Hīkina te Kohupara – Kia mauri ora ai te iwi

Ministry of Transport
TE MANATŪ WAKA

Enabling New Zealanders to flourish

Transport Emissions: Pathways to Net Zero by 2050

May 2021

GREEN PAPER

NOT GOVERNMENT POLICY

Table of Contents

Please note: At the time of writing Hīkina te Kohupara, statistics from the 2018 Greenhouse Gas (GHG) Inventory were used. The GHG Inventory is updated annually, and the 2019 statistics have recently been published. The Ministry of Transport will use the updated 2019 GHG Inventory data for future policy considerations.

No change has been made to Hīkina te Kohupara at this point in time.

Foreword
Kupu whakataki

Hon Michael Wood
Minister of Transport

The challenge is clear. If we are to mitigate the worst effects of climate change, we have less than 15 years left to halve greenhouse gas (GHG) emissions. That's why this Government declared a climate emergency, and it's why we are taking action to reduce emissions.

While Aotearoa's transport system is often seen as just about getting people or products from A to B, it is also a major contributor of emissions and has an enormous impact on our health, environment and quality of life. Transport accounts for 47 percent of our carbon dioxide emissions, and roughly a fifth of NZ's GHG emissions. Air pollution, accidents and congestion from traffic are bad for our health and productivity.

The challenge before us is without precedent. However, eliminating emissions across our economy and within the transport system is achievable and can help support our economic recovery. Reaching that goal will create a better future for us and our tamariki, support the creation of entirely new businesses in low carbon industries, and create sustainable jobs across the country. Reaching our aspirations will also help unclog our cities, move freight more sustainably, and improve our air quality.

The Government's actions to date have already begun to lay the groundwork to reduce transport emissions. We have the opportunity to build a cleaner, healthier, safer and more equitable transport future. New policies, which include the Clean Car Standard, decarbonisation of the public transport fleet and the biofuels mandate are a solid start. However, to effectively reduce emissions across the entire transport system, more action is needed.

The Ministry of Transport's *Hīkina te Kohupara Kia mauri ora ai te iwi* sets out a strategic and phased set of potential pathways and approaches to phase out emissions across our transport system. While the pathways outlined in *Hīkina te Kohupara* are not Government policy, we want to have a national conversation about the changes we all need to make.

Hīkina identifies opportunities to move Aotearoa towards a net zero carbon transport system by 2050. The plan considers the key relationships transport has with other sectors, such as energy and urban development; and considers the impacts not only on the transport sector, but generationally, by gender, socio-economically, and ethnically, with a focus on Māori and Pasifika.

A key challenge will be to incorporate the need to reduce emissions across transport projects and urban development. We will also require innovative approaches to decision-

making and financing for infrastructure choices, and move away from ‘business as usual’ approaches.

As a nation, we need to accept that the journey to halve our transport emissions by 2035 will lead to some hard choices, not only within the sector but across the economy and our society. Any climate response, however innovative it might be, must be fair, equitable and inclusive. Therefore, a carefully considered approach with public input is vital to manage the impacts and opportunities that come with moving to a net zero carbon economy.

The Government’s priority is to build a zero carbon Aotearoa that better meets the needs of people, communities and the planet. *Hīkina* explores how this could be achieved.

Executive Summary

On 2 December 2020, Government declared a climate emergency for Aotearoa and committed to taking urgent action to reduce emissions.

Hīkina te Kohupara – Kia mauri ora ai te iwi: Transport Emissions: Pathways to Net Zero by 2050 (Hīkina te Kohupara) identifies what Aotearoa could do to shift the transport system onto a zero emissions pathway. It sets out a system-wide approach for reducing transport emissions.

This discussion paper will contribute to the Government's Emission Reduction Plan, which must be completed by December 2021. It will also be used to develop a 10-15 year time horizon action plan for how Aotearoa will continue to reduce its transport emissions.

Our transport system needs to shift to a low/zero carbon pathway as soon as possible to meet our emissions reductions commitments and targets. Transport is responsible for 47 percent of total domestic CO_2 emissions, and 19.7 percent of total greenhouse gas emissions. Without largely decarbonising transport, Aotearoa will not be able to achieve its net zero carbon target as mandated by the Climate Change Response Act 2002 (CCRA) by 2050.

Decarbonising our transport system will be challenging. However, this transition could make Aotearoa a healthier, safer, more vibrant, resilient, and prosperous place to live and work. There are many opportunities to reduce emissions while improving well-being and the liveability of our towns and cities. This will require difficult choices to be made by Central and Local Government about how to prioritise investment and other action to move different sectors to low-carbon pathways. This will include considering which policies are progressed, and assessing what regulatory, investment, economic and education tools will help deliver these choices. Alongside this will be the need to negotiate the choices, including understanding what trade offs within transport and across sectors are made to achieve or implement chosen policies.

Local and central government have been taking action to address transport emissions. This has included investment through the Government Policy Statement on land transport for public transport, walking and cycling, and rail. Government has agreed to implement the Clean Car Standard and there are road user charge exemptions for electric vehicles to encourage uptake. However, a lot more is required for our transport system to significantly reduce emissions at the pace required.

Hīkina te Kohupara identifies opportunities to reduce emissions across three themes, based on the 'Avoid, Shift, Improve' framework.

- ***Theme 1*** *– Changing the way we travel:* We need to shape our towns and cities to make it easier, safer, and more attractive for people to access work, schools, shops, and other opportunities by public transport, walking, and cycling. This will reduce dependence on private motorised vehicles, and avoid/reduce emissions. Transport needs to be integrated with land-use planning to encourage quality compact mixed-use urban development, while providing better transport options. Transport pricing, and other demand management tools, could also play an important role.

- ***Theme 2*** – *Improving our passenger vehicles:* 67 percent of Aotearoa's transport emissions currently come from light vehicles (including cars, small vans, and SUVs). Decarbonising the light vehicle fleet is crucial. We need to increase the supply of clean vehicles, increase demand for them, and provide supporting infrastructure. Biofuels could also play an important role in reducing emissions from the current fleet (and other modes). Public transport fleets, particularly buses, also need to shift to being cleaner vehicles. Cleaner aviation technologies are in the early stages of development, but there are opportunities to reduce emissions by using sustainable aviation fuel.

- ***Theme 3*** – *Supporting a more efficient freight system:* 23 percent of Aotearoa's transport emissions currently come from heavy vehicles (mostly trucks). While light vehicles currently produce the most emissions, trucks will produce the most emissions by 2055 without further interventions. Emissions could be reduced by improving the efficiency of supply chains, shifting freight to low emission modes, and improving the fuel efficiency, and carbon intensity of freight modes and fuel. Trucks will need to be decarbonised through the uptake of alternative fuels such as biofuels, electrification, and/or green hydrogen.

These changes will need to be co-ordinated, and staged, to maximise the opportunities for reducing emissions from now to 2050. Many decisions need to occur within the first emissions budget (2022 to 2025).

While everyone in Aotearoa will experience changes from the transition to zero emissions, and many people will benefit, the impacts of this shift will not be spread evenly. People who already experience social/economic disadvantages could be disproportionately affected if transport costs increase. This means that Government needs to carefully consider the impacts of policies and changes on different communities and regions to ensure a Just Transition.

Future work will need to ensure that policies are fair, equitable, and inclusive. Government must work with Iwi/Māori, communities, regions, and sectors to manage the impacts and maximise the opportunities of the changes ahead.

There are many pathways that Aotearoa could take to achieve a zero carbon transport system by 2050. Hīkina te Kohupara models four potential pathways. These pathways are not limited by current Government policies or commitments. The pathways aim to provoke thinking and illustrate the scale of the changes required. The modelling shows that it will be challenging to reach net zero by 2050, *but* it can be achieved if complementary policies are implemented across the transport system.

Aotearoa's pathway to a zero carbon transport system will be shaped by the actions of Government, civil society, business, and consumers over the next three decades. Substantial and sustained actions will be required to decarbonise our transport system. Actions taken or not taken within the next five years will significantly shape this future pathway, and determine how close we get to, or stray from a zero carbon target.

Hīkina te Kohupara is one step on our path to a zero carbon transport system. We do not underestimate the challenges ahead, but we recognise the imperative to change. We also see the opportunities to create a better transport system through this transition that is cleaner, healthier, safer, inclusive, and resilient, and enables the people and businesses of Aotearoa to flourish.

Guide to reading this document

This document has three main parts, as summarised below.

Part One: Context		
Chapter 1	**Introduction**	*Sets out the purpose of Hīkina te Kohupara and how it relates to advice from the Climate Change Commission, the Emissions Reduction Plan and a future transport strategy.*
Chapter 2	**Transport emissions – our current state and pathway**	*Outlines Aotearoa's rising transport emissions, and where they come from. It also includes the principles used to shape our analysis.*
Chapter 3	**Government's role in reducing emissions**	*Summarises the range of levers that Government can use to reduce transport emissions.*
Chapter 4	**The role of innovation in the transport system**	*Outlines the opportunity that innovative ideas, policies, and technologies provide to improve the way people and goods move around.*
Part Two: Opportunities to reduce emissions		
Chapter 5	**Avoid, Shift, Improve Framework**	*Explains the framework that underpins our strategic approach.*
Chapter 6	**Theme 1: Changing the way we travel**	*Identifies opportunities to avoid and shift emissions from people travelling, by developing better towns and cities that support transport mode shift.*
Chapter 7	**Theme 2: Improving our passenger vehicles**	*Identifies opportunities to reduce emissions by improving our vehicle fleets (including light vehicles, public transport, and domestic planes).*
Chapter 8	**Theme 3: Supporting a more efficient freight system**	*Identifies opportunities to reduce freight emissions.*
Part Three: Pathways		
Chapter 9	**Supporting a Just Transition**	*Outlines key considerations for supporting a Just Transition, and mitigating potential distributional impacts of transport emission reduction policies.*
Chapter 10	**Four potential pathways**	*Sets out four potential pathways for how we could reach a zero carbon transport system by 2050 and a breakdown of the potential investment required to achieve this outcome.*
Chapter 11	**What opportunities should the Government progress in the first three emissions budgets?**	*Sets out current policies that contribute to mitigating emissions and proposals for the first three emissions budgets.*
Chapter 12	**Where to next?**	*Sets out the next steps for Hīkina te Kohupara.*

Chapter 1: Introduction

On 2 December 2020, Government declared a climate emergency for Aotearoa and committed to taking urgent action to reduce emissions.[1] In declaring a climate emergency, Aotearoa commits to reducing emissions to avoid more than 1.5 degrees rise in global warming. This is one step towards tackling climate change. Much more is required from across a range of sectors including transport, energy, agriculture and communities. Hīkina te Kohupara seeks to identify opportunities to reduce emissions from the transport sector to assist Aotearoa to move towards net zero emissions and to respond to the climate emergency. Information on how Hīkina te Kohupara was developed is at Appendix A.

Purpose of Hīkina te Kohupara

This discussion paper identifies what Aotearoa could do to shift our transport system on to a zero emissions pathway and seeks feedback on options to achieve this

Aotearoa's transport system needs to decarbonise. Transport currently produces over 19.7 percent of our domestic greenhouse gas (GHG) emissions, and almost half of our carbon dioxide (CO_2) emissions.[2] Transport emissions are still increasing. Without major interventions, transport emissions will not fall quickly enough to deliver on our domestic and international climate commitments and targets.

Various government initiatives exist to reduce transport emissions, and more are underway. However, broader and deeper changes are needed to quickly shift our transport system to a zero emissions pathway.

Hīkina te Kohupara sets out a system-wide analysis of the opportunities for reducing transport emissions in Aotearoa. It highlights potential priority areas and areas that Government could focus on to make the biggest impacts on reducing transport emissions. This includes opportunities within the transport sector, as well as interdependent sectors and systems that have a significant impact on transport emissions.

While Government will play a leading role in making the shift, it needs to work closely with iwi, communities, businesses, and councils to reduce transport emissions

All New Zealanders have a stake in our transport system, as we all form part of this system every time we walk, bike, bus, drive, fly, or catch a train or ferry. Everything we make, grow, buy, or sell in Aotearoa also moves through complex road, rail, air, and sea networks.

The shift towards a zero emissions pathway will therefore be experienced by all people and businesses in Aotearoa. Although government can drive and influence many changes within the transport system, it needs to work with communities to grow the mandate for changes, and to make changes happen.

We are seeking feedback on this discussion paper, including views on policies that should be progressed and implemented.

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[1] Hon James Shaw. (2020). *Climate Emergency Declaration will be matched with long-term action.* Retrieved from: Climate emergency declaration will be matched with long-term action | Beehive.govt.nz

[2] Ministry for the Environment. (2020). *Our atmosphere and climate.* Retrieved from: https://www.mfe.govt.nz/sites/default/files/media/Environmental%20reporting/our-atmosphere-and-climate-2020-report.pdf. P15

Hīkina te Kohupara has dual purposes – to inform the Government's first Emissions Reduction Plan and support a 10-15 year transport emissions action plan

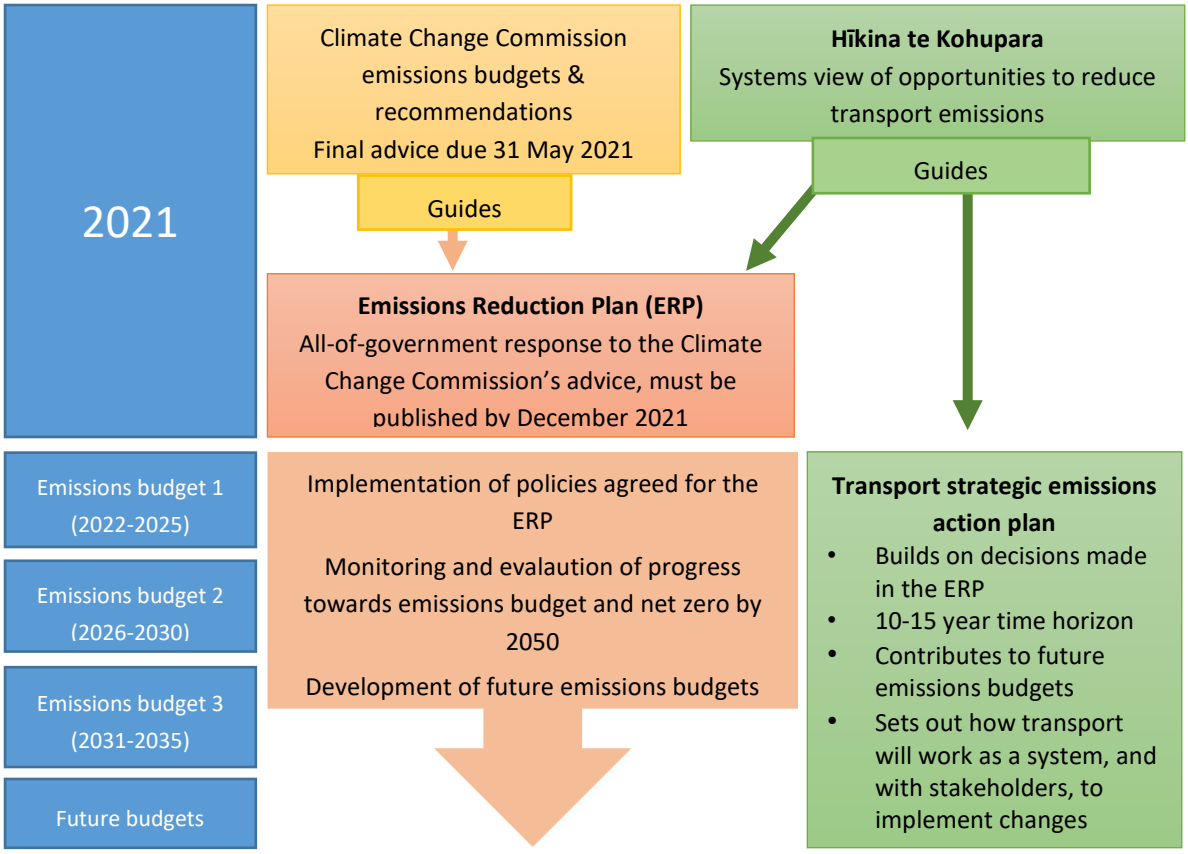
In 2016, Aotearoa committed to taking action against climate change when the Government signed and ratified the international Paris Agreement. The Government agreed to reduce GHG emissions to 30 percent below 2005 levels for the period 2021-2030.

New Zealand's Parliament subsequently passed the Climate Change Response (Zero Carbon) Act in 2019 (CCRA). This Act provides a framework for implementing climate change policies, and for preparing and adapting to the effects of climate change. The CCRA sets a domestic target for Aotearoa to reduce net emissions of all GHGs (except biogenic methane) to zero by 2050.

Globally, reducing carbon dioxide (CO_2) emissions to net zero is the highest priority in the fight against climate change, because unlike other gases it stays in the atmosphere for hundreds of years.

Hīkina te Kohupara will also inform the development of a 10-15 year time horizon strategy that sets out **agreed** Government policies that extend beyond the first Emissions Reduction Plan. It will include their potential effect on mitigating transport emissions, resource and investment considerations, and the interdependent relationships with other government departments, business, Iwi/Māori that the Ministry will need to engage with to deliver a net zero carbon transport system.

The diagram below illustrates the relationship of Hīkina te Kohupara with the Climate Change Commission's advice, the development of an all-of-government Emissions Reduction Plan and a transport strategic action plan.

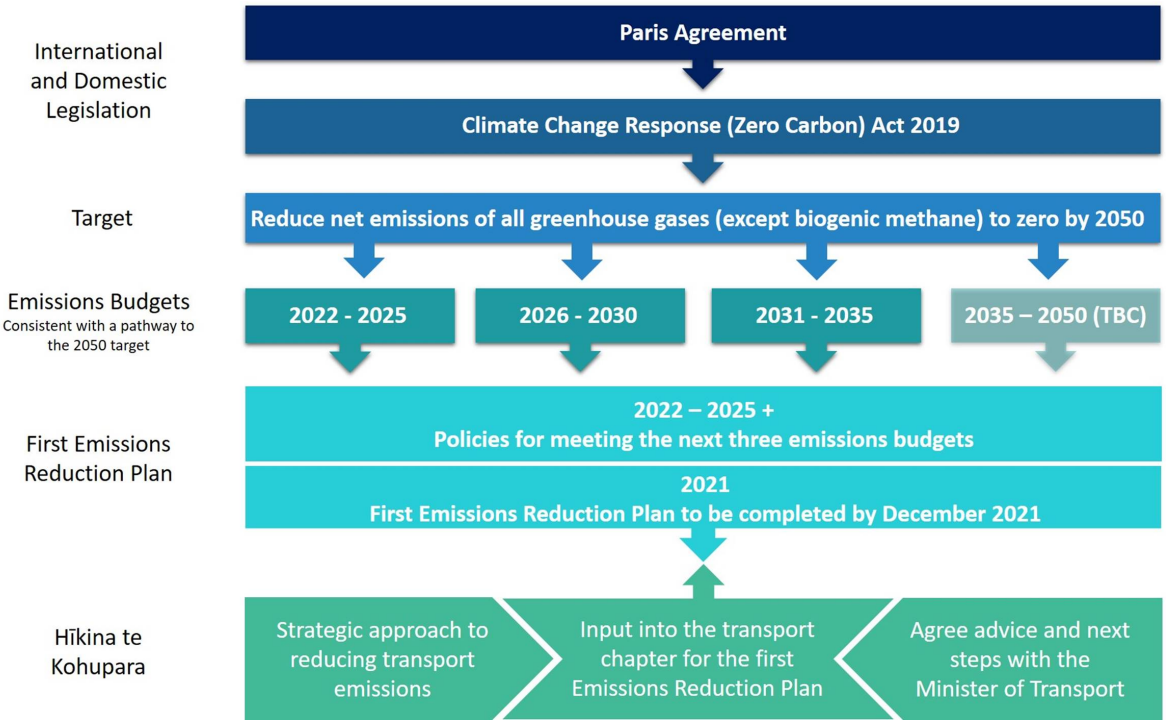


The Government must prepare an Emissions Reduction Plan under the CCRA

The CCRA sets emissions budgets for Aotearoa. These operate as stepping stones to keep us on track to meeting our long-term emissions reductions targets. The Climate Change Commission (the Commission) advises Government on each emissions budget, which cover five-year periods from 2022 onwards (except the first period, which is four years).

The Government needs to confirm and publish its first Emissions Reduction Plan for the period 2022-2025 by 31 December 2021. This will identify policies for meeting emissions budgets from 2022 to 2035. This plan also needs to demonstrate that we are on a pathway to meet our 2050 target.

Hīkina te Kohupara informs the Government's Emission Reduction Plan, by outlining strategic approaches and opportunities to reduce transport emissions. The diagram below illustrates the role of Hīkina te Kohupara in relation to the Government's first Emissions Reduction Plan.



The Climate Change Commission has issued draft advice on its first three emissions budgets

The Commission, He Pou a Rangi, released its draft advice and emissions budgets on 1 February 2021 for public consultation. The advice sets out the Commission's draft advice on the first three emissions budgets and the Government's first emissions reduction plan.[3] The Commission's final advice is due on 31 May 2021.

[3] Climate Change Commission (2020). *Our Advice and Evidence.* Retrieved from: Our advice and evidence » Climate Change Commission (climatecommission.govt.nz)

For transport, the Commission identified the following as key to Aotearoa transitioning along it's pathway to decarbonise transport.

Climate Change Commission's Table 3.1: Key transitions along their path.

		Budget 1	Budget 2	Budget 3
Transport	*Road transport*	Accelerate EV uptake Improve average efficiency of new Internal Combustion Engine (ICE) vehicles		Phase out new light ICE vehicles Electrify medium and heavy trucks
	Reducing travel demand	Encourage remote working for those who can Encourage switching to walking, cycling and public transport		
	Non-road transport	Electrification of rail	Biofuel blending Start electrification of ferries and costal shipping	

A number of recommendations are made by the Commission for transport. These include emphasis on:

- developing an integrated national transport network to reduce travel by private vehicles and increase walking, cycling, low emissions public and shared transport
- a package of measures to accelerate light electric vehicle uptake, including consideration of EV battery refurbishment and waste; steps to mitigate impacts for low-income households and people with disabilities, regional and remote access, and with limited access to electricity; and evaluating the role of other pricing mechanisms beyond the NZ Emissions Trading Scheme.
- policies to increase the use of low carbon fuels for trains, ships, heavy trucks and planes.

Additionally, the Commission recommends in the first budget period that Government promote the evolution of urban form to enable low emissions transport and buildings through ongoing legislative reform. This should include ensuring a coordinated approach to decision making across government agencies and local councils. This would help embed a strong relationship between urban planning, design and transport. This may help ensure that communities are well designed, supported by integrated, accessible transport options, including safe cycleways between home, work and education.

Officials will use the emissions budgets to shape advice to Government and to inform the development of the first all-of-government Emissions Reduction Plan. The first Emissions Reduction Plan will focus on Budget 1.

Our transport system needs to shift to a low carbon pathway very rapidly to meet our targets

The most optimistic baseline modelling shows that transport emissions in Aotearoa will be nine percent above 2005 levels by 2030. We will not reach a 30 percent reduction in

transport emissions (from 2005 levels) until 2038 – a decade beyond Government's agreed target.

If transport does not make a meaningful contribution to the first Emissions Budget, the transport system will face significantly higher pressures and expectations in later years. Actions to reduce emissions now could avoid the need for more drastic actions in the future. Changes in the transport system often take decades to play out (such as turnover of vehicle fleets, new infrastructure, and shifts in urban form), so the transport sector needs to move to a zero carbon pathway as soon as possible.

The transition towards zero emissions will deliver many social, economic, and environmental benefits

Decarbonising our transport system will not be easy. However, this transition could make Aotearoa a healthier, safer, more vibrant, and prosperous place to live and work. For example, our cities will become healthier and more peaceful as vehicle fleets go electric. Improvements in public transport and cycling networks will give people more travel options, manage road congestion, and make it safer and more enjoyable to access workplaces, schools, local services, and shops. More freight will move by rail and coastal shipping, while trucks transition to using biofuels, electricity, or hydrogen. Local energy production will grow, and Aotearoa will become less dependent on international oil markets.

While we focus our vision on reducing emissions, we also need to keep an eye on opportunities to deliver co-benefits from this transition. We need to ensure that the transport system is inclusive, safe, resilient, and supports economic activity. The Transport Outcomes Framework (see Figure 1), which guides all long-term planning in the transport sector, provides a useful framework for identifying these outcomes that could be enhanced, or affected, by initiatives to reduce emissions. This framework has guided Hīkina te Kohupara, and the opportunities within it.

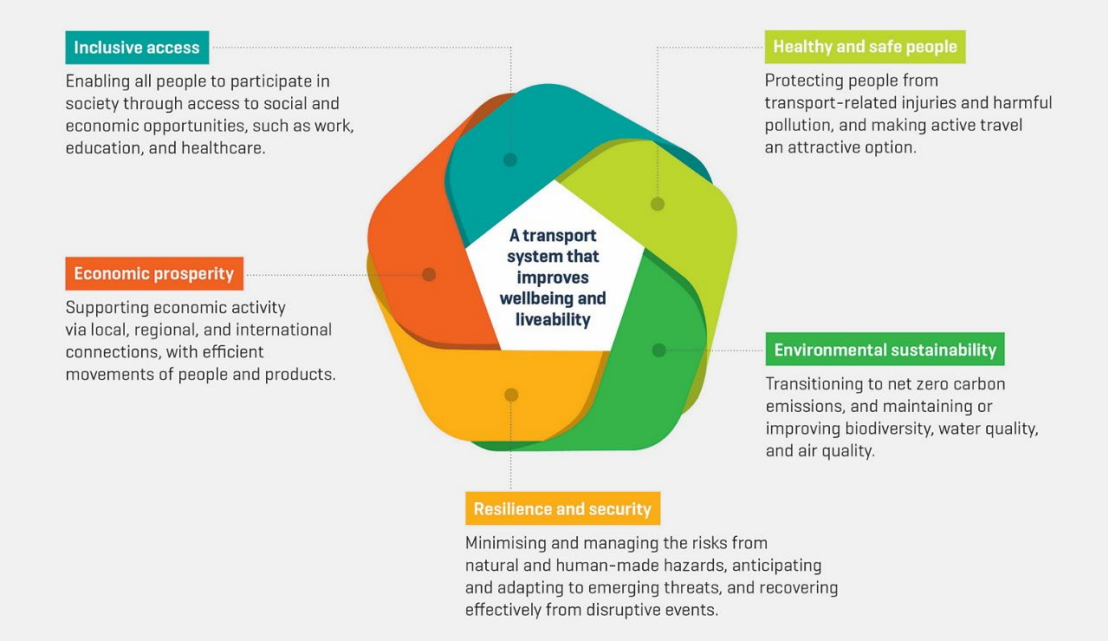


Figure 1 Transport Outcomes Framework

We need to make a Just Transition

While everyone in Aotearoa will be affected by the transition towards zero emissions, the impacts will not be evenly spread. People who already experience social/economic disadvantages could be disproportionately affected if transport costs increase. This means that Government needs to carefully consider the impacts of policies and changes on different communities and regions. The Government should consider investing in such communities early to provide them with more transport choices to support a Just Transition.

Hīkina te Kohupara identifies some of the distributional impacts of potential policies and actions, and highlights a need to mitigate these impacts for disadvantaged groups.

Te Tiriti o Waitangi will underpin policy development to reduce emissions

Te Tiriti o Waitangi (the Treaty of Waitangi) should underpin the Māori-Crown partnership, and collaboration to support the policy development required to reduce transport emissions.

Critical to this is understanding te ao Māori: the Māori world view. A te ao Māori world view inherently and intrinsically acknowledges the interconnectedness and interrelationship of all living and non-living things. It affirms mātauranga Māori – Māori knowledge systems – as fundamental to seeing, understanding, and living within te ao Māori. It also acknowledges te taiao as a taonga, and responsibility for its kaitiakitanga as a cross- and inter-generational responsibility.

It is therefore imperative to seek to understand the total system, not just parts of it. This is in harmony with the approach taken in this report – whereby we have chosen to review the whole transport system to better understand it's interconnectedness and opportunities to reduce emissions.

The principles of whanaungatanga (relationships) and kaitiakitanga (environmental guardianship) are central to this work and underpin our ongoing engagement to reduce emissions from the transport system.

We intend to commence this through the establishment of marae-based technical advisory groups with regional Iwi. This will provide an opportunity to build relationships for the ongoing work that results from Hīkina te Kohupara, such as the development of the Emissions Reduction Plan and specific transport policies.

Scope of this discussion document

Hīkina te Kohupara covers **domestic** transport GHG emissions. It does not cover international aviation and maritime emissions for travel to/from Aotearoa, as the Paris Agreement is silent on their inclusion (and subsequent domestic obligations). The government is addressing international emissions through its involvement with the International Civil Aviation Organization and the International Maritime Organization. However, Hīkina te Kohupara does consider some domestic opportunities for reducing maritime and aviation emissions, such as low carbon fuels, which could also reduce international emissions to/from Aotearoa.

Hīkina te Kohupara does not consider embodied emissions in transport infrastructure (such as roads, rail, ports etc.). This is because infrastructure emissions will be captured elsewhere in the Emissions Reduction Plan.

Principles used in Hīkina te Kohupara that shaped our advice

We developed a set of key principles to help shape our advice to the Government on transitioning to a zero carbon transport system. The intention of these principles is to guide discussions around which options Aotearoa should pursue further and prioritise.

Principle 1. The transport sector will play a lead role in meeting our 2050 net zero carbon target

Addressing climate change requires transformational and fundamental change to the transport system. The CCRA sets a domestic target for Aotearoa to reduce net emissions of all GHGs (except biogenic methane) to zero by 2050. Transport is responsible for 47 percent of total domestic CO_2 emissions, and 19.7 percent of total GHG emissions. Early, deep reductions in transport emissions are therefore needed for Aotearoa to meet its emissions reduction targets and our international climate commitments. Our analysis and advice aligns with putting us on a pathway to the 2050 target.

Principle 2. We need to focus on moving to a zero carbon transport system, rather than offsetting emissions

It is unclear how much carbon offsetting will be used at a national level to help meet Aotearoa's emission reduction obligations and targets. This means that we do not know how much we may or may not be able to offset Aotearoa's transport emissions going forward. Other sectors in Aotearoa are likely to find it harder, or take longer, to reduce emissions in comparison to transport, and therefore may be prioritised over transport when it comes to carbon offsetting. Given this uncertainty, we need to focus on what could be required to take us as close to zero transport emissions as possible. We acknowledge that absolute zero would be very difficult to achieve by 2050.

Principle 3. We need to take a strategic approach to reducing transport emissions

Some interventions may take a long time to play out, and require ongoing dedicated action over decades. We need to take a strategic approach that capitalises on short-term opportunities and puts in motion changes that deliver a large impact in the medium and long term. We also need to be strategic about which options we pursue to reduce emissions - prioritising initiatives that will have the largest impact on avoiding and reducing emissions, while delivering value for society (including co-benefits).

Principle 4. Co-ordinated action is required across the transport system to avoid and reduce emissions

We need to pursue multiple, co-ordinated actions to reduce and avoid emissions – both within the transport sector, and in other sectors (such as land use planning) that have a strong influence on transport emissions. This helps to manage risk by avoiding relying too heavily on one solution to meet our targets (for example, a solution that requires technological improvements or significant behaviour change). While Government will play a leading role in making the shift, it needs to work closely with iwi, communities, businesses, and councils to reduce transport emissions.

Principle 5. To ensure a Just Transition we need to manage the impacts and maximise the opportunities brought about by changes to the transport system

Everyone in Aotearoa will experience changes from the transition to a zero emissions transport system. However, some people may be more impacted – for example, people who already experience social/economic disadvantages could be disproportionately affected if transport costs increase. At the same time, policies to reduce emissions can deliver multiple benefits. For example, there are many opportunities to reduce air and noise pollution, improve physical health and mental wellbeing, and make our towns and cities more liveable.

The Government needs to carefully consider both the costs and benefits of policies and changes on different communities, iwi/Māori and regions to ensure a Just Transition and deliver maximum value for New Zealanders.

Principle 6. We need to forge a path to zero transport emissions by 2050, while recognising that there is not one way to get there

There are many pathways that Aotearoa could take to achieve a zero carbon transport system by 2050. Substantial and sustained actions will be required to decarbonise our transport system. Actions taken within the next five years will significantly shape this future pathway, and determine how close we get to, or stray from a zero carbon target. We base our advice on evidence as much as possible. However, we also need to recognise that we will never have all the evidence we need about the future, and that future modelling is often based on experience. We will need to keep adapting to reduce emissions along our future path.

Principle 7. Innovation and technologies will play an important role in reducing emissions, but people are the key to our future

Many existing technologies and techniques are already available to avoid and reduce emissions. Innovative approaches and business models, as well as new technologies, will keep changing the way that people and products travel. While the Government does not usually ‘pick winners’, it can play a powerful role in accelerating the uptake and diffusion of new transport technologies and services. However, ultimately, technological change and uptake depends on people – so we need to put people at the centre of our policy development.

Consultation question 1

Do you support the principles in Hīkina te Kohupara? Are there any other considerations that should be reflected in the principles?

Chapter 2: Transport emissions – our current state and pathway

Key points

- Transport is Aotearoa's second-largest source of GHG emissions, contributing 19.7 percent of gross domestic emissions.
- Transport emissions are increasing, while other sources of emissions have plateaued.
- The majority of transport emissions come from light vehicles (67%), followed by heavy vehicles (23%).
- Per capita, our larger cities generate fewer emissions than rural towns. However, because cities have so many people and vehicles, they produce more emissions overall than rural towns.
- Aotearoa's high level of car dependency has wider impacts on the environment, as well as public health and the economy.

Transport's contribution to Aotearoa's GHG emissions profile

Transport is Aotearoa's second-largest source of GHG emissions

Transport contributes 19.7 percent of gross domestic emissions. In comparison, about 48 percent of emissions come from agriculture, and 20 percent from other energy use.

In 2018, transport was responsible for 47 percent of Aotearoa's total domestic CO_2 emissions. Road transport (including cars, light duty trucks, heavy-duty trucks, buses and motorcycles) emitted 43 percent of Aotearoa's gross CO_2 emissions in 2018.

Transport emissions have risen more than any other emissions source with an increase of approximately 90 percent between 1990 and 2018. This compares with 24 percent for gross emissions across the total economy.

The Ministry's base case forecasts road transport emissions to keep rising until around 2024 (Figure 2), unless major interventions are made to put us on a different pathway.

Emissions will then plateau before slowly declining closer to 2030. This forecast assumes an increasing rate of electric vehicle uptake.

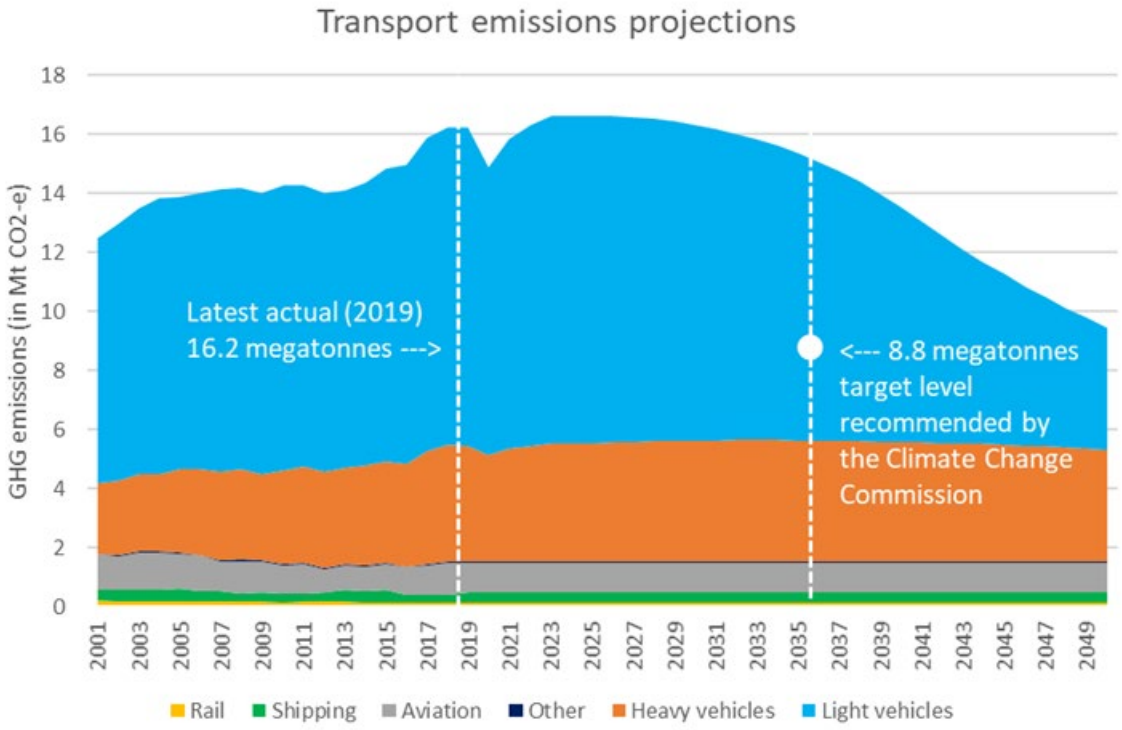


Figure 2. New Zealand's forecasted transport CO_2 emissions by vehicle type

Our per capita transport emissions are high in comparison to other countries

Aotearoa has the fifth highest per capita rates of CO_2 emissions from road transport in the 43 Organisation for Economic Co-operation and Development (OECD) countries with data for road transport emissions.[4] The top four countries were Luxembourg, the United States, Canada and Australia. Our high per capita transport emissions are a result of several factors, including:

- **Heavy reliance on fossil fuels for transport.** Electricity and biofuels are less than 0.1 percent of the transport fuels used in Aotearoa. In comparison, in Sweden, renewable fuels are 14.7 percent.

- **Poor fuel economy of light vehicles entering our fleet.** In 2020, light passenger vehicles (cars and SUVs) entering our fleet had an average reported emission intensity of 158 grams of carbon dioxide (CO_2) per kilometre travelled (g CO_2/km); and the figure was 219 g CO_2/km for light commercial vehicles (vans and utilities) entering the fleet. In

[4] OECD (2017) *Environmental pressures rising in New Zealand.* Retrieved from: Environmental pressures rising in New Zealand - OECD

contrast, it was 122 g CO_2/km for cars and 158g/km for light commercial vehicles registered in 2019 in Europe.[5]

- **Reliance on road freight.** Seventy percent of our freight moves by road, 16 percent by rail and 14 percent by coastal shipping, reflecting the needs of our more dispersed population when compared to Europe. In Europe, 50 percent of the freight task moves by road, 37 percent by shipping and just over 12 percent by rail.

- **Many of our urban areas are characterised by sprawling low-density land-use patterns supported by motorways.** This has contributed to vehicle dependence and has limited the potential for public transport and active transport use.

- **Decades of private vehicle oriented transport planning and funding have encouraged car use over alternatives.** For example building extra lanes to solve traffic problems rather than changing how we travel.

Breakdown of emissions by transport mode

Aotearoa's transport system is comprised of road transport, aviation, shipping and rail. However, as Figure 3 shows, our transport emissions come predominately from road transport (the heavy and light fleets), which contributes 91 percent of transport emissions.

Light vehicle fleet

The light vehicle fleet includes cars, sports utility vehicles (SUVs), utes, vans and light trucks with a gross vehicle mass of 3.5 tonnes or less. Travel by light vehicle accounted for 67 percent of transport GHG emissions and 13 percent of Aotearoa's total gross GHG emissions. The light vehicle fleet's CO_2 emissions were 7 percent higher than 10 years previously.

