipal landfills and farm fills which receive organic waste but do not capture any landfill gas. Lastly, closed legacy landfills that have no gas capture systems will continue to have emissions from the accumulated waste.

This problem can be addressed by either diverting waste from non-municipal landfills and farm fills to sites with gas capture, or by installing gas capture systems at legacy and non-municipal landfills. Gas capture systems can be fitted to these sites, though is can be difficult and expensive to do so – meaning that they are unlikely to happen in the absence of market incentives or regulation. Gas capture systems at farm fill sites is also impractical due to the lower volumes of waste and large number of farm fills scattered across the country.

Policies / approaches:

Measures to support more landfills becoming low emissions could include, for example:

- Introduce regulation to prohibit organic waste from being sent to landfills that do not have gas capture systems or incentivise gas capture at landfills without gas capture systems

- Introducing measures to encourage best practise LFG management, including across a wider range of disposal sites (e.g. closed landfills, non-municipal landfills). This could include regulation that mandates non-municipal and legacy sites to capture LFG gas.
- Require comprehensive audits of LFG capture systems to ensure they are up to standard.

Manage transition from hydrofluorocarbons

Refrigerants are essential chemicals that support modern society by, for example, enabling the transport and storage of perishable food and cooling interior spaces. They could be relied on as space heating and cooling, and process heat transitions to the use of electricity as a fuel. Hydrofluorocarbons (HFCs) are the most common type of refrigerant used in Aotearoa. They are potent synthetic greenhouse gases with a global warming potential up to 14,800.[80] In 2018, emissions from the leakage of refrigerants from refrigeration and air conditioning equipment was 1.7 Mt CO_2e.

As a signatory to the Kigali Amendment to the Montreal Protocol,[81] Aotearoa aims to considerably reduce the use of HFCs through a controlled phasedown. In 2020, the Government declared refrigerants as one of six priority products under the Waste Minimisation Act. This will establish a mandatory product stewardship scheme aimed at increasing end of life recovery and destruction. Increased recovery, proper disposal, and alternative refrigerants are significant emissions reduction opportunities.

The phasedown of HFCs in the Commission's pathway sees total emissions from HFC use reduced by 18% by 2030 and 33% by 2035. The Commission also modelled a more stringent phasedown with early retirement of existing equipment, increased use of low global warming potential (low GWP) refrigerants, and improved industry practice that could see emissions reduced by 45% by 2035.

Challenges

There is a considerable bank of HFCs currently within equipment in Aotearoa.[82] As such, there would be a lag between action taken to comply with the phasedown and achieving emissions reductions. In addition, there is no limit on the import of HFCs in finished products, or on recycled bulk refrigerants,[83] which may result in the continued import and reuse of HFCs. This extends the duration of these types of refrigerants in the economy.

Allowing the import of bulk recycled HFCs ensures sufficient amounts of refrigerant to service the existing equipment in Aotearoa without stranding assets. This limits the financial impact on end users but prolongs emissions from HFC use and results in a relatively ineffective phasedown of HFCs.

In addition, the existing fleet of equipment is not compatible with most low GWP refrigerant alternatives. The cost of replacing equipment to ensure compatibility, and risk aversion to new, flammable compounds, act as barriers to a timely transition away from HFCs.

[80] The global warming potential of HFCs range from 53 to 14,800 depending on the chemical make-up of the substance.
[81] The Kigali Amendment puts in place a worldwide phase down on the production and consumption of HFCs. It limits the bulk net import of HFCs but does not restrict import of equipment pre-charged with HFC refrigerants. The Amendment requires Aotearoa to reduce emissions from HFCs by 85% by 2036.
[82] Approximately 7,000 tonnes
[83] Refrigerants can be recovered from equipment in large quantities. This unprocessed HFC gas can be imported, recycled and re-used under the Kigali Amendment.