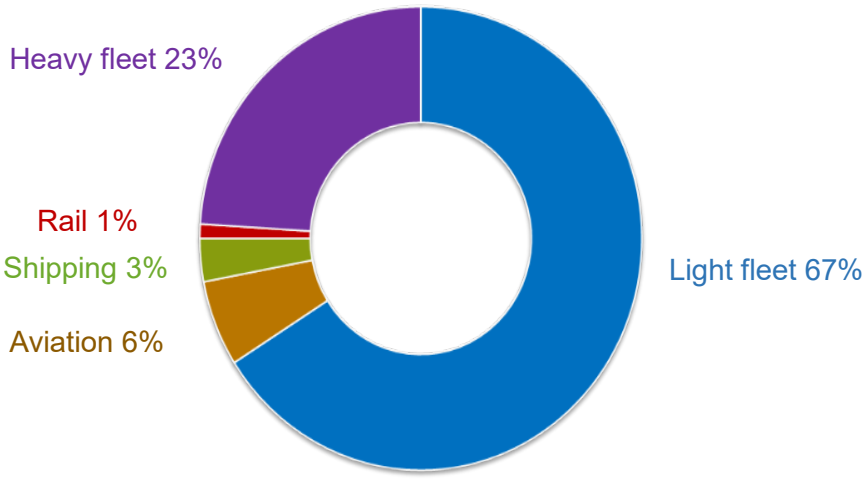


Figure 3. Aotearoa's domestic CO2 emissions by transport mode

[5] The NZ data is from Ministry of Transport analysis and the European data retrieved from: Average CO2 emissions from new light-duty vehicles registered in Europe increased in 2019, requiring significant emission reductions to meet the 2020 targets | Climate Action (europa.eu).

Currently, the majority of new and used light vehicles entering Aotearoa's fleet are powered by fossil fuels. Fully electric-powered vehicles made up a small portion of Aotearoa's fleet in 2018 at about 2 in every 1,000 light vehicles (about 0.5 percent). Further, the light vehicles entering our fleet are more emissions-intensive than in most developed countries Table 1 below shows emissions from the average vehicle entering the Aotearoa fleet compared to Japan and Europe. This is partially due to the high proportion of used vehicles that enter the Aotearoa fleet, with relatively higher emissions compared to new vehicles manufactured in Europe and Japan (and low numbers of used imported vehicles entering their fleets). It is also due to the fact that Japan and Europe do not purchase utes for personal use like we do in Aotearoa. Further Aotearoa no longer has a vehicle manufacturing sector.

Table 1. Average vehicle emissions entering the fleet for Aotearoa, Japan and Europe

Aotearoa	Japan	Europe
165 gCO_2/km[6] (2020)	105 gCO_2/km (2014)	105 gCO_2/km (2020) 95 gCO_2/km (from 2021)

Aotearoa was one of only three developed countries that had no regulations, and limited incentives to influence the fuel efficiency of light vehicles entering the country. As a result, the vehicles supplied to Aotearoa are among the most fuel inefficient of any OECD country. The new Clean Car Standard recently agreed by Government will begin to address this.

Heavy vehicle fleet

The heavy vehicle fleet consists of vans, buses and trucks with a 3.5 tonnes gross vehicle mass or more. The heavy fleet accounts for 23 percent of transport emissions even though it only accounts for 6 percent of the annual road vehicle kilometres travelled. Its disproportionate contribution reflects the fact that the heavier a vehicle is, the more energy it takes to get it moving.

Nearly all trucks in Aotearoa use diesel. The total amount of GHG emissions produced from road freight is directly related to the amount of diesel used by trucks. Fuel consumption by the truck fleet has been steadily increasing over the past 18 years. Heavy trucks contribute the most to overall GHG emissions as they travel the greatest distance and carry the most freight by weight.

[6] This figure is based on the New European Driving Cycle (NEDC) emissions test, as of 30 September 2020.

Figure 4 shows that without any new interventions, GHG emissions from trucks will be the main contributor to road transport GHG emissions by 2055.

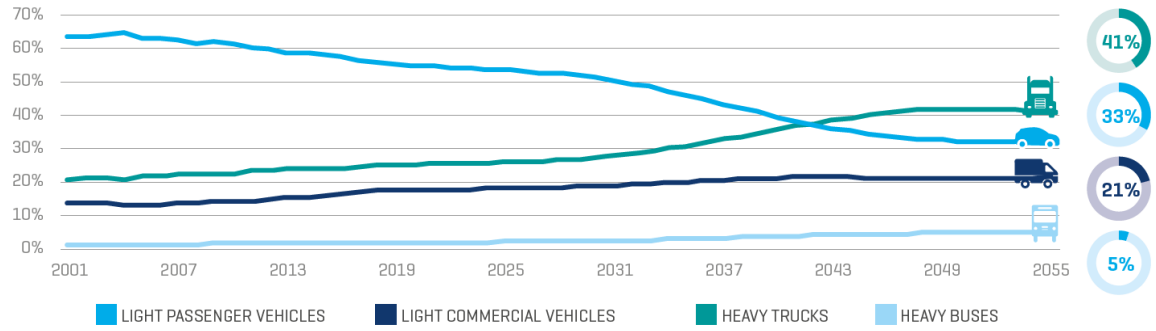


Figure 4. Current and projected greenhouse gas emissions from Aotearoa's transport fleet by vehicle type

While a fall in road emissions is expected in the light fleet (mainly due to an anticipated increase in the uptake of EVs), emissions from the heavy fleet are expected to steadily increase into the 2020s, then plateau at about 11 percent above 2015 levels by 2040. The markedly different emissions path for the heavy fleet reflects the difficulties with decarbonising heavy vehicles compared to light vehicles.

Aviation

Domestic aviation accounts for 6 percent of our transport emissions. In 2012, domestic aviation emissions fell below 1990 levels but since 2015 they have been steadily growing. Domestic aviation emissions have increased, in part, due to a reduction in the real cost of airfares. At the same time the fuel efficiency of air travel has increased due to higher load factors, advances in aircraft design and improvements in air traffic management for aircraft approaches to airports.

Most airports have experienced significant growth in recent years due to increases in domestic and international tourism and new routes offered by airline operators and regional airlines. COVID-19 has had a significant impact on aviation. It is too early to tell what the impact of COVID-19 will be on the aviation sector and its emissions going forward.

The Paris Agreement is silent on the inclusion of international aviation sector. This is because of the difficulty with attributing emissions from international aviation to particular States. Instead, States have agreed to work through the International Civil Aviation Organization (ICAO) to pursue emissions reductions in international aviation. Aotearoa is an active participant in environmental discussions at the International Civil Aviation Organization (ICAO).

Shipping and Maritime transport

Aotearoa is dependent on shipping for the movement of goods in and out of the country and for connectivity within and between the North and South Islands. The domestic shipping sector contributes around three percent of Aotearoa's overall transport emissions. Aotearoa's domestic fleet includes cargo vessels, passenger ferries, fishing trawlers, tugs, cement carriers and fuel tankers. GHG emissions from shipping have remained steady since

1990, in comparison with other domestic sectors e.g. aviation which has seen nearly 100 percent growth in GHG emissions.

International shipping, like aviation, is silent in the Paris Agreement due to the same difficulty with attributing emissions from international shipping to particular States. Rather States, including Aotearoa, work through the International Maritime Organization (IMO) to pursue emissions reductions from international shipping.

Rail transport

The national rail network totals approximately 3,700 kilometres. Emissions from rail are about 1 percent of our total emissions. The government, through the state-owned enterprise KiwiRail, owns and controls the rail infrastructure and the majority of the rolling stock. There are urban rail networks in both Wellington and Auckland, which provide approximately 26.1 million passenger trips annually, comprising 12.1 million trips in Wellington and 13.9 million trips in Auckland. Rail carries 16 percent of freight in tonne kilometres within Aotearoa.

Since 2000, emissions from rail transport have been largely consistent at just under 200 kt (CO_2-e). Since 2012 there has been a very gradual decline in emissions. This may be, in part, due to a gradual increase in the electrification of railway lines in Auckland but may also be attributable to a gradual decline in rail freight in favour of road freight.

Aotearoa's rail system is currently in the midst of a 7 to 8 year rebuild, with significant investment, to improve and replace locomotives, rail lines, bridges and tunnels across the country. It is anticipated that this investment will lead to improved services and potentially grown Aotearoa's freight task onto rail.

Regional versus urban patterns

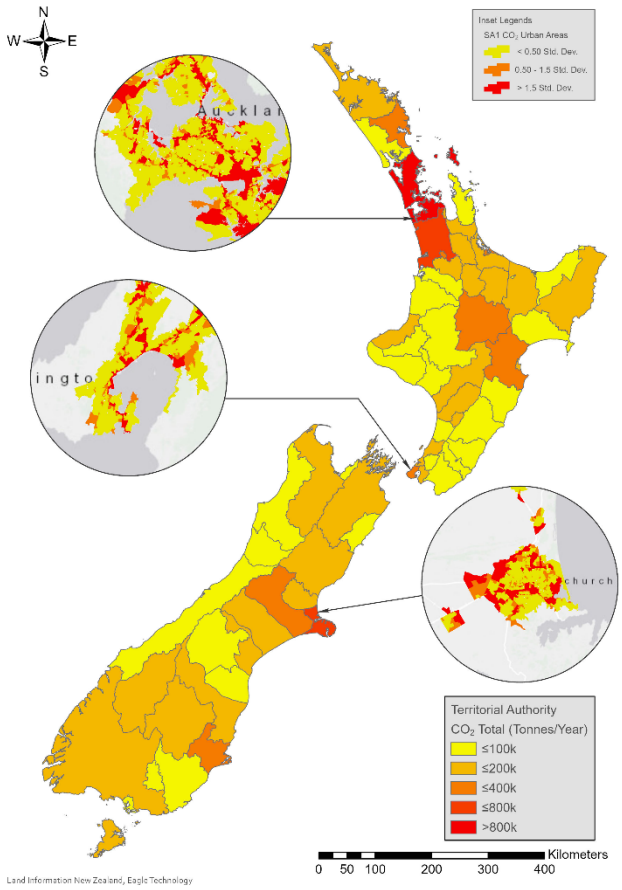
When we consider where our emissions are generated we need to acknowledge that there are different regional and urban patterns of travel. Our larger cities generate more emissions than rural towns based on population and the number of vehicles. Per capita, transport emissions are lower in cities.

Waka Kotahi's Sustainability Monitoring Report[7] notes that nationally, urban areas contribute half of our land transport emissions. These emissions are concentrated in the largest urban centres of Auckland, Wellington and Christchurch where a large part of the population lives and where a large portion of economic activity occurs. Transport emissions in the Auckland and Wellington regions are particularly dominated by urban travel.

Rural travel accounts for the remainder of the emissions, and includes a combination of freight, local travel and regional travel.

[7] Waka Kotahi. (2020). *Tiakina Te Taio: Our Sustainability Monitoring Report.* Retrieved from: Tiakina Te Taiao sustainability monitoring report (nzta.govt.nz)

The following map shows the spread of emissions across regions. By examining Auckland, Wellington and Christchurch in greater detail we can see the higher GHG emissions on key road corridors.



Implications of COVID-19

As a result of lockdown due to COVID-19, global daily fossil fuel CO_2 emissions decreased by 17 percent.[8] Surface transport (i.e. the movement of people or goods by road, train or ship) accounted for nearly half of the decrease in emissions during the lock down period. While this resulted from drastic measures, it corresponds to the level of emissions seen in 2006.

A study examining the impact of lockdown measures on global CO_2 emissions, found Aotearoa's CO_2 emissions fell by 41 percent compared to 2018 levels.[9] This was second only to Luxembourg. The Ministry estimates due to travel restrictions in COVID-19 Alert Levels 3 and 4 that Aotearoa's annual CO_2 emissions were reduced by between 8 and 10 percent. Further, road traffic exhaust pollutants reduced by 75 percent on average across main centres during Level 4. Since Aotearoa lifted restrictions on travel movements CO_2

[8] Le Quéré, C., Jackson, R. B., Jones, M. W., Smith, A. J., Abernethy, S., Andrew, R. M & Friedlingstein, P. (2020). Temporary reduction in daily global CO 2 emissions during the COVID-19 forced confinement. *Nature Climate Change*, 1-7.

[9] Waka Kotahi Transport Agency. (2020). *COVID-19 impacts on transport*.

emissions, air pollutant emissions, motor vehicle sales and mode use (including public transport patronage) appear to be returning to near pre-COVID-19 levels.

These changes, observed globally and in Aotearoa, do not reflect the structural changes in the economic, transport or energy systems needed to maintain lower emissions. Aotearoa's statistics highlight that lockdown is not a sustainable method of reducing transport emissions, either socially or economically. Subsequently, we need to find other mechanisms that realise the same kind of benefits without the fallout. COVID-19 has given us a sense of the scale of change required.

On the other hand, the enforced lockdown meant that New Zealanders tried different ways of working, accessing goods and services, and connecting socially. This revealed opportunities to reduce emissions through remote working and for implementing targeted urban design interventions to reduce travel demand and encourage walking, cycling and public transport. It has resulted in ongoing changes to travel patterns (e.g. more people working from home post lockdown) and introduced a level of uncertainty regarding future mode use and travel demand.

Policies have been introduced to reduce transport emissions, but more is required from Aotearoa

Government has introduced a range of policies to mitigate emissions from the transport sector. For example, this includes road user charge exemptions for the light and heavy fleet to increase the uptake of low-emission vehicles; and increased investment for walking and cycling, public transport and rail freight. A contestable fund for low emissions vehicles is also set up to encourage innovation and increase its uptake.

Additionally, there are a range of actions that are being taken by central and local Government to address climate change, such as the Government Policy Statement on land transport, Waka Kotahi's Toitu Te Taiao – Sustainability Action Plan; and regional plans to address climate change. The Government's Urban Growth Partnerships programme, the National Policy Statement on Urban Development, and Resource Management reforms will also deliver more integrated transport and land use planning to support mode shifts and transport emissions reductions.

These collective actions are a good start to addressing transport emissions. However, a lot more is required if Aotearoa has a credible chance of reaching net zero by 2050.

Chapter 11 of this paper provides more detail on existing policies and overarching work that is underway. It also explores the opportunities across the transport system that would complement what has already been implemented and could be included in the future emissions budgets.

Chapter 3: The Government's role and levers for reducing transport emissions

Key points

- Achieving emissions reduction targets will require a combined effort from all New Zealanders including central and local government, iwi, communities and businesses.
- Central government has a particularly important role to play, given its influence in the transport system. Leadership will be required for the significant changes necessary to shift our transport system onto a zero emissions pathway.
- Government must build and strengthen its relationships with key stakeholders and partners to ensure success. This will include collaboration between central and local government, Iwi and hapū, the private sector, industry associations and advocacy groups.
- Sectors connected with the transport sector have a significant impact on transport emissions. Collaboration with these sectors will be important. The interdependencies between key sectors and transport include the planning system, housing and urban development, the energy sector, and the tax system.
- Many sectors and individual players, public and private, will need to align their settings and priorities to reduce emissions from the transport system.
- Government has a range of levers it can use to influence emissions reductions in the transport system including investment, regulation, and economic and education tools.

What is the Government's role in reducing transport emissions?

Achieving Aotearoa's emission reduction targets will require major and long-term changes and adjustments to all parts of the transport system. Government needs to influence change where it can, while recognising that it cannot make all of these changes on its own. Government needs to build on the social mandate for reducing emissions, by working with others. This includes working with local government, iwi, communities, and businesses to reduce transport emissions.

The Government has an important role to ensure our institutions (including, where appropriate, our legal and regulatory frameworks) support transport emission reductions.

The Government can also make it easier for people and businesses to access places by low-carbon modes, and to make sustainable transport choices that support a transition to a low carbon transport system. This will require leadership by Government, close collaboration with a wide range of stakeholders, and consideration of a wide range of policy levers within and beyond transport.

Leadership

Strong government leadership will be fundamental to achieving significant emission reductions from the transport system. The Government has many levers to achieve emission reductions from the transport system (discussed in more detail below).

The Government already has initiatives underway to reduce transport emissions. Further action, will be required to shift our transport system onto a zero emissions pathway. Aotearoa's international agreements and the CCRA both create an imperative for action.

As discussed in Chapter 1, the Government must prepare an ERP under the CCRA. This will identify policies for meeting five-yearly emissions budgets from 2022. This plan also needs to demonstrate that we are on a pathway to meet our 2050 target.

Hīkina te Kohupara will inform the Government's ERP, by outlining strategic approaches and opportunities to reduce transport emissions.

Ministry of Transport's role

The Ministry is both system steward and lead adviser to the Government on the best opportunities to decarbonise the transport system.

Our work is guided by the Transport Outcomes Framework, which aims to ensure our transport system improves wellbeing and liveability. This framework has five core outcomes for the transport system to deliver over time: inclusive access, healthy and safe people, economic prosperity, environmental sustainability, and resilience and security. The environmental sustainability outcome includes transitioning the transport system to net zero carbon emissions. This highlights the important role that the transport sector has to play in responding to climate change. The five outcomes are interrelated and need to be met as a whole to improve intergenerational wellbeing and the quality of life in Aotearoa. Where possible, it is important to pursue opportunities that deliver co-benefits across outcomes, rather than just trading off outcomes against each other.

There are levers outside of the transport system that can have a significant impact on transport emissions. For example, decisions affecting land use and urban development, such as how densely we build our cities, can have a significant impact on transport emissions, especially over the longer term. Subsequently, greater collaboration and leadership is required across government to align land use, urban development and transport planning to reduce GHG emissions from the transport system.

Further, leadership should be shown across the public sector and include strengthened cross-agency collaboration on modelling and policy development efforts to understand what will be required to reduce transport emissions. It should be part of a systems response to reduce transport emissions and include cross agency, sectors and stakeholder participation. This collaboration should include the Ministries of Housing and Urban Development, Environment, Transport, and Business, Innovation and Employment (MBIE); and the New Zealand Infrastructure Commission (Te Waihanga).

Collaboration within the transport system

The government has to engage with a wide range of players in the transport system. This requires a strong focus on collaboration, with the government growing and strengthening its relationships with Te Tiriti partners and key stakeholders to ensure success.

Central government

Central government is heavily involved in the transport system as a planner, funder, partner, enforcer and regulator. Transport sector agencies, including the Ministry, Waka Kotahi, the Civil Aviation Authority and Maritime New Zealand and KiwiRail, all play a role in reducing transport emissions.

Local government

Collaboration between central and local government is critical for achieving emission reductions. Local government has a significant role in planning and funding transport and urban development at a regional and local level. Under the Land Transport Management Act 2003 (LTMA), local government is responsible for local roads, planning and contracting for public transport, and walking and cycling infrastructure and initiatives. Many councils also partly or fully own airports and seaports in their regions.

Many councils are developing or have already developed plans setting out how they intend to reduce emissions and respond to climate change. An example is Te Tāruke-ā-Tāwhiri[10], Auckland's climate plan.

Stronger collaboration between central and local government will be important to ensure there is a joined up systems approach to mitigating transport emissions. This should include clear signals from Government regarding how Aotearoa will be stepping towards the net zero goal.

Iwi and hapū

Government has responsibilities under Te Tiriti o Waitangi – the Treaty of Waitangi – to acknowledge Māori as partners and their status as tangata whenua – the indigenous people of Aotearoa. Effective, meaningful partnership with Māori is key to improving transport and broader social outcomes for Iwi/Māori, and to ensure the transport system serves all New Zealanders equitably.

Private sector

The private sector is a major employer and investor in the transport system. It also leads innovation in many areas which will have a significant impact on the future of the transport system and on transport emissions. The government can make it easier for the private sector to reduce emissions by providing certainty and early notice of upcoming decisions that will impact them. It will be important for government to engage closely with the private sector, so that businesses can make the most of opportunities for transitioning to a zero emissions economy, and so that they can understand their responsibilities.

Industry associations and advocacy groups

Within the transport system, there are a large number of groups advocating for the perspectives and interests of particular parts of the sector. This includes groups advocating for particular types of transport (e.g. cycling advocacy groups), neighbourhood groups (e.g. for a public road) and other groups that may be established to support or oppose a specific policy or initiative.

As government develops its approach to reducing emissions, it will need to engage with these groups – bringing important perspectives, data, and evidence into the policy process.

[10] Auckland Council. (2020). Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan. Retrieved from: Auckland's Climate Plan (aucklandcouncil.govt.nz)

Collaboration with other sectors

There are also sectors outside of the transport sector, which have a significant impact on transport emissions. Co-operation is needed across sectors to reduce emissions across society. There are interdependencies between several key sectors and transport, including the following.

Planning system (including spatial planning)

The way we plan our towns and cities has a significant impact on transport emissions, especially over the long term. It affects the distance people need to travel to reach jobs, schools, shops, amenities, and other important destinations. This will in turn affect the volume and frequency of urban freight delivery. Transport and spatial planning also influences how people travel, by affecting the range and quality of transport options available, including low carbon modes such as public transport, walking, and cycling.

Greater collaboration and leadership is required across government to align land use, urban development and transport planning to reduce emissions from the transport system. This can help to ensure Aotearoa's infrastructure delivers value across multiple outcomes, and promotes an efficient land use system.

Housing and urban development

Closely related to the planning system, housing and urban development also has a significant impact on transport emissions. The type of buildings we construct, their location, and their accessibility to different transport modes, affects how much people and products travel, and associated transport emissions. To reduce emissions, there needs to be close collaboration between transport agencies, the Ministry of Housing and Urban Development, Kāinga Ora and the development sector.

Social development and health

The Ministry should work with the Ministries of Social Development and Health to ensure policies that implement mode shift opportunities for communities considers how equity in the transport system can be improved. With a greater emphasis on moving more New Zealanders onto public transport, there are many in our communities who are not adequately served either because no services exist, or the services don't meet local needs or the cost prohibits its use. Collaboration on how the transport system can help improve social and health outcomes would benefit all of Aotearoa.

Energy

There is a very close relationship between transport and energy. The shift to cleaner fuels in the transport system will have significant implications for the energy sector. In particular, the shift towards electric vehicles will significantly increase the demand for electricity (which needs to come from renewable energy sources), as well as the capacity for electricity storage. Increasing demand for biofuels will also affect the energy sector. If hydrogen is used for transport, this will also impact the electricity system (if electricity from renewable sources is used to produce the hydrogen).

To support the transition of heavy freight, aviation and maritime sectors, there is a need for the energy sector to secure the right type of alternative fuels at the right price. Additionally,

fuelling and charging infrastructure is another area where transport and energy intersect. Work is underway across government on a plan (strategy) setting out a pathway for the future charging infrastructure Aotearoa needs for our low carbon future.

Taxation

The tax system in Aotearoa also affects transport emissions. For example, there are existing financial incentives and accounting practices that encourage the purchase and use of some vehicles, such as double cab utes, that produce more pollutants than other vehicles. Conversely, the tax system could play a role in stimulating demand for low emission transport options. Consideration should be given to how the tax system can be used to complement and support the pathway to net zero by 2050.

Other sectors

There are also opportunities for cross-government collaboration in other sectors. For example, with education (e.g. school travel plans), forestry (connection with biofuels and potential transport offsets), building and construction (e.g. in relation to transport infrastructure), and technology, information and digital innovation (e.g. innovative new transport services and technologies).

Reducing emissions will require many sectors and individual players, public and private, to align their settings and priorities to support reducing emissions from the transport system.

Levers within the transport sector that the Government can use to reduce transport emissions

Delivering emission reductions will rely on a variety of levers the Government can use to influence the transport system. This will often require multiple agencies, using a combination of levers together, and in a coordinated way over time.

Investment

The Government makes funding and investment decisions in the transport system. Funding can enhance or maintain existing infrastructure and services, and influence behaviour by providing a range of affordable, safe and attractive travel options.

The Government Policy Statement on land transport is a critical transport document outlining the government's strategy for investment in land transport over the next 10 years. Prepared under the LTMA, the Government Policy Statement is implemented by Waka Kotahi through its National Land Transport Programme, which sets out a three-year programme of land transport investments.

A key purpose of the National Land Transport Fund (NLTF) is that it was designed and intended to fund and maintain the essentials for Aotearoa's transport system, e.g. provision of roading where needed, maintenance of the system etc. Emissions reductions is a significant step change in investments for the NLTF, which will always be far beyond what the NLTF could do or was ever intended to do. There is no doubt that some big investments in public transport, for example, may have to be funded by the Crown.

The main current constraint of the NLTF is that more than three-quarters of the fund over the next ten years is already allocated to maintaining the existing transport network, funding public transport services, Road to Zero initiatives, public private partnership repayments and completing large projects for new infrastructure that are already underway. This limits how much impact investment through the existing NLTF can have on reducing emissions over and above current initiatives.

There will be a greater need for investment from alternative sources, such as Crown and Local Government funding, and third party investment. Such alternative investment sources will be critical for achieving and implementing the policies for emission reductions required from transport to meet Aotearoa's targets. For example, Crown funding has been provided to support the development of the CityRail Link and investment in rail.

Generational planning and investment

The Ministry is leading work on a Generational Investment Approach (GIA) that will evaluate investment choices for the transport system, out to 30-50 years from now.

The GIA takes a structured approach to compare the benefits that various investment options and interventions might achieve. Coordination across the system is facilitated by sharing and evaluating the same evidence, and this encourages trade-offs to be made so that investment and resources can be allocated efficiently. Understanding our long-term investment priorities is an important aspect of redesigning the revenue system and regulatory frameworks, which may also be used to encourage a reduction in transport emissions.

Regulation

The transport regulatory system ensures safety and helps protect New Zealanders from harm and achieve other transport outcomes, including, reducing emissions. It influences behaviour and provides the legal frameworks that enable the system to operate effectively.

The system is comprised of laws made by Parliament (primary legislation) and second order regulations, rules and instruments that those laws allow (secondary legislation). Legislation, however, is only part of the picture. Transport Crown entities, as well as the Ministry, need to deliver services, educate and inform and make sure that people follow the requirements set out in legislation. The regulatory system works together to influence people's behaviour.

To meet the net zero by 2050 better use of existing and more use of new regulatory tools may be necessary. As each future policy is scoped and developed, the Ministry will need to consider regulatory changes to enable future policies on climate mitigation.

Economic and educational tools to influence behaviours

To transition to a low carbon transport, we must drive sustainable changes in the behaviour of transport users. It is important that we invest efforts to gain a broader understanding of how people behave and make decisions. Behavioural insights can be used to help people make decisions that are in their long-term interests and that overcome the inertia of their habits.

Providing information about transport options at specific locations and times (making it easy), about changes other transport users are making (making it social) and about time, health and safety benefits (making it attractive) could be the strategies to use. For example, educational tools, such as journey planning apps, mobility as a service (MaaS) and social marketing can make it easy for people to change their behaviour without an economic push, and are most effective when those tools are used over a longer term.

In some cases, financial incentives or disincentives will be necessary to supplement these 'softer' measures. These instruments aim to provide better pricing signal to people of the impacts of their travel choices and influence the choices they make in the future, by putting a price on those which produce negative impacts (or otherwise a subsidy). The price of transport can reflect the direct costs of using the network, the externalities/indirect costs (such as emissions), or it can be set relative to other modes to influence the use of one mode over another.

The use of behavioural measures can help to develop transport policy interventions that account for behavioural biases, defaults and shortcuts. Combining different types of behavioural measures with other complimentary interventions can help to achieve the outcomes we want to see in the transport system such as reduced congestion, reduced emissions and better health outcomes in a more efficient way.

Analytics and modelling

Analytics and modelling plays a key role in understanding the expected effects of different measures on emissions outcomes, and the interactions between different transport and other non-transport measures. Over the past year, the Ministry has improved its tools and capability to project the long-term changes in vehicle fleet compositions, the level of travel, and GHG emissions. These projections have strong economic underpinnings with key drivers such as vehicle purchasing behaviours, population growth and economic conditions which are updated periodically.

The Ministry plays a lead role in providing evidence-based transport analyses and advice on behalf of the sector. This includes working closely with other departments such as Waka Kotahi, the Climate Change Commission, the Ministries for the Environment and Business Innovation and Employment, the Energy Efficiency and Conservation Agency. This includes participating in related interagency working groups. Tools such as the Vehicle Fleet Emissions Model, Electric Vehicles Uptake Model and Cost Benefit Analysis modelling are used frequently and will continue to be crucial to inform and estimate the impacts from ongoing transport emissions policy. Further work to understand how best to estimate and account for the benefits from improving urban land use development and transport planning will be needed to understand the relative roles infrastructure plays in reducing transport emissions.

Monitoring, evaluation and oversight

The Ministry of Transport has a key role in monitoring and evaluating the performance of the transport system. Annual reporting of Transport Indicators (based on the Transport Outcomes Framework) provides an ongoing mechanism to track high-level outcomes achieved from the transport system, including emissions. The Ministry also evaluates specific regulation, policy and investment, including as related to emission reductions.

The Ministry should strengthen its monitoring and evaluation role in relation to emissions by partnering with delivery agencies to undertake a more comprehensive monitoring and evaluation programme to track progress and drive greater accountability. This should stem from measurable outcome indicators, so that links can be made with the desired outcomes for climate mitigation alongside transport equity and other outcomes. This will be important for addressing future emissions budgets and the impacts of those budgets on our communities.

International standards

While international standards, such as those for the aviation and maritime sectors, are specific to international activities, they can provide a knock on effect by influencing behaviour and subsequently providean impetus to reduce domestic emissions. International standards can help overcome social mandate challenges and assist with garnering a broader commitment and social licence to implement change to reduce emissions.

Consultation question 2
Is the government's role in reducing transport emissions clear? Are there other levers the government could use to reduce transport emissions?

Chapter 4: The role of innovation in the transport system

Key points

- Innovation has always been an inherent driver of change in the transport system. Innovative ideas, policies, business models and new technologies can improve the way people and goods move around. The best innovations add value to the transport system by improving environmental, social and economic outcomes, which can include reducing emissions.
- Electrification, shared mobility and automation are likely to have a significant impact on how people and goods travel. Electrification and shared mobility will have a significant impact on emissions but the impact of automation is less certain.
- Exploring different approaches for reducing emissions in the transport system should include the role of urban design and placemaking.
- Government has a key role to implement policies that support transport innovation, including decarbonisation. Regulatory policies that encourage transport innovation with positive outcomes, building strong connections between government and non-government players in the innovation sector, leveraging the skills and expertise of the private sector and targeted investment can help direct innovation towards new products or services that can contribute to reducing emissions.

What do we mean by transport innovation?

Decarbonising the transport system is complex and challenging. Innovative ideas, policies, business models, and technology can improve outcomes from the way people and goods move around. Transport innovation, therefore, can support positive outcomes like decarbonisation. As well as new ideas, we can also take advantage of the many ideas and solutions already available, and address the barriers to using these solutions.

Innovation can range from improvements to vehicles and street design, new business models (e.g. bike share and car share schemes) and new vehicle technologies (e.g. autonomous vehicles (AVs), drones, and electric ships). It also includes innovative uses of transport data to improve transport services (including freight system movements), user experiences and infrastructure.

Some innovation in transport is continuous, such as making cars more efficient, or making improvements to public transport service operating models. In contrast, technologies can be disruptive by arriving unexpectedly or result in fundamental changes to the system or both together.

Autonomous vehicles, are an example of a disruptive technology that is not widespread in the sector yet but is likely to have deep impacts on how we move. E-scooters are an example of a new technology that arrived very quickly and the impacts on the system are still emerging.

How can transport innovation support GHG emission reductions?

Transport emissions in Aotearoa are increasing, so new ways of moving people and goods are essential to achieving the emissions reductions targets that have been set. Increasing the share of vehicles powered by electricity, biofuels and hydrogen will be important to reduce emissions. Improving the technology of these vehicles will be important in

accelerating their uptake by consumers. However, the scale of uptake required is immense and there will need to be concerted and joint action across the government and private sectors to ensure low emission vehicle uptake targets are achieved.

Focussing on improving vehicles or fuels, can reduce the emissions they produce and encourage uptake, especially if technological developments lead to, for example, reduced battery costs or extended driving ranges for electric vehicles. Innovative business models, such as car sharing, and other innovative forms of shared mobility, can reduce car ownership and use, which can also reduce emissions and encourage more physically active modes like walking and cycling.

Different approaches to managing the transport system will also be important, including how urban design and placemaking can be used to support emissions reductions. Waka Kotahi's *Innovating Streets for People Programme* encourages councils to think about road space differently and try new approaches.[11] This Programme provides funding to councils for temporary cycle lanes, traffic calming devices, street art and other relatively new/modern street design and placemaking initiatives. Such approaches can encourage walking and cycling by making those options more attractive and accessible. This can encourage mode shift, which leads to reduced emissions.

Key examples in the transport sector of innovation and technology

Advancements in transport innovation to support GHG emissions reductions fit into three broad categories. These are:

1) Recent innovations that are likely to have a major impact on decarbonising vehicles
    - Light electric vehicles – EVs are increasingly accessible, the range is better, and costs are expected to fall.
    - Heavy vehicle technology – a few electric trucks are now in the domestic market, as well as electric buses in many public transport fleets. Additionally, hydrogen and biofuel also have potential for freight vehicles. The Ministry of Transport's Green Freight Project[12] highlights these opportunities.

2) Recent innovations that are likely to have a positive impact on avoiding or reducing emissions
    - Mass rapid transit technologies – new forms of mass rapid transit such as small autonomous shuttles, larger guided systems (for example, autonomous metro rail systems and trackless trams) and on demand public transport.
    - New street design principles and approaches – to designing streets for people and places may lead to increased mode share by active modes and potentially reduced emissions, as well as more pleasant spaces for people to use.
    - The integration and the better use of transport data by transport operators to make their services more efficient and by packaging information on transport options, booking and payment into one channel for consumers through apps on smart devices ("mobility as a service").

[11] Innovating Streets - All updates | Waka Kotahi NZ Transport Agency (nzta.govt.nz)

[12] Green freight project | Ministry of Transport

3) Emerging innovations may have a positive or negative impact, which depends on
    - how the technologies evolve
    - their uptake and penetration into the transport system, which will be driven by consumer preferences and, in some cases, government encouragement
    - how government regulation affects the roll out of new technology and how it is operated.

We are seeing three major innovation trends in transport relevant to decarbonisation - electrification, shared mobility and automation

The following trends are likely to have a significant impact on how people and goods travel. They could all contribute to decarbonisation, depending on how they are adopted and how government and society shapes them. This range of new technology, when managed effectively, creates an opportunity for a shift in the way we travel, and the need to travel.

- *Electrification*

  Advancing battery and charging technology is allowing a wider range of electric vehicles to be developed and sold, with better features like longer range. Electric cars, vans, buses, trucks, and drones will have a major role in decarbonising the transport system. Electric light aircraft, ferries, bikes and e-scooters may also make a contribution.

- *Shared mobility*

  Car sharing can support environmental sustainability and public health by reducing car ownership and use and encouraging active travel. While maintaining or increasing access, shared mobility can reduce the number of vehicles or the distance they travel. This reduces GHG emissions. Some other innovative forms of shared mobility, such as e-scooter rental schemes, may also contribute to emissions reduction but current evidence is mixed, especially where the technology has a short life cycle.

- *Automation*

  Automated vehicles, including cars, aircraft, drones, and ships, have the potential to make drastic changes to the transport system. However, the scale, nature and timing of this technology's impact is uncertain. Many new cars have autonomous features but the appearance of fully autonomous cars in significant numbers is likely to be more than a decade away. Initially, such cars are likely to be rolled out in constrained geographical areas, such as "robo-taxis" being introduced to urban areas. The speed of uptake will also be affected by how transport policies regulate the technology.

  Most new forms of automated transport are likely to be electric, including aircraft. As a result, automated transport may also contribute to emissions reductions if they become popular. For land transport as well, automated vehicle technology has the potential to reduce harm from vehicle accidents, make more efficient use of space in the road network, reduce the cost of travel, and provide accessible options to non-drivers. However, this technology could also have negative consequences. Automated cars, for example, may lead to more vehicle movements and increased urban sprawl, conflicting with strategies to avoid and shift emissions through more

quality compact urban form. Drone technology may threaten privacy and cause noise and visual pollution.

The use of data, information and communication technologies holds another key opportunity for substituting physical travel in cities with digital communication and virtualisation. This means less commuting and more flexible working arrangements such as working from home or community 'satellite offices'. Data, analytics and digital innovation also has a significant role in transitioning the transport system to low emissions.

Government has a role in supporting transport innovation

Much of the major transport technological developments including those that affect transport emissions, will be led internationally by large, global companies like Uber, Google and Tesla. These companies will have a major influence on the transition to lower carbon transport and whether this influence is positive or negative will depend on commercial incentives.

While Aotearoa will have a limited ability to influence what these companies produce, government can play an important role to steer and support innovation that reduce emissions. Government's role can include:

- making sure regulation supports, encourages or mandates the uptake of positive innovations (and does not hinder it)
- encouraging collaboration and stronger connections between the government and non-government sectors, including leveraging the skills and expertise of the private sector
- providing targeted funding and other support for developing, trialling and supporting new technology and approaches (e.g. heavy vehicle charging stations).

There is considerable government support for innovation in the economy and some specific transport initiatives, such as the Low Emission Vehicle Contestable Fund administered by the Energy Efficiency and Conservation Authority (EECA). However, there has not been a strong focus in the past on transport innovation. New initiatives, such as making funding available for transport innovation through the Government Policy Statement on land transport are starting to address this gap. Investment from other sources may also be required.

To get the greatest benefit from innovative ideas, Government needs to ensure the transport system is flexible and adaptable to disruptive thinking and technologies. There needs to be a balance of adequately assessing the risk of disrupting business as usual, and the future benefits of new and innovative approaches. We need to ensure the system settings can quickly respond to new ideas, and support the people behind them to grow their ideas in positive directions and make them mainstream or widespread.

Consultation question 3
What more should Government do to encourage and support transport innovation that supports emissions reductions?

Chapter 5: The Avoid, Shift, Improve Framework

Key points

- Hīkina te Kohupara uses the Avoid-Shift-Improve (ASI) framework to identify opportunities to reduce emissions across the transport system.
- Transport emissions are driven by transport activity (number of trips and kilometres travelled), mode share (percentage share of different modes), energy intensity (quantity of fuel used per kilometre) and carbon intensity (emissions from quantity of fuel per kilometre).
- The ASI framework addresses each of these four elements:
    - Avoid – improve the overall efficiency of the transport system through interventions to reduce the need to travel and trip lengths.
    - Shift – improve the efficiency of trips by promoting mode shift to low carbon modes, such as walking, cycling, public transport, coastal shipping and rail freight.
    - Improve – lower the emissions of transport vehicles and fuels.
- The Ministry has developed three themes to group together opportunities within this framework and highlight interdependencies within different parts of the system. Theme 1 and 2 focus on people and Theme 3 on freight.

The Avoid-Shift-Improve (ASI) framework

Transport energy use and GHG emissions are driven by four key elements:

1. Transport activity (the number of trips and kilometres travelled)
2. Mode share (the percentage share of different modes)
3. Energy intensity (the quantify of fuel used per kilometre)
4. Carbon intensity (the emissions from the quantity of fuel per kilometre).

Together these elements contribute to total transport GHG emissions (Figure 5).[13]

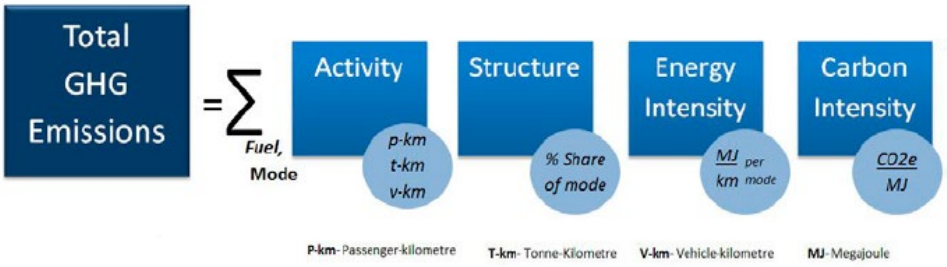


Figure 5. Avoid-Shift-Improve framework - key elements

[13] Figure from Deutsche Gesellschaft fűr international Zusammenarbeit (GIZ), Urban Transport and Climate Change. p. 12.

The Avoid-Shift-Improve (ASI) framework is a strategic framework that addresses each of these four elements to reduce emissions from the transport system (Figure 6).[14]

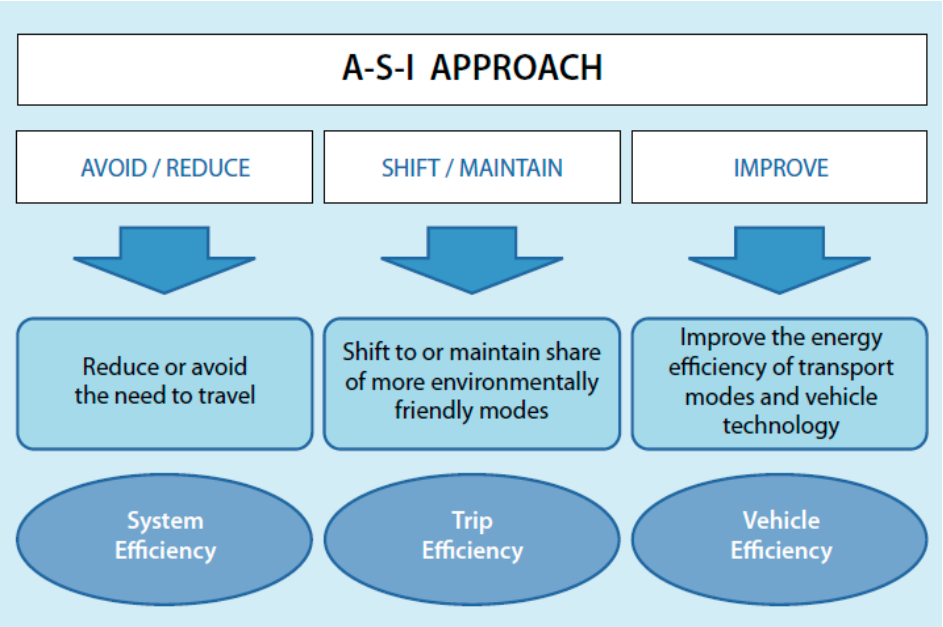


Figure 6. The Avoid-Shift-Improve Approach

Avoid/reduce – addresses 'transport activity'. It looks to improve the overall efficiency of the transport system through interventions that reduce the need to travel and trip lengths

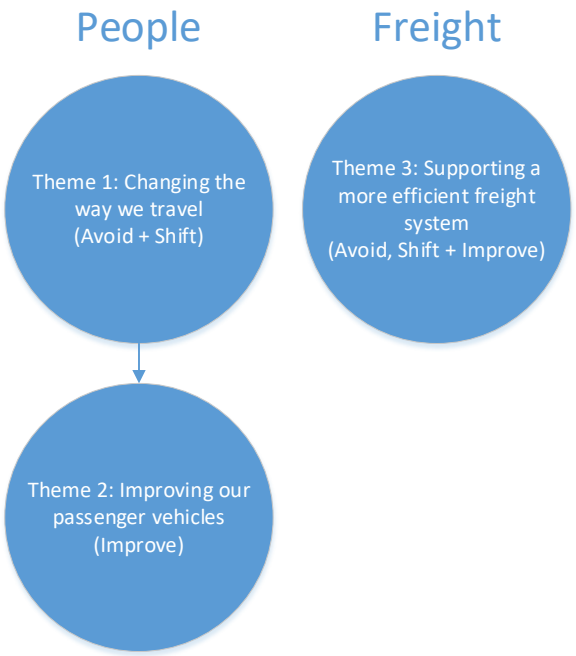
Shift/maintain – addresses 'mode share'. It looks to improve the efficiency of trips by promoting mode shift from the most energy intensive transport modes towards low-carbon modes. In particular, a shift towards active transport modes and public transport. In places where mode-shift is already high, the objective is to maintain the mode share.

Improve – addresses 'energy intensity and carbon intensity'. It focuses on vehicle fuel efficiency, low carbon fuels, and optimising transport infrastructure. It seeks to improve the energy efficiency of transport modes and related technologies.

[14] Figure from Sustainable Urban Transport Project (SUTP). (2011). *Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)*. Retrieved from: Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I) - SUTP

The Ministry's three themes

The Ministry has used the ASI framework to identify opportunities to reduce emissions across the transport system. We have grouped these opportunities into three themes. This helps the Ministry to highlight key opportunities and interdependencies within different parts of the system. Theme 1 and 2 focus on people and Theme 3 on freight. However, there are overlaps and interdependencies between each of these three themes.



Theme 1: Changing the way we travel

This theme covers Avoid and Shift for people (as opposed to freight). It includes how we shape our towns and cities to avoid the need to travel, reduce trip distances and encourage sustainable transport modes. It also includes how we can support mode shift through providing better travel options, such as public transport, walking, cycling and shared mobility. This theme also explores the role of demand management (pricing) approaches to influence transport choices.

Theme 2: Improving our passenger vehicles (including light vehicles, public transport and planes)

This theme covers Improve for passenger vehicles, including light vehicles, public transport and planes - but not freight vehicles. It includes how we improve the energy efficiency and carbon intensity of light vehicles, public transport and aviation (acknowledging that aviation is also part of the freight system).

Theme 3: Supporting a more efficient freight system

Theme 3 covers Avoid, Shift and Improve for freight, including trucks, rail and maritime (acknowledging that maritime can also be used for passenger transport). It includes how we can improve the efficiency of our overall supply chain, shift freight to low emission modes and improve the fuel efficiency, and carbon intensity of freight modes and fuel.

Chapter 6: Theme 1 – Changing the way we travel

Key points

- Shaping our cities and towns is key to improving the overall efficiency of the transport system. We need to integrate land-use, urban development and transport planning to reduce emissions, especially over the medium to long term.
- To encourage mode shift to low emissions transport modes such as walking, cycling, and public transport, we need appropriate urban form. Quality compact, mixed-use urban development can reduce trip distances, reduce car dependence and encourage the uptake of walking, cycling and public transport.
- From an emissions reduction perspective, the need to orient urban development towards compact urban form is most pressing in our largest and fastest-growing cities where emissions are highest. This includes Auckland, Hamilton, Tauranga, Wellington, and Christchurch. However, we also need to encourage compact urban form, and multi-modal transport options in smaller cities and towns to avoid car use, especially as these places grow over time.
- Transport infrastructure investments have a major impact on urban form, and how people travel. For example, investments to expand urban state highways and roads encourage urban dispersal/sprawl and car use. In contrast, investments in frequent public transport services and rapid transit could support more compact urban form. To reduce and avoid transport emissions, central and local government have to reconsider planned investments in major urban highway and road expansion projects if they would induce more vehicle travel.
- We can influence how people travel by providing better travel options that are energy efficient and generate low or no emissions. This includes providing quality public transport services, safe and accessible walking and cycling networks, and shared mobility options such as car sharing and shared micromobility.
- We can design and manage our streets to be more inclusive of different people and to encourage travel by active modes and public transport. This includes applying multi-modal street layouts, lower speed limits, tactical street changes, and universal design principles. We can also discourage single-occupant vehicle trips through measures such as traffic calming and parking management.
- Street changes to support public transport and active travel could potentially be made swiftly, as it is possible to reallocate space on existing streets to deliver mode shift without building major new infrastructure. Regulatory and funding settings need to support rapid street changes.
- Placemaking is critical for supporting higher density urban developments, to create places that people want to live and work in, and that are good for people's wellbeing.
- Transport demand management, including transport pricing, is critical for supporting more liveable cities and encouraging people to make sustainable transport choices.

Shaping our cities and towns is key to improving the overall efficiency of the transport system

Eighty-seven percent of Aotearoa's population live in urban areas, with most people living in cities. As a result, much of our transport related GHG emissions come from our largest urban areas[15], where private vehicles are the dominant mode of passenger transport.

[15] Auckland, Hamilton, Tauranga, Wellington and Christchurch.

The shape of our cities and towns affects the overall efficiency of the transport system and Aotearoa's transport emissions. Urban form fundamentally affects transport GHG emissions in two connected ways. It affects the distance people need to travel to reach jobs, schools, shops, amenities, and other important destinations. It also influences how they travel, by affecting the range and quality of transport options available, including low carbon modes such as public transport, walking, and cycling.

At the same time, the transport system plays a pivotal role in enabling and shaping urban development. For example, investments to expand urban state highways and major roads (such as road widening and extensions) can encourage urban dispersal/sprawl by making it quicker for people to travel long distances between places by car. This, in turn, leads to more people living in car-oriented suburbs, which causes increasing car use and traffic, emissions, and higher travel times and costs.

In contrast, frequent public transport services and rapid transit systems can provide the backbone for transit-oriented urban development in cities. This enables growing populations to move efficiently through urban areas without creating more congestion and emissions. Improved walking and cycling networks enable people to access public transport services as well as places nearby.

There are significant interdependencies between the shape of our cities and towns and transport, which means that we cannot consider transport interventions in urban areas on their own. We need to integrate land-use, urban development and transport planning to reduce GHG emissions from the transport system (especially over the medium to long term), and achieve a wide range of co-benefits for our towns and cities. This requires significant collaboration between transport agencies, the Ministry of Housing and Urban Development, Kāinga Ora, and local government.

Quality compact, mixed use urban development can reduce trip distances and encourage the uptake of sustainable transport modes

Quality compact, mixed use urban development can play a pivotal role in reducing transport GHG emissions by reducing trip distances and car dependence in urban areas, and encouraging the uptake of walking, cycling and public transport.[16]

This kind of urban development does not simply involve increasing the density of buildings and housing. The quality, location, and type of densification (shaped by urban planning and policies) can result in different outcomes and emissions levels. In general, we expect transport emissions to decrease in urban areas with the following features: mixed land use, good access to public transport, recreational options and green spaces, and safe and attractive urban environments/streets for walking and cycling. This can happen at different scales in a wide range of urban environments from our larger cities to smaller towns. *Higher* density includes medium-density town houses, terraced housing and small apartments – it does not solely refer to high-rise buildings.

Quality compact, mixed use urban development needs to be encouraged around both public transport hubs and employment hubs (including areas of employment and economic activity outside of Central Business Districts), to make it easier for more people to access jobs, shops, schools, and other important destinations by walking, cycling and/or using public transport.

[16] Intergovernmental Panel on Climate Change (IPCC), 2014, "Chapter 8: Transport" in *Climate Change 2014: Mitigation of Climate Change*, retrieved from: https://www.ipcc.ch/report/ar5/wg3/

The cumulative impact of urban development, land use and transport policies on transport GHG emissions has the potential to be significant.

International research has found that doubling residential density across an urban area can lower households' transport demand by 5 to 12 percent. If coupled with high employment concentrations, mixed land uses, and other supportive demand management measures, transport demand can decrease by 25 percent.[17] The OECD report "*Decarbonising urban mobility with land use and transport policies: the case of Auckland, New Zealand*" found that reforming existing land use policies in Auckland to enable greater densification could reduce emissions by an additional 10 percent when combined with policy packages that promote public transport and electric vehicles.[18]

Quality compact urban form supports GHG emission reductions in other sectors and delivers additional environmental benefits

By reducing the need for private motorised vehicles and the size of our fleet, compact urban form can also help to avoid emissions and other environmental impacts associated with the following:

- infrastructure construction, including road and state highway construction and maintenance;
- vehicle manufacturing/refurbishment, and disposal/recycling at the end of life;
- fossil fuel extraction, processing, and importing to Aotearoa; and
- mineral extraction and processing (including for electric vehicle batteries).

Quality compact, mixed use urban development offers significant co-benefits

The co-benefits of quality compact, mixed use urban development can be significant, and provide a compelling case beyond the GHG emission reduction component. For example, co-benefits include:

- maintaining and improving access as cities develop (e.g. by increasing the range and number of opportunities and amenities that people can access within a short distance or time frame and reducing the high costs associated with car ownership/use).
- supporting economic prosperity (e.g. by helping to manage/avoid congestion driven by car-based urban expansion; and reducing the size of infrastructure investments in water, sewage, and road infrastructure that are required for urban expansion).
- improving health and safety in communities (e.g. by reducing traffic speeds and volumes, increasing physical activity, reducing stress, improving air quality and quieter urban areas through lower vehicle volumes, and mode shifts to low emissions transport modes).
- improving environmental sustainability (e.g. by reducing run-off from vehicles into waterways, protecting urban ecosystems and habitats, ensuring future food security by reducing the development of productive land, and improving amenity by protecting natural areas on the urban periphery).

Planning rules that affect urban form affect housing and living costs

Planning rules that enable compact, mixed use urban development can increase the overall affordability of living in urban areas with good access to jobs, education, and amenities.

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[17] International Transport Forum (ITF). (2020). "Land-use Planning" in *Transport Climate Action Directory*, retrieved from: https://www.itf-oecd.org/tcad-measures?=Apply

[18] OCED. (2020). *Decarbonising Urban Mobility with Land Use and Transport Policies: The Case of Auckland, New Zealand*, retrieved from: http://www.oecd.org/publications/decarbonising-urban-mobility-with-land-use-and-transport-policies-the-case-of-auckland-new-zealand-095848a3-en.htm

Enabling housing intensification in appropriate areas can help to make urban land markets more competitive and increase housing supply. It can also reduce costs associated with the land required per housing unit, residential parking requirements, infrastructure and utility costs, and household expenses (including heating and transport). As a result, quality compact urban growth can potentially increase the affordability of living in urban areas overall, particularly for first homebuyers and lower income residents who live in multi-family housing and rely on walking, cycling and public transport. [19] The OECD modelling in Auckland in 2019 concluded that land use intensification policies can be powerful tools for improving well-being and can help to slow growth in housing prices. [20]

However, there is a risk that compact neighbourhoods with high amenity values can result in higher housing prices and rents, which can displace low-income residents and increase social inequity. Initiatives that increase the supply of social and affordable housing as part of urban development can help to address this challenge.

In the absence of supporting policies and a suitable transport system, higher density environments can also result in traffic congestion, noise and air pollution, and encroachment on biodiversity and green spaces. This can all result in adverse welfare impacts. Providing mixed land uses, vibrant public places, good access to public transport, green spaces and other public resources, and safe and attractive urban environments for walking and cycling is critical to mitigating these effects and encouraging people to live in higher density environments. This emphasises the importance of designing density well because poorly designed density can have adverse outcomes.

Planning rules that limit or control urban expansion into some areas also affect land prices, with spill on effects for housing costs, so these impacts also need to be carefully considered. One of the main drivers behind the Government's Urban Growth Agenda is to improve housing affordability in a way that also assists emissions reductions, improves access, and enables quality-built environments while avoiding unnecessary sprawl.

Supporting quality compact, mixed use urban development is an important strategy for reducing transport emissions and creating sustainable cities and towns in the long-term

Reshaping urban form can take a long time. Therefore, these changes generally only impact on travel and emissions over the medium to long term (e.g. 10-30+ years). This means that strategies to deliver quality compact, mixed use urban developments can play a valuable role in achieving long-term and enduring emissions reductions, but they will not deliver significant emissions reductions within a short time-frame (e.g. less than ten years). They need to form part of a package of initiatives to deliver net-zero emissions by 2050. However, we should aim to introduce measures urgently that support quality compact urban development to ensure that we realise the benefits as soon as possible. This also means that central and local government have to reconsider planned investments in major urban highway and roadway expansion projects if they would induce more vehicle travel.

From an emissions reduction perspective, the need to orient urban development towards compact urban form is most pressing in our largest and fastest-growing cities where emissions are highest. This includes Auckland, Hamilton, Tauranga, Wellington, and Christchurch. However, we also need to consider the benefits of compact urban form, and

[19] Victoria Transport Policy Institute. (2019). *Smart Growth*, retrieved from https://www.vtpi.org/tdm/tdm38.htm

[20] OECD. (2019). *Decarbonising urban mobility with land use and transport policies: The case of Auckland*

multi-modal transport options, in smaller cities and towns to reduce car-dependency, especially as these places grow over time.

The National Policy Statement on Urban Development 2020 (NPS-UD) has several policies that support quality compact, mixed use urban development. These include enabling greater intensification in urban centres and places close to rapid transit stops, as well as other areas with good access to destinations by active and public transport modes. Local authorities will also no longer be able to regulate minimum parking requirements. The removal of car parking minimums supports intensification and means that people who do not need or want a car park are not required to pay for one.

Greater alignment between land use, urban development and transport is required to further support quality compact, mixed use urban development. This includes reflecting land use and transport integration in the Government's resource management reforms, infrastructure funding and finance, Urban Growth Partnerships and wider urban policy.

Placemaking and inclusive streets can encourage walking, wheeling, cycling and public transport use in our towns and cities

The way we create places and design our streets affects how much people walk, wheel, cycle, and take public transport, which affects the liveability of urban environments and transport GHG emissions.

Since the middle of the last century, Aotearoa's cities and towns have predominately followed car-oriented forms of urban development. Although there have been some recent shifts, most housing has been characterised by low-density developments in areas without good public transport services. This has made many New Zealanders highly reliant on private vehicles to access jobs, education, shops, open spaces, and other amenities, which are often dispersed over wide areas.

Our streets reflect this reliance on cars, with most street space dedicated to moving and storing/parking cars and other light vehicles. There is less priority given to people travelling by other modes (e.g. by foot, bike, or bus), which can make it difficult, unappealing or unsafe to travel by these modes. This also affects the attractiveness of streets as destinations for meeting, shopping and spending time.

We need to design and manage our streets to be more inclusive of different people and transport modes

We can create our streets in a way that prioritises, encourages, or discourages any transport form, including walking, wheeling, cycling, public transport and private vehicles. For example, the way we allocate street space affects whether our streets are safe and attractive for people to travel using a range of transport modes. Multi-modal street layouts can reduce car traffic and encourage more sustainable transport modes. This often requires improvements to walking and cycling infrastructure, such as widening footpaths to prioritise intersections for walking and providing separated cycle ways. It can also include dedicated bus lanes and bus priority measures.

We can also design our streets to be inclusive of all people. For example, applying universal design principles can help to ensure environments are accessible for all people, regardless of age, disability or other factors. This in turn affects how people choose to travel and consequently transport emissions.

Lower speed limits in urban areas can also have significant benefits for the safety and amenity of urban areas, which can encourage walking, cycling and public transport use.[21] Lower speed limits need to be accompanied by traffic calming measures so that people travelling in cars travel below these limits.

We can also choose to turn our streets into vibrant places that encourage people to travel by active modes

Placemaking is the process of turning spaces into vibrant public places that are good for people's wellbeing, and that make urban areas attractive places to live, work and visit. Placemaking helps to make walking, cycling and public transport more attractive transport choices. It can also reinforce the context of a street as a low speed and people-friendly environment, which can encourage walking and cycling.

Public transport stops and stations provide natural opportunities for placemaking, given their focal point in public life.[22] Placemaking can enhance destinations, such as schools, libraries and playgrounds, and unlock transit orientated development by revitalising adjacent neighbourhoods and becoming a gravity point for social and economic activity.

The place function of a street can be enhanced by urban design that encourages business activity, social interaction and play, and makes streets include for people of all ages and abilities (e.g. through making it easy to cross roads and streets, providing places to stop and rest, things to see and do, and adequate lighting, shade and shelter).[23]

Alongside placemaking, integrating green spaces and living infrastructure (e.g. trees and green walls and roofs) into new urban developments and alongside transport routes also has the potential to encourage walking and cycling by increasing the walkability of urban environments. In addition to sequestering carbon, green spaces and living infrastructure can also support urban ecosystems to sustain biodiversity. This is critical to the health and wellbeing of residents in denser urban environments.

The growth of 'low-traffic neighbourhoods' in response to the COVID-19 pandemic

Low traffic neighbourhoods are being increasingly used in cities around the world to reduce vehicle traffic in residential areas, and increase local walking and cycling. In response to COVID-19, initiatives to revive local neighbourhood life and increase urban walkability, such as Barcelona's 'superblocks', Paris's '15-minute city' concept, New York's Open Streets, or London's 'low traffic neighbourhoods' have gained momentum for their co-benefit of supporting safe physical distancing. Many cities have adopted pedestrianisation, the temporary closure of streets to motor traffic, and re-purposing on-street car parking spaces to reduce vehicle traffic and create more space for pedestrians and cyclists. Already part of efforts to create a healthy urban environment and promote low-carbon transformations before COVID-19, such actions have now assumed even stronger value.

[21] Todd Litman. (2020). *Land Use Impacts on Transport: How Land Use Factors Affect Travel Behaviour*, Victoria Transport Policy Institute. Retrieved from: https://www.vtpi.org/landtravel.pdf

[22] Project for Public Spaces. (2018). *Placemaking in Transit.* Retrieved from: https://www.pps.org/article/placemaking-in-transit

[23] Healthy Streets, *About*. Retrieved from: https://healthystreets.com/home/about/

Creating temporary or permanent car free or car-lite spaces in our neighbourhoods (urban areas that encourage little to no car use through a range of mechanisms) can be a low cost, rapid and efficient way to encourage mode shift, and improve the safety, wellbeing and liveability of communities. This is particularly important in higher density environments to ensure residents with limited access to private gardens or urban parks, or who live in crowded flats or poor quality homes, can take a breath of fresh air, play, exercise and socialise, while maintaining a safe physical distance. Longer term, establishing neighbourhoods in which it is possible to safely walk and cycle, linked to a wider network of safe pedestrian routes and cycleways, is a key strategy to encouraging a shift toward low carbon transport.

Placemaking and inclusive street design are also crucial for quality compact, mixed use urban development

To ensure that higher density urban environments attract more people to live and work in them, we need to ensure that they have high levels of access and amenity (including access to green spaces). Placemaking and street design can also minimise the potential adverse effects of increasing urban density on wellbeing and liveability (e.g. traffic congestion, noise and air pollution, and potential encroachment on biodiversity and green spaces).

Creating streets where people want to walk, wheel, cycle, and spend time supports a range of co-benefits

Creating vibrant, inclusive urban environments where people enjoy living, working and visiting supports social, environmental, economic and health outcomes. Co-benefits can include:

- supporting economic prosperity (e.g. by encouraging local shopping and economic activity);
- improving safety in communities (e.g. by reducing traffic speeds and volumes);
- improving physical and mental health (e.g. by increasing physical activity, reducing stress, and improving air quality through lower vehicle volumes, and mode shifts to low-emissions transport modes); and
- improving environmental sustainability (e.g. by reducing vehicle run-off into waterways, and supporting biodiversity).

Movement and place functions of streets need to be integrated across urban areas

Our urban transport systems need to enable both movement and place – with transport corridors and streets designed for a mix of purposes. The Movement and Place Framework (Figure 7)[24] aims to recognise the complex nature of road environments and provides a way to measure and prioritise the needs of all road users. This helps planners to balance the safe and efficient movement of people and goods along key movement corridors with enabling vibrant and inclusive places for people.[25]

[24] Figure from Greater Newcastle Future Transport Plan, retrieved from: Customer Outcome 3: Movement and place framework | Future Transport (nsw.gov.au)

[25] Waka Kotahi is developing a new 'One Network Framework' based on the 'Movement and Place' approach but with more detail. One Network Framework | Waka Kotahi NZ Transport Agency (nzta.govt.nz)

In some cases, placemaking and inclusive street design will affect the movement and storage of vehicles (e.g. by slowing speeds, closing streets to cars or removing parking). While these types of interventions are likely to improve access for people overall, they may affect the access of some people in the community and how they travel. Roads and streets also need to accommodate the efficient movement of products and freight.

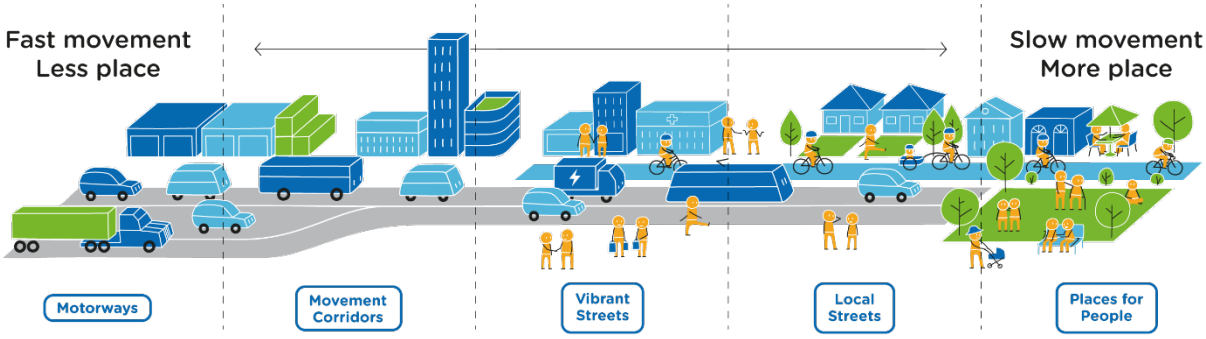

Figure 7. Movement and Place Framework

Reshaping streets to support public transport, active modes, and placemaking could potentially be done swiftly and cost-effectively

To deliver mode shift for emissions reductions, comprehensive cycling/scooting networks are needed in urban areas, along with more dedicated/priority bus lanes, and better urban environments for walking.

Street changes to support public transport and active travel could potentially be made swiftly and cost-effectively, as it is possible to reallocate space on existing streets to deliver mode shift without building major new infrastructure. Low cost, tactical street changes (often referred to as tactical urbanism), such as utilising street furniture, planter boxes, artwork and other features, can be used to calm and reduce traffic speeds and to create 'pop up' bike/scooter lanes. Waka Kotahi's Innovating Streets Programme provides good examples of this.[26]

The main challenge with reallocating street space is that communities are seldom united when it comes to changing existing streets. Even when a majority of people in a community support street changes, some people can strongly resist changes that involve removing on-street car parks and/or lane space for private motorised vehicles. While it is important for local government to engage well with local communities on proposed street changes, consultation requirements and processes can also make it difficult to enact changes. Councils often consult communities on city-level or neighbourhood-level changes (e.g. cycling networks or bus priority routes), and then consult communities again on every street-level change (e.g. removing individual car parks).

Local government is responsible for local road development and maintenance, and walking and cycling infrastructure and initiatives. This means that local government has more control than central government in making street changes. However, local government always

[26] Waka Kotahi's Innovating Streets for People programme aims to make it faster and easier to transition streets to safer and more liveable spaces – more information can be found here: About the Innovating Streets programme | Waka Kotahi NZ Transport Agency (nzta.govt.nz)

operates within a regulatory and funding context set by central government. Central government also co-funds local street construction and maintenance, and public transport services that use those streets. Central government can strongly influence local street layouts through rules, regulations, standards, guidelines, and incentives. It could therefore more strongly enable, support, and require local government to make some street changes to support active travel, public transport, and placemaking.

There are also opportunities to leverage street changes during the street renewals/maintenance process. Both local and central government invest substantially in maintenance and renewals. The vast majority of these are 'like for like' renewals. In some situations there will be opportunity to 'build back better' by upgrading streets (where appropriate) during the renewals process to improve streets for people walking, cycling/scooting, and using public transport. This would deliver better value for money, as it would avoid the need to change streets twice for renewals/upgrades. It would also build momentum for ongoing street improvements over time.

Shaping our towns and cities: possible key actions

The responsibility for reducing transport emissions does not rest with transport decision-makers alone, as many of the following possible actions require a coordinated approach by different agencies involved in land use, urban development and transport policy.

Quality compact, mixed use urban development:

- Through the proposed Strategic Planning Act (part of the RMA reforms), require spatial plans to be developed and implemented to better integrate land use, urban development and transport planning to achieve quality compact, mixed use urban development. Both central government and local government need to work together to improve capabilities for spatial planning. **(Underway through RMA reforms)**
- Integrate land use and transport planning and investment as part of the RMA reforms.
- Make transport investments conditional on having clear links to land use and urban development plans that support quality compact, mixed use urban development. This will affect the types of projects that are included in Regional Land Transport Plans.
- Require transport GHG emission impact assessments for proposed urban developments (including the transport GHG emissions of residents and business owners that would be located in the development). Developments that would result in high emission generation could potentially be required to undergo redesign and/or an acceptable form of durable mitigation.
- Develop clear guidance and expectations to link urban density and mixed land use with accessibility (particularly by way of public transport, walking, and cycling).
- Enable Waka Kotahi, Local Government, KiwiRail and Kāinga Ora to take more active roles in developing sites around frequent public transport stations.

Placemaking and inclusive street design:

- Remove barriers and improve funding for tactical urbanism and innovative approaches to street design (e.g. expand on Waka Kotahi's Innovating Streets for People Programme).
- Develop design guidance and expectations for quality high-density environments (including streets, public spaces, buildings, and green space).
- Invest in placemaking and urban design capability and capacity of transport agencies and transport functions within local government.
- Clarify the principles of living infrastructure, and set expectations that living infrastructure is incorporated into transport plans and projects.
- Review standards and guidance for street design, and develop nationally applicable consistent sets of standards for Aotearoa.
- Prioritise the need to reallocate street space and to create connected networks for delivering transport mode shifts in the next GPS on land transport, and/or for any additional funding for active modes and public transport.
- Set higher Funding Assistance Rates for walking and cycling investments and dedicated/priority bus lanes to strongly incentivise Road Controlling Authorities to prioritise and accelerate street changes.
- Investigate if regulatory changes are needed to empower Road Controlling Authorities to more easily consult on and make street changes to support active travel, public transport, and placemaking.
- Set targets for councils to deliver public transport and active travel networks that require street changes (e.g. dedicated/priority bus lanes on some routes; connected cycling networks) by a specific date. There could be funding consequences if Road Controlling Authorities do not deliver these changes within these timeframes.
- Make changes to policy and funding settings to ensure Waka Kotahi and Road Controlling Authorities maximise opportunities to 'build back better' when doing street renewals (to improve streets for people walk, cycling, and using public transport).

(Ministry of Transport and Waka Kotahi have some projects underway that support placemaking and street design e.g. Aotearoa Urban Street Guide, the One Network Framework, and Reshaping Streets scoping project)

Consultation question 4

Do you think we have listed the most important actions the government could take to better integrate transport, land use and urban development to reduce transport emissions? Which of these possible actions do you think should be prioritised?

Providing better travel options can support mode shifts and improve trip efficiency

As noted earlier, most New Zealanders are currently very reliant on private vehicles to meet their daily needs. Private vehicles are useful for many transport tasks due to their flexibility and speed (especially over long distances). However, private motorised vehicles also produce the majority of our transport emissions, and can be detrimental to people's wellbeing by contributing to air/noise pollution, and poor quality urban environments. Car-oriented urban expansion/dispersal also leads to increased traffic, congestion, journey times, and travel costs.

We need to develop a transport system that addresses these issues and improves the wellbeing of New Zealanders. Increasing the share of travel by public transport, walking, cycling, and shared mobility in our towns and cities is important for reducing emissions and achieving a wide range of co-benefits.

We can influence how people travel by providing better travel options that are energy efficient and generate low or no emissions. This includes providing quality public transport services (both intra-regional and inter-regional), safe and accessible walking and cycling networks in urban areas, and shared mobility options, such as car sharing and shared micromobility.

Note: The street changes discussed in the previous section on Placemaking and Inclusive Streets are also highly relevant to this section, as street changes are needed to encourage travel by public transport and active modes.

Public transport can be the foundation for more sustainable mode use in cities

Attractive, safe, and reliable public transport systems (including shuttles, buses, rail and light rail) can provide a foundation for the use of more sustainable modes in cities. Shifting travel from cars to public transport, in urban areas where its provision is viable, can save energy and reduce emissions. Net energy savings depend on how much public transport services are used.

Public transport is critical for supporting higher density urban environments

Frequent public transport services become more viable and well used in medium to high density urban environments where high concentrations of people can easily walk/wheel/bike to a public transport service. At the same time, public transport is critical for supporting compact, mixed use urban development because it is the most efficient way of moving high volumes of people quickly. For example, cars travelling at 50 kilometres per hour are estimated to require about 20 times as much space as trams or buses to move large quantities of people.[27]

When people use public transport instead of private cars, it also reduces the amount of space needed for car parking/storage. Most cars currently sit in car parks or in garages for approximately 90 percent of their working life, taking up space in streets and in buildings, and around businesses, homes, parks, and recreational areas.

Public transport services can therefore help to free up valuable urban space that could be used for housing, commerce, or civic purpose instead of for moving and parking/storing private motorised vehicles. By reducing pressures for more and wider roads, as well as car

[27] Nello-Deakin, S. (2019). "*Is There Such a Thing as a 'Fair' Distribution of Road Space?*" Journal of Urban Design 24 (5): 698–714.

parking, public transport can also help to reduce GHG emissions (as well as other harmful pollutants) from road construction and maintenance.

Coaches and trains also offer an alternative to interregional air travel and car travel

Rail and bus/coach services offer a lower-emission alternative to interregional air travel and travel by car. There are currently two inter-regional passenger rail services operating in Aotearoa (Palmerston North to Wellington, and a trial service from Hamilton to Auckland). Historically, for passengers who wish to travel longer distances, air travel and road transport (including buses and coaches) have largely replaced rail as the favoured, more economical, and faster means of travel in Aotearoa. Where it is feasible, increasing the number, efficiency and quality of inter-regional passenger rail and bus/coach options has the potential to reduce transport GHG emissions by providing an alternative to regional travel by air and private vehicle. Before decisions are made on if Aotearoa should increase interregional rail, we would need to consider its economic viability and competitiveness against changes in our vehicle and aviation fleet to be low-emissions. Inter-regional passenger rail travel can take longer, and choices made by individuals will be dependent on their purpose for travel and the time they have available to use this alternative mode.

Domestic air travel for some is a form of public transport, but it needs to be low-emissions aviation

Domestic air travel is a public transport option, and for some users it may be the only logical method of transportation to meet their needs. Air travel meets the needs of people who might travel for medical reasons, business, are time poor or are unable to travel long distances in alternative modes. Air travel is also important for its role in connecting our regions and provides opportunities for regional development. The popularity of domestic travel is likely to increase post-Covid 19. Consideration must be given to how Aotearoa will improve its domestic air fleets, to make them more sustainable. Options to achieve this include increased production and availability of sustainable aviation fuels, consideration of electric planes as the technology evolves (noting smaller 19-seater electric planes are now commercially available) and continued operational improvements by aviation operators. Cleaner aviation is discussed in more detail in Theme 2.

Public transport provides co-benefits, including supporting the access of non-drivers

Attractive, safe and reliable public transport has a number of co-benefits in addition to those outlined above. For example:

- Improving health and safety in communities (e.g. reducing road accidents and fatalities, as public transport is the safest mode of travel[28], increasing physical activity, reducing stress, and improving air quality and reducing noise through lower vehicle volumes, and mode shifts to low emissions transport modes).
- Maintaining and improving access to social and economic opportunities including for those who do not drive or cannot afford their own private motorised vehicle
- Supporting economic prosperity (e.g. by helping to avoid congestion created by private vehicles).
- Improving environmental sustainability (e.g. by reducing vehicle run-off into waterways).
- Increases resilience to shocks and disruptions in the transport network (e.g. through providing an alternative transport option to private, road transport).

[28] Frith et al. (2015). The role public transport can play in Safer Journeys and, in particular, to advance the Safe System approach. Waka Kotahi research report, retrieved from: Research report 581: The role public transport can play in Safer Journeys and, in particular, to advance the Safe System approach - December 2015 (nzta.govt.nz)

Public transport improvements can make a difference to GHG emissions both in the short and long term

Improvements to public transport infrastructure and services can make a difference in the short and medium to long term. For example, increasing the number and frequency of public transport routes/services, and street changes to prioritise bus movements, can increase mode shifts and reduce transport GHG emissions in the short term. Major improvements to public transport infrastructure, such as busways and rapid transit services, also shape urban form in the longer term (e.g. 10-30+ years) to encourage quality compact mixed-use urban development. We should take into account any potential rebound effects of improving public transport services (such as induced travel demand from reducing congestion on roads) and look for opportunities to address it through measures that manage car travel, such as street changes, road pricing and parking pricing.

Walking, cycling and other active modes can reduce emissions, improve access and have significant health benefits

Walking, cycling and other active modes can reduce transport emissions by substituting motor vehicle trips and supporting public transport. Walking and cycling are separate modes but share many of the same benefits and therefore we have discussed them together.

There is a significant opportunity for Aotearoa to increase the uptake of active modes. In 2014, over three-quarters of journeys to work in Aotearoa were by car, while only four percent involved walking and three percent were by bicycle.[29] A third of all transport trips in Aotearoa are less than two kilometres – a distance that is easy for most people to walk or cycle. Some other countries, particularly in Europe, have much higher rates of walking and cycling (for example, 44 percent of trips are made by walking and cycling in the Netherlands).

There is major untapped potential for walking and cycling in Aotearoa

Some cities in Aotearoa have higher uptake of active modes, demonstrating the potential for these modes. For example in Wellington and Dunedin nine percent of people walked to work in 2014, compared to four percent of people in Auckland.[30] Evidence also consistently shows that there is significant latent demand for cycling in Aotearoa's cities.[31] However, most of our cities are making slow progress in making streets safer and more attractive for cycling. Some flagship cycling projects and routes are making progress, but there is less progress being made on connecting and completing currently disconnected urban cycling networks.

Changes in travel behaviour also demonstrate the potential for mode shift in our towns and cities. One of the most profound changes in the past several decades has been the reduction in the number of children that walk or cycle to school. Research from 2013 revealed that the key predictor of whether children would walk or bike to school was the distance between their home and school.[32] The Ministry's 25 Years of Travel study in 2015 showed that 42 per cent of school journeys by primary school pupils were made on foot in

[29] New Zealand Household Travel Survey (Ministry of Transport).

[30] Ibid 6.

[31] Waka Kotahi. Assessing Cycling Demand. Retrieved from: Assessing cycle demand | Waka Kotahi NZ Transport Agency (nzta.govt.nz)

[32] F Conlan (2013). *Getting to School.* Retrieved from: FConlon-Gettingtoschool-dissertation.pdf (sustainablecities.org.nz)

the late 1980s. By 2014 that had fallen to 29 per cent. Cycling fell from 12 per cent of journeys, to fewer than five percent.

E-bikes are increasing the potential for cycling in Aotearoa

E-bikes are growing in popularity and have potential to improve efficiency, sustainability and wellbeing within Aotearoa's urban transport systems. E-bikes enable people to cycle more quickly, with less effort and sweating, and to cover longer distances.

A study by Auckland University highlighted a number of other benefits of E-bikes experienced by users, for example:

- increased commuting efficiency (e.g. higher levels of commuting 'control' and arrival time reliability, especially in congested conditions);
- easier trip chaining for active transport (e.g. pedal-assist makes trips quicker and less tiring, easier to carry things and children);
- reduced commuting stress; and
- increased uptake of active transport by women (a count on Auckland's North-western cycleway showed that while women represented 27 percent cyclists, they made up 41 percent of e-cyclists).[33]

The key benefit of E-bikes is that they broaden the pool of people who would cycle if there was safe and connected infrastructure to do so in Aotearoa. Therefore, creating networks of safe, separated cycleways is likely to be the best way to harness the potential of E-bikes in Aotearoa.

Walking and cycling offer significant co-benefits, especially for public health

In addition to reducing GHG emissions, encouraging the uptake of walking and cycling can result in major co-benefits. The main co-benefit is improving public health through increasing levels of physical activity[34]. Aotearoa has the third highest adult obesity rate in the OECD, partly due to lack of physical activity. Further, obesity rates are rising. On average, New Zealanders spend less than an hour walking per person, per week. A 2010 Aotearoa study found that physical inactivity costs $1.3 billion a year.[35] Physical activity also has mental health benefits, with stress relief, increased social interaction, and possible reduced risk of depression. Other co-benefits include improved air and noise pollution outcomes.

Improving non-motorised transport options can also contribute to greater social equity and economic opportunities for people who may not have access to a car. Some of these people may be socially, economically, and physically disadvantaged. Additionally, increased rates of walking and cycling can reduce traffic and parking congestion.[36]

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[33] Kirsty Wild and Alistair Woodward. (2018). *Electric City: E-Bikes and the future of cycling in New Zealand.* Retrieved from: https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/c/520/files/2018/08/Electric-City-Ebikes-and-the-Future-of-Cycling-in-NZ-1rihn5y.pdf

[34] World Health Organization. (2018). *Global Action Plan on Physical Activity 2018-2030.* Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf

[35] Auckland Council, Waikato Regional Council, Wellington Regional Strategy Committee. *The Costs of Physical Inactivity: Toward a regional full-cost accounting perspective*. Retrieved from: WGN_DOCS-#1153301-v1-The_Costs_of_Physical_Inactivity_-_Toward_a_regional_full_cost_accounting_perspective_-_F (waikatoregion.govt.nz)

[36] Todd Litman. (2010). Quantifying the benefits of non-motorized transportation for achieving mobility management objectives. *Victoria Transport Policy Institute*, *28*.