Over time, HFC scarcity and a rising carbon price would increase the cost of HFCs for end users. Although this would incentivise leak minimisation and improved handling practices, it is not expected to result in significant conversion to low GWP refrigerant compatible equipment as refrigerant cost would likely remain less than 10% of the total cost of new equipment.

Approaches / Policies:

Measures to reduce emissions from refrigerants and to support a managed transition away from HFCs include:

- Considering extending import restrictions to finished products and recycled bulk refrigerants.
- Timely development, deployment and scale up of the mandatory product stewardship scheme under the Waste Minimisation Act to improve end-of-life recovery and destruction of HFCs.
- Support workforce and end user education and safe practises. This includes technician training and licensing around monitoring, minimising equipment leakage, and improving disposal practices.
- Measures to reduce the upfront capital cost of switching to low GWP compatible equipment.

17.4 Policies to manage impacts

The transition to low emissions will bring a mix of opportunities, benefits, challenges and costs. The way Aotearoa transitions and the policies that we put in place will have diverse impacts – both positive and negative – on different groups of society, regions, sectors of the economy, and generations. These issues are discussed in considerable detail in the impacts chapter of this report.

Actions and approaches to reduce emissions should ensure that the benefits of climate action are shared across society, and that certain individuals and sectors do not unfairly bear the cost-burden of the climate transition. This includes, for example, designing incentives that help to support lower-income groups affected by costs stemming from climate mitigation policies, and to support affected regions. These elements are highlighted by the Stockholm Environment Institute, together with the need to support workers affected by downscaling, and the need to avoid ongoing investments in emissions intensive industries that would create carbon lock-in and undermine the transition.[84]

The wellbeing of iwi/Māori throughout the transition to low emissions is a central part of this. He Ara Waiora presents a mātauranga Māori approach to wellbeing and framework against which to assess impacts of climate policy for iwi/Māori.[85] It also provides a frame for ensuring that climate policies and approaches consider broader wellbeing of people and the environment, for current and future generations. When developing and implementing the emissions reduction plan, the Government should consider how those measures impact the four dimensions of wellbeing identified in the framework (Mana Tuku Iho, Mana Tauutuutu, Mana Āheinga and Mana Whanake).

[84] (Atteridge & Strambo, 2020)

[85] He Ara Waiora was initiated by the Tax Working Group, co-designed with Māori thought leaders and iwi representatives and is currently under the stewardship of the Treasury. (McMeeking et al., 2019)

An equitable transition also supports the principles of tiakitanga and intergenerational equity. Managing challenges and impacts for an equitable climate transition requires considering not only the impacts on society today, but also the impacts on our mokopuna, and subsequent generations. The need to care for and be active stewards and custodians of our whenua and taonga for future generations must be central to our approach. This requires an inclusive approach to planning the transition.

Managing the impacts of the transition must be a central consideration as the emissions reduction plan is developed. A wide range of approaches and measures will be needed over different timeframes to address diverse challenges. Some important action that needs to happen as a matter of urgency includes providing education and training to support a low emissions workforce, the provision of targeted support to vulnerable communities most affected by the transition, and the initiation of an inclusive, transparent transition planning process.

Localised transition planning that is inclusive and transparent

Some regions and communities of Aotearoa will 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. In some places, entire communities, ways of life and local identities have been built around large businesses that may face closure. Such closures can therefore have a big impact beyond the people employed directly. If unemployment rises and consumer spending falls, there would be a flow-on effect to other businesses and workers within the wider community.

Climate mitigation policies that are perceived to unfairly affect certain individuals, communities or businesses are at risk of losing their public acceptability. Maintaining the principle of equity and putting people at the centre of our climate policy will therefore help to ensure the equality of support across communities, industries and business. This is important to make sure that the policy response is enduring, and that emissions reductions can be sustained.

Challenges

The Grantham Institute and others emphasise that a "just transition" to a low emissions economy is a multidimensional challenge and note that the transition must address both social and spatial elements, ensuring that economic development through the transition is regionally inclusive.[86]

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 many others will not. Affected communities may therefore end up 'stranded', with significant numbers of workers with skills and expertise that are no longer in demand.[87]

In such situations, transition planning that is tailored to the specific community or region would be needed. This would require central government to work closely with local businesses, workers, iwi/Māori, community and local interest groups, and local government to develop a long-term vision and strategy for the affected region. This includes exploring the infrastructure and skills available in the region, and potential new industries that could make become anchored in the region.

[86] (Robins et al., 2018)
[87] (OECD, 2017b)

The OECD emphasises that localised transition planning will 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. [88] Transparent and inclusive processes, and active social dialogue regarding the transition, would be key to achieving a transition that is accepted and enduring.[89] The goal of this approach is to ensure the transition is place-and-people led.

Localised transition planning is also important for achieving successful and enduring transition outcomes and aligning government and business investment priorities.[90] In some situations, businesses are likely to invest only if they know that complementary investments, such as to infrastructure, are being made.[91] It will be important that there is alignment to ensure government initiatives are not working at cross-purposes to the outcomes being sought by the community or businesses.

International examples and research suggest that important elements of initiatives to support 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.

Approaches / policies:

The Government needs to ensure that transition planning is co-developed through a bottom-up approach that involves local communities, iwi/Māori, businesses, civil society groups and other stakeholders. In developing an approach, the Government should research examples of transition planning that have taken place internationally and investigate their applicability to circumstances in Aotearoa.

It will be important that, regardless of the specific approach Aotearoa takes to inclusive transition planning, that equitable access to opportunities for iwi/Māori and Pacific Communities is a central consideration.

The Government should also investigate the potential for developing redeployment programmes, to support workers most affected by the transition.

Box 17.5: Some international examples of approaches to achieving a "just transition"

In **Spain**, "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 mitigate 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.[92]

In **Germany**, the successful shift away from a coal and steel-based economy in the West German Ruhr region is often cited as a model. Market forces led to a dramatic decline in the number of

[88] (OECD, 2017b)
[89] (OECD, 2019b)
[90] (New Zealand Productivity Commission, 2018)
[91] (New Zealand Productivity Commission, 2018)
[92] (Bouyé et al., 2019; Gobierno de España, 2020)

mining industry and steel workers in the region in the second half of the twentieth century. In the early 1990s, after efforts to shore up the sector failed, the Government introduced an industry policy focused on active diversification. New and innovative industries have since developed in the region, and many coal workers found new employment opportunities. This was achieved in part thanks to wage subsidies, labour market support and the development of new infrastructure paid for with European funds. Early retirement support and worker retraining programmes were also central to the success, as was a *"a clear vision of the future, supported by a comprehensive policy framework"*.[93]

Provide targeted support to vulnerable communities

Some communities will need targeted support through the transition, including to take advantage of opportunities to reduce emissions and associated costs. For example, low-income households may need financial assistance to install insulation or adopt low emissions technologies. Some workers could face job losses and may need support to find new work or retrain.

Without targeted assistance vulnerable groups and communities – including low income households, iwi/Māori and Pasifika, people with disabilities, and women – would likely be disadvantaged and unfairly lose from the climate transition.

The nature and combination of assistance should be specific to the community affected and focus on the communities whose livelihoods are most impacted. This includes households with the least ability to absorb costs, or workers who are least able to find new employment. A crucial component of the transition is equity and ensuring that existing social or economic inequalities are not exacerbated. Different time frames need to be considered as policies are designed to address the impacts the transition to a low emissions society. Support will be needed to help affected communities and individuals deal with immediate impacts in the near term, but it will also be important to help people their capability to adjust in the medium and longer terms.

Challenges

Low-income households spend a greater proportion of their income on emissions-intensive goods, like transport or energy. They also have limited means for reducing emissions by investing alternatives such as electric vehicles or home insultation, which can have high up-front costs. This is particularly relevant for iwi/Māori and Pacific Peoples households, who are overrepresented in low-income groups.