Taking a network approach is key to reducing emissions through walking and cycling

In Aotearoa there are real and perceived safety risks with cycling, and providing a safe way to cycle is key to increasing the uptake of this mode. The key opportunity is investment in safe and high quality infrastructure for both walking and cycling. Infrastructure must be joined up in a network to enable convenient movement around a city. Different speeds of active modes need to be separated from each other. Infrastructure also needs to be integrated with other modes (e.g. secure cycling facilities at public transport hubs). There is a risk that if we take a piecemeal approach to developing walking and cycling infrastructure then we will not see the benefits. The challenge of this approach is that it requires us to reconfigure streets across large urban areas (see also the discussion on reallocating street space in the section on Placemaking and Inclusive Streets).

Alongside investment in infrastructure, public education and information campaigns could play a useful role. When successful, these types of campaigns can increase the social acceptance and understanding of alternative modes. These campaigns can be specific, for instance not only helping drivers understand cyclists perspectives more, but encouraging active mode users to more considerately share space as well. The inclusion of walking and cycling in travelling planning information and apps can also encourage these modes by showing travel times, and safe cycling routes. Some apps show the nearest bike hire location and cost.

Cargo-bikes, and other forms of micro-freight, could play a key role in supporting compact, mixed use urban development and car free streets

Increasing urbanisation, population growth, and demand for 'just-in-time' deliveries has lead to growth in freight movements in many international cities. As a result, the distribution of urban goods has become associated with negative impacts such as increased traffic congestion and higher emissions.

Cargo bikes, especially electric cargo bikes, may be a promising solution for congested and polluted urban centres for some types of freight, such as parcel and food delivery. Electric cargo bikes offer two improvements on traditional bike couriers: they can carry larger loads and their electric pedal assistance allows riders to more easily ascend hills and cover long distances.

In urban centres, electric cargo bikes can be more efficient and produce less air and noise pollution than cars, vans and trucks. They are also easier to park and take up less space – reducing the impact of unloading operations on traffic congestion.[37] In addition, repurposing streets to create more space for pedestrians and cyclists can affect the access of larger vehicles. Cargo bikes can help to overcome this barrier and can also operate in low emission zones and avoid congestion charging.

Cities around the world are looking at innovative ways to incorporate electric cargo bikes into urban freight systems. For example, Berlin has piloted the use of electric cargo bikes as a sustainable solution for delivery in urban areas. The city set up a cooperative micro-hub for use by several parcel service providers. The service providers use larger vehicles to drop off parcels to the central location, and then electric cargo bikes distribute the parcels in the local area. This pilot was successful and the companies involved have agreed to continue using the micro-hub beyond the funding period.[38]

Consideration could be given to expanding existing funds, such as the Low Emissions Vehicles Contestable Fund administered by EECA, to include support for these modes.

As our towns and cities look for opportunities to encourage the uptake of cycling, we should keep in mind how cycling networks can also be used to move goods as well as people.

Shared mobility forms part of the suite of transport options that enable people to reduce their car dependence

Alongside public transport, walking and cycling, shared mobility forms part of the suite of transport options that enable people to reduce their car dependence and choose more sustainable transport options. By reducing car dependency, shared mobility also supports quality compact, mixed use urban development, which can contribute further GHG emission reductions.

[37] Sandro Melo and Patricia Baptista. 2017. *Evaluating the impacts of using cargo cycles on urban logistics: integrating traffic, environmental and operational boundaries*, European Transport Research Review, retrieved from: https://etrr.springeropen.com/articles/10.1007/s12544-017-0246-8

[38] Smart City Berlin, *KoMoDo – cooperative use of micro-depots*, retrieved from: https://www.smart-city-berlin.de/en/projects-list/project-detail/komodo-cooperative-use-of-micro-depots/

Shared mobility refers to various modes and services that may increase transport system efficiency by sharing vehicles and rides, including car sharing, micromobility sharing (bike and scooter sharing), carpooling/ride sharing and shared on-demand shuttles.

The benefits of shared mobility differ depending on the type of shared mobility and its location – Cities have experienced different impacts with shared mobility depending on the market (e.g. car ownership levels, ease of driving), scheme coverage and maturity, and the level of policy support. In many cases (such as with shared scooters or E-bikes), the direct impact of shared mobility on GHG emissions is uncertain. In other cases (such as car sharing), their emission reduction potential could be more significant.

In general, shared mobility options are most likely to affect emissions in larger urban environments, where they can grow to a scale that attracts a significant number of users. On their own, these schemes will only have a small impact, but they play a more significant role when considered as part of the broader urban transport system. In smaller towns and rural areas, shared mobility options can supplement or be an alternative to traditional public transport services, which are often not as viable in low-density areas.

When it comes to supporting shared mobility, the Government needs to undertake further work to understand when and how it should act relative to the market.

Car sharing can reduce GHG emissions by reducing car ownership and Vehicle Kilometres Travelled (VKT), and encouraging the uptake of public transport, walking and cycling

Car sharing refers to a system in which a group of people share a fleet of vehicles and access them on an as-needed basis. The basic premise is that vehicle costs and usage are shared amongst a group of people. The cars are parked in a network of locations in a city or neighbourhood. Users are typically charged each time they use the vehicle, which can be by the hour/minute, or for several days at a time. Car sharing is a type of car rental service rather than a ride hailing/taxi service because people drive themselves.

Car sharing can reduce GHG emissions through reducing car ownership and vehicle kilometres travelled and encouraging the uptake of public transport, walking and cycling.[39] Car sharing, as part of an integrated transport system, gives people the opportunity to drive when they need to because the alternatives do not make sense for a given trip. Car sharing options give people comfort that if they choose not to own a car because they prefer to drive less, they can still access one when they need it.

Car sharing also supports people living in inner city suburbs to not own a car but still have convenient access to a car for when a car is the best transport option. At the same time, quality compact urban form makes car sharing a much more viable option because you need a car less for access to opportunities.

Wellington has approximately 90 car share vehicles, shared by over 7000 members. Data from 2019/20, provided by Wellington's two car share providers Mevo and Cityhop, shows that across the two schemes, one car share vehicle now replaces 11 private vehicles in the city.[40]

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[39] Todd Litman. (2015). *Evaluating Carsharing benefits*, Victoria Transport Policy Institute. Retrieved from: https://www.vtpi.org/carshare.pdf; Shaheen, S., Cohen, A., & Farrar, E. (2019). Carsharing's impact and future. In *Advances in Transport Policy and Planning* (Vol. 4, pp. 87-120). Academic Press.https://escholarship.org/uc/item/2f5896tp

[40] Wellington City Council. (2020). Car Share schemes driving force for eco-city status. Retrieved from: https://wellington.govt.nz/your-council/news/2020/09/car-share-schemes.

In addition to reducing GHG emissions, car sharing can also result in a wide range of co-benefits. This includes reducing congestion and demand for parking and vehicle storage, improving public health by supporting the uptake of active modes, improving transport choices and increasing access, and saving individuals, businesses and other organisations money (car sharing can be a cost effective alternative to low use cars e.g. cars only used once a week).

Shared micromobility is playing an increasing role in some cities, which may be supporting emission reductions

Shared micromobility, including bike share (standard bikes and E-bikes) and scooter share (kick and e-scooters), enables people to have short term access to these modes on demand from a variety of locations.

The impacts of shared micromobility on the environment are still largely unknown internationally and in Aotearoa. It varies depending on the business model (station based or dockless) and its location (e.g. which city/country). International research suggests that shared micromobility can reduce GHG emissions by encouraging trips that would otherwise have been made by private vehicles.[41] However, many people also use shared e-scooters to make trips that they would otherwise make by walking or using public transport. Total energy use for bike and scooter rebalancing (redeploying the vehicles around the network) may affect the net environmental impacts of a sharing scheme.

Shared micromobility could support GHG emissions reductions by contributing to the suite of sustainable transport options that are available, which enable people to reduce their car dependency. Auckland Council has indicated that shared e-scooter schemes support the council's goal of quality, compact urban form and the ability for car free living.[42]

Technology may lead to new breakthroughs with carpooling – encouraging people to share rides

Carpooling allows travellers to share a ride to a common destination. Carpooling can reduce the number of cars needed by travellers, which can reduce VKT, fuel consumption and GHG emissions.[43]

There are several forms of carpooling, including casual carpooling – generally an informal arrangement between friends and colleagues or strangers (picked up at designated car pooling spots). Typically, no money is exchanged or only nominal amounts to reimburse drivers for expenses. There is also app-based carpooling – people arrange ad hoc rides on-demand, usually shared with strangers, using smartphone apps or websites. Typically, passengers are picked up at their current location or an agreed upon pick-up location.

In addition to reducing GHG emissions, carpooling can result in a wide range of co-benefits, including reduced air pollution and improved public health, mitigating congestion, reduced demand for parking, enhanced accessibility and economic opportunity for low-income households, and provides cost savings from shared travel costs.

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41 Shaheen, S., Cohen, A., Randolph, M., Farrar, E., Davis, R., & Nichols, A. (2019). *Shared Mobility Policy Playbook*. Retrieved from: https://escholarship.org/content/qt9678b4xs/qt9678b4xs.pdf?t=q3qu5m

42 Auckland Council. *Rental e-scooter trial: Provisional Strategic Evaluation.*

43 Shaheen, S., Cohen, A., & Bayen, A. (2018). *The benefits of carpooling*. Retrieved from: https://escholarship.org/content/qt7jx6z631/qt7jx6z631.pdf?t=ph07of

On-demand shared shuttles may also play a role in reducing emissions by supplementing or replacing public transport in lower-density areas

There is growing interest around the world in the potential of on-demand shared shuttle services (also called microtransit) to improve access in lower density areas or for specific groups of the population (e.g. the elderly and the disabled).[44] They are considered particularly suitable for rural areas because of their flexibility, and ability to adapt to local needs. On-demand services are usually designed to either supplement or replace a fixed route public transport service. Waka Kotahi sponsored some research that found that there is significant potential for these types of shared transport services in Aotearoa's small towns and rural communities.[45] International research has found that demand-responsive services should be part of a broader, multimodal package of solutions, including supplementing regular public transport services.[46] The impact of on-demand shared shuttles on GHG emissions still needs to be investigated but it is likely to depend on the type of scheme and the local context.

In the future, Mobility as a Service could facilitate the use of sustainable transport modes

Mobility as a Service (MaaS) is a concept describing the integration of various forms of transport services, allowing users to see, plan, and book a multi-leg and multi-mode journey from a single accessible on demand platform. If implemented in Aotearoa, MaaS could help facilitate the use of sustainable transport modes and encourage shifts in behaviours, which could help to reduce transport emissions. However, more research is needed to understand how MaaS might enable reduced GHG emissions.

Providing better travel options in our smaller cities, towns and regions

As noted earlier, 87 percent of Aotearoa's population lives in urban areas, with most people living in cities. Aotearoa's main urban areas contribute over half our land transport emissions, with emissions concentrated in our largest cities – Auckland, Christchurch and Wellington. This provides a strong argument for initially prioritising efforts to reduce emissions (from the movement of people, at least) in New Zealand's cities, especially when these places are growing quickly.

However, we also need to reduce transport emissions and make our transport system safer and more inclusive in smaller cities and towns in the regions. The majority of emission reductions for regional transport will come from Theme 2 and 3 initiatives (discussed in chapters 7 and 8), which focus on decarbonising both the light and heavy vehicle fleets. However, there is still a role for land use planning and mode-shift initiatives to reduce transport emissions in regional Aotearoa.

People living in towns and rural areas tend to be highly car dependent because housing, jobs, schools, and amenities are widely dispersed, and frequent public transport services do not usually exist.

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[44] OECD, *International Experiences on Public Transport Provision in Rural areas*. Retrieved from: 15cspa_ruralareas.pdf (itf-oecd.org)

[45] Cheyne C and Imran M. (2010). *Attitudes and behaviour in relation to public transport in New Zealand's non-metropolitan regions*. Retrieved from: https://www.nzta.govt.nz/assets/resources/research/reports/419/docs/419.pdf

[46] OECD, *International Experiences on Public Transport Provision in Rural areas*. Retrieved from: 15cspa_ruralareas.pdf (itf-oecd.org)

It is possible to encourage compact mixed-use urban development, as outlined earlier in this chapter in small settlements as well as large ones. For example, housing, public services, and shops can be clustered closely together in town. In addition, planning that protects the rural landscape can help to preserve agricultural land and open space, protect air and water quality, provide places for recreation, and create tourist attractions that bring investments into the local economy.

Smaller settlements could also benefit from improved public transport services. This could include improved interregional public transport services and local demand-responsive shuttle services (such as the on-demand service being trialled in Timaru[47]). Research sponsored by Waka Kotahi found that there is significant potential for this type of shuttle service in small towns to expand people's transport choices – particularly for people who are mobility disadvantaged (e.g. the elderly, women, youth and the disabled).[48]

New technologies are also making shared mobility services, such as carpooling and car sharing, more viable in rural communities. Informal carpooling already happens in rural communities and can be an important option for people who do not drive or own a vehicle. Technology could make it easier to match people, trips, or vehicles.

Pedestrian and cycling improvements can also be implemented in small towns and settlements, enabling residents and visitors to enjoy active travel. Improving the walkability of main streets, including through placemaking, can also attract more people to the area for shopping and recreation. Good cycling networks can link rural neighbourhoods and destinations, serving both the community and tourists.

Providing people with better transport options in towns and rural areas could help to make these places more accessible for people who do not drive, which as Aotearoa's population ages, could become a larger percentage of people living in these communities.[49] However, there is always likely to be a high level of car dependency in regional Aotearoa. This means that we will need to focus our efforts on encouraging the uptake of low emission vehicles in regional communities and ensure there is adequate infrastructure to support their use (see discussion in the next two chapters).

Providing better travel options: possible key actions

For all of these possible actions, we need to consider where they are appropriate. Some of them should be targeted at our major urban growth areas where they are most viable, and where they can make the biggest impact on reducing emissions. Public transport could be improved in all of our cities, and is most needed n our largest and fasted-growing cities where most people live. Walking and cycling improvements could be made in towns and cities throughout Aotearoa. Shared mobility schemes could be provided in a range of settings, depending on population levels and urban density.

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47 Doug Sail, 2020, *Timaru's on-demand bus service eclipses traditional public transport,* Stuff. Retrieved from: https://www.stuff.co.nz/timaru-herald/news/121887016/timarus-ondemand-bus-service-eclipses-traditional-public-transport

48 C Cheyne and M Imran, 2010, *Attitudes and behaviour in relation to public transport in New Zealand's non-metropolitan regions.* Retrieved from: https://www.nzta.govt.nz/assets/resources/research/reports/419/docs/419.pdf

49 Ministry of Social Development, *Our ageing population.* Retrieved from: https://www.superseniors.msd.govt.nz/about-superseniors/media/key-statistics.html

Note: this section should be read in combination with the possible key actions from Shaping our towns and cities (above), which includes options to accelerate street changes to support public transport and active travel.

Public transport:

- Further invest in public transport infrastructure to increase the capacity, frequency, quality, and reliability of services. **(Some investment currently occurring through GPS on land transport, NZ Upgrade programme, and local Government)**
- Increase incentives to use existing public transport (such as reduced fares or service improvements). **(Councils already provide some incentives to specific users e.g. students, children. The Government's SuperGold card provides free travel to over 65s off-peak)**
- Invest in improving public transport operations (e.g. bus priority measures, and more efficient payment options etc.).
- Invest in additional public transport services (e.g. increasing service frequencies, extending existing services, adding new routes).
- Invest in better passenger amenities (e.g. better shelters/terminals, improved access and facilities at stops, and better connections with walking and cycling).
- Clarify the roles of agencies to deliver large frequent public transport systems in Aotearoa, and ensure that there are legislative settings in place to enable them (e.g. land acquisition and consenting).
- Review the Public Transport Operating Model to ensure that it remains fit for purpose and contributes to the Government's transport priorities. **(Underway)**

Walking and cycling:

- Invest in high quality cycling infrastructure (connected urban cycling networks, as well as secure bike parking and storage at key journey points). **(Some investment currently occurring through GPS on land transport, NZ Upgrade Programme, and by local Government)**
- Invest in better walking infrastructure, including improvements to footpaths and intersections, and reducing severance between places that are difficult to access by walking. **(As above)**
- Invest in and support walking and cycling for utility journeys, including to/from school and work (develop clear travel planning guidance including expectations around secure bike parking facilities).
- Invest in and support public education campaigns to promote walking and cycling (including supporting cycle skills training).
- Develop clear and nationally consistent guidance for wayfinding for walking and cycling.
- Require greater network planning for walking and cycling to support network connectivity.
- Investigate whether there are regulatory barriers, or historic design practices that pose barriers, in relation to walking and cycling (following on from the Accessible Streets work currently underway).

- Investigate legislation that defines and regulates the use of E-bikes to remove potential barriers.[50]
- Support road controlling authorities to develop integrated plans for schools and education sites that enable students to walk and cycle to school (including for example, speed reduction, travel planning, infrastructure delivery, training for pupils and parents, etc.).

Shared mobility:

- Provide dedicated on/off street parking for shared mobility in convenient, highly visible locations and encourage shared mobility parks to be incorporated in new and existing facilities (e.g. through national car parking guidance). **(Some Councils already provide dedicated parking for car sharing)**
- Provide car share companies with grants, loans or other incentives or subsidies (e.g. providing on street parking at low or no cost to help reduce car sharing operator costs and rates for users). **(Some car share companies have received funding through the Low Emission Vehicle Contestable Fund)**
- Increase incentives to use shared mobility (e.g. reduced rates).
- Develop procurement guidelines and expectations for the All of Government vehicle fleet (e.g. to encourage greater use of car share by Government in place of having a fleet or permit the fleet to be used by car share businesses at night and on weekends to reduce costs).
- Enable and support shared micromobility hire schemes, including investing in appropriate infrastructure, parking, and local government capability to support the safe and effective operation of shared micromobility).
- Partner with employers and carpooling providers to support local carpooling efforts (e.g. providing tools to make it easier for employees to match with others for carpooling).
- Define a national vision/strategy for MaaS in Aotearoa and invest in pilots.
- Regulate for data access/data sharing between public and private transport providers.

Consultation question 5

Are there other travel options that should be considered to encourage people to use alternative modes of transport? If so, what?

[50] Research Report 621 Regulations and safety for electric bicycles and other low-powered vehicles | Waka Kotahi NZ Transport Agency (nzta.govt.nz)

Transport demand management is critical for supporting more liveable cities and encouraging people to make sustainable transport choices

Transport demand management is the application of strategies, policies and interventions to create and manage capacity on the transport network. This includes initiatives that optimise networks and redistribute trips to other modes, times, routes or by removing the trips from the network. Transport demand management can encourage people to shift to public transport, walking and cycling, or to encourage people to reduce their travel or not travel at all. These choices can affect transport emissions. They can also support quality compact, mixed use urban environments by reducing congestion and managing demand for parking.

Transport demand management is the overarching umbrella under which transport pricing, Low Emission Zones and parking management fit.

Transport pricing can help to capture the environmental costs of travelling by private car and deliver meaningful behaviour changes

Transport pricing generally refers to charges imposed on transport users for the use of the system. Examples include congestion charging and distance pricing. These mechanisms can help to capture the social and environmental costs of travelling by private motorised vehicles, and with the right incentives, can deliver meaningful behavioural changes. For example, they can encourage people to make choices that minimise the negative external impacts of their travel, while delivering cost savings and health and safety benefits.

Transport pricing can also help to address any rebound effects that come from investment in public transport, walking and cycling, such as induced car travel from reducing congestion. This helps to make investment in other modes more effective and increase their mode shift potential.

Transport pricing can be a strong signal to change people's behaviour but it can have material impacts on household budgets and access to essential goods and services. It is important that we clearly understand the distributional impacts of pricing mechanisms, before imposing costs on users that could have unintended social consequences. We should also consider the distribution/allocation of any revenue raised.

The government could also consider subsidies or incentives that could encourage the uptake of low carbon modes, such as cycling and public transport, rather than solely focusing on pricing changes that impose costs.

Congestion charging can improve traffic flows and network performance, which can affect GHG emissions

Congestion charging is an example of a pricing mechanism that can improve traffic flows and network performance in urban areas, which in turn can have a second order effect on GHG emissions in areas where congestion is severe. Congestion in urban centres slows traffic down especially in peak periods. In Aotearoa, our six largest metropolitan areas experience between 20 and 31 percent average extra travel time because of congestion.[51] Congestion pricing is a method used to improve network performance by charging road users to encourage some to change the time, route or way in which they travel. Road users

[51] TomTom Traffic Index 2019

can respond by paying the charge, shifting to alternative modes to avoid the charge, changing the time of travel to outside peak times, or by not travelling at all.

The ability for congestion charging to have an impact on emissions is dependent on the resulting behaviour change from the charge (i.e. choosing to drive at different times or not driving). In addition, an impact of congestion is that people spend time moving in stop-start traffic, which consumes more fuel and therefore causes more emissions. By increasing the speed of traffic flow, there are some second order emission benefits from decreased idling time.

In terms of co-benefits, reducing congestion can reduce harmful emissions (such as nitrogen oxides and particulate matter) in dense urban areas where it affects human health. Congestion charging helps to improve the flow of traffic and can therefore increase efficiency for the movement of goods and increase economic productivity. A congestion zone can help create more liveable city centres by reducing traffic in cities.

An increased fuel tax could shift behaviour towards more fuel efficient and low-carbon vehicles

All users of fuel for vehicles pay an Emissions Trading Scheme levy, approximately 9 cents per litre for petrol, and 10 cents per litre for diesel.[52]

This is a fuel tax, but it is very low. An increase in the fuel tax (i.e. a higher carbon tax on fuel) is a mechanism that can be used to assist with changing vehicle owner's behaviours and encourage the use of more fuel efficient vehicles or a change to a more efficient or low-carbon vehicle. A fuel tax is a user pays mechanism. Such a fuel tax would be larger than the existing small fuel tax changed at the pump. It would impose an additional cost per litre of fuel on users and would be paid in direct proportion to the fuel used and therefore the emissions that are generated from its use. Payment of such a tax by vehicle owners would be difficult to avoid if they use fossil fuelled vehicles. Additionally, this type of tax would have low implementation costs.

Revenue from an increase in fuel tax could be recycled back to activities that support climate mitigation and adaptation. An example of this occurring is in Canada, which in 2020 introduced a price on carbon pollution, with the proceeds from its collection being returned to communities.[53]

Distance-based road user charges could be used to encourage the uptake of cleaner vehicles

Distance-based road use charges (sometimes called vehicle miles taxes) are a land transport revenue tool, used to charge road users an amount linked directly to how much they drive. Our existing RUC system is a pre-paid system where users can buy licenses in 1,000 kilometre increments, and is designed to recover the costs of road damage – it currently does not include the cost of emissions or other externalities.

In a number of developed countries, fuel tax revenues are declining as vehicle fleets consume less fuel by transitioning to more fuel-efficient and low emission vehicles. A

[52] Petrol Tax - How Fuel Excise is Made Up | AA New Zealand

[53] Government Announces Climate Action Incentive Payments for 2021 - Canada.ca

distance based charge such as RUC ensures that motorists contribute equitably based on road usage, regardless of vehicle type or fuel use.

A distance-based road user charge could incorporate some sort of subsidy to low or zero emission vehicles, and high emission vehicles could have an additional GHG emission surcharge. This could incentivise people and businesses to purchase a car that produces low or zero GHG emissions. However, we need to understand the social impacts of this type of policy. The Ministry's position is that it should be looked at, but support for it is yet to be established.

Smart road pricing could reduce vehicle kilometres travelled and encourage the uptake of public transport, walking and cycling

Smart road pricing is the pricing of the road network via electronic means and has the potential to influence demand and incentivise behaviour change by encouraging greater mode share of public transport, walking and cycling, or reduced overall vehicle kilometres travelled. Such a system does not currently exist on a nationwide scale anywhere in the world. However, there is increasing international interest in the concept of smart road pricing, including city or state level schemes. A range of approaches, including pilots and staged approaches to smarter road pricing are being considered in some jurisdictions.[54]

Road users could be charged for road use in a way that seeks to reduce external impacts of transport by increasing the price of using the network in close proximity to alternative mode options. Smart road pricing could inform road users about their road use making them more acutely aware of road use. Information generated from smart road pricing could be used to help road users to make better travel decisions, considering costs, traffic conditions and their carbon footprint.

Smart road pricing could also result in several co-benefits. It could improve liveability by reducing traffic in certain areas and encouraging the uptake of cleaner, safer and quieter modes. It could support economic outcomes by improving the overall efficiency of the road network and supporting access to employment, increasing supply chain efficiency and reducing congestion.

A smart road pricing system could also provide the benefit of consolidation of various charging schemes (e.g. low emission zones, congestion charging etc.).

Depending on the technology chosen, smart road pricing could potentially be expensive to set up. If pursued as a tool, further analysis of its costs and how the privacy / ethics aspects of the tool would be managed would need to be fully examined. As for distance-based RUC, the Ministry's position on this option is that it should be looked at, but support for it is yet to be established.

New technologies are enabling more customised pricing approaches

The development of technology and devices that record and store information about transport journeys and patterns can be utilised for more complex and influential pricing mechanisms.

Technology is an enabling factor for smart road pricing. A successful scheme needs technology that can support four core information parameters – time of day, location,

[54] D'Artagnan Consulting. 2018 -, *Review of international road pricing initiatives, previous reports and technologies for demand management purposes.*

vehicle type, and an observation or measure of chargeable events. It will also need to consider the privacy of collected information. Any scheme will also need to be supported by information to enable users to understand and react to change behaviour. Three key developments in technology are driving the increase in the status of smart road pricing:

- increasing use of Automatic Number Plate Recognition (ANPR)
- improvements in the accuracy of Global Navigation Satellite Systems (GNSS) and the emergence of new systems
- increasing engagement and use of smartphones.

Consolidation of travel information, including costs and payment interface, can also enable complex and effective pricing and transport management approaches. Integrated ticketing in particular, would not only bring all travel information to one central place making it easier for users to interact with, but would provide a platform for smart pricing initiatives across modes to have more influence. The advancements in technology could be coupled with greater investment in research and design to obtain the benefits of this digital transport solution.

There are significant implementation challenges associated with new pricing mechanisms

To implement transport pricing would likely have implementation costs, and in the case of a nation-wide scheme, potentially significant changes to the transport revenue and funding system.

Aotearoa does not currently have comprehensive pricing tools intended for outcomes broader than revenue raising. We do have a successful distance-based road user charges scheme (including provisions for electronic road user charges) that could be built on to create a smart pricing scheme. However, it would still be a major reform for road pricing to incorporate a wider range of costs into the calculations, and to bring all vehicles into the scheme. Previous international attempts to implement national smart pricing schemes have been unsuccessful, with the key barrier typically being public opposition. Therefore, new pricing tools could be difficult to implement and we cannot be certain that they will result in significant changes to the outcomes we are seeking.

If we are to pursue more complex pricing tools, we need to ensure that initial policy development is done well, and considers the broad range of impacts that pricing could have on different groups and communities. The Ministry has done some advanced thinking on congestion pricing in Auckland, scoped an electronic distance-based RUC scheme for light vehicles, and has a project underway considering how the transport revenue system might be replaced. The Government needs to be clear of the benefits and ensure they will outweigh the risks and costs of implementation.

Low Emission Zones could reduce GHG emissions and harmful pollutants in urban areas

Aotearoa could use the low emission zone approach that is utilised in European cities. Internationally, the focus of Low Emission Zones is to reduce harmful pollutants from vehicles by implementing a charge for specific vehicles to enter the designated zone. Application of Low Emission Zones here could focus on vehicles with high carbon dioxide

(CO_2) emissions and harmful emissions like nitrous oxide and reduce vehicle traffic in cities, encourage the use of cleaner vehicles, and reduce transport GHG emissions.

Low emission zones also create more liveable and pleasant urban environments. Consequently, this increases the attractiveness of public transport, walking and cycling, which can also reduce transport emissions. The main co-benefit that comes from low emission zones is the reduction in harmful emissions and noise, which supports better health outcomes. In addition, reducing traffic and increasing the attractiveness of public transport (especially if it is low carbon), walking and cycling can also improve the quality of public spaces, and the quality of life in cities and towns.

To ensure these measures do not have a negative impact on access to employment, education and healthcare, there needs to be adequate provision of public transport, walking and cycling.

Parking management can significantly influence demand for parking and encourage people to shift to more sustainable transport modes

Car parking is a significant factor in private vehicle travel because when people drive a car they require a car park at both the origin and destination of their trip. Therefore, effective parking management can significantly influence the demand for parking and encourage people to shift to more sustainable modes or reduce overall private vehicle trips. This in turn affects transport GHG emissions.

Parking management can help to control the supply of parking spaces, and who, when and how long vehicles may park at a particular location. Unlike other pricing mechanisms, parking management interventions are available now. This includes time restrictions, user restrictions, and distribution of parking in urban areas. Parking management also includes parking pricing and the ability to remove parking and minimal requirements for parking in urban development, which can be an effective way of encouraging people to use other modes or avoid travel. A typical privately owned vehicle is parked for the majority of its lifetime. Parking spaces can have relatively high construction and maintenance costs – especially those provided in structures or basements in centres, owing to space constraints/value of land. Yet most parking facilities (both commercial and private housing) are unpriced, with their costs borne indirectly through taxes, rents, higher prices for retail goods, and lower employee benefits.[55] The opportunity cost of land used by parking spaces is also a significant issue for sustainable urban development.

Combined with other measures, such as improving public transport, parking management can lead to significant shifts towards public transport use. For example, an integrated transport plan that incorporated access restrictions, public transport enhancements and parking policies saw public transport modal share increase from 11 percent to 30 percent in Strasbourg over a period of ten years. After introducing a similar strategy in Oxford, public transport mode share increased from 27 percent to 44 percent.[56]

Parking management can also deliver significant co-benefits. For example, by reducing parking demand, it could support the repurposing of parking space for walking and cycling

[55] Victoria Transport Policy Institute. (2020). *Parking Pricing Implementation Guidelines*

[56] ITF. *Parking Pricing, Transport Climate Action Directory measures*. Retrieved from: https://www.itf-oecd.org/transport-climate-action-directory-measures

infrastructure, which encourages active travel and better health outcomes. It can also reduce cruising for parking, which reduces vehicle traffic and related impacts.[57]

Using blunt charging tools could change behaviour but has distributional impacts and risks

In Aotearoa, there are a limited set of existing mechanisms that the Government uses to charge users for their use of roads, to recover costs imposed on the road network, and to fund investment in infrastructure and services for the land transport system. New Zealanders pay fuel excise duty for all petrol purchased. This is a revenue tool and is one of two key land transport revenue tools used to fund investment and infrastructure for land transport in Aotearoa.

A deliberate tax on fuel, in addition to the Emissions Trading Scheme (ETS), for the purpose of reducing emissions from transport could be one way of encouraging mode shift, a change to cleaner vehicles and avoidance of discretionary travel by car. A tax on fuel should also consider the equity between different levels of charges applied to different vehicles using the same road and the different fuels used. For example a car using bioethanol does not pay excise duty but a vehicle using biodiesel has to pay road user charges, and liquefied petroleum gas (LPG) and compressed natural gas (CNG) are taxed at a much lower rate than petrol.

Transport pricing and management: possible key actions

Transport pricing:

- Consider congestion pricing. **(Already being investigated for Auckland through Congestion Question project)**
- Investigate distance pricing as a means to encourage mode-shift, dis-incentivise discretionary travel, and address the rebound effects caused by public transport investment.
- Consider incentives (subsidies or rewards) that could encourage alternative modes of travel.

Low emission zones:

- Enable and implement low emission zones to reduce CO_2 (based on GHG emissions).

Parking management:

- Require councils to continue to develop and implement parking pricing strategies.
- Introduce maximum parking standards/requirements in some areas, e.g. for new high-rise buildings and shopping centres.
- Enable and implement workplace/private property/commuter parking levies.
- Implement car parking regulations in the land use planning system as per the NPS-UD. **(Underway)**

Carbon charges:

- Increase rates of fuel excise duty after 2023.
- Implement an increased transport fuels only carbon tax. **(Already small charge through the Emissions Trading Scheme)**

Where we work and learn impacts transport emissions

Teleconferencing and online learning has now enabled many people to work and learn from home. This was illustrated through the COVID-19 lockdowns with environmental and economic savings resulting from the large reduction in travel.

The Energy Efficiency and Conservation Authority's (EECA) Gen Less information campaign encourages New Zealanders to work from home and travel less for business meetings. EECA found that if just one in five people who currently drive worked from home one day a week, it would save 84,000T[58] of CO_2 emissions, equivalent to emissions from 35,000 cars on the road.[59] Business travellers moving between Auckland and Wellington are responsible for 65,000 tonnes of carbon each year, the equivalent of 27,000 cars on the road. If a portion of these commuters chose to connect online, significant carbon emissions could be avoided. Further, working from home reduces road congestion and air pollution, particularly in central business districts. For example, NIWA analysis found that air pollution from traffic in Aotearoa's major cities dropped dramatically during the first week of the COVID-19 lockdown.[60]

The potential emissions savings from working from home vary widely. There have been extensive international studies on telecommuting and teleworking, showing at best a modest net energy saving. While it could cut the number of work-based trips, it could also lead to increases in acceptable commute distances (living further from the workplace), other vehicle travel and home energy consumption.[61]

Similarly, we could also save transport emissions by students learning from home. Distance or e-learning allows students to take courses and study without having to attend school or university in person. Emissions savings could also be found by simply ensuring students go to their closest school.

COVID-19 lockdowns have shown that there are varied ways some New Zealanders can work and learn that are less carbon intensive. There have also been flow on and ongoing changes to travel patterns, including more people working from home post lockdown. While the Ministry cannot create policies to enforce working from home, information campaigns encouraging people to work from home could operate alongside other interventions, such as road and parking pricing, to reduce travel demand and greenhouse gas emissions. Such steps can also be supported and influenced by other agencies and Local Government.

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58 This is equivalent to about 0.51 percent of total domestic transport emissions in 2018. Annual transport emissions are about 16.6 mega tonnes.

59 Live more with less energy, 6 July 2020. genless.govt.nz/stories-and-case-studies/stories/live-more-with-less-energy

60 'Coronavirus: Traffic pollution plummets across the country during lockdown', 2 April 2020. Retrieved from: www.stuff.co.nz/environment/climate-news/120763215/coronavirus-traffic-pollution-plummets-across-the-country-during-lockdown

61 Axsen, J., Plötz, P., & Wolinetz, M. (2020). *Crafting strong, integrated policy mixes for deep CO 2 mitigation in road transport*. Nature Climate Change, 10(9), 809-818.

Consultation question 6
Pricing is sometimes viewed as being controversial. However, international literature and experiences demonstrate it can play a role in changing behaviour. **Do you have any views on the role demand management, and more specifically pricing, could play to help Aotearoa reach net zero by 2050?**

Chapter 7: Theme 2 – Improving our passenger vehicles

Key points

- Passenger vehicles include light vehicles (e.g. cars, vans, SUVs), public transport, planes, and associated infrastructure
- Decarbonising the light vehicle fleet is critical for meeting our emission reduction targets. We need to increase our supply of clean cars and increase demand for them, as well as provide supporting infrastructure.
- Given the slow turnover of vehicle fleets, we need to consider options to decarbonise the existing fleet. This includes removing fossil-fuelled vehicles from the fleet and transitioning to biofuels.
- As we encourage mode-shift to public transport, we also want to ensure our public transport modes are low emission, including transitioning our bus fleet to cleaner fuels and electrifying more of the passenger rail network.
- Cleaner aviation technologies are in the early stage of development but there are still opportunities to reduce emissions, including with sustainable aviation fuel.

Decarbonising the light vehicle fleet is critical for meeting our emission reduction targets

While the opportunities outlined in Theme 1 will support people to travel by public and active transport, the majority of trips in Aotearoa will still be by car, especially in the short to medium term. Therefore, decarbonising the light vehicle fleet[62] is an important part of reaching a net zero emissions transport system.

Two thirds of transport emissions come from the light vehicle fleet. We have a strong reliance on private vehicles in Aotearoa and over half of all household travel time is spent driving.[63] The vehicle fleet must shift from its reliance on international combustion engines (ICE) vehicles, towards a greater uptake of low emission options such as electric, hydrogen fuel cell vehicles and biofuels. This requires us to consider opportunities to increase the availability and access to low emission vehicles, and ensure that vehicles entering Aotearoa's fleet move towards low emission, and eventually the elimination of all ICE vehicles. In addition, high-emitting vehicles should be effectively removed from the fleet.

The scale of uptake required to reach a net zero emissions transport system is significant. Electric vehicles only comprise less than one percent of the current vehicle fleet. If Aotearoa continues at the same pace of uptake we are currently projecting, there will not be enough of an impact on emissions.

We need to increase our supply of clean cars to make them a viable alternative to fossil fuel vehicles

There are currently over 27,000 electric vehicles in the Aotearoa vehicle fleet, and each month this year, around 400 to 600 electric vehicle registrations have been recorded (aside from April and May 2020 due to the COVID-19 lockdown).[64] However, this is still a very small proportion of the overall vehicle fleet. There are currently more than 4 million light vehicles in

[62] The light vehicle fleet includes passenger vehicles and light (under 3.5 tonnes gross mass) commercial vehicles such as vans and utes.

[63] Ministry of Transport, Household Travel Survey, 2015-2018.

[64] Ministry of Transport, Vehicle fleet statistics.

our fleet. The Government can signal the importance of low emission vehicles by supporting their supply into Aotearoa with regulatory levers. This could have a very direct and potentially strong impact on emissions reduction – if regulatory interventions are well timed, well designed and well implemented within wider transport system changes.

We need to recognise that the supply of cleaner cars relies heavily on the global market. Government has a role in understanding global supply trends for electric vehicles and other emerging vehicle types, and ensuring policies allow these vehicles to arrive in Aotearoa's market to keep up with demand.

There is an opportunity to align with road safety objectives

Regulating the supply of vehicles to Aotearoa is not a new idea and can support Government in achieving broad system objectives. The New Zealand Road Safety Strategy – *Road to Zero* – sets out our vision for Aotearoa where no one is killed or seriously injured in road crashes. As part of the immediate actions in the 2020-2022 Action Plan, Government has set an initial action of raising the safety standards for vehicles entering Aotearoa.

Aligning low emission vehicle standards with *Road to Zero* safety standards presents a wider opportunity to ensure vehicles that enter Aotearoa's vehicle fleet achieve positive health, safety, environmental and wellbeing outcomes for New Zealanders.

Introducing a fuel efficiency standard is key to driving the supply of cleaner vehicles

Introducing and implementing a CO_2-based fuel efficiency standard is one example of Government action in this priority area that can support this objective. A fuel efficiency standard, commonly known as the Clean Car Standard policy, would restrict the type of vehicles that can be imported, resulting in an overall improvement of fuel efficiency and emissions reductions. Other similar actions include a maximum CO_2 limit, setting a progressively more stringent 'average' target for vehicles and fleets of vehicles over time. In line with other countries, a schedule for phasing out of the importation of fossil fuelled vehicles could also be implemented. All of these actions should be signalled well in advance to support the vehicle imports and sales industry to transition and ensure compliance.

Countries around the world are signalling the phase out of fossil fuel vehicles

Many countries around the world have signalled commitments to phase out fossil fuel vehicles to help to reduce their transport emissions. In an aim to speed up the rollout of low emission vehicles, the United Kingdom (UK) recently announced it was bringing forward the end of fossil fuel vehicle sales and importing to 2030, as opposed to the original target of 2040. The sale of hybrid vehicles will be permitted until 2035.[65] Many other countries are taking the same action, or are due to. Japan plans to phase out the sale of conventional fossil fuel vehicles in 2035, though hybrids will still be permitted.