Targeting financial assistance to low-income households, either through social assistance or via tax credits, can help to alleviate some of the burden of higher prices.[94] Policies that directly support low emissions alternatives, for example investments in home insulation, would also be beneficial.

Communities that are reliant on emissions-intensive or single industries will also be vulnerable. Workers in these communities may face limited or reduced employment opportunities from the transition. Support can be provided directly to those affected via targeted financial assistance and active labour market policies.

[93] (Gambhir et al., 2018)
[94] (New Zealand Productivity Commission, 2018)

Approach / policies:

There are a range of measures that can help to support vulnerable communities through the transition, including financial assistance through the welfare or tax system, support towards the costs of changes to reduce emissions (such as home insulation or public transport), or supporting workers through active labour market policies.

Any financial assistance should be carefully targeted, and could either address direct financial losses, or a broader range of losses. In their *Low Emissions Economy* report the Productivity Commission recommended a combination of adjustments to existing benefits and tax credits as the lowest-cost option for assisting affected households.[95] Benefits and superannuation are automatically adjusted to reflect changes in the cost of living, although some welfare payments, such as the Working for Families benefit, are not.[96]

However, income support may not be enough on its own to help some lower-income households, who will not be able to make the necessary one-off investments in low emissions alternatives – such as insulation or more efficient heating. These options often have a high upfront cost which can make them unaffordable, particularly for renting households where the landlord has little incentive to make the necessary investments. Policies specifically designed to improve energy efficiency and home insulation would help households save in energy costs and benefit from improved health outcomes from warmer and drier homes. See *Chapter 13: Households and communities* for more information.

Similarly, given the higher upfront costs of electric vehicles compared with conventional ICE vehicles, low-income households may find it difficult to access low emissions transport options. See the transport section above for more information on measures to increase EV uptake.

There are also a range of things we can do to support workers. This includes income-smoothing measures for displaced workers, or assistance to find new employment opportunities. The precise mix of support should be developed by local communities and affected groups, alongside government departments.

The Government could also look into providing job-seeking services, mental health support and financial planning.

Education and training support a thriving, low emissions workforce

Some high-emitting industries will be deeply affected by the transition to low emissions, and some workers will become displaced. Other industries will grow and thrive in a low emissions economy. Some completely new industries and businesses are likely to develop.

As Aotearoa transitions to low emissions, new skills, knowledge and capability will be needed in the workforce. Ensuring that the workforce's skills match what is required in the labour market is key to ensuring that businesses can innovate, adopt new technologies or commercialise new ideas.[97] Thriving businesses will create flow-on benefits for workers and communities. Changes to current approaches to education and training will be needed to prepare the current and future workforce for rapid change.

[95] (New Zealand Productivity Commission, 2018, p. 296)
[96] (New Zealand Productivity Commission, 2018)
[97] (New Zealand Productivity Commission, 2016, 2019)

Challenges

The nature of the skills needed in the Aotearoa workforce will change with the transition to low emissions, along with other pressures such as technological change and automation. There are likely to be skills shortages in some areas likely to be important to support development and uptake of low emission technologies and practices – for example in science, technology, engineering and mathematics skills.

However, there is currently a lack of alignment between firm needs and tertiary institutions offering training, which could make the skills' gap worse over time. The current education and training system is largely aimed at young people moving in to the job market, with limited services aimed at ongoing training and supporting adults in need of retraining.[98] This will create challenges, as the changes that will happen over the course of the transition to low emissions mean that individuals are likely to need to acquire new skills over their lifetimes.

In the past, level of education has been the largest defining factor affecting rates of job displacement in Aotearoa. Compared to workers with a bachelor's degree or higher, twice as many workers with lower secondary education or Level 1-3 certificates were displaced between 2009 and 2016, and almost three times as many people with no qualification.[99] Our modelling suggests that, compared to what would occur under current policy settings, the low emissions transition will particularly affect individuals with higher levels of education, particularly those who work in the oil and gas sector.

Investing in education and retraining would be important for supporting workers through the transition, and to help prepare displaced workers for the new job opportunities that emerge with it. Vocational education and training systems will need to be able to adapt quickly to changing skill demands.[100]

Approach / policies:

Policy intervention should focus on the skill needs of those who have the most difficulty gaining new employment. For example, research shows that workers with few or no qualifications are most at risk of being displaced and are more likely to remain unemployed for extended periods of time. Older workers over the age of 50 are also particularly vulnerable to displacement, and the likelihood of finding a new job after being displaced decreases with age.[101]

Other measures include:

- Approaches to make the education system more flexible, and able to support the needs of mid-career professionals who face the need to re-skill or re-train;
- Address barriers that restrict all New Zealanders from participating in education and training – including iwi/Māori, Pacific Peoples and low-income groups;
- Education and training by Māori, for Māori also important. This should include supporting iwi/Māori to retrain for skilled jobs that will needed as Aotearoa transitions to a low emissions economy, and could include investments in schools, kura, and wānanga to ensure

[98] (OECD, 2017a)
[99] (OECD, 2017a)
[100] (OECD et al., 2015, p. 107)
[101] (OECD, 2017a)

they have the necessary resources and technology to prepare rangatahi for jobs of the future.

17.5 Critical actions

As shown in our modelling, there is a clear gap between projected emissions based on current policy settings, and what would be needed to meet the 2030 and 2050 emissions reduction targets.

The Commission investigated different ways of meeting the 2050 target through four scenarios which test different potential futures for how technology and behaviour could change over the next 30 years. Using these scenarios, the Commission has recommended a set of budgets to 2035 which are consistent with putting Aotearoa on track to meeting the 2050 target under a wide range of future circumstances.

Based on the Commission's analysis these budgets have been assessed to be feasible, the Commission considers that the actions to put Aotearoa on this path can be delivered, and that the Government can implement pricing and other policies to ensure this. To meet the pathway, policies would need to drive an appropriate balance between emissions reductions in long-lived gases, emissions reductions in biogenic methane, and removals from forestry.

Achieving the actions under the pathway also depends on a balance between early efforts to reduce emissions now, and action that is necessary to unlock future emissions reductions and to ensure that reductions are enduring over time. Our modelling shows that changing behaviour can play an important role in helping achieve earlier emissions reductions, reducing costs and delivering wider benefits, but is insufficient on its own to deliver deep decarbonisation.

The considerable inertia in the system, due largely to the dynamics of stock turnover, limits the rate at which emissions can be reduced without escalating costs. For example, only a small fraction of the vehicle fleet turns over each year, meaning that even if all new vehicle purchases were electric from now on the reduction in emissions would take time to accrue. The long lifetime of infrastructure and buildings, which are generally retrofitted or replaced only after many decades, offers another example.

To overcome this inertia and drive the necessary change, the emission reduction plan needs to include actions to build markets, capability and skills needed to roll out and implement actions when they are required. To meet the pathway, we encourage early action in a number of areas. The key areas for urgent most action are described in the following sections.

The Commission has identified seven key areas that are highest priority for action. These are areas that must be addressed as a matter of urgency in the Emissions Reduction Plan, or Aotearoa will be at risk of not meeting the emissions budgets and targets:

I. **Drive low emissions choices through the ETS**. To allow the NZ ETS to contribute effectively to drive low emissions choices consistent with our targets, NZ ETS unit volume and price control settings need to be aligned with the desired path for meeting emissions budgets. Key issues include increasing NZ ETS price control settings and considering how best to set up the NZ ETS to contribute to delivering the right amount and type of afforestation. An appropriate market governance regime is needed to

safeguard the scheme's effectiveness and should be progressed as a high priority, with the involvement of agencies with financial markets expertise such as MBIE.