California was the first state in the United States to commit to a phase out of fossil fuel vehicles and will require sales of all new passenger vehicles and trucks to be zero-emission by 2035. California also intends to mandate that all medium and heavy duty

[65] Prime Minster's Office, 10 Downing Street, '*PM outlines his Ten Point Plan for a Green Industrial Revolution for 250,000 jobs*', https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs.

vehicles be zero-emission, where feasible, by 2045. Transport currently accounts for more than half of California's carbon emissions.[66]

China plans to require all new cars sold after 2035 to be 'new energy vehicles'. The plan states that 50 percent of new cars sold in China will be electric, plug-in hybrid, or fuel cell vehicles and 50 percent of new cars will be conventional hybrids. Vehicle manufacturing will have the same 50/50 requirement. China has a large vehicle manufacturing industry and has an opportunity to make a significant global impact in producing zero and low emission vehicles.[67]

As more countries announce targets to phase out the production and importation of fossil fuel vehicles, we need to consider what Aotearoa should do. If we do not put in place our own ambitious targets to reduce our fossil fuel vehicles we risk becoming a dumping ground for high emitting vehicles with the associated economic, environmental and health related consequences.

We also need to increase demand for cleaner vehicles by ensuring they are the safest, easiest and obvious choice

Increasing the supply of clean cars will not achieve significant emissions reduction without encouraging the demand for these vehicles. As people make purchase decisions about vehicles, an electric vehicle (or similarly clean car) needs to be an easy and safe choice that is cost-competitive with the costs of owning and running ICE vehicles.

Government has a range of levers available to encourage the uptake of low emission vehicles. The actions Government chooses to take need to focus on mitigating the most significant barriers to the purchase of low emission vehicles. Some of the common barriers include: high upfront purchase costs, range anxiety (fear that an electric vehicle will run out of charge and be stranded), and the availability and cost of relevant infrastructure (such a charging stations). Additional issues are the high cost of hydrogen production, distribution and storage, higher costs of biofuel production and risks of compatibility with components that we know little about.

Beyond these common barriers, car ownership in Aotearoa is intrinsically tied to socio-cultural identity. There will be behavioural factors such as the look and feel of vehicles that will also be a continuous barrier to uptake of clean vehicles. Fuel efficient vehicles have typically been smaller vehicles, which does not match Aotearoa's increasing preference for utes and SUVs. Broader challenges around the marketing and images associated with larger light vehicles in Aotearoa will need to be addressed in some way.

Vehicle technology is continuously evolving in this space, meaning that a range of vehicle preferences and features can be incorporated into low emission vehicles, such as models of electric powered utes due to come to market and be available in Aotearoa shortly.

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[66] Office of Governor Gavin Newsom, '*Governor Newsom announces California will phase out gasoline –powered cars'* https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/.

[67] Dow, Jameson, '*China plans 2035 gas car ban that doesn't actually ban gas cars',* https://www.popularmechanics.com/cars/hybrid-electric/news/a28140/china-ban-cars-combustion-engines/

Consumer research indicates that the high purchase price for electric vehicles is the biggest obstacle to uptake

Once low and/or zero emission vehicles achieve price parity, the high purchase price barrier to widespread adoption will reduce. In the meantime, we can mitigate the upfront cost barrier and Government can use levers to incentivise people to purchase low emission vehicles. The Government is currently considering options for an incentive scheme to help New Zealanders switch to cleaner vehicles.

The safety of low emission vehicles should also be considered. A lot of light electric vehicles have different safety profiles to ICE vehicles. We need to encourage both low emissions and safe vehicles in our frameworks.

We need to invest in the infrastructure required to support low emission vehicles

We need to give further consideration and investment to infrastructure that supports low emission vehicles; clean fuels, biofuels and hydrogen networks, charging networks for electric vehicles. This should include smart home charging infrastructure; and the standardisation of such infrastructure; and parking and priority use on roads for low emission vehicles (while not undermining other transport outcomes). The Ministry has commenced work to develop a strategy to support the ongoing implementation of infrastructure, which should also include charging infrastructure for other modes such as for ships at ports.

Government supply and funding of infrastructure that supports the uptake of low emission vehicles can help to mitigate some of the barriers to uptake. In addition to public infrastructure, Government could regulate new developments to give consideration to charging infrastructure or similar infrastructure when the development provides car parking.

Government can support the uptake of electric vehicles through its own procurement

Government has announced a requirement for an all-of-government policy to decarbonise. This includes the procurement of the Government fleet vehicles to be electric or another low emission vehicle or fuel type. This has an added co-benefit of using Government procurement to ensure low emission vehicles transition into the used vehicle market once their lifetime in the Government fleet has ended.

Where possible, there could be incentives for other non-government fleets to show leadership in this area as well. Local government, industries, and the volunteer/charity sector could be good groups to target, as a way to increase procurement of clean cars.

Further investigate the potential for tax incentives

There are many tax levers available. We are aware that the specific tax treatment of certain vehicles has created financial incentives that could work against reducing emissions and these need to be addressed as part of transitioning to a low carbon fleet. The intrinsic link between vehicle kilometres travelled and land transport revenue is another tension that needs to be acknowledged in the treatment of clean cars in the tax system.

Taxes could stimulate the demand for low emission vehicles. Some suggestions are: reducing fringe benefit tax on zero emission vehicles, reducing GST on the purchase of

zero-emission vehicles, offer refundable tax credits on the purchase of zero-emission vehicles, replacing the road user charges (RUC) exemption for electric vehicles with an upfront subsidy, increasing tax depreciation for electric vehicles.

Taxes pertaining to fossil fuelled vehicles could increase. Some suggestions are: elevating the carbon price under the ETS or increasing the price of diesel through a health/environmental tax.

Such changes could introduce equity concerns as any changes would inevitably create winners and losers. International research suggests tax advantages at the point of purchase have a stronger influence on consumer choices than annual tax payments.[68]

Given the slow turnover of Aotearoa's vehicle fleet, we also need to consider options to decarbonise the existing fleet

Government has been exploring a range of initiatives to improve Aotearoa's vehicle fleet. This includes a recent agreement to implement the Clean Car Standard and an agreement in principle to implement a sustainable transport biofuels mandate. Government is also giving consideration to options for an incentive scheme to encourage uptake of low-emission vehicles. These policies step Aotearoa's fleet towards being low emissions.

Increasing the supply and demand for low emission vehicles will be important, but vehicles in Aotearoa currently remain in the fleet a long time after they are imported, so there needs to be incentives to remove high emission vehicles as soon as possible.

Removing fossil-fuelled vehicles from the fleet

Government has levers available that can encourage the sustainable rollover of vehicles in our fleet, including a potential rolling age ban for used vehicles to combat emissions from ICEs. A wider rollout of a vehicle scrappage scheme could be considered. For both of these policies more evidence of their effectiveness at contributing to reducing emissions may be required. Additionally, if chosen as policies for implementation, these policies would need to be done alongside other policies to create a whole of system approach. For example these could be done alongside investigating opportunities linking licensing to emissions, i.e. warrant of fitness (WOF) and certificate of fitness (COF) fees including how to mitigate the behaviour risk of people not obtaining a WOF or COF. This supports the creation of demand for lower emission, safer vehicles with newer technology. It also works to encourage the earlier disposal of fossil fuelled vehicles, therefore having a somewhat indirect impact on emissions reduction as it depends on what vehicle, if any, replaces the vehicle exiting the fleet.

[68] Wappelhorst, S., Mock, P., Yang, Z., (2018). *Using vehicle taxation policy to lower transport emissions: An overview for passenger cars in Europe*. International Council for Clean Transportation, December 2018. https://theicct.org/publications/using-vehicle-taxation- policy-lower-transport-emissions.

Reducing reliance on fossil fuels by transitioning to biofuels would go some way in decarbonising the fleet

In December 2020, Government agreed in principle to implement a sustainable transport biofuels mandate, subject to the outcomes of officials' review of the 2008 Biofuels Sales Obligation.

Biofuel presents an immediate opportunity for decarbonising the vehicles that are already in the fleets. It is highly likely that we will need to use biofuels to reduce emissions from the vehicles already occurring in the fleet. Biofuels can be used immediately in most vehicles that are fossil fuel powered and produce significantly less emissions than fossil fuels. This will be an important and significant part of emissions reduction from transport in Aotearoa's transition.

Funding and investment for the transport system will need to be planned for

The NLTF is generated from road user charges (RUC) and fuel excise duty (FED). It supports transport activities by funding things like maintenance of infrastructure, public transport, and cycling, but is essentially reliant on maintaining if not increasing vehicle kilometres travelled in order to generate sufficient revenue to fund such activities.

EVs are subject to RUC, but are currently exempt to encourage their uptake. The exemption to date has resulted in a small loss of revenue to the NLTF. Decisions will need to be made to determine if the current RUC exemption for EVs is extended. Longer term planning for transport system requirements will be needed to address the resultant funding challenges as Aotearoa steps towards next zero, including how funding will be provided to meet future investment needs.

A cleaner vehicle fleet will result in several co-benefits

The benefits of these actions, in addition to reducing emissions, could be wide-ranging. There would likely be benefits to individuals and households, business and Government.

Low emission vehicles could help reduce overall household transport costs generally. A clean car standard and clean car discount in particular would encourage households to purchase low emission vehicles and lead to reduced transport costs from having a more efficient ICE or electric vehicle. Public health benefits of low emissions vehicles may also be significant. Lower harmful emissions lead to improved air quality, which can reduce emissions related harm such as respiratory and cardiovascular illnesses. In addition, low emission vehicles reduce the health and wellbeing impacts of noise pollution, particularly in cities and densely populated urban areas.

There are business opportunities for sectors to transition, or new employment opportunities for those not transitioning. Ensuring the safe and environmentally friendly reuse, recycling and disposal of vehicle waste, (such as electric vehicle batteries, and ICE vehicle parts), provides a business opportunity that we could seize locally rather than exporting the work overseas. In addition, it would support a circular economy that has wide environmental benefits. We can also expect that the demand for services relating to new vehicle technologies (mechanics and technical experts), and infrastructure (charging and communication networks) would increase and provide employment opportunities.

Aotearoa's energy security would be improved as we become less reliant on imported fossil fuels and therefore more resistant to oil price shocks. Increasing the uptake of electric vehicles in particular would encourage greater energy efficiency, sustainability and resilience, particularly as over 85 percent of our electricity comes from domestic renewable sources and the Government is working to increase this.

Shifting to cleaner vehicles poses some challenges for transport industries

As mentioned earlier, regulation and restrictions on the supply of clean cars will affect the motor trade industry and their concerns will need to be accounted for. Fuel suppliers and retailers would incur disruption, including a fall in sales and revenue as a result of consumers reducing or avoiding the purchase of liquid fossil fuels. However, the cost of not meeting our emissions targets will result in higher costs for our communities. Further, early involvement by these industries to transition to lower emission vehicles and fuels will help to mitigate some of the disruption that might result.

Although there will be an inevitable long-term reduction in opportunities for businesses servicing ICE vehicles, there will be new business opportunities to service the new technology vehicles. Business changes will also include new methods needed for repairing accident damaged electric vehicles, and battery replacements, along with niche businesses converting vehicles (including agricultural vehicles) to electricity-powered operations.

Distributional impacts

The Ministry has assessed the social impacts of the Clean Car Standard and the Clean Car Discount (feebate) scheme. Currently, hybrids and electric vehicles cost more to buy than conventional vehicles. However, the increased cost can be recouped through considerable fuel savings. The Clean Car Discount is intentionally designed to mitigate any equity impacts that arise from the increased price of hybrids and electric vehicles by lowering their purchase prices. It would make it easier for low income households to access the savings in motoring costs that higher income households can more easily enjoy. This is important because low income households spend more of their disposable income on fuel costs.

The Ministry's social impact analysis found that compared to high income households, a greater proportion of low income households would either receive a rebate, or not be charged a fee under the feebate scheme. This is because low income households tend to buy more relatively lower emission vehicles.

Considering the potential distributional impacts of the Clean Car policies, and any future transport policy seeking to reduce emissions will be an important part of our transition. However, we can use mitigating policies to ensure no group is left behind in Aotearoa's transition to a zero emission transport system. Additional support measures for the most vulnerable transport users will need to be a focus.

For example, a policy such as the clean car discount (feebate) scheme (applied on new and used imports not the existing fleet) could achieve a net benefit to the nation. The Government is considering options for an incentive scheme to help New Zealanders switch to cleaner cars such as electric vehicles. Depending on the design of the scheme, it may have an impact on households that cannot alter their vehicle purchasing choices may be required to pay a fee. We may also find that rural populations are affected disproportionately.

In relation to the Clean Car Discount again, its design may have an impact on the number of rural households that may be affected. Other policies to support minimising the distribution impact could also be considered, such as a scrappage scheme with incentives (noting the lack of evidence that such a scheme is effective in reducing emissions).

Decarbonising the light vehicle fleet: possible key actions

Increasing the supply of clean cars:

- Introduce and implement the fuel efficiency standard agreed by Government. **(Agreed by Cabinet and underway)**
- Consider the potential for a rolling age limit for used vehicles.
- Investigate how a maximum CO_2 limit would improve the fleet.
- Consider a schedule for phasing out the importation of fossil fuelled vehicles.
- Investigate how Aotearoa could mandate a market share of zero emission vehicles.

Encouraging the demand for clean and safe cars:

- Investigate and implement a vehicle feebate/subsidy. **(Government is considering options for an incentive scheme)**
- Investigate introducing a Government subsidy to support the uptake of cleaner cars. **(As above)**
- Further investigate potential tax incentives (including Fringe Benefit Tax, Depreciation and Tax Grants and RUC).
- Further investigate infrastructure funding. **(Some infrastructure has already been funded through the Low Emission Vehicle Contestable Fund, and the Ministry of Transport is doing a strategy to consider future infrastructure needs)**
- Pursue the standardisation of charging infrastructure.
- Consider how parking and priority use on roads for low emission vehicles can encourage uptake, or reduce the use of ICEs.
- Encourage acceleration of Government procurement of low emission light vehicles, including encouraging the procurement of safe low/zero emitting vehicles. **(Underway through Carbon Neutral Government Programme)**

Decarbonise the existing fleet:

- Investigate the use of a vehicle scrappage scheme to encourage the removal of inefficient, unsafe vehicles.
- Consider basing vehicle licensing on emissions.

Consultation question 7

Improving our fleet and moving towards electric vehicles and the use of sustainable alternative fuels will be important for our transition.

Are there other possible actions that could help Aotearoa transition its light and heavy fleets more quickly, and which actions should be prioritised?

As we encourage mode shift to public transport, we also want to ensure our public transport modes are low emission

Public transport vehicles, including buses and ferries, are largely diesel powered, which contributes to GHG emissions and other air pollutants harmful to public health. We estimate that around 300 kilo tonne CO_2 equivalent emissions are emitted by all heavy buses (with a gross vehicle mass over 3.5 tonnes) in 2018 and 2019. This represents two percent of total road emissions. Public transport buses accounted for roughly half of this, i.e. one percent of road emissions.

While this is a comparably small amount when compared to the emissions from the light vehicle fleet, this is still an important part of our transition to net zero. We expect emissions from buses would increase in the future if no significant interventions are in place particularly if public transport uptake increases substantially.

We can transition our bus fleet to cleaner vehicles

Cleaner buses are an important part of the system-wide move to cleaner transport, and to reaching our emissions targets. The number of electric buses in active use in our public transport network at the end of January 2021 was 36. This number is expected to grow rapidly during 2021 as more electric buses join the fleet. The remainder of the approximately 2,600 public transport buses operating in Aotearoa are powered by diesel.

Electric buses are commercially available but there are still barriers to their uptake

Electric buses are now developed and suitable for public transport fleets. However, there remains a range of barriers to uptake. Some of the challenges are the significantly higher purchase costs for an electric bus relative to a diesel bus (although operating costs are expected to be lower), as well as the accompanying infrastructure for charging that is needed at depots. There is a lead in time for the purchase of buses and subsequently local government decisions need to be made early for benefits to be realised a few years later. There is also concern that the framework for public transport planning and procurement (Public Transport Operating Model (PTOM)) may not support the uptake of electric vehicles.

There are several ways the Government can support the uptake of cleaner buses

Supporting local government to invest in clean buses and related infrastructure is one way Government can support public transport operators to shift to electric buses. Funding for the buses themselves, or the supporting infrastructure can incentivise the uptake and realise emissions reductions sooner. Electric buses require more significant depot investment than what is currently utilised - a depot typically needs larger spaces for servicing e-buses compared to diesel buses.[69] There is also the challenge of charging entire fleets en-masse on local power supplies/transformers that will need to be considered.

Government can also reduce the ongoing operational costs of electric buses by continuing the current RUC exemption. If this exemption was extended beyond the current expiration date of 31 December 2025, it may provide an incentive for public transport operators to consider if they need to purchase new electric buses for any tender or contract variation they may have. Councils in the three largest metro areas, Auckland, Wellington and Christchurch,

[69] Auckland Transport has modelling suggesting that a 30-40% increase in spacecould be required

have already made commitments towards decarbonising their bus fleets. Government could push this further by implementing a mandate requiring zero emission new buses and/or setting a date for the fleet to be zero emission.

Government has recently announced it will require Councils to purchase only zero emissions buses by 2025 and to target the decarbonisation of the public transport bus fleet by 2035. It is also supporting regional councils to achieve these outcomes through a $50 million fund over four years. Work on this policy is underway.

The Government is considering whether changes to PTOM could remove or reduce system barriers to decarbonisation. It is also exploring whether changes to the usual procurement and ownership arrangements for zero-emission buses, depots and supporting infrastructure could reduce the current cost premium faced by councils, allowing a faster transition.

Supporting the use of technology and innovation for public transport vehicles to reduce energy use, together with investigating a biofuel mandate could also be considered.

Supporting the uptake of cleaner buses can also achieve co-benefits, including improving air quality and reducing noise in our cities

In terms of co-benefits, health is significant. Nitrogen oxides and particulate matter from diesel vehicles creates city pollution known to cause respiratory and associated diseases. Auckland Transport estimates that diesel vehicles (including buses, trucks and other diesel vehicles) are responsible for 81 percent of all vehicle-related air pollution health costs in Auckland, which are estimated to have a social cost of $466 million annually[70]. Improvement in city liveability is linked to decarbonising buses as a cleaner healthier city environment makes inner city living more desirable.

In terms of Just Transition, we recognise the business opportunities from cleaner buses such as coach building, manufacturing components for zero-emission powertrains, and alternative fuels (and associated infrastructure). Aotearoa has two domestic coach manufacturing companies that are already building on electric bus platforms and one manufacturer is also building the country's first hydrogen bus. Regional employment could be bolstered by the manufacture of zero emission public transport vehicles because the local contribution to manufacture is higher in comparison to diesel buses. There could be flow-on export potential from this industry.

Aotearoa's major cities have already set targets to decarbonise their bus fleets

Auckland Transport

- In November 2017, the Mayor of Auckland joined 11 international cities in signing the *C40 Fossil-Fuel-Free Streets Declaration*. The Declaration commits Auckland to buy only zero-emission buses from 2025 and ensuring a major area of the city is zero-emission by 2030. This commitment is reflected in Auckland Transport's detailed plan to transition to a zero-emission bus fleet by 2040.

[70] Auckland Low Emission Bus Roadmap - attachment-1-to-item-111-auckland-low-emissions-roadmap.pdf.

Greater Wellington Regional Council (GWRC)

- On 21 August 2019, GWRC declared a climate emergency and formally established a target to become carbon neutral by 2030. One of the key actions to achieve this is decarbonising the bus fleet.

Environment Canterbury

- *ECAN's Regional Public Transport Plan* targets a transition to a zero-emission bus fleet, including a short-term target that more than 40 percent of the public transport vehicle fleet is low or zero-emission by 2025 and a medium-term plan that all new buses procured after 2025 are zero-emission.

Over the next few years these councils will deploy an increasing number of zero emission buses, including 98 additional zero emission buses in Wellington, 25 in Canterbury, and 32 in Auckland.

There is an opportunity to electrify more of the passenger rail network

Rail is an important part of Aotearoa's public transport system in our two biggest cities, Auckland and Wellington. Metro rail provides rapid, mass transit to and from the city centres, providing access to jobs, education and social opportunities. It helps reduce congestion on roads and supports productivity in our cities. It also supports more sustainable urban development, housing and growth. Metro passenger rail services share the network with freight and inter-regional services, and use electric trains, which are faster, quieter and more energy efficient with low emissions.

Most of the metro passenger rail networks in Auckland, Wellington and Christchurch are fully electric, but there are some exceptions such as the Wairarapa and Capital Connection commuter train from Palmerston North to Wellington (which is diesel powered). A fully electric public transport system is an important start to transforming our transport system in its entirety. This transition requires investment from the Government to ensure upgrades to existing networks have the funding needed. Electrifying existing parts of the network complements measures in Theme 1 that seek to improve and extend the overall public transport network, encouraging mode shift. Electrification of the rail is expensive. Further expansion to electrify the rail network would need to consider the cost, scale of change required (i.e. only metro rail rather than the whole network) and the challenges such as Aotearoa's topography, to determine if it is a sensible investment.

Decarbonising the public transport fleet: possible key actions

- Implement the mandate for local government to procure only electric buses by 2025. **(Underway)**
- Provide support for the decarbonisation of the bus fleet and its required infrastructure.
- Extend the RUC exemption for electric buses (which is due to expire in 2025). **(Under consideration)**
- Consider how to fund foregone revenue for the National Land Transport Fund if road user charges exemptions are extended for heavy electric vehicles or expanded to include hydrogen or other low carbon fuels.

- Examine if the Public Transport Operating Model can be adjusted to enable accelerated decarbonisation of the public transport bus fleet. **(Underway)**
- Consider the further electrification of existing parts of the passenger rail network.
- Consider future investment needs to ensure existing rail networks are fit for purpose.

Consultation question 8

Do you support these possible actions to decarbonise the public transport fleet? Do you think we should consider any other actions?

Cleaner aviation technologies are in the early stage of development but we still have opportunities to reduce emissions

There is a strong commitment in Aotearoa aviation to reduce emissions, but still significant room for improvement.

Aviation has a role in moving both people and freight to domestic and international destinations. Its role is important for Aotearoa given our distance from markets. Aviation's contribution is critical because of its freight role to move freight that has high value or is of high importance, such as medical supplies. Its freight role is important to our role in the Pacific, our social needs and for Aotearoa's trade markets.

Aviation's role is not easily replaced by other modes of travel. Reducing air travel will be challenging, and subsequently efforts must be made to make aviation, domestic and international, greener. Aotearoa is an isolated country where air travel is an essential mode for inter-city and inter-regional travel. Air travel is a high emission mode, with carbon emissions estimated to be in the magnitude of 1.5Mt per annum (representing about six percent of Aotearoa's domestic emissions).

We can reduce emissions from domestic aviation through a variety of interventions, although some technologies that could substantially reduce emissions are still in the early phases of development, for example, electric powered large commercial passenger planes.

Compared to the light fleet, or buses, new vehicles or fuels for aviation are less developed. As noted earlier, in December 2020, Government has agreed in principle to implement a sustainable transport biofuels mandate, subject to outcomes of officials' review of the 2008 Biofuels Sales Obligation. This mandate will be mode agnostic, and will also apply to aviation.

The New Southern Sky and Performance Based Navigation procedures contribute to improvements for aviation. New Southern Sky[71] gives direction on incorporating new and emerging technologies into the aviation system to ensure the safe, cohesive, efficient and collaborative management of Aotearoa's airspace and air navigation to 2023. New Southern Sky will enable shorter journeys, improved safety and lower carbon emissions. Performance Based Navigation[72] procedures effectively redesign airspaces, which improves air traffic flow and efficiency. These actions provide significant benefits in fuel savings, which in turn reduces emissions.

[71] New Southern Sky - About the programme (nss.govt.nz)

[72] Airways | Performance Based Navigation

Efforts must be made to invest in aviation to ensure it rapidly moves towards being low emissions. This will require research and development, and investment to develop sustainable aviation fuels and improve plane technologies. Aotearoa cannot afford to delay efforts to move aviation in this direction given our reliance on international markets and partners.

Improving planes to reduce emissions will be a key action for decarbonising aviation

There are currently two main technologies being developed to improve planes. These are the use of sustainable aviation fuel (SAF)[73] and electric planes.

Sustainable aviation fuel has the most potential to reduce aviation emissions in the short to medium term

A significant change that could reduce emissions is the wide adoption of SAF. This could now replace up to 50 percent of the jet fuel burn, and probably will be approved for a higher proportion in the future. For shorter routes in Aotearoa it is likely that electric powered planes could be used, with the design of some suitable aircraft now underway internationally.

Currently there are high costs and long time frames for research and development of aviation technology. SAF provides a shorter term and relatively easy abatement of up to 40 percent of emissions: around 600,000 tonnes CO_2 per annum. In time, electrification has the potential to make all short route flights zero-emission. This will be dependent on battery weight and the low specific energy stop becoming limiting in terms of aviation physics. Additionally, hydrogen aircraft could be used for short or long-haul flights, once the technology is sufficiently advanced.

SAF could present an opportunity for Aotearoa woody biomass processing. Woody biomass from plantation-grown trees is Aotearoa's most significant renewable energy resource. Increasing the area of planted forest by 1.8 million hectares could supply around 60 percent of the country's transport fuels by 2040. Planted on low to medium quality land, energy forests would also provide ecosystem services such as erosion and flood prevention.[74] Producing biofuels from woody biomass would contribute significantly to our energy sustainability and system resilience.

Domestic biofuels (including SAF) production and processes would create jobs related to construction and other development work as well as enduring jobs, so it supports a Just Transition (this is further discussed in the context of Theme 3).

Electric aircraft technology is developing quickly, and may have significant potential in the future especially for smaller aircraft

For efficient electrification, a new approach to aircraft frame design is needed. We support the development of an industry strategy to give direction to decarbonising the aviation sector, alongside investigating alternative fuels in aviation and the potential for a fuel efficiency standard or a biofuels mandate for aviation.

COVID-19 has presented unique challenges, as the aviation sector is one of the worst impacted industries, with many countries closing borders and suspending air travel. The decarbonisation or improving aircraft is nowhere near as simple as transitioning to low emission light vehicles – but there is hope. Sounds Air have endeavoured to purchase

[73] SAF is an advanced biofuel with similar chemical and physical characteristics to conventional jet fuel. SAF reduces some 80% of emissions compared to jet fuel.

[74] Scion. *Increasing the use of bioenergy & biofuels*. Retrieved from: Scion - Increasing the use of bioenergy & biofuels (scionresearch.com).

electric 19-seater planes – offering Aotearoa's first zero emission flights, which are scheduled for operation in 2026.

There are also opportunities to improve airports and operations to reduce emissions

We consider that immediate operational improvements have the potential to abate around five percent of aviation emissions. Two potential immediate actions that could have an impact would be to implement better air traffic flow management and improved navigation to reduce fuel burn. This could include considering if the current air navigation system could be more efficient. The effort and cost of making some of the improvements identified is not high. In terms of co-benefits, there will be some positive advantages in all categories. New Southern Sky and Performance Based Navigation already contribute to these improvements.

The specific action identified is to support the facilitation of operational improvements to reduce emissions from aviation. Better air traffic flow management and improved performance based navigation can allow aircraft to reduce taxi times, fly direct routes, navigate weather, have shorter approach paths and facilitate continuous descent, all of which reduce fuel burn, therefore reducing emissions. There is also an opportunity to improve ground operations to reduce emissions such as the use of low emission tender vehicles.

The abatement potential for improving ground operations may not be as large as electrification or the use of biofuels in the skies, but it is a fast, low-cost measure with an emissions abatement potential of five to seven percent of gross aviation GHG emissions. These are gains quickly made, and contribute to our overall goal of a cleaner transport system.

There is also large airport constructions that are implemented as airport owners make decisions about expanding or improving their airport facilities. As these evolve, efforts should be made to ensure the construction of airports give due consideration to how they are constructed and how emissions might be reduced.

International Aviation is moving to being more sustainable

In 2016, the Government agreed to participate in the Carbon Offsetting Reduction Scheme for International Aviation (CORSIA) at the 39th International Civil Aviation Organization (ICAO) Assembly. This is a global market-based measure for reducing and offsetting carbon emissions in the international aviation sector.

International aviation is responsible for approximately 1.3 percent of global CO_2 emissions, and the Paris Agreement is silent on its inclusion. For both international aviation and maritime, it was agreed the respective sector bodies would be responsible for taking action to reduce emissions. The Paris Agreement has set an expectation of universal participation in the global response to climate change.

CORSIA is one of four measures the international aviation sector is focused on to reduce its carbon footprint. The other measures are sustainable aviation fuels, aircraft technology and standards, and operational improvements (e.g. improved ground operations and air traffic management).

Technological and operational improvements alone will not be enough to meet ICAO's aspirational goal of carbon neutral growth from 2020. Sustainable alternative fuels require

further development and maturity to make a significant contribution to reducing CO_2 emissions.

Efforts Aotearoa makes towards alternative fuels that can be used for aviation activities will contribute to the global goal of reducing international aviation emissions.

CORSIA commenced on 1 January 2021. Member States, including Aotearoa, began monitoring and reporting activities on 1 January 2019, to assist ICAO to set the baseline for CORSIA. The baseline will form the carbon neutral growth baseline from 2020 for ICAO.

The COVID-19 pandemic has reinforced the important role that aviation links have to Aotearoa's economy. These links are critical to our imports, exports, support of the Pacific and social connection. In order to sustain this as Aotearoa transitions to being low-emissions will require more investment in greener long-haul aviation than some other countries given our distance from markets.

Decarbonising the aviation fleet: possible key actions

- Invest in, produce and mandate sustainable alternative fuels that can also be used by the aviation sector. **(This has commenced with work on a biofuels mandate)**
- As technology advances, consider its implementation for Aotearoa, e.g. wider use of electric planes.
- Support research, development and production of sustainable aviation fuel.
- Examine if the current air navigation system is effective or could be more efficient. **(Partially underway through New Southern Skies and Performance Based Navigation)**
- Implement operational improvements such as better air traffic flow management and improved navigation to reduce fuel burn. **(As above)**

Consultation question 9

Do you support the possible actions to reduce domestic aviation emissions? Do you think there are other actions we should consider?

Chapter 8: Theme 3 – Supporting a more efficient freight system

Key points

- The Ministry is starting work on a National Supply Chain Strategy that will provide strategic direction and set out priorities amongst the various objectives for the supply chain, one of which being the reduction of emissions.
- Given the market-led nature of the supply chain system, initiatives to reduce emissions would have to be carried out in close consultation with the freight industry and/or be private sector-led, with government providing a vision and direction for change and/or supporting infrastructure. Concerted effort by industry has the potential to drive rapid emissions efficiency gains, with the right incentives.
- Shifting some of the freight task to less carbon intensive modes will help reduce emissions, including to rail and coastal shipping. The Government already has work underway to support improvements in rail and coastal shipping.
- Decarbonising freight vehicles will be critical for reducing transport emissions. This could include increasing the uptake of alternative green fuels, such as biofuels, electrification and/or green hydrogen. There is a high degree of uncertainty around the timeframe in which zero emission freight vehicles will be commercially available, more rapid than expected technological progress could accelerate decarbonisation of this sub-sector.
- Our international obligations will help to drive emission reductions in shipping, including through encouraging cleaner, more efficient ships and ports. The Government is also investing to improve our rail network, including through renewing locomotives and the inter-island ferries which will support reductions in the emissions from rail.
- Aviation plays a role in our freight system through its movement of people and freight domestically and internationally and efforts to decarbonise it must be considered given our trade and social connection needs and Pacific responsibilities.
- Improving the efficiency of our supply chain considering the role that all modes play could also help to avoid and reduce emissions. There are a range of possible initiatives trialled overseas and the feasibility of applying them in Aotearoa could be studied in more depth. These include optimising freight routes, equipment and vehicles, and through making better use of data and supporting information sharing and collaboration.

Improving the efficiency of our supply chain can help to avoid and reduce transport GHG emissions

Heavy vehicles, the majority of which are freight vehicles, contribute almost a quarter of Aotearoa's transport GHG emissions.

The movement of freight within Aotearoa plays a vital role in the economy. It allows producers to get their goods to consumers, including domestic goods and international imports and exports. In 2017/2018 Aotearoa's freight task (i.e. the freight transported within Aotearoa) was 278 million tonnes of freight or 30 billion tonne-kilometres. Our modelling indicates that the freight task will increase at 0.86 percent compounding over the next 30 years. For the most part, this forecast is driven by assumptions on population growth and

demand for Aotearoa goods (both domestically and internationally).[75] This forecasted growth in the freight task has significant implications for transport emissions.

Supply chain systems are complex

Freight supply chains are a complex system of systems. These consist of networks of infrastructure, services, information and operators through which freight is transported from producer to end user. This means that to reduce freight emissions, we need to take a systems approach that looks for opportunities to improve efficiency and value across the whole of Aotearoa's supply chain. This will also help us to take into account the relationships and interdependencies between different parts of the freight system. It will also help improve Aotearoa's overall productivity. We do have to recognise that parts of Aotearoa's freight industry are highly competitive, have low margins and contains a large number of operators. This makes them sensitive to change, and less able to make large or long-term investments that have commercial risk.

We also have to be realistic about how Aotearoa's geographical context has and continues to shape its supply chain. Aotearoa is a geographically dispersed country with relatively low density population centres, which encourages a reliance on roads for its system. We have built-in imbalances between centres of consumption (primarily the Upper North Island region) and where exports are generated (primarily rural regions further south), which poses challenges for freight load optimisation.

A National Freight Strategy will consider opportunities to reduce supply chain emissions

The Ministry is starting work on a National Freight Strategy that will provide strategic direction and set out priorities amongst the various objectives for the supply chain, one of which being the reduction of emissions. It will take a systems view across the Aotearoa's supply chain instead of a purely mode-by-mode analysis, which may help to identify opportunities for greater emissions reduction.

The following sets out potential measures to reduce emissions generated from freight. Many of these have been identified by the International Transport Forum (ITF) as having some evidence of potential impact on GHG emissions[76]. These could help inform future discussions on emissions reductions in the freight sector. Much of the ITF's evidence has been obtained outside of Aotearoa, the feasibility of applying these initiatives within Aotearoa's context has to be studied in more depth. Given the market-led nature of the supply chain system, analysis of these measures would also have to be carried out in close consultation with the freight industry and/or be private sector-led. Given the industry's interest in whole-of-life costs, efficient fleet management, and containing fuel expenditure, more rapid than expected gains could be made if low-emissions freight vehicle technologies arrives more rapidly than assumed here.

[75] Ministry of Transport. (2017). *Transport Outlook: Future State*. Retrieved from: TransportOutlookFutureState.pdf

[76] International Transport Forum. *Transport Climate Action Directory.* Retrieved from: https://www.itf-oecd.org/transport-climate-action-directory-measures

Optimising freight routes, equipment and vehicles has the potential to reduce transport emissions

There may be opportunities to optimise freight routes, the freight moved, equipment and vehicles to reduce transport emissions. However, further work and sector consultation is required to gain a comprehensive understanding of Aotearoa's freight system and the best options to improve efficiency across our supply chain to reduce emissions.

We need to understand if the spatial layout of our freight routes and logistics nodes can be improved to identify opportunities to reduce emissions

Aotearoa's major population and production centres are widely dispersed across two main islands and challenging terrain. Our geography presents significant distances that domestic freight potentially has to travel. We need to fully understand the optimal spatial layout of transport and logistics nodes (e.g. ports, rail, freight hubs, etc.) in Aotearoa.

A comprehensive mapping of the spatial organisation of key freight nodes and corridors could help private operators and infrastructure owners identify if there are any inefficiencies, avoid duplication, and guide better investment decisions in freight infrastructure. Work on a national freight strategy should consider whether the system is set up as well as it can be given the challenges Aotearoa faces as mentioned above. A freight strategy should also consider and be informed by the context of the Resource Management Act reforms.

In addition, complementary land-use planning and resource management activities could support supply chain efficiencies, by minimising freight trips, assisting freight consolidation, and minimising the friction between freight and other network users and activities (e.g. in creating dedicated lanes for freight). Alongside other aspects of the freight system, this should be discussed with the freight logistics sector and other community stakeholders to better understand the opportunity it provides and the trade-offs involved.

We may be able to improve the efficiency of first/last-mile urban deliveries

A January 2020 World Economic Forum report has forecasted a 32 percent increase in emissions from last-mile deliveries over the next 10 years as the number of urban dwellers and online shoppers grows.[77] Globally, demand for urban last mile delivery is predicted to grow 78 percent by 2030, with a corresponding 36 percent rise in delivery vehicles in inner cities. This trend is likely to have relevance in Aotearoa as well. Other countries have been able to improve urban freight efficiency through consolidating deliveries in urban consolidation centres (UCCs) or drop-off/pick-up points for self pick-up. Some forms of UCCs are already being used in Aotearoa in the large population centres of Auckland and Wellington. How much more scope there is for Aotearoa to open further consolidation centres and complement these with last-mile low emission modes such as electric vans or cargo-bikes remains to be studied.

[77] World Economic Forum. (2020). *The Future of the Last-Mile Ecosystem.* Retrieved from: The Future of the Last-Mile Ecosystem | World Economic Forum (weforum.org)

Consumer and business owner demands could influence freight patterns

There are a range of ways that consumer demands affect freight activity. For example, the significant growth in online shopping and increasing demand for quicker delivery or 'just-in-time' delivery has influenced how freight companies operate. In particular, it has lead to freight companies focussing on speed and efficiency. This makes slower and lower emission modes (such as rail and coastal shipping) less competitive.

If supply chain managers and consumers accepted slightly longer delivery times, it could enable slower modes, which are often lower emission, to play a larger role. This may require efforts to shift and shape consumer preferences, which will be challenging. Alternatively, continuing to focus on speed and convenience could also change where and how goods are manufactured. For example, centralised manufacturing may change to more dispersed locations. This could enable businesses to deliver their products to consumers more quickly. Higher levels of confidence in the resilience and reliability of the supply chain could also reduce the demand from business owners for speedy deliveries that often means goods are hurried to their final destination only to then wait.

The key is that if consumers demand more sustainability in the supply chain it could lead to innovative ways to deliver goods. This could include improving the efficiency of the supply chain, switching to lower emission modes or changing where goods are manufactured in the first place. Demand sustainability could be supported through engagement, promotion and education activities to create public demand for sustainable supply chains.

Some companies are already responding to consumer demand for more sustainable freight options by providing customers with information on the emissions arising from their current transport choices and the option for slower 'greener' delivery of their goods.

Improving the efficiency of freight payloads could potentially reduce GHG emissions

Payload refers to the carrying capacity of vehicles. Improving the load factor for freight is one of the most efficient ways to improve energy efficiency and lower carbon emissions. By transporting as much freight as possible per load, the number of trips required is reduced, and empty running (which arise due to an imbalance in outward and return freight volumes) could be minimised. This also depends on the type of goods that are being transported and their value. There are also cost savings to be gained by logistics companies and freight owners. However, there are challenges in doing so in Aotearoa given the imbalance in freight flows where there is more freight flowing from the North Island to the South compared to flows from South to North.

The use of high productivity motor vehicles (HPMVs) increases the ability to transport a given freight task with fewer vehicle kilometres travelled, resulting in lower fuel consumption per unit of transported cargo. The gains come from a mix of either increased mass and/or increased vehicle length which increases cubic capacity. The evidence in the literature on

the impacts of HPMVs on emissions has been mixed, largely due to varying assumptions about road freight price elasticity and the specific payloads, distances, and costs considered. The introduction of HPMVs in some countries like Canada, Australia and Sweden and also in Aotearoa has been associated with freight efficiency, reduced road traffic and lower GHG emissions.

Since 2011, Aotearoa has increased the maximum capacity of heavy vehicles beyond the 44 tonne standard limit on gross vehicle mass and also provided increased length. The limit of 50 tonnes and longer vehicle with a corresponding 9-axle configuration (50 MAX) compared with a standard 8-axle truck and trailer has been calculated to incur no additional material wear and tear on pavements and bridges after allowing for efficiency gains. Waka Kotahi has also invested in upgrading strategic freight routes to allow for more widespread use of these 50 MAX trucks and other HPMVs. Some routes have even been approved for use by specifically designed 62 tonne HPMVs. It may be possible to explore whether more sections of the road network could support higher capacity trucks and whether any additional costs of maintenance and infrastructure upgrades could be justified. However, allowing heavier and greater cubic capacity loads on trucks might conversely lead to competition with lower carbon modes on some routes.

Intelligent Transport Systems (ITS) can help to improve freight efficiency

Intelligent Transport Systems (ITS) make use of technologies like wireless communication, cloud computing, and big data analytics to provide better quality, real time, automatically collected data to transport users. They could be applied to vehicles, infrastructure and operating systems to improve freight management, including improving load factor, finding optimal delivery routes, and improving delivery times.

The impact on emissions would result from better fleet and traffic management and energy consumption, although this is difficult to quantify as it would depend on the specific technologies applied. Its effectiveness in the Aotearoa context needs to be assessed.

In Aotearoa, some form of ITS is being used by many freight operators, e.g. to track freight movements and monitor fuel utilisation. Raising the awareness and benefits of ITS could encourage further uptake by smaller operators.

Promoting eco-driving can reduce GHG emissions, as well as offer significant co-benefits for businesses

Truck and train driver training and technologies that assist fuel efficiency and lower maintenance provide a good opportunity to reduce transport emissions. Driver training can involve techniques as simple as scanning the horizon or paying attention to traffic lights to avoid sudden stops and starts. Assistive technologies include on-board equipment that monitors and provides feedback to inform driving, and tyre pressure management systems, which dynamically adjust tyre pressure according to the terrain.

According to the Aotearoa Safe and Fuel Efficient Driving (SAFED) programme (administered by Waka Kotahi), eco-driving on roads could lower fuel consumption by as much as 10 percent, with corresponding impacts on reducing emissions. It also presents a

strong business case and co-benefits to encourage businesses to implement this approach which assists them in lowering maintenance costs, reducing damage to goods transported and improving road safety. Effort will be required to embed new behaviours with the road and wider freight industry, including improving their ability to monitor fuel use.

We can make better use of data and support information sharing and collaboration to reduce freight emissions

Data and information sharing will be essential to assist us to gain a better understanding of the freight system and opportunities to reduce transport emissions. The availability of more and better quality data could assist the government to gauge the efficiency of the freight sector, design fit-for-purpose interventions, determine their effectiveness, price in externalities and make efficient infrastructure investment decisions. Privacy and commercially sensitive data considerations would need to be balanced, especially if we give consideration to making this data available to the private sector to assist with guiding their business decisions.

Currently, the Ministry of Transport's Freight Information Gathering System (FIGS) and the National Freight Demand Study provide valuable information on freight volumes, origins and destinations, modes used and types of commodities. However, more detailed, real time data could be required to build a better understanding of the overall system, identifying risks and emerging trends, and assessing the impact of infrastructure decisions through dynamic modelling. Data from the E-RUC could also be more routinely analysed to identify risks and emerging trends to assist future uptake of electric vehicles. Additional data which would be useful to have includes (but is not limited to) freight interactions across modes, peaks and troughs of freight traffic along key corridors, and ownership and operating structures of various players in the industry. There may be resistance from the highly competitive freight industry. It would need to see clear private benefits before publicly divulging potentially commercially sensitive information.

The gathering of more data will require a cross-government response and should include departments such as Stats NZ and MBIE to address data gaps.

We could encourage data sharing and cross-business collaboration

The sharing of data and best practices could be encouraged through voluntary collaborations between businesses that aim to build sustainability into their operations. Collaboration between businesses across the supply chain may generate opportunities to optimise routes and modal share, share loads, and leverage back-loading opportunities. This would likely require freight owners and operators to share their data in a way that protects commercial confidentiality. We understand that customers are already starting to demand improved transport emissions performance in their normal course of business. The extent to which cross business cooperation and sharing is already happening could be further explored, as well as whether there is scope to encourage more of such collaborations or provide more support to existing ones.

Improving the efficiency of our overall freight supply chain: possible key actions

Optimising freight routes, logistic nodes, equipment and vehicles:

- Undertake an examination of the efficiency of the spatial organisation of supply chain nodes (e.g. location of ports and freight hubs).
- Examine the potential to improve the efficiency of first and last-mile delivery centres (e.g. urban consolidation centres, drop-off/pick-up consolidation points, use of micro-freight, pilot of concessions).
- Consider if there is potential to optimise payloads, e.g. load maximisation and back loading.
- Support the further use of Intelligent Transport Systems (ITS).
- Analyse if there is opportunity or restrictions to the further expansion of the weight and length limits of high-productivity motor vehicles (HPMVs).
- Further promote eco-driving and driver training programmes.[78] **(Promoting work already being implemented by industry)**

Information sharing and collaboration:

- Examine opportunities for the collection and better use of data to improve efficiencies in the freight system.
- Consider encouraging/supporting voluntary business collaborations to reduce emissions in logistics.

(Many of these actions will be considered through the National Freight Strategy)

Consultation question 10

The freight supply chain is important to our domestic and international trade. Do you have any views on the feasibility of the possible actions in Aotearoa and which should be prioritised?

[78] Waka Kotahi Transport Agency. (2020.) *Operator Rating System (ORS).* Retrieved from: https://www.nzta.govt.nz/commercial-driving/operator-rating-system-ors/

We can improve the resilience and reliability of less carbon intensive transport modes to improve modal choice

Shifting freight movements from road to more efficient and less carbon intensive transport modes would reduce emissions. Currently, freight movement is dominated by road transport which carries about 92.8 percent of tonnage of 75.1 percent of tonne-kilometres. This is compared to the 5.6 percent tonnage/11.5 percent tonne-kilometres and 1.6 percent tonnage/13.4 percent tonne-kilometres carried by rail and coastal shipping respectively.[79] Road freight emits on average 136g of CO_2 equivalent per tonne-kilometre, compared to 28g by rail (21 percent of road) and 16 to 45g by coastal shipping (12 to 33 percent of road).[80]

However, the amount of freight that can be shifted to these modes is limited due to Aotearoa's geographical characteristics, market expectations around timeliness and total costs (including transfer costs), limited access to rail and coastal shipping for rural freight users, infrastructure constraints (e.g. fixed tunnel heights for rail), the characteristics of the cargo, as well as the distance travelled. Road freight tends to be the cheapest option where distances are short and cargo volumes are low and where geographic constraints prohibit cost effective rail and coastal shipping infrastructure.

Some studies, albeit from some time ago, have estimated that rail[81] and coastal shipping[82] could increase their respective mode shares to 20 percent of the freight task on a tonne-kilometre basis. However, these studies looked at rail and coastal shipping separately and did not consider how the two modes may compete for some of the same contestable freight.

Both rail and coast shipping are important parts of the supply chain system, and the National Freight Strategy will have to consider how systems settings can better enable modal-choice by freight shippers.

Long-term investment is required to improve modal choice in the freight system

Our rail infrastructure has suffered from a lack of long-term investment and inadequate planning and funding frameworks. There have been issues around the resilience and reliability of the rail network to support supply chains. To address this, the Land Transport (Rail) Legislation Act 2020 implements a new long term planning and funding framework for the heavy rail track network under the Land Transport Management Act 2003. Investment in a reliable and resilient rail network is anticipated to take 7 to 8 years to complete, and will enable it to maintain and improve service levels. This will provide a platform for future investment in growth in rail freight services.

Current investment priorities for rail as outlined in the draft New Zealand rail plan, include the replacement of freight locomotives and the inter-island ferry assets which are at or beyond their economic lives. Renewing these assets will lead to further reductions in the emissions from the rail network. The Government is also already investing extensively in the Wellington and Auckland passenger networks to improve reliability and support the growth of these

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79 Ministry of Transport.(2017). *National Freight Demand Study.* Retrieved from: NFDS3 Final Report 011019-Rev1 (transport.govt.nz)

80 Ministry for the Environment. (2019). *Measuring Emissions: A Guide for Organisations. 2019 Detailed Guide*.

81 Mackie H, Baas P and de Pont J. (2007). *Prediction of freight growth by 2020 and rail's ability to share the load*. IPENZ Transport Group Conference, Tauranga.

82 Rockpoint Corporate Finance Ltd. (2009). *Coastal Shipping and Modal Freight Choice.*

networks into the future. This includes joint investment in the City Rail Link in Auckland, with the Auckland Council, which is the biggest infrastructure project in Aotearoa.

Going beyond these investments and considering matters such as additional electrification of the rail network, will need to be carefully weighed against the relative benefits of other initiatives to reduce emissions, given the substantial costs of these investments.

Similarly, the Government Policy Statement 2021 includes a coastal shipping activity class of up to $45 million over three years, but more work is required to determine how this could best support coastal shipping.

The government has invested to support the development of inter-modal hubs to facilitate employment opportunities, modal choice and improve supply chain efficiency

Intermodal freight terminals are nodes in the logistic chain which enable the efficient transfer of goods between different modes of transport. While there may be transfer costs incurred, intermodal terminals could optimise the use of transport modes, providing greater capacity, efficiency, reliability and resilience for operators. They could therefore allow freight owners more choice in the mix of modes they use. Existing examples of intermodal freight terminals in Aotearoa include log transfer yards, rail-enabled distribution terminals, container transfer sites, inland ports or industrial parks with transfer facilities.

There has been little public sector investment in intermodal terminals in Aotearoa over the last forty years. However, around the world, the use of inter-modal solutions by the private sector has increasingly been supported by government investment. The government has invested in inter-modal hubs through the Provincial Growth Fund (PGF) in light of the objective to revitalise our heartland regions through growing employment and economic opportunities. Examples include the following.

- Central North Island Regional Economic Growth Hub – KiwiRail has received investment to undertake the design (Master Plan) of the hub, have the land designated for rail use and has commenced purchasing the required land.[83]

- Kawerau Container Terminal Rail Siding - Development of a Kawerau Container Terminal with rail siding access and related infrastructure. The terminal develops adjacent to the current KiwiRail yard with a second line being built to create a rail siding.[84]

The extent of emissions reduction from the use of intermodal terminals largely depends on the mix of modes and transfer costs used in the freight journey, including whether the journey taken reduces the emissions generated during any international legs involved. Movements where the road component is minimised compare more favourably than when extensive road transport is required at the start or end of the rail/shipping component.

83 https://www.kiwirail.co.nz/what-we-do/projects/regional-freight-hub/

84 Public list of projects: https://www.growregions.govt.nz/media-centre/funded-projects/

Rail and coastal shipping also provide co-benefits

Rail and coastal shipping provide demonstrable value in the form of reduced road congestion, air and noise pollution and maintenance costs, as well as improved road safety outcomes.[85] Coastal shipping and rail could also build resilience in supply chains by providing alternative transport option during road and/or wider land-based disruptions.

Enabling modal-choice in freight through the use of low emissions modes: possible key actions

Rail and coastal shipping:

- Improve the resilience and reliability of the rail network through completing investments over the next decade outlined in the New Zealand Rail Plan.[86]
- Consider how coastal shipping fits within the supply chain and how its activity class in the Government Policy Statement for land transport 2021 could be implemented. **(Underway)**
- Complete the development of PGF funded intermodal hubs. **(Underway)**

Decarbonising freight vehicles will be critical for reducing transport emissions

Aotearoa uses a combination of aviation, truck, rail and coastal shipping to move freight. All of these modes contribute to our domestic emissions, and therefore we need to consider steps towards decarbonising them. There are opportunities for Aotearoa to use more efficient, cleaner trucks, rail, ships and planes, and improve supporting infrastructure.

Decarbonising road freight provides the best opportunity for Aotearoa to reduce freight emissions

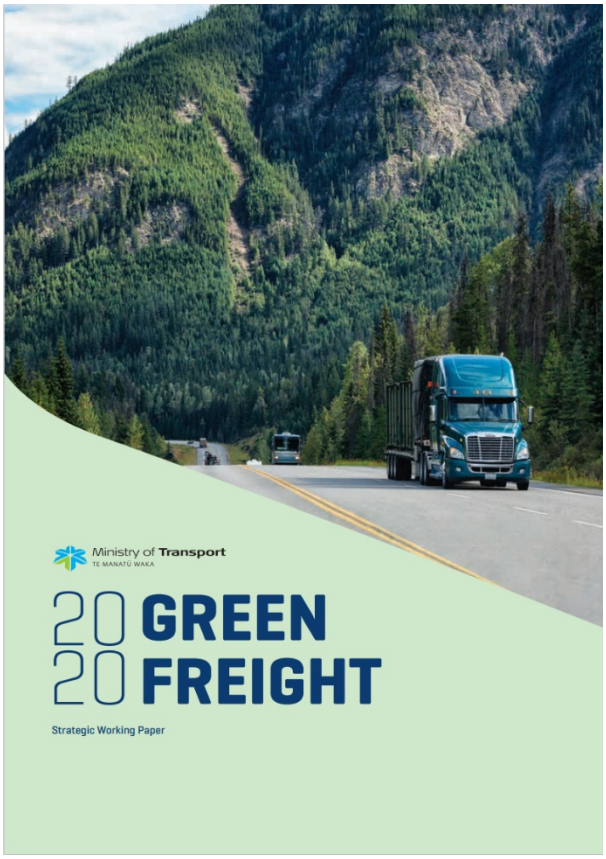
There are about 150,000 trucks on the road, travelling a combined total of nearly three billion kilometres. These heavy vehicles, the majority of which are freight vehicles, are responsible for almost a quarter of Aotearoa's transport GHG emissions. Given that the majority of the freight task is likely to continue to be transported by road, decarbonising road freight will be important for achieving Aotearoa's emission reduction targets.

[85] Ministry of Transport. (2020): *The Externality Value of Rail in New Zealand;* Ministry of Transport. 2020. *The Externality Value of Coastal Shipping.*

[86] Ministry of Transport. (2020) *Te anamata o te ara tereina: future of rail,* retrieved from: https://www.transport.govt.nz/area-of-interest/infrastructure-and-investment/future-of-rail/

The Ministry of Transport's Green Freight Strategic Working paper highlights several opportunities to transition road freight to alternative green fuels

The Green Freight working paper highlights a range of options to support the uptake of biofuels, electrification and green hydrogen in the road freight industry.[87]



Conventional biofuels, along with the advanced biofuels being produced commercially overseas, have the potential to provide an immediate solution to reduce GHG emissions

Conventional biofuels are already being produced in Aotearoa in low volumes, and could be scaled up with greater investment. Aotearoa could also look at options to increase the uptake of advanced biofuels, which could also be used in aviation and maritime. Aotearoa could also consider if imposing penalties on high GHG emitters or incentives for lower emitters operating truck fleets is a feasible option that could shift behaviour change.

Battery technology is developing quickly but battery electric heavy trucks are still not readily available and there remain significant barriers

Aotearoa is well placed to reduce emissions through electrification because of our high level of renewable electricity. However, the current upfront cost of battery electric vehicles is a significant barrier to their uptake in Aotearoa, as is the uncertainty around their ability to deliver the freight task. At this time, electrification is best suited to medium trucks undertaking shorter urban freight delivery tasks, and heavy trucks with return-to-base operations or delivering niche services across the freight industry. Electric vehicle technology is improving and becoming cheaper very rapidly; a more rapid introduction of low emission freight vehicles than assumed in the pathways in this document may be achievable, subject to further progress. We should consider options that help to influence vehicle supply chains, and incentivise the uptake of low and zero-emission vehicle options across the freight industry.

[87] Ministry of Transport. (2020). *Green Freight Strategic Working Paper,* retrieved from: https://www.transport.govt.nz/assets/Import/Uploads/Our-Work/Documents/Green-Freight-Strategic-Working-Paper_FINAL-May-2020.pdf

Green hydrogen is increasingly being considered as a transport fuel but there are also significant barriers facing the adoption of hydrogen fuel cell vehicles

In 2019, Government published a green paper called "A vision for hydrogen in New Zealand.[88] This report notes that Aotearoa possesses large, and as of yet undeveloped renewable electricity resources. This renewable electricity could be used to produce predominantly green hydrogen, which could become a fuel source for Fuel Cell Electric Vehicles (FCEV).

Green hydrogen can be used as a transport fuel source by storing it under pressure in cylinders in the vehicle and converting it with oxygen to electricity. There is global recognition that hydrogen has the potential to be a significant fuel of the future for certain applications.[89] Yet in balancing this, converting electricity into hydrogen and back to electricity can involve energy loss in the order of 45 percent making it an inherently inefficient process.[90]

FCEVs appear best suited to long-haul freight tasks, along with emerging heavy electric trucks and ultra-fast charging technologies. However, as with battery electric trucks these vehicles are not readily available globally.

Supporting infrastructure is critical for enabling the transition to both battery electric vehicles and FCEVs

Freight companies are unlikely to invest in vehicles that cannot be easily recharged/refuelled. If the Government pursues widespread adoption of biofuels, electrification and green hydrogen then it should consider how to support market investment in infrastructure, as well as provide clear signals through its own investments.

Cleaner trucks will also support co-benefits, such as improving air quality in our towns and cities

Increasing the number of low-emission trucks on Aotearoa's roads could have benefits for the health and wellbeing of New Zealanders. In particular, by reducing air and noise pollution in densely populated parts of the country and on freight routes.[91]

Our international obligations will help to drive emission reductions in shipping, including through encouraging cleaner, more efficient ships and ports

Aotearoa is dependent on shipping for the movement of goods in and out of the country and for connectivity within and between the North and South Islands. It is currently projected that global maritime freight transport will grow at a compound annual growth rate of 0.86 percent over the next 30 years.

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88 New Zealand Government. (2019). *Green Paper: a vision for hydrogen in New Zealand*. Retrieved from: https://www.mbie.govt.nz/dmsdocument/6798-a-vision-for-hydrogen-in-new-zealand-green-paper

89 International Energy Agency. June 2019. *The Future of Hydrogen*

90 Youmatter. (2019). *Hydrogen Cars vs Electric Cars: Which is More Sustainable.* Retrieved from: Hydrogen Cars Vs Electric Cars: Which Is More Sustainable? (youmatter.world)

91 PIARC. (2020). *Road Traffic Noise.* Retrieved from: https://www.piarc.org/en/PIARC-knowledge-base-Roads-and-Road-Transportation/Road-Administration/Environment/Act-on-Road-Traffic-Noise

Global increases in maritime freight are expected to happen due to new international trade agreements, emerging markets and new trade routes. Growing e-commerce is also expected to increase demand for container shipping. Ninety-nine percent of our international trade is transported by sea[92]. Our future freight movement growth will depend on if we pursue new trade agreements and routes, and if our growing population puts greater demand on e-commerce transactions. Aotearoa will likely see some growth in its freight movements but probably not anywhere near the rate that is predicted globally.

Subsequently, if freight movements increase and there has been no change to improving the efficiency of ships that shift freight, it is likely that emissions from this activity would increase.

Ships visiting Aotearoa are part of the international shipping sector, whose emission reductions are being progressed through the International Maritime Organization (IMO). As part of Hīkina te Kohupara we are focusing on possible actions that could reduce emissions from ships undertaking domestic journeys in Aotearoa's national waters. This is irrespective of whether they are Aotearoa-flagged vessels or foreign vessels.

Aotearoa is currently in the process of acceding to Annex VI of MARPOL (International Convention for the Prevention of Pollution from Ships)

Annex VI specifically controls emissions to air from ships. As most port calls are made by international ships registered in countries that have already ratified MARPOL Annex VI, the greatest environmental gains for Aotearoa from acceding relate to our application of the emission rules to domestic shipping.

The domestic shipping sector contributes a relatively small proportion of Aotearoa's overall transport emissions and several key players in the maritime industry are already driving improvements to the sector without any direction set by government. Ships however contribute significantly to local air pollution in Auckland and Wellington.

Domestic ships in Aotearoa are a mix of new and second hand ships with a lifespan of approximately 25-30 years. Technical energy efficiency measures (improved ship design) are generally most effective for new ships. Therefore, additional actions will be needed to address emissions from the existing fleet.

There are several opportunities that address the energy efficiency of ships and port operations, as well as associated activities

Operational measures such as slow-steaming and hull cleaning are already undertaken by some ships to improve their operational energy efficiency and fuel consumption. We could introduce incentives for those ships already operating as efficiently as possible with incentives to encourage others to implement operational measures to improve their energy efficiency.

There is also opportunity to electrify the maritime sector through encouraging the use of fully electric/hybrid vessels; installation of renewable shore-side power supply for ships; and implementation of hydrogen/electric infrastructure for port operations. Other activities that might contribute to reducing emissions are improving the ship-port interface (reducing

[92] Ministry for the Environment. (2019). *Our marine environment*. Retrieved from: https://www.mfe.govt.nz/sites/default/files/media/Environmental%20reporting/our-marine-environment-2019.pdf

waiting time for ships entering ports), and green procurement (the inclusion of requirements relating to low- or zero-emission transport in public procurement processes, the purchasing of energy efficient vessels and the procurement of services in which vessels are used). The Commission acknowledges that the installation of a larger dry dock in Aotearoa could reduce emissions (which would mean large domestic ships would not have to travel overseas for maintenance and repair), however the contribution to emissions reductions may not be significant given the small size of Aotearoa's domestic shipping fleet.

All of these opportunities are likely to need significant capital investment and therefore cost effectiveness would need to be explored.

The most significant emissions reductions are likely to be realised following the uptake of alternative fuels. Those being explored internationally for use in shipping include LNG, methanol, biofuels, hydrogen and ammonia.

Supporting the uptake of cleaner ships will also result in co-benefits, such as improved local air quality in our port-cities and reduced ship noise

By reducing the time a ship spends in port, or changing the fuel it burns while berthed, we can improve local air quality through a reduction in pollutants such as nitrogen oxides (NOx, NO_2), sulphur oxides (SOx) and particulates. This would have positive impacts on the health of those communities living near ports and improve the liveability of the surrounding area. Onshore charging facilities could have additional benefits in terms of reduced noise pollution particularly in ports that have visiting ships that run auxiliary engines.

While the impact of shipping on biodiversity is not well documented, a reduction in pollutants and noise, both above and below the water, will also have benefits for wildlife.

Rail contributes a relatively small amount to Aotearoa's transport emissions but there are opportunities to reduce rail emissions

Today, the national rail network consists of 3,700 kilometres of track. Emissions from rail account for one percent of the transport sector emissions.

In the 2019 financial year, KiwiRail reported that the carbon footprint for direct emissions for its activities was 240,068 tonnes of CO_2-e emissions.[93] We note this likely includes both rail and ferries.

Electrifying our rail networks could reduce emissions but requires significant capital investment

Currently, only the central part of Aotearoa's North Island Main Trunk line is electrified. The high capital investment required to further electrify the rail network lines (for freight), build supporting infrastructure, and procure more electric locomotives may be prohibitive for it to be further electrified. KiwiRail has estimated that it would cost $2.5 million to electrify one kilometre of a single track.[94] For the high initial costs of electrification to be justified, modal

[93] KiwiRail. (2019). *Kiwirail's 2019 Annual Integrated Report*. Retrieved:https://www.kiwirail.co.nz/assets/Uploads/documents/Annual-reports/2019/b563b44217/KiwiRail-Integrated-Report-2019-FINAL.pdf

[94] KiwiRail. (2016). *Media release: Kiwirail announces fleet decision on North Island Line*. Retrieved from: https://www.scoop.co.nz/stories/BU1612/S00810/kiwirail-announces-fleet-decision-on-north-island-line.htm

shift of freight from road to rail would need to be intensified to yield higher levels of rail traffic, and therefore greater gains from lower operational costs. Battery-powered trains able to travel on non-electrified routes could be explored. These could bridge gaps between electrified sections of the rail network and potentially reduce the proportion (and costs) of the network that needs to be electrified.

Biofuels could be a more cost-effective solution for decarbonising the rail network

As an alternative to electrification, we should consider the benefits of using biofuels for rail. Biofuels would be suitable for transport modes that are difficult to electrify such as heavy long-haul road and rail transport. Ethanol and biodiesel, added as blends in petrol and diesel respectively could offer immediate options to reduce emissions and increase Aotearoa biofuels use. For example, KiwiRail is testing biodiesel in some diesel trains and also the Interislander ferry.[95]

A cleaner rail system could support co-benefits, including reducing operational costs

Electric motors can act as power generators, where they recover the energy spent in braking to feed back into the national electrical grid. Given the much higher energy efficiency of electric engines and the need for less maintenance, electric locomotive operating costs could be much lower than a diesel train.

The economic benefits from implementing electric trains include lower fuel costs, and because they are marginally lighter than diesel trains there is less wear on tracks, which may reduce maintenance costs. Additionally, the costs of overhead lines maintenance would be reduced.

Improving the design of existing infrastructure and vehicles can reduce emissions

Improving the design of road and rail vehicles to improve fuel efficiency would contribute to reducing emissions. These could include adaptations to improve transmission efficiency and to reduce aerodynamic drag, vehicle weight and rolling resistance.[96]

There are barriers to adoption including high upfront costs of equipment, which may make these efficiency gains particularly prohibitive and risky for smaller companies. The competitive nature of the market also leads to a lack of incentive to invest in the absence of external pressures (e.g. stricter fuel and emission standards, or government subsidies for using these adaptations). The long lifetime of assets (both trucks and train locomotives) further complicates the uptake of these adaptations, although some can be retrofitted onto existing fleets. Government could explore working with the industry to investigate the extent to which the fuel efficiency in freight vehicles could be further improved, as well as what levers could be used to encourage change and help smaller companies manage risks. This could include examining the current rules around vehicle dimensions that prevent the use of aftermarket aerodynamic devices.

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[95] 'Kiwirail firms up plans for biodiesel trials despite supply doubts' retrieved from: https://www.rnz.co.nz/news/national/392180/kiwirail-firms-up-plans-for-biodiesel-trials-despite-supply-doubts

[96] As cited in International Transport Forum. (2018). *Towards Road Freight Decarbonisation Trends Measures and Policies.*

There is some evidence that better design and maintenance of roads could reduce GHG emissions.[97] There may be benefits in reviewing the design of roads to reduce fuel consumption, e.g. deducing the optimal mix of materials used, reducing the number of curves, surface roughness (including sealing rural roads) or gradient of the road. There may also be scope to improve the maintenance of road conditions in Aotearoa, which also has safety implications. A July 2020 report by the Office of the Auditor General found that since 2009/2010 less has been spent on renewing state highways than the rate of depreciation for the state highway network, which poses some risk to Waka Kotahi's long-term ability to maintain its condition.[98] Adequately maintaining the condition of roads would be important especially if Aotearoa explored further expanding the weight limits of HPMVs, as mentioned earlier.

Decarbonising aviation is important to Aotearoa's trade and social connections

Aviation will play a role in Aotearoa's decarbonisation of the transport system. Aviation contributes to our freight system through the fast movement of people and goods to destinations domestically and internationally. It is a mode that is generally relied upon to quickly shift high value and/or perishable products to our trade markets, such as medicines. Substituting alternative modes to shift high value/perishable products is not generally feasible because of the need to meet tight timeframes and/or to travel to places that can only be readily accessed by aviation.

Aviation is a high emitter and efforts will need to be made to reduce aviation's contribution to our emissions profile. Our participation in CORSIA begins to address international aviation emissions, however more is required both domestically and internationally. Efforts to decarbonise our long-haul flights, given their trade contribution, Pacific and social connection will be important given our distance from markets.

Decarbonising freight modes: possible key actions

Cleaner trucks:

- Introduce vehicle CO_2 standards.
- Implement EURO 6 to improve air pollutants from trucks.
- Consider if the current RUC exemption for heavy electric trucks should be expanded to other low emission fuels used by heavy trucks. **(Under consideration)**
- Consider expanding the scope of the existing low emissions vehicles technology funding to accelerate the uptake of proven low emissions vehicle technology.
- Investigate the viability of introducing a penalty or financial disincentives system for high GHG emitting heavy trucks.
- Investigate the viability of providing upfront grants or other incentives (such as changing depreciation rates) for low and zero emissions trucks.
- Investigate and introduce Green freight procurement through third party contractor rules for government activities.

[97] A 2019 study found that preventative maintenance of road pavements could reduce GHG emissions by up to 2%, even after adopting a life-cycle perspective and taking into account pollution generated during road construction.

[98] Controller and Auditor General. (2020). *New Zealand Transport Agency: Maintaining state highways through Network Outcomes Contracts*. Retrieved from: https://oag.parliament.nz/2020/nzta-contracts/docs/nzta-contracts.pdf

- Phase out the registration of diesel heavy vehicles beyond a certain date, e.g. from 2035 or banning diesel trucks in certain cities or zones
- Invest in domestic industry to refurbish diesel trucks with zero emissions options
- Implement a biofuels mandate

Cleaner rail:

- Investigate the use of biofuels for rail. **(Included in biofuels mandate, which is under development)**
- Explore the feasibility of future electrification of rail (i.e. non-metro rail) or other low-emission alternatives.

Cleaner ships and ports and associated activities:

- Introduce targets, rewards, incentives for energy efficient ships using Aotearoa ports.
- Apply MARPOL Annex VI energy efficiency requirements to the Aotearoa domestic fleet. **(Aotearoa is acceding to MARPOL Annex VI)**
- Introduce a target /mandate for renewable fuel (biofuels, hydrogen, ammonia) for ships that applies to the domestic fleet. **(underway)**
- Consider introducing a mandatory speed limit (i.e. impose slow steaming) for ships transiting around Aotearoa.
- Electrify Aotearoa's fleet (ferries, tugs, cement carriers and fuel tankers). **(Some private electric ferries already built/procured)**
- Improve the ship/port interface by implementing Just-in-Time arrival guidance.
- Incentivise or invest in renewable shore-side power supply for ships.
- Incentivise or invest in renewable energy for port operations.
- Consideration of a large dry dock in Aotearoa.
- Invest in future technologies (e.g. autonomous shipping that provide low carbon alternatives to road freight).
- Introduce decarbonisation as a criterion in government procurement of ships and shipping services.

Improving existing infrastructure and vehicles:

- Investigate potential for adoption of more efficient vehicle design.
- Investigate the impacts of better road design and maintenance.

Decarbonising fuels:

- Consider implementing a carbon intensity standard for all transport fuels.
- Incentivise and/or provide financial support to expedite the uptake of renewable fuels.
- Investigate and implement renewable fuel targets.
- Incentivise or invest in infrastructure for alternative fuels and/or electrification, including ultra fast charge. **(Some Government investment has already taken place e.g. for hydrogen production)**

Exploring opportunities for the domestic production of sustainable alternative fuel

Biofuels and green hydrogen both offer potential for reducing Aotearoa's transport emissions. There is an opportunity for Aotearoa to scale up production of these fuels, and in doing so be able to meet Aotearoa's collective transport demands. Investment is required, and to encourage this certainty is required by investors – certainty of the pathway that Aotearoa will be taking to reduce emissions. Clear government policy direction will enable investors, businesses and consumers to consider how they participate in the market.

In September 2020, the Ministry for Primary Industries (MPI) released its stage one report Aotearoa wood fibre futures. The report identifies wood processing technologies that could help Aotearoa move to being a high value and low carbon economy. It focused on how Aotearoa could build on the forestry industry's current strengths to create a low-carbon future. The report identified possible alternatives to concrete and steel, and biofuels made from woody biomass. The report identified 15 technologies found globally that Aotearoa could prioritise and laid out ways to attract investors.

MPI has released a request for proposal (RFP) for Stage 2 of the project, which will focus on building the investment case and provision of a detailed feasibility study for the priority technologies. This work will involve discussions with key industry partners, including those in forestry, transport, construction, and energy. MPI will work closely with other agencies, including the Ministry of Transport and MBIE, to identify policy tools to incentivise investment.

The four priority product candidates in scope of the RFP are:

- Wood-based products: that will provide a large source of 'residues' that could be the feedstock for the making of the priority product candidates below;
- Biocrude oil;
- Liquid biofuels, including Safer Aviation Fuel and Biodiesel; and
- Solid fuels (e.g. Wood Pellets, Dried Wood Chip or equivalent).

Consultation question 11

Decarbonising our freight modes and fuels will be essential for our net zero future. Are there any actions you consider we have not included in the key actions for freight modes and fuels?

Chapter 9: Supporting a Just Transition

Key points

- Government has committed to taking a 'Just Transition' approach to becoming carbon free – this means making the transition fair, equitable and inclusive.
- The transition to a low carbon economy will create significant economic opportunities for businesses, and job creation in the transport and energy sectors.
- Some parts within the transport sector may be more affected by the transition than others, especially if they face rising transport costs, and/or find it difficult to adapt. Government could assist the sector to adopt new technologies to encourage an earlier transition, and support education and upskilling.
- Many people will benefit from the transition to a zero carbon transport system. For example, many New Zealanders will benefit from better transport options, better health, and lower and more stable transport costs over time.
- People who already experience social/economic disadvantages are likely to be disproportionately affected by any rise in transport costs (as already occurs when fuel prices rise). To make a Just Transition, Government needs to mitigate the impacts of interventions that could increase transport disadvantage. There are also opportunities for the Government to improve transport equity during the transition.
- The speed of change is an important consideration for a Just Transition. We urgently need to transition to a zero carbon system, so Government needs to clearly signal changes to give businesses and consumers time to prepare and make the necessary changes. Government also needs to work collaboratively with industries to ensure the transport sector can adapt and overcome challenges associated with the transition.

What is a Just Transition?

When passing the CCRA, Government committed to taking a Just Transition approach to becoming carbon free. A Just Transition is fair, equitable and inclusive and makes sure that Government carefully plans with iwi, communities, regions and sectors to manage the impacts and maximise the opportunities of the changes brought about by the transition to a low emissions economy.

A Just Transition approach ensures that people affected by changes are considered by those making decisions. Early action on a Just Transition can minimise the negative impacts and maximise positive opportunities. The Paris Agreement on climate change includes Just Transition as an important principle.

The government's Transition Hub provides advice to the Government on how we transition to a low emissions economy. It also supports government sectors such as the energy, transport, built environment and waste sectors to make the transition. This includes making

sure policies of the various sectors align. The hub is made up of people from government agencies in the natural resources sector.[99]

Government needs to work with industries and workforces that will find it difficult to transition quickly

As transport in Aotearoa is decarbonised, impacts will fall differently on the various industries and workforces in the transport sector. For example, there could be disproportional impacts on large versus small freight operators. Smaller operators may not have the capacity to transition to new technologies or change business models, or they may not have the finances to buy a new electric truck. Mechanics whose businesses are based on servicing ICE vehicles may also face challenges.

At the same time, there is significant potential for economic opportunity and job creation as we shift towards a low emission transport system. This includes through the uptake of new transport technologies, active modes, and increased domestic production and use of biofuels. Training and upskilling the sector to shift into these new areas will be important. There is potentially a significant positive opportunity for Aotearoa to make its own biofuels from agricultural and forestry resources, replacing some imported fossil fuels. This will also contribute to energy security and resilience as we become less dependent on importing oil from international oil markets which fluctuate (and are sometimes volatile).

The Freight Sector

The freight sector is a highly competitive industry in Aotearoa. Currently low and zero-emission heavy trucks cost substantially more than their diesel equivalents, and will take longer to reach price parity than their light vehicle counterparts. Electric trucks will weigh significantly more, and take significantly longer to recharge/refuel, compared to current diesel trucks. They will also require charging infrastructure, which will require additional investments. High investment costs for trucks and charging may delay the road freight sector transitioning to cleaner vehicles. However, as the cost of fossil fuels rise, the sector should look towards the overall costs of their fleet and begin to decarbonise. Support to assist with the higher costs associated with the transition to lower carbon modes, like electric trucks, hydrogen and biofuels may encourage earlier transition. As noted in Theme 3, the Ministry is starting work on a National Supply Chain Strategy to provide strategic direction and prioritise the objectives for the supply chain, one of which is reducing emissions.

Vehicle CO_2 emission standards could also result in some trucks becoming obsolete, and the cost of newer, fuel-efficient trucks may be out of reach for some operators. To mitigate the impacts of this, Government could consider assisting the freight sector to transition. Possible actions include offering support to the freight sector; bulk purchasing arrangements for zero emissions trucks, sharing best practice around GHG emissions reduction approaches, and agreements around setting freight industry wide GHG emissions targets. The current RUC exemption for heavy vehicles also provides an incentive to encourage uptake.

Early adoption of new vehicle technologies can be high risk; if technologies fail it can result in a wasted investment, stranded assets or safety issues. Government financing to allow

[99] Ministry for the Environment. (2020). *The transition to a low-emissions and climate resilient Aotearoa New Zealand.* Retrieved from: https://www.mfe.govt.nz/climate-change/climate-change-and-government/climate-change-programme.

trialling of electric heavy vehicles, or funding to support infrastructure like low/zero emission freight vehicles charging infrastructure could be a good way to assist the freight sector in adopting new technologies, as it ensures any limitations of new electric heavy vehicles could be tested before purchasing.

The $27 million allocated to the National New Energy Development Centre in 2019 is an example of government and industry working together to implement a Just Transition – and the kind of investment and collaboration needed for a cleaner freight sector.

Vehicle servicing industry

Decarbonising the light and heavy vehicle fleet may see skill redundancies in the vehicle-servicing industry. Aotearoa has over 15,000 motor mechanics who will be affected by the shift away from internal combustion engine (ICE) vehicles towards low emission vehicles, and this sector has a skills shortage as it is. Electric vehicles have no need for oil changes, spark plug replacement, less wear on brakes and fewer parts to maintain, so less need for servicing. This could mean that relatively new and different skills may be required of mechanics. Mechanics would need training to become more electrically skilled, rather than mechanically skilled, in order to service electric vehicles safely and efficiently.

Education and upskilling is a significant opportunity here. Retraining and upskilling mechanics can ensure we retain a skilled workforce who can service the anticipated influx of electric vehicles coming into Aotearoa, alongside minimal skill redundancies in a sector which is already struggling to obtain adequate staffing.

We need to keep industries and businesses informed and stay consistent in our approach

Government signalling is a significant part of ensuring the transition to a low emissions transport sector goes smoothly. Major changes in requirements to our transport systems need to be signalled far enough in advance to allow the industry to prepare and plan. Consistency with any new policies will also be essential. Bipartisan support and industry acceptance of new policies would also help to ensure consistency through changes in Government.

We need to work collaboratively with industry to ensure the transport sector can adapt and overcome any challenges associated with the zero economy transition.

Government also needs to consider the distributional impacts in society to enable a Just Transition

As part of Aotearoa's commitment to a Just Transition, we need to consider how the transition to a zero carbon transport system will impact different groups of New Zealanders. Everyone will experience changes during this transition. Many people will benefit, but these benefits will not be evenly spread. Some people could also face higher transport costs. We must recognise the rights of iwi/Māori under Te Tiriti o Waitangi and build a strong Crown-Māori partnership as part of a Just Transition.

There are already major inequities in the transport system

Extensive international research demonstrates the important role of transport in creating an inclusive society.[100] The research shows that people who lack affordable access to transport have difficulty accessing goods, services and opportunities that are available to others as a fundamental part of belonging to society. This includes access to education, employment, health services, healthy food choices, and sporting, leisure, and cultural activities. From an equity perspective, there are two aspects that need to be considered to enable a fair and inclusive transition:

- *transport disadvantages*: some people have a lack of transport choices, which limits their options to participate in everyday activities
- *transport poverty*: some people overcome a lack of choices by paying more than they can reasonably afford for mobility, typically by buying and operating a car.

To make a Just Transition, government needs to mitigate the impacts of interventions that could increase transport disadvantages and/or transport poverty. Beyond this, government can also make interventions that improve transport equity.

Low-income households are more likely to face transport disadvantages and transport poverty than others in the population because they often live in car-dependent areas (e.g. on the edges of cities and in rural/remote areas), and face higher daily travel costs. Housing costs are usually cheaper in these areas relative to places with many jobs and amenities, but daily travel costs are often higher due to the need to travel long distances, usually by private car. This can perpetuate cycles of inequality, where low-income people living in areas with limited access to jobs, education, health care, and social services face high transport/living costs to participate in society.

Disabled people experience more transport disadvantages than others in the population. For example, they may find it difficult to use public transport (where available) if vehicles and services are not accessible, and many streets/footpaths have not been well-constructed and maintained for people in wheelchairs and with physical impairments. Disabled people also tend to have lower incomes than average.

Māori also tend to experience more transport inequities than other New Zealanders because they have lower incomes on average. They are also more likely to have an impairment at younger ages than other ethnicities. Many Māori people live and work in areas that are not well served by public transport.