II. **Align investments for climate outcomes**. Policy decisions and investments made now must not lock Aotearoa onto a high emissions future or increase exposure to climate change risks. There are currently insufficient safeguards in place to prevent this from happening. The Government should incorporate long-term abatement cost values that are consistent with climate change goals into cost-benefit and cost-effectiveness analysis, to make sure that policy and investment decisions are compatible with net zero emissions. Local government and private sector use of long-term abatement cost values would also help to make sure that other infrastructure and investment decisions are future proof.

III. **Accelerate light electric vehicle uptake**. Reducing the emissions of vehicles entering the fleet is a high priority, and the Government needs to take urgent action to stop high emitting vehicles entering the fleet. Meeting the third emissions budget requires significant uptake of EVs, and Aotearoa must be well on this pathway in earlier budgets. To achieve this, light EV uptake needs to be accelerated as fast as possible. The introduction of measures to reduce the upfront costs of EVs would support this. If Aotearoa is to achieve a low emissions vehicle fleet by 2050, all light vehicles entering the country must be low emissions by 2035. Implementing a restriction or ban on new internal combustion engine light vehicles entering Aotearoa would help to achieve this.

IV. **Target 60% renewable energy by no later than 2035**. While a large proportion of electricity is generated from renewable sources, across the whole energy system only around 40% of energy use comes from renewables. Achieving the 2050 target of net zero long-lived gases means Aotearoa needs to transition away from fossil fuels and rely more heavily on renewable electricity and low emissions fuels like bioenergy and hydrogen, and improve energy efficiency. Setting a broader, system-wide target for renewable energy would signal the scale of emissions reductions required across the whole energy system. The development of a national energy strategy would help ensure that emissions reductions, future energy developments, infrastructure, equitable industry transitions, regional and economic development planning to support the transition of our country's energy system are all considered in a coherent way.

V. **Reduce biogenic emissions from agriculture through on-farm efficiency and technologies**. Changing on-farm management practices can reduce biological emissions now and will be enough to meet the 2030 biogenic methane target. The Government needs to incentivise and enable farmers to make the necessary efficiency improvements. Government is already working with industry through the He Waka Eke Noa Partnership to develop a farm level pricing system, information and support services. It will be important that these tools can deliver emissions reductions consistent with emission budgets and targets, and that they endure beyond 2025. The successful development of new technologies and practices to reduce biological emissions (such as a methane vaccine) would provide greater flexibility and allow Aotearoa to meet the more ambitious end of the 2050 biogenic methane target. The Government needs to develop a long-term plan for targeted R&D to reduce biogenic emissions from agriculture, and review regulatory regimes to ensure that new technologies can be rapidly deployed as and when they are developed.

VI. **Manage forests to provide a long-term carbon sink.** Both production forests and new permanent native forests will play an important role in meeting the emissions budgets and targets for Aotearoa. Production forests can help to meet earlier emissions budgets, while new permanent native forests can provide an enduring carbon sink to balance emissions from hard to abate sectors in the long term. The Government will need to introduce measures to ensure that emissions removals by forests are aligned with emissions budgets. Policies should be put in place to encourage new permanent native forests on currently unproductive land. Forestry objectives will need to be achieved through a combination of policies, including amendments to the ETS, other financial incentives like grants and land use planning rules.

VII. **Ensure an equitable, inclusive and well-planned climate transition**. The transition to a low emissions society needs to be well-signalled, equitable, and inclusive. This will support a transition to a low emissions society that maximises opportunities, minimises disruptions and reduces inequities. This is important to ensure that the transition is enduring. To make sure this happens, the Government will need to develop an evidence base to understand the distributional impacts of climate change policies, and a process for factoring those impacts into policy making.

In addition to these critical priorities, partnership with iwi/Māori throughout the policy process will be critical to success. In developing and implementing its emissions reduction plan, the Government should consider how approaches will impact the four dimensions of wellbeing identified in the He Ara Waiora framework, and partner with whānau, hapū, iwi, and communities to incorporate mātauranga and tikanga Māori into the ways solutions are developed and decisions are made.

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