Other groups of people who often experience transport disadvantages include children, solo mothers, and elderly people.[101]

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[100] See for example Social Exclusion Unit. (2003). *Making the connections: final report on transport and social exclusion.* http://www.socialexclusionunit.gov.uk/publications/reports/html/transportfinal/summary and Mackett, R, & Thoreau, R (2015), *Transport, social exclusion and health*. Journal of Transport & Health 2 (2015) 610–617.

[101] Rosier, K, McDonald, M. (2011). *The relationship between transport and disadvantage in Australia*. Australia: Australian Institute of Family Studies.

There are opportunities to reduce transport disadvantages during the transition, particularly in urban areas

Initiatives to provide people with better transport options, and to increase affordable housing close to jobs and amenities, will help to reduce transport disadvantages while also reducing emissions.

Public transport can play a particularly valuable role in reducing transport disadvantages. Improvements to the reach and frequency of public transport services (along with changes in urban form that support this) could make our transport system more accessible and inclusive, especially if services are significantly improved in socially deprived areas (where suitable). It is not always possible for people to use public transport to get to where they want to go, when they want to travel, even where frequent services exist. However, public transport services can provide a useful substitute for many trips, particularly for getting to and from work in some urban areas. In addition to improving public transport services, Government could also consider targeting public transport concessions at a wider-range of New Zealanders so that people on low-incomes and/or with an impairment can travel on public transport for less.

Urban cycle networks could also help to reduce transport disadvantages, by providing people with another low-cost travel option. Improvements to footpaths and intersections to give more priority to people walking and wheeling would also benefit a wide range of people, including disabled people, children, and elderly people.

A shift to low carbon transport modes will also help to reduce air and noise pollutants, and encourage more active travel. This will deliver better health outcomes, including for many low income households.

Under the Housing portfolio there is a significant amount of work to enable Māori to deliver on their own housing aspirations and to work in partnership to do this. Iwi and Māori aspirations include development on whenua, ability to develop papakāinga and the need for infrastructure to support this, often in areas that are rural. The transport sector will need to consider how it can support these aspirations in a way that enables communities to thrive and is consistent with Aotearoa's low emissions goals.

People living in outer-urban and rural/remote areas are less likely to benefit during the initial phases of the transition

The benefits outlined above are most likely to be experienced in urban areas, particularly places close to urban centres, where it is easier to provide people with access to a good range of travel options. People living in remote/rural areas, or on a city's fringe, usually have poor travel options other than using a car. Many low-income households live in these areas, where housing costs are cheaper compared to urban centres. It is usually not viable to provide frequent public transport services in these areas due to the low population densities. It can also be difficult for people to walk or bike to places for work, healthcare, education, amenities, and places of cultural importance due to the long travel distances involved.

In some urban areas where frequent public transport services are not viable, integrated walking and cycling networks could help to put public transport within reach of neighbourhoods. In more dispersed areas, it could be possible to improve shared mobility options such as on-demand shuttles. Some communities already run shared shuttles to

transport members of their communities to and from health services, marae, and local amenities. There could be opportunities for Government to support more of these services. It may also be possible to improve access to goods and services remotely, or via deliveries and/or mobile services, so that transport is not a barrier to affordable goods and services.

This discussion also reinforces the importance of creating quality compact mixed-use urban developments that includes options for affordable housing. Currently, many low-income households are forced to live in car-dependent areas with poor transport options. This can perpetuate inequities over time, as high transport costs reduce overall household incomes and savings.

There are risks that transport poverty could rise with some initiatives, unless government addresses the needs of disadvantaged groups during policy development

Government interventions that increase the cost of using vehicles, such as road pricing mechanisms, could have a disproportionate impact on low-income households who rely heavily on using a car. Government is already considering potential ways to mitigate the impacts of road pricing through its *Congestion Question* project.

Interventions that increase the cost of using fossil fuels could also increase transport poverty. This dynamic already occurs when fuel prices rise at the pump (due to government levies and/or rising international oil prices).

Low-income households will face higher travel costs if it costs more for them to purchase a vehicle. However, there will still be plenty of affordable used ICE vehicles available in Aotearoa over the next decade at least (and likely well beyond this). Even if imports of ICE vehicles are phased out in the 2030s, there will still be many ICE vehicles available domestically over the following decade – especially as more households, businesses, and government agencies shift to cleaner vehicles, or decide that they do not need to own so many cars due to better alternatives, and sell their previous vehicles.

While low-income groups will not necessarily face higher costs to purchase ICE vehicles, they do currently face financial barriers for shifting to cleaner vehicles. Government should consider ways to support more affordable access to cleaner vehicles for lower-income groups so that more people can benefit from the transition, especially in the short-term. Potential options include social leasing schemes, vehicle sharing schemes, and low-interest finance schemes.

As the supply of new and used electric vehicles in Aotearoa increases over time, cleaner vehicles will become more affordable. Initiatives to accelerate the uptake of EVs in Aotearoa over the next few years will therefore help to grow the market for more affordable used EVs in the future.

The shift to cleaner vehicles will reduce transport poverty longer-term

Low-income households in car-dependent areas are vulnerable to the impacts of fluctuating oil prices and higher petrol prices. Unexpected break-downs and maintenance of vehicles can also put severe strain on household budgets.

EVs, in comparison to ICE vehicles, are cheaper to operate. They have lower maintenance requirements. Charging costs are also more stable and predictable than petrol costs, as

retail electricity prices in Aotearoa tend to change slowly over time. Aotearoa also has an abundance of renewable energy sources to generate more electricity as demand increases.

Eventually, the shift from ICE vehicles to electric vehicles will therefore lead to lower and more stable transport costs for most households and communities, including low-income groups.

Transport levers alone will not be able to mitigate all of the inequities in the transport system

While there are many opportunities to reduce transport disadvantages by providing people with better transport options, and to avoid increasing transport poverty by mitigating the impacts of some interventions, it is also important to look beyond the transport system to make a Just Transition.

Broader interventions (e.g. in the social welfare/education/health sectors) that could also be considered to reduce transport disadvantages and transport poverty include:

- locating social housing in urban areas within walking and cycling distance of jobs, shops, and schools, and in areas well-served by frequent public transport services
- making school bus services (procured by the Ministry of Education) available for more students in remote/rural areas
- broader initiatives to reduce poverty and increase household income for low-income people.

Consultation question 12
A Just Transition for all of Aotearoa will be important as we transition to net zero. Are there other impacts that we have not identified?

Chapter 10: Four potential pathways – What could it take to meet a zero carbon by 2050 target for transport?

In Chapters 5 to 8, we discussed a broad range of opportunities to reduce GHG emissions from the transport system. We grouped these opportunities into three themes: 'Changing the way we travel', 'Improving our passenger vehicles', and 'Supporting a more efficient freight system'. In this chapter, we explore what it could take to meet a zero carbon target for the transport system by 2050.

Pathways to zero carbon by 2050

We have modelled four pathways for reducing transport emissions

All four 'pathways' outline how a combination of initiatives (Table 2) could reduce transport GHG emissions to almost zero by 2050. We have drawn these initiatives from across the three themes covered in the previous chapters, as it will not be possible to reach a zero carbon target without progress across the whole system. The estimated outcomes of these pathways are compared with the Ministry's base case[102] (see Chapter 2).

Table 2. Pathway initiatives by theme

	The model includes the following initiatives
Theme 1	Land-user changes; public transport improvements and pricing (including parking, congestion and distance-based pricing).
Theme 2	Phasing out the importation of ICE light vehicles by 2035; banning the use of all ICE light vehicles in 2050; adoption of biofuels in light vehicles and buses and electrifying the PT bus fleet by 2035.
Theme 3	Energy saving and logistic improvements (such as freight routes optimisation; freight consolidation and improved last mile efficiency); mode-shift from road freight to rail and to coastal shipping; adoption of biofuels for road freight and accelerating uptake of electric medium trucks.

Pathway 4 was developed following the release of the Climate Change Commission's draft advice. It seeks to achieve the Climate Change Commission's draft recommendation of a 47 percent reduction (relative to 2018) in transport emissions by 2035.

[102] The Ministry's base case includes the Clean Car Standard and Clean Car Discount.

Why do these pathways aim for zero carbon, rather than *net* zero carbon?

While the Government has committed to reducing all GHG emissions (excluding biogenic methane) to net zero by 2050, it is still unclear to what extent carbon offsetting will help to achieve this target. This means that we do not know the extent to which we may or may not be able to offset Aotearoa's transport emissions going forward. Other sectors in Aotearoa may find it harder or take longer to reduce emissions in comparison to transport, and therefore may be prioritised over transport when it comes to carbon offsetting. Given this uncertainty, these pathways explore what could be required to take us as close to zero transport GHG emissions as possible. We acknowledge that absolute zero would be very difficult to achieve by 2050.

The pathways place a different weight on avoid, shift and improve initiatives

In all pathways, electrification of the vehicle fleet is important to achieve as close to zero carbon as possible by 2050. Where these pathways differ is the relative weight given to 'avoid', 'shift' and 'improve' initiatives within each theme (see Figure 8).

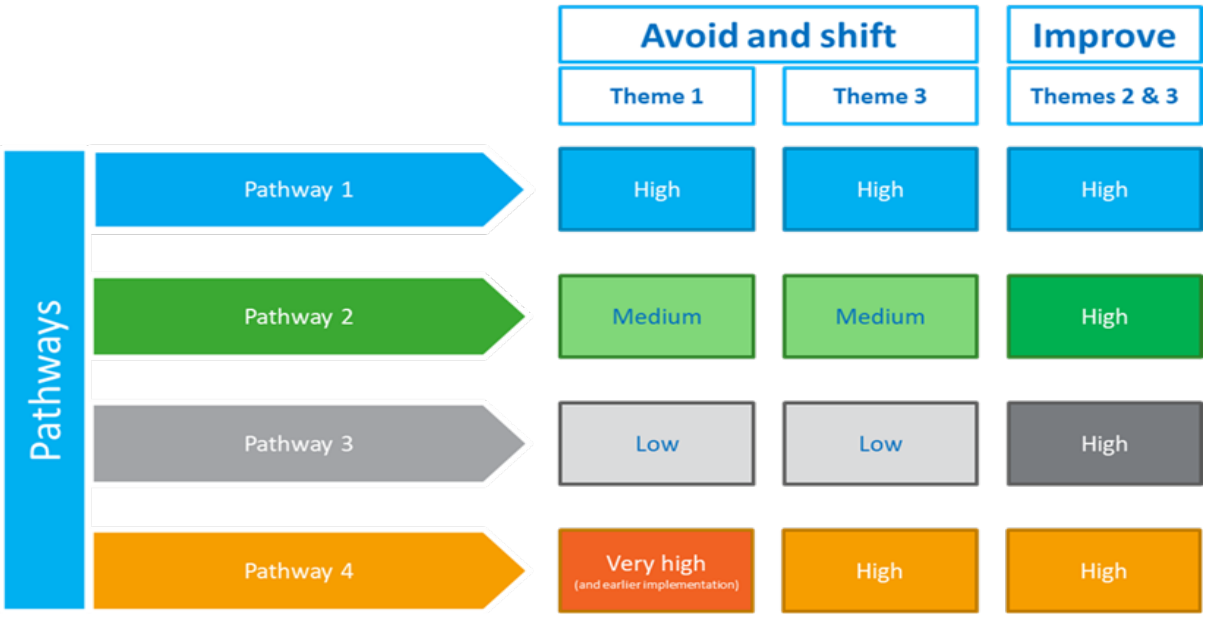

Figure 8. Relative weight given to avoid, shift, and improve interventions in each pathway

- **Pathway 1** assumes 'avoid' and 'shift' initiatives (Theme 1) play a significant role in reducing transport GHG emissions. This pathway requires reducing nearly 30 percent of the light vehicle kilometres travelled by 2050 through reducing trip distances and encouraging mode shift to public transport, walking and cycling. It also requires higher mode-shift from road to rail and coastal shipping.

- **Pathway 2** assumes 'improve' initiatives (Theme 2) play a significant role in reducing emissions than Pathway 1. This pathway requires a larger number of electric vehicles with greater use of biofuels in the short to medium terms. There is also emphasis on 'improve' initiatives for freight.

- **Pathway 3** assumes 'improve' initiatives (Theme 2) play a more significant role in reducing emissions than the other pathways. In this pathway, bringing more EVs into New Zealand transport system compensates for the limited avoid and shift changes. There is also much more emphasis on 'improve' initiatives in freight.

- **Pathway 4** gives even stronger weight to 'avoid' and 'shift' initiatives (Theme 1) than all other pathways. This includes assuming that 'avoid' and 'shift' interventions happen more swiftly, bringing forward their impact on emissions and that the clean car policies will be very successful in accelerating the uptake of electric vehicles. This pathway requires reducing nearly 40 percent of the light vehicle kilometres travelled by 2035 and over 55 percent by 2050. In the long term, the greater impact of 'avoid' and 'shift' initiatives reduces the number of vehicles that need to be electrified.

The pathways with more emphasis on 'avoid' and 'shift', such as Pathway 1 and 4 are more effective at reducing emissions (Figure 9). Avoiding activities that produce emissions is, on balance, a more effective strategy than minimising the emissions from those activities.

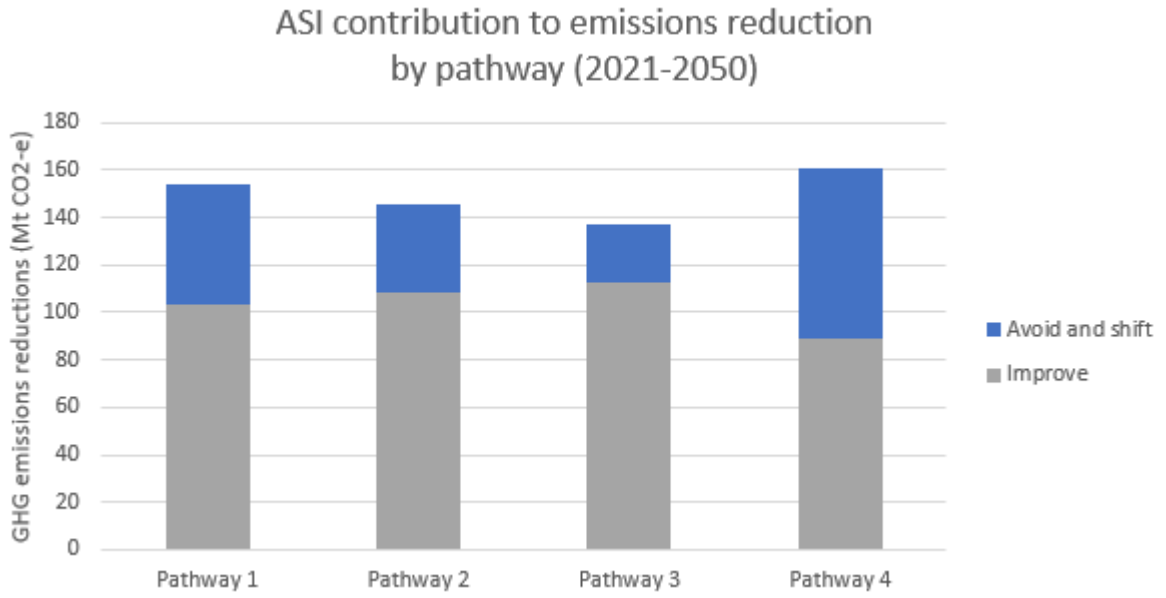

Figure 9. Avoid, shift, and improve contribution to emission reduction by pathway

Compared to the Commission's draft pathway to 2035, the level of reduction in distance travel in Pathway 4 is a lot higher (39 percent versus 14 percent) due to a much higher level of electrification in the Commission's estimates (1.9 million light vehicles and around 22,000 heavy vehicles compared to less than 0.8 million light and heavy vehicles combined in Pathway 4).

Appendix B outlines the assumptions behind the modelling of these pathways.

Potential impact of pathways on transport GHG emissions

Figure 10 shows the impact of each pathway on emissions out to 2050. Table 3 outlines how each pathway impacts on different aspects of the transport system by theme.

The baseline projections for Pathway 4 are different from the other pathways because it assumed the clean car policies are very effective in accelerating the uptake of low emissions vehicles due to relaxing the supply constraint assumption in this pathway.

There are multiple pathways Aotearoa could take to achieve a zero carbon transport system by 2050

The four pathways illustrate that there are different strategies we can take to reduce transport GHG emissions, which include changing the relative weight given to initiatives within each theme. However, given the scale of the challenge, and the limited time available, we need to take advantage of the opportunities to reduce emissions across the whole transport system. Meeting a zero carbon target by 2050 requires a major transformation of the transport system. Currently, our modelling suggests Pathway 1 would come the closest to **realistically** meeting the level of GHG emissions required. In contrast, Pathway 4 comes closest to the target set down in the Commission's draft advice, but makes bold assumptions to get there.

These pathways are not limited to current Government policies or commitments

The Government has not considered all of the potential interventions covered by *Hīkina te Kohupara*, which go beyond current policy commitments and initiatives.

These pathways therefore aim to provoke thinking about what it ***could*** take to transition to a zero carbon transport system. They do not capture the only paths that we could take. They simply illustrate the scale of changes to reach the target, and the need to lean more heavily on some options for reducing emissions if we do not make progress in other areas.

Our actual pathway will look different

Our pathway to a zero carbon transport system will be shaped by the actions of government, civil society, businesses, and consumers over the next three decades. Actions in the next five years will significantly shape this future pathway, and determine how close we get to, or stray away from, a zero carbon target.

The pathways in this chapter are based on current available evidence, and assumptions about the future. As the future is uncertain, our ability to reduce transport GHG emissions could become harder or easier depending on how it unfolds. Critical uncertainties which could affect our ability to reduce transport GHG emissions are discussed towards the end of this chapter

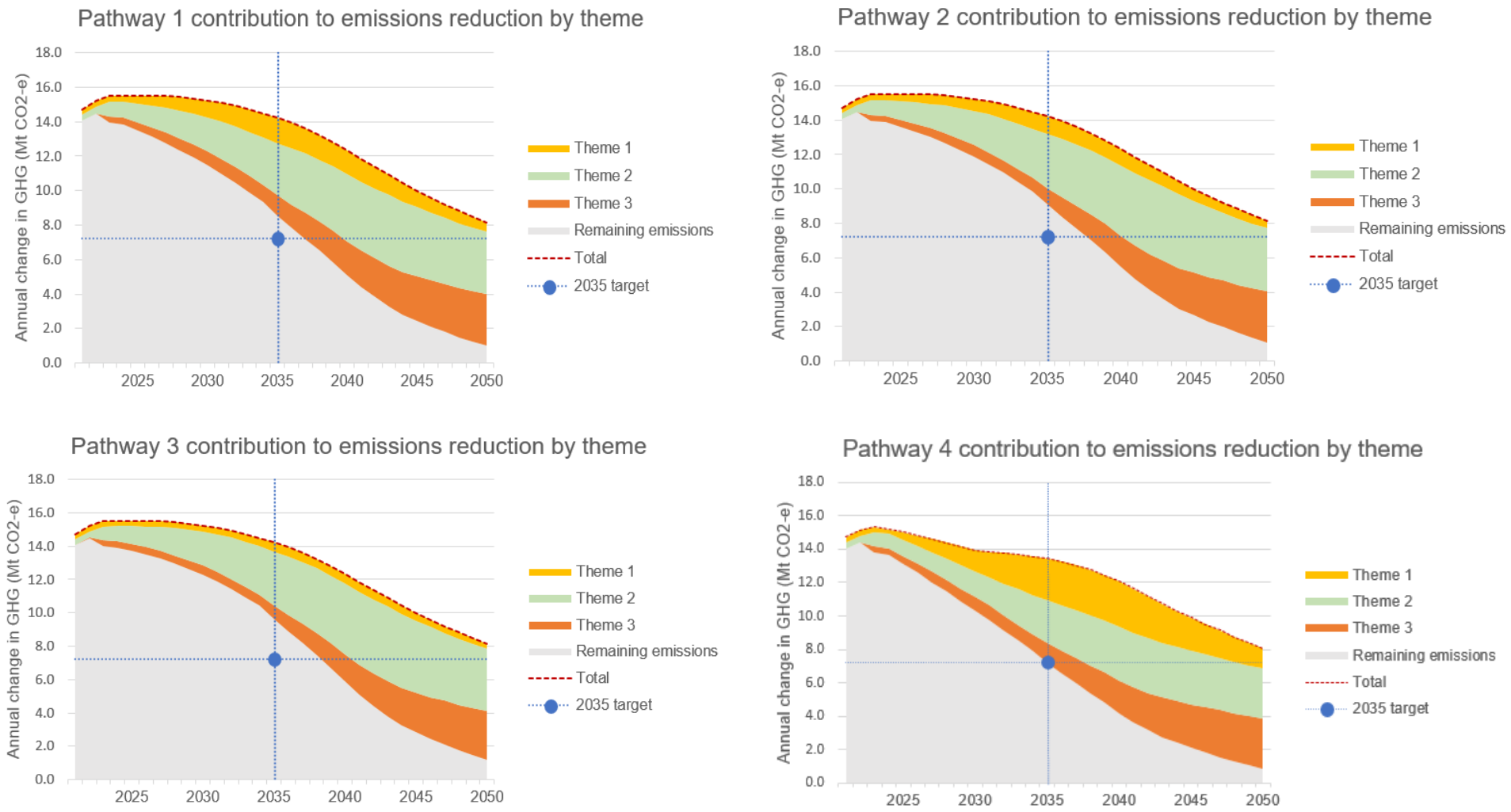

Figure 10. Pathways - Contribution to transport emissions reduction by theme

Hīkina te Kohupara Pathways – Key summary

Table 3. Summary of impact of each pathway on different themes

	Measure	Pathway 1	Pathway 2	Pathway 3	Pathway 4	CCC's pathway 2035
Percentage reduction in transport GHG emission achieved (relative to 2018)						
	By 2035	41%	37%	34%	47%	47%
Percentage reduction in road transport GHG emission achieved (relative to HtK baseline) (rounded to nearest 5%)						
	By 2035	Approx. 40%	Approx. 35%	Approx. 30%	Approx. 45%	n/a
	By 2050	Approx. 90%	Approx. 85%	Approx. 85%	Approx. 90%	
Theme 1	Reduction in light vehicle distance travel (combined effects)					
	By 2035 By 2050	Approx. 20% Approx. 29%	Approx. 13% Approx. 17%	Approx. 6% Approx. 8%	Approx. 39% Approx. 57%	14% n/a
Theme 2	Number and share of the light vehicle fleet transitioned to electric					
	By 2035 By 2050	670,000 20% 3.2 m 90%	730,000 20% 3.7m 90%	790,000 20% 4.1 m 90%	758,000 27% 2 m 94%	1.9 m 41% n/a n/a
	Increase in public transport bus fleet					All buses
	By 2035 By 2050	+10,300 +16,900	+6,900 +10,000	+3,100 +4,600	+17,200 +28,300	+3,800 n/a
	Share of public transport buses that are electric					All buses
	By 2035 By 2050	97% 100%	97% 100%	97% 100%	97% 100%	80% n/a
	Number of vehicles using biofuels (up to 100% by 2050)					
	Light vehicles in 2035 Light vehicles in 2050	3.1 m 290,000	3.3 m 340,000	3.6 m 370,000	2.1 m 126,000	n/a n/a
	Buses in 2034 Buses In 2050	400 0	300 0	200 0	600 0	n/a n/a
Theme 3	Medium trucks transitioned to electric (share of fleet in brackets)					
	By 2035 By 2050	3,200 4% 22,000 25%	3,200 4% 22,000 25%	3,200 4% 22,000 25%	3,200 4% 22,000 25%	21,500 16% n/a n/a

	Number and share of medium and heavy trucks using biofuels (up to 100% by 2050)									
	Medium trucks in 2050 Heavy trucks in 2050	66,000 47,000		66,000 54,000		66,000 61,000		66,000 47,000		n/a n/a	
	Assumed modal shift from heavy trucks to rail and coastal shipping										
		Rail	Ship	Rail	Ship	Rail	Ship	Rail	Ship	Rail	Ship
	By 2035	12.5%	7.5%	7.5%	3.5%	3.5%	10%	12.5%	7.5%	7.5%	7%
	By 2050	20%	15%	15%	10%	3.5%	5%	20%	15%	n/a	n/a

- n/a – not available

Policy implications from the pathways chosen in Hīkina te Kohupara

The pathways in this chapter clearly illustrate that deep and widespread changes will be required to reach a zero carbon target for the transport sector by 2050.

To inform thinking on which opportunities the government should pursue, this section highlights policy implications that became evident while modelling the different pathways and through research for *Hīkina te Kohupara*. It identifies implications for the **short-term** (up to five years), **medium-term** (five to 15 years), and **long-term** (15 years plus).

Policy implications from Theme 1 'Changing the way we travel'

Quality compact, mixed use urban development and placemaking

- The government should pursue urban development and land use changes that support emissions reductions from transport as soon as possible. Our cities and towns will only realise the full benefits of changes to urban development and land-use planning over the long term (see appendix B for more details on how land use contributes to VKT increases over time). An early start will bring the bigger benefits forward and avoid locking in further transport GHG emissions from unnecessary urban sprawl and car dependency.

- Government needs to deliberately shape urban form for low emissions options. This means prioritising investments in public transport, walking, and cycling over urban state highway/road expansion. The opposite would continue to encourage travel and emissions from private motorised vehicles. This also means that central and local government have to reconsider planned investments in major urban highway and roadway expansion projects if they would induce more vehicle travel.

- Government needs to build on recent policy initiatives, such as the National Policy Statement on Urban Development (NPS-UD), to support quality compact, mixed use urban development. In the short term, the planned reforms to the Resource Management Act 1991 (RMA) offer a critical opportunity to further support this, through stronger integration of urban development, land-use and transport planning.

- Street changes will be crucial to support higher-density living and transport by way of walking, wheeling, cycling, shared mobility and public transport. The Government should explore whether institutional changes are required to accelerate street changes.

Public transport, walking, cycling and shared mobility

- The pathways that make the most difference to emissions reduction involve significant policy interventions and infrastructure investments in public transport, walking, and cycling in both the short and medium term.

- A 'quick win' for mode shift would be to prioritise implementing Waka Kotahi and local government's mode-shift plans for New Zealand's high-growth areas.[103] Although these mode-shift plans were developed primarily to improve access outcomes, they are likely to also reduce emissions resulting from mode-shift. Revisiting these plans to ensure they are designed to also target transport GHG emission reductions will help maximise results.

- As discussed in earlier chapters, it is necessary to consider other changes to increase the uptake of public transport, walking and cycling.

- We did not model the potential for shared mobility incentives (e.g. car sharing, bike sharing, and scooter sharing schemes) to reduce transport emissions.

Transport pricing

- Pricing mechanisms can help us to make the most out of land-use changes and public transport investments. They can encourage mode-shift and address any rebound effects that result from investing in public transport, walking and cycling (such as induced car travel from reduced congestion). The pathways in this chapter all modelled the introduction of congestion pricing, parking pricing, and VKT distance pricing in 2025 (see appendix B for more details).

- Distance and congestion pricing both require substantial changes to the transport revenue and funding system – but could piggyback on upcoming changes. The government has the opportunity to consider what our land transport revenue system needs to be for the future. Further investigation is needed to understand whether his new system could be used as a way to apply distance and congestion pricing.

- Although pricing mechanisms can be a powerful lever for change, the Government needs to consider the distributional impacts of these mechanisms. Pricing mechanisms can make driving more expensive relative to other transport options and this is likely to be more burdensome for low income households. Investigation will be needed to assess how the benefits and burdens of pricing schemes, alongside the land use and public transport improvements affect different groups. Some of this work is already available for the potential impacts of introducing congestion pricing in Auckland.[104]

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[103] Waka Kotahi *Keeping Cities Moving* https://www.nzta.govt.nz/assets/resources/keeping-cities-moving/Keeping-cities-moving.pdf

[104] The Ministry of Transport. The Congestion Question. Retrieved from: https://www.transport.govt.nz/area-of-interest/auckland/the-congestion-question/

Policy implications of Theme 2 'Improving our passenger vehicles'

Decarbonising light vehicles

- A much larger number of zero emissions vehicles will be needed if we do not avoid/shift emissions by changing the way we travel. For example, Pathway 3 requires 2.3 million more electric vehicles compared to Pathway 4 by 2050.
- In all four pathways, decarbonising the light vehicle fleet will be critical for reaching a zero carbon target by 2050. This requires a rapid transition that will not be achievable without significant government intervention. Policies and actions are needed in the short-term to accelerate the uptake of low emission vehicles, and provide clear signals to individuals and businesses, allowing them more time to transition.
- In the short term, the Government is planning to introduce a fuel efficiency standard (the Clean Car Standard) to increase the supply of cleaner vehicles. This standard will need to become progressively more stringent, leading to an eventual phase out of fossil fuel vehicle imports in the medium term.
- In the short and medium term, the Government can encourage the uptake of low emission vehicles by helping to address their high upfront costs. For example, a 'fee-bate' scheme (a Clean Car Discount) could make low emission vehicles more affordable, and provide a disincentive to purchase high emitting vehicles at the same time. The Government could also increase investments in infrastructure such as electric vehicle charging stations.
- Additional measures and incentives to accelerate the uptake of electric vehicles should also be considered. The model assumes there will be an increase in vehicle imports from 2040, resulting in an extra 100 thousand EV imports each year until 2050. This is unlikely to occur without any measures or incentives.
- Imports of ICE vehicles would need to be phased out between 2030 and 2035 to meet a zero carbon transport target in 2050. This is because New Zealanders hold on to their cars for a long time, on average 19-20 years. Alternatively, we would need measures to exit ICE vehicles from the fleet. Our model was based on phasing out ICE imports by 2035. As with many other opportunities identified in *Hīkina te Kohupara*, these are not currently government policy.
- The Government can also support the uptake of electric vehicles through its own procurement practices. The Government is already planning to transition the government fleet to zero emissions vehicles.
- To address emissions in the existing fleet, the Government needs to consider increasing the uptake of bioethanol. For all the pathways in this chapter, the model was based on running the existing ICE light vehicle fleet on a 10 percent bioethanol blend from 2023. This would require government intervention in the short term to ensure this level of uptake (for example, through a biofuel mandate). We would also need to ensure adequate bioethanol supply in Aotearoa.

Decarbonising public transport

- Public transport bus fleets account for about one percent of our total transport GHG emissions. Government has already committed to decarbonise bus fleets, which will reduce these emissions.

Decarbonising aviation

- Domestic aviation emissions are not included in the model, and international aviation emissions are not specifically within the scope of *Hīkina te Kohupara*. Domestic aviation emissions account for just over six percent of our total transport GHG emissions.
- Sustainable aviation fuel has the most potential to reduce aviation emissions in the short to medium term. The Government needs to keep working with the aviation industry to investigate its potential in Aotearoa.
- Electric planes may be viable for reducing short-haul air travel emissions.

Policy implications of Theme 3 'Supporting a more efficient freight system'

Optimising freight routes, equipment and vehicles

- The freight sector already has financial incentives to move freight in an economically efficient way. However, there may be some opportunity to further improve freight efficiency and further reduce emissions. This could be through rerouting, consolidation, last mile efficiency, logistics improvements, driving training etc.
- It is unclear how much potential there is for the Government to support 'avoid' type initiatives (other than measures that increase fuel or transport costs), but the Government could investigate these opportunities further in the medium term.

Shifting road freight to rail and coastal shipping

- There is a clear opportunity for the Government to support shifts from road freight to rail and coastal shipping.
- Our pathways modelled how much emissions would fall if 10 to 20 percent of road freight shifted to rail, and five to 15 percent shifted to coastal shipping, by 2050. Further work is needed to explore whether mode shifts of this scale could be practically achievable.
- The New Zealand Rail Plan sets out the Government's vision and priorities for rail until 2030, and the level of investment needed to achieve a reliable, resilient and safe rail network.
- In the short term, the Government can implement the New Zealand Rail Plan and the coastal shipping activity class in the GPS to support freight mode shift. These initiatives will support mode shifts, but not of the magnitude of 15-20 percent. Further work would be needed to identify opportunities for supporting a larger scale of mode shift.

Cleaner trucks

- Decarbonising trucks will be critical for achieving a zero carbon transport system, and would have the largest impact on reducing emissions from freight.
- Our pathways modelled the potential to reduce transport GHG emissions from biofuels for both medium and heavy trucks, and electrification for medium trucks. Hydrogen-fuelled and additional electric trucks could potentially play an important role in the future.
- Biofuels could potentially play a major role in decarbonising trucks. Our pathways modelled the truck fleet running on a 10 percent biofuel blend from 2023, and renewable

diesel being added to the fuel supply from 2035. By 2050, road freight could be decarbonised if all diesel trucks ran on a blend of 10 percent conventional biofuel and 90 percent drop-in renewable diesel. As with light vehicles, this transition would require significant government intervention.

- In the short term, the best opportunity for the Government to reduce emission from trucks is to introduce a fuel efficiency standard for trucks and a biofuel mandate. As with light vehicles, these standards will need to ramp up over time. There is currently a limited amount of biofuel available in New Zealand, so the Government may want to investigate supporting a domestic biofuel industry.
- In the medium term, the Government could introduce a carbon intensity standard, which is fuel agnostic (e.g. it could also apply to hydrogen fuel) and would require more time to implement than a biofuel mandate.
- Alongside these policies, the Government could also increase the funding available to accelerate the uptake of zero and low emission (electric/hydrogen) trucks. It could also consider targeted investments in infrastructure for green fuels and for fast-charging heavy vehicles. In addition, it could consider setting fuel economy standards and minimum entry requirements for trucks.

Cleaner rail

- We did not explicitly model rail GHG emissions in our pathways, but accounted for increases in rail emissions due to mode shift. Rail emissions account for just over one percent of our total transport emissions, and could rise with increased freight movements.
- Electrification of our rail system or the use of biofuels could potentially reduce rail emissions in the longer term.

Cleaner ships

- Emissions from domestic maritime activities were not modelled in our pathways. (International maritime emissions are not within the scope of *Hīkina te Kohupara*).
- Domestic maritime emissions account for just over three percent of our total transport GHG emissions, and could rise with increased freight movements. In the medium to long term, the Government could work with the maritime industry to investigate options to decarbonise shipping fleets.

Investment costs

Decarbonising our transport system through influencing energy and travel choices and demand would require substantial and sustained investment but, more importantly, such investment will need to commence soon.

We can classify the investment required into four broad categories:

- *Growth enabling* – this includes basic infrastructure expansion to manage population and economic growth and additional investment to change demand.
- *Mode choice provision* – this includes investment in sustainable transport choices to manage demand.

- *Pricing systems* – this includes parking pricing and a distance based charging system to replace the current system that is tied to petrol use and other additional pricing strategies to manage demand during specific times and locations or by different vehicle types.

- *Energy infrastructure* – this includes electricity system and grid upgrade, additional renewable energy production plants and alternate energy refilling/charging infrastructure (including biofuel, electricity and hydrogen).

Growth enabling

As the population grows, the level of transport and non-transport infrastructure investment needed would also increase simply to maintain and manage demand. Existing regional mode shift plans that are sought to be delivered through GPS2021 is unlikely to deliver the level of mode shift required to decarbonise road transport. In addition, the need to address other transport outcomes means the scope for re-prioritisation of the National Land Transport Fund may be somewhat constrained. The size of the additional investment required can vary depending on the pathway chosen. For example:

- Pathway 1 would require investment in high density residential areas and development of liveable cityscapes
- Pathway 2 would require similar but a lower level of investment as for Pathway 1
- Pathway 3 would require additional roading investment to manage traffic growth
- Pathway 4 would require significant investment in transport infrastructure and medium to high-density residential areas, as well as swift policy action in these areas.

The cost of urban and residential housing development depends on location and the size of the development. Although the one-off investment is high, the average cost per unit in a dense residential housing build is likely to be lower than a townhouse or low-rise apartment. Increasing the density of residential areas can result in a higher reduction in carbon emissions due to reduced travel needs. However, such investment tends to take a longer time to plan and develop and the emissions savings are not immediately recognised.

Mode choice provision

Roading improvements alone cannot achieve meaningful change in travel demand because improved conditions tend to attract new traffic and are likely to increase carbon emissions. Achieving the level of modal shift to decarbonise transport demand requires increasing mode choice provision and influencing demand with supporting policies (e.g. pricing). Pathway 4 would require the most investment in public transit, shared mobility and active modes, followed by pathway 1, 2 and the least for pathway 3.

Land use and urban development investment varies significantly between regions, project and investment types. For example, according to the National Land Transport Programme and New Zealand Upgrade Programme, road corridor improvements on State highway 20B to add bus and high occupancy vehicle lanes and bus interchange cost around $70 million, whereas adding two new railway stations, park and ride facilities at Drury cost $247 million. On the other hand, early information from Auckland and Canterbury indicates switching the

diesel bus fleet to electric could cost an additional $120,000 to $240,000 per medium and large bus, after considering energy cost savings and charging infrastructure, electricity system and grid upgrade cost.[105]

Pricing system

To influence modal shift behaviour, car users need to consider the true costs of travel in accordance with the level of use.

There would be minimal difference in the level of investment between pathways for distance-based pricing. Irrespective of the pathway chosen and as the vehicle fleet electrifies, the government needs to explore an alternate road use pricing regime (e.g. distance based pricing) to replace the current fuel excise duty that raises revenue for transport infrastructure investment, maintenance and operation purposes.

An initial investigation of switching to basic electronic distance-based charging would cost $50 million for system design and setting up appropriate enforcement infrastructure and equipment plus $800 million for equipping the vehicle fleet with Global Navigation Satellite System enabled on-board units. These costs are highly indicative and exclude on-going costs associated with data analytics, maintenance and operation.

For managing congestion and peak demand, the pricing system would need to be capable of applying time and place-based pricing. It may be possible to incorporate this in a distance-based pricing system.

Smart parking pricing could be considered to manage demand for car travel before and in addition to the implementation of road use pricing regime. A Ministry study[106] shows that the majority of all car trips are not charged for parking at destinations (e.g. at shopping malls and other on-street parking). Such a pricing mechanism would require minimal infrastructure investment.

Energy infrastructure

Renewable energy generation will need to increase to meet transport needs in all pathways. The level of investment would be the lowest for Pathway 4, which achieves a high level of behavioural changes that reduce or meet travel needs through better land use and transport planning or more energy efficient modes. Pathway 3, on the other hand, would incur the highest level of energy generation and system costs to meet growing car-dependent transport demand.

Energy generation infrastructure includes biofuel production plants, renewable electricity generations and grid upgrade and, the potential production and distribution system of hydrogen. According to a 2018 report by Scion, total capital investment to achieve a 30 percent substitution of biofuels use in transport was estimated at between $6 and $6.8 billion. On the other hand, increasing the production of renewable electricity could cost

[105] There are currently around 13,000 public and private buses in operation in New Zealand, including some 2,600 public buses. By 2030, the total bus fleet could increase to over 16,700. With the current cost premium estimates, electrifying the entire bus fleet by 2030 could cost $3 billion. This is equivalent to around 7 percent of the total expenditure target of the National Land Transport Programme or one-tenth of the expenditure of the Auckland Transport Alignment Project, over the same time period. However, this cost premium is likely to reduce over time as technology develops.

[106] Draft Domestic Transport Costs and Charges report on Car Parking, Ministry of Transport, 2021

between $8 and $12 billion.[107] In addition, private and public investment in infrastructure and equipment for charging electric vehicles could cost between $5 and $9 billion.

In addition to the public sector investment cost discussed above, there would also be additional capital expenditure to private vehicle owners from switching to electric vehicles as they currently attract a price premium. This cost is likely to reduce over time as the price for electric vehicles and ICE vehicles reach parity in the next decade. However, there will be substantial savings to vehicle owners in energy cost.

Total investment costs for the pathways

The following table provides a high-level indication of potential investment costs for the four pathways. While additional data collection and research is needed to put a number on these potential costs, the investment cost will be substantial irrespective of the pathway chosen. Given the kind of infrastructure investment needed has a long lead time to plan, develop and build, it is necessary to commence related planning activities in the near term to ensure infrastructure is ready for the shift or transformation needed.

Table 4. Indicative relative investment requirements

	Pathway 1	Pathway 2	Pathway 3	Pathway 4
Urban design and development *Better land use and transport planning*	Vary with interventions and locations	Vary with interventions and locations	Vary with interventions and locations	Vary with interventions and locations. Early implementation needed
Transport infrastructure *Manage growth and investment in sustainable transport choices*	$$	$$$	$$$	$$
Transport pricing systems *To achieve mode shift, dis-incentivise discretionary travel and manage rebound effects from improvements*	$	$	$	$ Early implementation needed
Energy infrastructure *Electricity system, grid update and charging infrastructure*	$	$$	$$	$
Electric vehicle and private charging equipment	$	$$	$$	$
Alternative energy source *Infrastructure investment*	$$	$$	$$$	$$

Indicative scale (comparison investment between pathways): $ = lowest; $$ = moderate; $$$ = highest

[107] Source: Concept Consulting (2018), *Driving change – Issues and options to maximise the opportunities from large-scale electric vehicle uptake in New Zealand, Prepared for Orion, Unison, and Powerco.*

Critical uncertainties

Future pathways are always based on assumptions about what could happen in the future, and how effective our actions could be in making changes. Modelling is always limited by the availability of current knowledge. Aotearoa will not neatly follow any of the pathways discussed above. The value of these pathways is that they highlight the long-term implications of forging different pathways, and the scale of challenges and opportunities that we face.

The pace and scale of transport GHG emissions reductions will be affected by a range of drivers within, and beyond, the transport sector. This section highlights critical uncertainties that could slow us down and hinder our ability to achieve a zero carbon transport system, as well as speed up, and help us to achieve this quicker than projected in the pathways above.

These headwinds and tailwinds are summarised in seven categories: technologies; availability and cost of alternative fuels; the social mandate for change; economic shocks; global dynamics; unanticipated changes in travel demand; and population growth.

Vehicle technologies

New and adapted technologies have always driven major changes in the transport sector. Over the next thirty years, the transport technology that is most likely to drive emissions reductions is the electrification of vehicles. In our pathways, we assumed that the purchase price of electric vehicles will continue to decrease, battery ranges will keep growing, and more vehicle models will quickly become available in Aotearoa.

If the purchase price parity point for electric vehicles (relative to ICE vehicles) happens before the mid-2020s, this would help to accelerate emissions reductions in Aotearoa. On the other hand, if the price of electric vehicles does not come down as quickly as anticipated, or if the variety of electric vehicle models does not expand quickly enough to meet consumer demands, this may slow down the uptake of electric vehicles.

The price of electric vehicles is significantly affected by battery costs. Vehicle costs may not decrease quickly if battery advances primarily lead to higher capacity batteries that enable greater range (rather than simply lower costs). Battery costs could also be affected by supply constraints in the materials used to manufacture batteries, and global manufacturing capacity, as global demand for electric vehicles increases.

We also anticipate increasing automation of vehicles in coming decades. This will initially involve vehicles becoming ‘smarter’ and safer, rather than becoming completely driverless (although driverless vehicles are already used for public transport globally). We have not modelled the potential impact of fully automated vehicles in our pathways. Previous work by the government has explored the potential impacts of fully automated vehicles on urban form and vehicle travel.[108] Fleets of fully automated vehicles could help to accelerate emissions reductions if they are fully electric, and if they help to drive lower vehicle ownership. However, fully automated vehicles could also encourage urban sprawl and higher vehicle travel. This would work against emissions reductions.

[108] Ministry of Transport. Investigating the future of public transport. Retrieved from: https://www.transport.govt.nz/area-of-interest/strategy-and-direction/public-transport-2045/

Availability and cost of alternative fuels, particularly for freight

In addition to electric vehicles, biofuels and hydrogen both offer potential for decarbonising the transport system, particularly for freight. Biofuel is commonly used internationally, while hydrogen is at an earlier stage of development.

If major advances are made in drop-in renewable biofuel, or green (low/zero carbon) hydrogen, then this could help us to decarbonise the transport system more quickly. However, if alternative fuels do not develop as quickly as expected, or Aotearoa is unable to establish an effective domestic industry or distribution network for biofuels/hydrogen, then this would be a headwind. This would make us reliant on fossil fuel vehicles for longer, or require more emphasis on mode shifts or electrifying vehicles where viable.

The social mandate for shifting to a low emissions economy

Most New Zealanders are concerned about climate change, and support emissions reductions. We assume that this sentiment will grow over time, as the impacts of climate change grow and become more obvious, and younger generations who have grown up with the threat of climate change become more influential in decision-making.

To achieve a zero carbon transport system, major changes will be needed in the way that people and products travel, and the vehicles and fuels used. The scale and pace of changes will depend on, and affect, the social appetite for changes.

If the social mandate grows more quickly than expected, we could achieve a zero carbon transport system swiftly. This could be reflected in both the personal actions that people take to reduce transport GHG emissions, and collective support and demand for institutional changes (e.g. policies, pricing, and incentives). Alternatively, emissions reductions could be hampered if there is insufficient will or mandate for changes.

Economic shocks

Aotearoa has faced major economic shocks over the last couple of decades, including the global financial crisis, Canterbury earthquakes, and the impacts of COVID-19. We will face more shocks over the next thirty years. These could affect Government finances, borrowing, and debt levels. They will also affect employment levels and consumer/business confidence, and potentially the social mandate for further change.

Economic shocks are likely to have a detrimental impact on initiatives to reduce emissions, even if they cause short-term emissions reductions due to lower economic activity and travel. However, shocks can also create opportunities for change. For example, Governments often focus on the transport sector to stimulate economic activity and employment. These investments could prioritise infrastructure and services that reduce transport GHG emissions.

Global dynamics

International changes will affect emissions reductions in Aotearoa. For example, if other countries enact ambitious policies quickly (such as the United Kingdom’s plan to ban the sale of new petrol and diesel cars from 2030), this could create a bigger international market

for cleaner vehicles and fuels. Aotearoa could benefit from this, if mass production of electric vehicles leads to lower purchase costs. In the short term, Aotearoa is likely to compete with other countries as buyers of electric vehicles. Without any policy intervention, we could see an influx of cheap cars with internal combustion engines as the demand for these vehicles reduce in other countries.

Global dynamics will also affect the commitments that countries make to reduce GHG emissions, and their accountability for these reductions. Over the last 20 years, the global consensus to reduce emissions has grown significantly, even though there is often flux in the commitments made by individual countries due to domestic political changes. We expect global commitments and pressures to reduce emissions to grow this century, rather than diminish.

Changes in travel demand

How much, and how far, people and products travel is affected by many factors. In our pathways, we assumed for simplicity that the overall structure of New Zealand's economy remains relatively similar to 2050. We have not considered major changes in what people consume, or what businesses produce.

If people consume less in the future, and/or if Aotearoa shifts more towards a service-based high-value economy, with less emphasis on producing and transporting high-volumes of commodities, our carbon footprint could be smaller. Alternatively, if consumption grows more than expected, and/or if services play a relatively less important role in our economic future, then this would be a headwind.

Population growth

Our population growth rate will mostly be affected by immigration levels. This is because our birth rate is currently 1.63 children per woman, which is below the replacement rate. Aotearoa is a country built on immigration, and we are an attractive place for people from around the world to settle. Immigration settings will affect how large our population will become between now and 2050.

If our population grows more quickly than expected, this could become a headwind for emissions reductions due to increases in domestic travel demand. If immigration settings lead to slower population growth than expected, overall travel demand (and transport GHG emissions) might be lower. Ultimately, however, population growth needs to be decoupled from emissions by decarbonising the transport system and changing the ways that people and products travel.

Consultation question 13
Given the four potential pathways identified in Hīkina te Kohupara, each of which require many levers and policies to be achieved, which pathway to you think Aotearoa should follow to reduce transport emissions?

Chapter 11: What opportunities should the Government progress over the first three emissions budget periods?

In Chapter 10, we identified four possible pathways for how Aotearoa could reduce transport emissions towards zero carbon. Each pathway shows the choices and combinations of policies that will be needed to move towards zero. Most importantly, the pathways show that the effort required to reach the net zero target by 2050 will be significant.

Given this context, decisions on policies that will contribute to future emissions reductions for the transport system must be made now to ensure Aotearoa has a credible chance to achieve the changes required. This includes decisions about new policies that can be implemented during the first emissions budget period, and policies that are required in the future.

In doing this, we must also consider the systemic changes needed for the transport sector to effectivley reduce GHG emissions from the transport system by 2050. Future interventions must consider how Aotearoa transitions from the legacy practices:

a) of ‘trading-off transport outcomes against each other’ towards a new practice of ‘designing interventions to reduce GHG emission reduction that also achieve multiple transport outcomes, such as access, safety and resilience’.

b) that is largely based on ‘predicting and providing transport infrastructure to move light passenger vehicles’ towards a new practice of ‘optimising and managing travel demand across all transport modes’ (based on an agreed transport intervention hierarchy).

c) that emphasises ‘delivery of large road transport infrastructure projects’ towards a new practice that enables ‘the delivery of integrated multi-modal transport system programmes and activities’.

Overarching policies are already being implemented that support emissions reductions

A number of overarching policies have already been implemented to support Aotearoa’s efforts to reduce transport emissions – these are set out in the table below. For some of these policies the level of abatement that might be achieved from their implementation are yet to be actively measured and/or evaluated, although generally it is considered that they do contribute to mitigating transport emissions.

Table 5. Overarching policies that contribute to reducing emissions across the transport system

Title	Description
Government Policy Statements on land transport	Assessing how the Government Policy Statements on land transport can better focus on mode shift and climate change outcomes (both through implementation and monitoring).
Arataki 2021/31	Presents Waka Kotahi NZ Transport Agency's 10-year view of what is needed to deliver on the government's current priorities (as outlined in GPS 21) and long-term outcomes for the land transport system (as outlined in the Transport Outcomes Framework). Arataki 2021/31 outlines areas of focus to support key step changes needed to deliver on these priorities, including; tackling climate change and transforming urban mobility. It confirms that Waka Kotahi will use the Avoid-Shift-Improve framework and a complementary intervention hierarchy; (i) integrated planning, ii) demand management, iii) optimisation, iv) new infrastructure to reduce land transport greenhouse gas emissions.
Toitu Te Taiao – Sustainability Action Plan	Waka Kotahi is embedding its primary direction setting document which describes actions being taken to enable greenhouse gas reductions across the land transport system.
Investment Decision Making Framework	Waka Kotahi is reviewing its investment system that now factors in climate change considerations with further work underway to refine relevant processes, tools and resources.
Infrastructure Projects and Climate Change Policy	Establishing Waka Kotahi's new policy for infrastructure project applications to ensure they are compliant with COVID-19 'Fast-Track' legislation.
Infrastructure Sustainability Council of Australia Rating Tool	Applying this procurement requirement to specified infrastructure projects that require consideration of greenhouse gases – in particular as it relates to the design and construction of major infrastructure projects.
Provincial Growth Fund (PGF) projects	Implementing PGF projects with the aims of creating sustainable jobs; enabling Māori to reach their full potential; boosting social inclusion; building resilient communities; and help meet Aotearoa's climate change targets.
Innovation work programme	Investigating how innovation can better support transport outcomes in New Zealand, including how climate-focused innovation and technology can help us achieve our targets.
Carbon Neutral Public Service	The Ministry of Transport and Waka Kotahi are working to build on our existing efforts to reduce our corporate greenhouse gas emission footprint.
Regional Land Transport Plans (RLTP)	RLTPs document a regions' land transport objectives, policies and measures and sets the direction for the region. It provides a statement of the transport priorities for the region - climate change considerations are included in these plans.

A range of policies will be required to achieve the transport sector contribution to achieving the emissions budgets

Based on the Climate Change Commission's draft advice and modelling, the transport system will need to halve its emissions from 16.8 mega tonnes[109] of CO_2-e to 8.9 mega tonnes of CO_2-e in 2035. This ambition requires Aotearoa to implement a large number of policies to have a feasible chance of us getting close to it. This will require early and significant effort from all of us.

A strategic delivery of transport outcomes will be required for future policy developments

The Ministry uses the Transport Outcomes Framework to give government a way to set priorities for the transport system, and to measure progress. It connects the transport system with other systems, such as the wider economic system, and has been adopted by all transport agencies. The individual outcomes also help to better understand transport's contribution to the economy and society. The outcomes are inter-related, and need to be met through a range of interventions to improve intergenerational wellbeing.

As reflected in the Ministry's 2020 Briefing to the Incoming Minister[110] the strategic delivery of transport outcomes is structured through the use of long-term generational planning (using the Generational Investment Approach which sets out investment choices 10-50 years from now); medium-term mezzanine strategies, and short-term delivery through five key policy levers.

Mezzanine strategies drive outcomes for 10-15 years into the future by packaging suites of measures to address specific issues or problems. An example of this is the Road to Zero strategy. As noted earlier Hīkina te Kohupara will be used to develop a 10-15 year time horizon strategy on how the transport system can reduce its emissions.

Transport outcomes and government priorities are delivered through five key policy levers: Investment, Regulation, Economic and Education tools, Monitoring and Oversight and Influencing the international environment. Delivery relies on a combination of the five levers being used together, in a coordinated way, over time.

It should be noted, that dependent on the Government's objectives, the GPS and NLTF may not play a key role in meeting the objectives of a mezzanine strategy for reducing transport emissions. The NLTF funds maintenance, and enables some growth, while the GPS may be able to direct some investment so these things are aligned with a low emissions system. However, together these may not have a significant impact on the emissions profile, especially in the short term.

[109] Based on 2018 transport emissions.

[110] Transport - Strategic.pdf (beehive.govt.nz)

Policies that should be considered for inclusion in the emissions budgets

The following table sets out the policies that are underway that contribute to reducing transport emissions. It also provides details of proposed policies or specific areas that require further analysis before specific policies will be identified for the first three emissions budgets. These proposals will still need to be discussed and agreed with Ministers, including confirmation of which policies will be locked into the first emissions budget through the Emissions Reduction Plan.

Table 6. Policies underway and that should be considered for inclusion in emissions budgets

Theme 1 – Changing the way we travel			
Shaping our towns and cities			
Current work underway	**Budget period 1: 2022-2025**	**Budget period 2: 2025-2030**	**Budget period 3: 2030-2035**
	Note: The responsibility for reducing transport emissions does not rest with transport decision-makers alone. The following opportunities require a coordinated approach by different agencies involved in land use, urban development and transport policy.		
Urban Growth Partnerships • The Urban Growth Partnerships programme provides a long-term and integrated approach to land use and infrastructure planning. The current approach to spatial planning under Urban Growth Partnerships identifies climate change as a key challenge, alongside other big challenges relating to integrated land use and transport. Several Urban Growth Partnerships are considering how to respond to climate change in the development of spatial plans. Transport projects, including future rapid transit systems and frequent public transport networks, feature heavily in all of these evolving partnerships and spatial plans. However, most of these transport projects do not currently have funding allocated to deliver them.	• Continue to progress the Urban Growth Partnerships programme. These partnerships, and the spatial plans that are integral to them, could play a valuable role in reducing emissions. The Government should ensure that emission reductions are central to this approach to land use and infrastructure planning, and prioritise transport projects that contribute to emission reductions. • Government could enable Waka Kotahi, Local Government, KiwiRail and Kāinga Ora to take more active roles in developing sites around frequent public transport services. This would help to unlock compact development (and give more certainty of the outcome) and ensure growth takes place around key transport nodes. • Work with local government to establish how major transport projects agreed to in spatial plans could be funded in the future.		
Resource Management Act (RMA) reforms • The current Government has committed to reform the RMA. Proposed reforms to the RMA include a new Strategic Planning Act, which would improve long-term integrated planning. Regional spatial planning, which could become mandatory under this Act, is a useful tool to integrate transport planning/investments with land use planning. This could support the development of town and cities where housing is concentrated close to jobs, schools, amenities, and rapid transit nodes – making it easier for people to access places by walking, cycling, or using public transport.	• The RMA reform is a crucial opportunity for the Government to embed spatial planning. Central government also needs to work with local government to improve capabilities for spatial planning. By mandating spatial plans that integrate land use, urban development and transport planning to achieve quality, compact, mixed-use urban development, the RMA reform could have a significant impact on emissions over the long term. Councils could be required to demonstrate how spatial plans will deliver long-term emission reductions. • Begin implementing RMA reforms, including guidance to councils.	• Continue implementing RMA reforms.	
National Policy Statement on Urban Development (NPS-UD) and Government Policy Statement on Housing and Urban Development (GPS HUD) • Councils are currently implementing the NPS-UD, which requires them to plan well for growth and ensure a well-functioning urban environment for all people, communities and future generations. Reducing GHGs from urban development is one of its objectives. This will	• To build off the NPS-UD, the Government may need to undertake work that supports councils to accelerate widespread street changes to support walking, cycling, public transport and placemaking – all of which are critical for mode shift and supporting higher density living. The project the Ministry is currently scoping called 'Reshaping Streets' will help to understand the opportunities in this area.		

drive existing and future urban development including transport needs. • The Ministry of Housing and Urban Development is currently developing the GPS HUD which must be finalised by 1 October 2021. This will set out the Government's overall direction and priorities for housing and urban development, to provide direction to Kāinga Ora and to guide the actions of other actors in the housing and urban development system. It is required to provide expectations for how Kāinga Ora recognises the need to mitigate and adapt to the impacts of climate change but there is an opportunity to set broader expectations about how the housing and urban development system mitigates and adapts to climate change.	• Develop design guidance and expectations for quality high-density environments (including streets, public spaces, buildings, and green space).		
Making streets more sustainable, healthier, and inclusive • The Ministry of Transport is scoping a project called Reshaping Streets to determine whether transport system settings need changing to accelerate the uptake of widespread street changes in Aotearoa that support public transport, active travel, and placemaking. • Waka Kotahi is developing the One Network Framework, which will provide consistent classification system for streets and roads to support greater collaboration across planning sectors, and help improve urban form and mobility outcomes. • Waka Kotahi is developing the Aotearoa Urban Street Guide to provide a national framework and high-level principles for excellence in multimodal street design in urban contexts.	• Remove barriers and improve funding for tactical urbanism and innovative approaches to street design (e.g. expand on Waka Kotahi's Innovating Streets for People Programme). • Invest in placemaking and urban design capability and capacity of transport agencies and transport functions within local government. • Clarify the principles of living infrastructure, and set expectations that living infrastructure is incorporated into transport plans and projects. • Review street design standards and develop nationally applicable consistent sets of standards for Aotearoa. • Investigate if regulatory changes are needed to empower Road Controlling Authorities to more easily consult on and make street changes to support active travel, public transport, and placemaking. • Make changes to policy and funding settings to ensure Waka Kotahi and Road Controlling Authorities maximise opportunities to 'build back better' when doing street renewals (to improve streets for people walk, cycling, and using public transport).		
Linking funding more closely with requirements to reduce emissions • The Government Policy Statement on land transport 2021 (GPS 2021) includes a strategic priority on climate change.	• Government could make transport investments conditional on having appropriate land use and urban development plans. This is a strong transport lever, which could help to ensure that transport investments are effective through better integration of land use and urban development planning. This could include reconsidering and/or reprioritising projects included in current plans. • Government could consider how to encourage transport investments (including National Land Transport Fund and Crown investments) towards packages and programmes (as opposed to projects) that are purposefully designed to reduce long-term land transport GHG emissions as well as deliver wider benefits. • Government could require transport GHG emission impact assessments for proposed urban developments (including the transport GHG emissions of residents and business owners that would be located in the development). Developments that are inconsistent with		

	emission reduction objectives could potentially be required to undergo redesign and/or an acceptable form of durable mitigation. • Government could set targets for councils to deliver public transport and active travel networks (e.g. dedicated/priority bus lanes on some routes; connected cycling networks) by a specific date. There could be funding consequences if Road Controlling Authorities do not deliver these changes within these timeframes.		
Providing Better Travel Options			
Current work underway	**Budget period 1: 2022-2025**	**Budget period 2: 2025-2030**	**Budget period 3: 2030-2035**
Government Policy Statement on land transport 2021 (GPS 2021) • GPS 2021 invests in infrastructure and support for walking, cycling and public transport (including rapid transit, such as in Drury, Hamilton to Auckland passenger rail, and City Rail Link). *Crown investment in public transport, walking and cycling* • There is also investment from the Crown (e.g. NZ Upgrade Programme, Provincial Growth Fund) into public transport, walking and cycling infrastructure.	• Support mode-shift to public transport, walking, and cycling – prioritising New Zealand's largest urban areas. • Significantly increase investments by central Government in public transport (including public transport infrastructure, services and operations), walking and cycling (including improving footpaths and walking infrastructure, and quality connected urban cycling networks). • Prioritise the need to reallocate street space and to create connected networks for delivering transport mode shifts in the next GPS on land transport, and/or for any additional funding for active modes and public transport. • Set higher Funding Assistance Rates for walking and cycling investments and dedicated/priority bus lanes to strongly incentivise Road Controlling Authorities to prioritise and accelerate street changes. • Investigate the opportunity to incentivise mode shift by introducing nationally consistent public transport fare concessions.	• Consider mode-shift opportunities in remaining urban areas – whilst continuing to prioritise investment in New Zealand's main urban centres. • Continue significant investments in public transport, walking and cycling.	• Continue significant investments in public transport, walking and cycling.

Keeping Cities Moving (Waka Kotahi)
• Waka Kotahi's plan for enabling mode shift in urban areas. This includes a wide range of actions, including the development of specific mode shift plans for all high-growth urban areas as well as initiatives, such as Innovating Streets.
 	
Auckland Transport Alignment Project
• A strategic approach for transport in Auckland between central and local government, supported by a confirmed investment package. Modelling for the 2021-2031 package shows an increase in emissions of 6 per cent. The package by itself reduces emissions by 13 per cent but this is outstripped by population growth. Modelling out to 2051 shows an emissions reduction potential of around 50 per cent.
	• Support mode-shift by implementing Waka Kotahi and local government's mode shift plans for New Zealand's high-growth (and emerging high-growth) urban areas. However, these plans should be revisited to ensure they are designed to maximise transport GHG emission reductions.
	• Consider other barriers facing mode-shift to public transport, walking and cycling. In particular, the Government may need to undertake further work to:
	  ○ clarify the roles of agencies to deliver large frequent public transport systems and ensure that there are legislative settings in place to enable them (e.g. land acquisition, consenting)
	  ○ accelerate wide spread street changes, remove regulatory and investment barriers, require greater network planning, and develop guidance and standards.
	• Consider whether further support is warranted for shared mobility schemes – such as car share, car-pooling, shared micromobility and Mobility as a Service.		

Let's Get Wellington Moving (LGWM) • To 'future-proof' Wellington city's transport network to get ahead of growing demand by maintaining and developing Wellington's liveability, economic growth and productivity by reducing reliance on private vehicles and developing a multi-modal transport approach. Some initiatives may contribute to emission reductions and others may increase emissions.			
Accessible Streets – package of regulatory changes • Accessible Streets is a package of regulatory changes to increase the safety and attractiveness of walking and cycling. Accessible Streets has been publicly consulted on. Officials are now preparing advice for the Minister of Transport on how to progress the package, including whether changes to the proposals are necessary based on consultation. *Investment in integrated ticketing for public transport* • Waka Kotahi is developing an integrated ticketing system for public transport, which is likely to support public transport uptake. *Continued funding of SuperGold Card scheme* • The SuperGold Card scheme subsidises public transport use for those over the age of 65 and veterans.	• Implement Accessible Streets proposals. • Deliver integrated ticketing for public transport. • Consider extending public transport fare concessions to other low-income groups.		

Transport Pricing and Demand Management

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
Investigation into congestion pricing for Auckland (called the Congestion Question) • Investigation into whether congestion pricing could work for Auckland. No decisions have been made about implementing congestion pricing.	• Aim to introduce pricing mechanisms alongside land use changes and public transport investments. In the first budget period, this could involve implementing congestion pricing in Aotearoa's main urban centres, in particular Auckland. Congestion pricing could have more or less impact on emissions depending on its set up. The Government could also consider introducing incentives (subsidies and/or rewards) that encourage people to use public transport, walk or cycle.	• Introduce further pricing mechanisms, where appropriate in other urban areas.	
Future of the Revenue System project • This project looks at the future purpose and objectives of the land transport revenue system (was narrowed to focus on electronic distance-based charging in 2019, but scope has expanded again).	• Continue to investigate opportunities to innovate distance based charging, as more motorists switch from petrol powered vehicles to vehicles powered by other sources that will be subject to road user charges. This includes considering how all motorists can fairly contribute to funding the land transport system, including EV owners.		
	• Parking management can significantly influence demand for parking and encourage mode shift. The Government could require councils to continue to develop and implement parking pricing strategies, introduce maximum		

	parking standards for some areas, and consider workplace/private property/commuter parking levies.		
	• Government could investigate increasing rates of fuel excise duty and implementing a transport fuels only carbon tax.	• Consider increasing fuel excise duty / transport fuels only carbon tax.	

Theme 2 – Improving our passenger vehicles

Decarbonising the light vehicle fleet

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
Clean Car Standard • The Government has agreed to implement the Clean Car Standard, which will come into effect from 2022, to improve the fuel efficiency of new and used light vehicles imported into Aotearoa. *Road User Charge exemption and rates* • There is a Road User Charge (RUC) exemption in place for low emission light vehicles to increase the speed of their uptake. The Ministry is also investigating enabling RUC rates taking into account a vehicles' emissions. *Vehicle fuel economy labelling* • There is a vehicle fuel economy labelling (VFEL) system in place which allows buyers to compare the fuel economy of one vehicle against another (not emissions). Work is underway to expand the role of the VFEL so that it can support the purchase of low emission vehicles. *The Low Emission Vehicle Contestable Fund* • The Energy Efficiency and Conservation Authority (EECA) is reviewing the scope of its Low Emissions Vehicle Contestable Fund to accelerate LEV uptake through encouraging innovation. *Road to Zero strategy* • The strategy includes the aim of removing the most unsafe vehicles on the roads, which are generally also the highest emitting. *Government procurement* • All government departments have a 2025 target to be carbon neutral for all of their operations including transport. Government investment is available to facilitate this. A procurement rule is in place that requires government agencies to buy electric vehicles, unless there is a strong business reason not to. MBIE runs all-of-government procurement.	• Implement the Clean Car Standard • The Government should also clearly signal the phase out of light ICE vehicles – such as a commitment to phase out fossil fuel vehicle imports by 2030-2035. • Increase demand for cleaner vehicles by addressing their high upfront cost through introducing incentives. This could include a feebate scheme (e.g. the Clean Car Discount) and/or other subsidies. • The Government may need to ramp up its investment in electric charging infrastructure to support the increasing numbers of EVs in the fleet • Investigate the potential for tax incentives to stimulate the demand for low emission vehicles (including Fringe Benefit Tax, Depreciation and Tax Grants) and implement changes to the system if necessary. • Government departments must take steps to achieve the 2025 target to be carbon neutral.	• Strengthen the Clean Car Standard. • Consider policies that remove ICE vehicles from the fleet more quickly. • Continue to incentivise uptake of EVs. • Final decisions by government departments to complete their fleet transition to being zero emissions.	• The Government should phase out ICE light vehicle imports by 2030-2035.

Electric Vehicle Infrastructure – scoping project • The Ministry, with MBIE, EECA and Waka Kotahi, is scoping national guidance on electric vehicle public charging infrastructure to determine the best way to be ready for the uptake in low emission vehicles required to meet our targets.	• Consider scaling up investment in low emission vehicle infrastructure to support the uptake of low emission vehicles. The Ministry, with MBIE, EECA and Waka Kotahi, is currently scoping what might be required.		
Reviewing the 2008 Biofuel Sales Obligation for reinstatement • To support the development of a sustainable transport biofuels mandate.	• Implement a biofuel mandate to help address emissions from existing vehicle fleet.	• The Government may need to strengthen the biofuel mandate to increase biofuel use in existing fleet.	

Decarbonising the public transport fleet

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
Decarbonising buses • The Government has committed to a target of decarbonising the public transport bus fleet by 2035. • The Government will require only zero emissions buses to be purchased by 2025. • The Government has announced that it will provide $50m over four years to help councils achieve the targets. *Review of the Public Transport Operating Model* • This review will consider how changes could enable accelerated decarbonisation of public transport and support local government to reach the targets set by Government.	• Engage with the sector to identify what support is required to accelerate the decarbonisation of the bus and ferry fleet. • Implement zero emissions buses by 2025 mandate. • Consider extending the RUC exemption for electric buses. • Consider if legislative change is necessary to enable the acceleration decarbonisation of the public transport fleet. • Implement monitoring and reporting of funding to inform future decision-making. • Investigate options to decarbonise existing diesel buses, e.g. greater use of biofuels or synthetic diesel. • Consider future investment needs to ensure existing rail networks are fit for purpose.	• Ongoing engagement with the sector to identify whether continued support is required to accelerate decarbonisation of the bus and ferry fleet.	

Decarbonising aviation

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
Decarbonising aviation • Implementing the International Civil Aviation Authority's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) into domestic legislation. *Reviewing the 2008 Biofuel Sales Obligation for reinstatement* • To support the development of a sustainable transport biofuels mandate. This is intended to apply to all modes including aviation. *Operational improvements* • New Southern Sky (NSS) and Performance Based Navigation (PBN) have been implemented to implement emerging aviation technologies and improve air traffic flow and efficiency.	• Sustainable aviation fuel has the most potential to reduce aviation emissions in the short to medium term. The Government should keep working with the aviation industry to investigate its potential in New Zealand. • Implement a biofuel mandate to help address emissions from aviation. • Consider subsidies to support domestic biofuel production. • Continue implementation of operational improvements through NSS and PBN.	• Strengthen biofuels mandate. • Consider continuing subsidies to support domestic biofuel production. • Continue implementation of operational improvements through NSS and PBN.	• Strengthen biofuels mandate. • Consider continuing subsidies to support domestic biofuel production. • Continue implementation of operational improvements through NSS and PBN.

Theme 3 – Supporting a more efficient freight system

Improving the efficiency of our overall freight supply chain

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
National Supply Chain Strategy • Scoping work has begun on a National Supply Chain Strategy that will provide strategic direction and set out priorities amongst the various objectives for the supply chain, one of which is the reduction of emissions.	• Identify opportunities to improve the overall efficiency of the freight supply chain to avoid/reduce freight emissions. This is a focus of the National Supply Chain Strategy.	Implement opportunities agreed to improve the overall efficiency of the freight supply chain.	Implement opportunities agreed to improve the overall efficiency of the freight supply chain.

Enabling modal-choice in freight through the use of low emissions modes

Current work underway	Budget period 1: 2022-2025	Budget period 2: 2025-2030	Budget period 3: 2030-2035
Future of Rail • A range of decisions have been taken by the Government over the past 2 to 3 years with the aim of improving the viability of rail as an alternative freight choice in order to reduce the negative externalities of road freight, in particular GHG reduction. *Coastal Shipping* • Opportunities to improve the uptake of coastal shipping will be explored through the National Freight Strategy. A key driver is emissions reduction given coastal shipping has lower GHG than road transport. • The Ministry is working with Waka Kotahi to see how the newly created Coastal Shipping allocation in the National Land Transport Fund may contribute towards the aim of increasing coastal shipping.	• Identify opportunities for supporting mode shift. This is a focus of the National Freight Strategy.		

Decarbonising freight modes			
Current work underway	**Budget period 1: 2022-2025**	**Budget period 2: 2025-2030**	**Budget period 3: 2030-2035**
The Low Emission Vehicle Contestable Fund • The Energy Efficiency and Conservation Authority (EECA) is reviewing the scope of its Low Emissions Vehicle Contestable Fund to accelerate LEV uptake through demonstrating low-emissions technologies and fuels, supporting the development of vehicle charging and refuelling infrastructure. *Reviewing the 2008 Biofuel Sales Obligation for reinstatement* • To support the development of a sustainable transport biofuels mandate. *Extending the Road User Charge (RUC) exemption for heavy vehicles* • To increase the speed of heavy low emission vehicle uptake.	• Government should investigate the best opportunities for decarbonising trucks (building on the Ministry's Green Freight strategic working paper), including: ○ introducing CO2 standards for trucks ○ increasing funding available to accelerate the uptake of zero and low emission trucks. • Implement a biofuels mandate to help reduce emissions from trucks (in addition to light vehicles). • Consider subsidies to support domestic biofuel production. • Consider targeted investments in infrastructure for green fuels and for fast charging heavy vehicles. • Investigate and introduce Green freight procurement through third party contactor rules for government activities.	• Consider strengthening CO2 standard. • Strengthen biofuel mandate. • Consider continuing subsidies to support domestic biofuel production. • Consider continuing targeted investments in infrastructure for green fuels and for fast charging heavy vehicles. • Investigate disincentives for high emitting trucks. • Consider refurbishing used diesel trucks with zero emission options.	• Phase out the registration of diesel heavy vehicles beyond a certain date, e.g. from 2035 or banning diesel trucks in certain cities or zones. • Strengthen biofuel mandate. • Introduce disincentives for high emitting trucks. • Consider continuing subsidies to support domestic biofuel production.
The Future of Rail Review has recognised the importance of investment in core asset replacement to provide a resilient and reliable rail network and to facilitate mode shift. NZ's Rail Plan of investment priorities , which will also facilitate emissions reductions through: • Replacement of old assets with modern equivalents (i.e. assets which are more energy efficient) • Encouraging mode shift to rail as a result of greater resilience and reliability	• KiwiRail will progress its procurement of a new South Island mainline locomotive fleet. A key consideration will be improved engine performance. • KiwiRail progressively replaces lighter duty mainline locomotives and shunt locomotives across Aotearoa with new units with more modern technology. • The Government's investment in Auckland Metro rail network which involves several packages of work progresses. This includes the Wiri to Quay Park (Third Main) and extending electrification from Papakura to Pukekohe.	• Three ferries are replaced with two new rail-enabled ferries that are diesel-electric hybrids. • Ongoing exploration of the potential for further network electrification and its impact on the national grid. • Continued investigation of alternative propulsion technologies and adapting KiwiRail's rolling stock strategy as this evolves.	• Continued investigation of alternative propulsion technologies and adapting KiwiRail's rolling stock strategy as this evolves
MARPOL VI • MARPOL Annex VI is the international regulatory mechanism for addressing the climate change impacts from shipping and Aotearoa is in the process of aligning domestic legislation and regulations to accede to MARPOL Annex VI by early 2022.	• Work with the maritime industry to investigate options to decarbonise shipping fleets.		

Consultation question 14

Do you have any views on the policies that we propose should be considered for the first emissions budget?

Chapter 12: Where to next?

Hīkina te Kohupara was produced to help inform the Government's strategic approach to reducing GHG emissions from transport. It is the first step towards fully understanding how the transport sector can reduce its GHG emissions. It will be used to facilitate discussions with Ministers, Iwi/Māori, stakeholders and our wider communities on potential policies that we will carry forward in 2021 through to the first ERP under the CCRA.

Leadership and stewardship will be critical to achieving our goal

To credibly reduce transport emissions Aotearoa will require ongoing leadership and stewardship to ensure we are on a pathway to net zero by 2050. It will necessitate significant effort to ensure all New Zealanders play their part to reduce emissions from our transport system.

The people of Aotearoa must be kept informed about when we will progress policies to reduce transport GHG emissions, including which policies will be given priority. Doing so will provide certainty to iwi/Maori, businesses, investors and our wider communities on how we intend to reduce transport emissions.

Hīkina te Kohupara has highlighted that actions designed to reduce transport GHG emissions can also deliver wider benefits. Win-win approaches delivering multiple outcomes are sought ahead of trade-offs and single outcome actions. This includes ensuring that a Just Transition is supported and inequitable impacts from policies are mitigated.

Hīkina te Kohupara is underpinned by the principles of partnership, protection and reciprocity in Te Tiriti o Waitangi. It enables partnership for shared outcomes, protection for people, the environment and the planet, and recognition of multiple benefits for all people of Aotearoa.

There are many parties that have a part to play to reduce transport emissions

The Ministry will need to work with others to deliver the policy changes needed. This will include working with other central government organisations, local government, Iwi/Māori, key stakeholders and businesses across a range of industries.

Some of the policies proposed are not lead by the Ministry, but the Ministry will play a significant role in assisting the transport sector to decarbonise. Additionally, decarbonising the transport system will require effort from a cross sector of government agencies, local government, businesses, and all peoples of Aotearoa.

Hīkina te Kohupara is shaped by a commitment to a sustainable transport system that serves the needs of current and future generations.

Hīkina te Kohupara will help to inform the transport policies included in the ERP

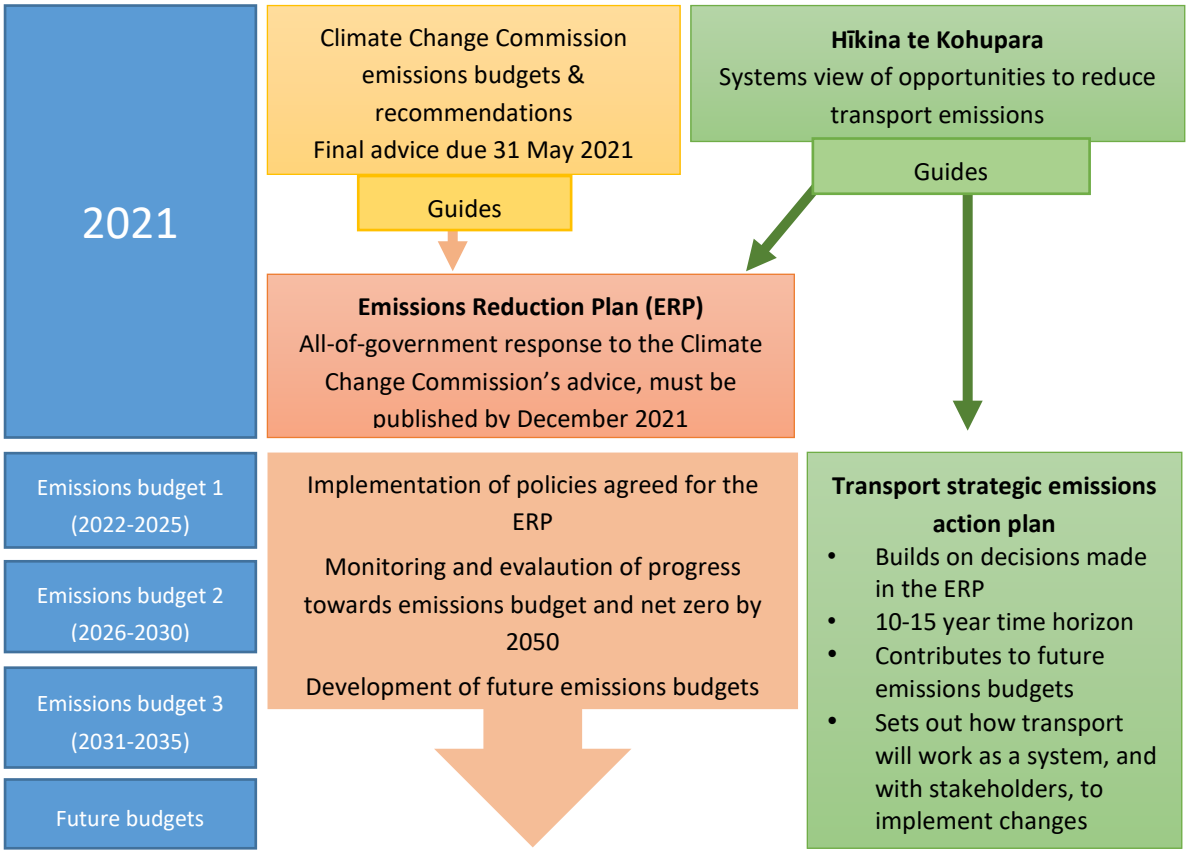
Government obligations under the CCRA includes a requirement to prepare a plan to set out the policies and strategies to meet the next emissions budget, and it may include policies and strategies for meeting other emissions budgets. The plan must include:

- sector specific policies to reduce emissions (and increase removals)
- multi-sector strategies to meet emissions budgets and improve the ability of sectors to adapt to the effects of climate change, and
- a strategy to mitigate the impacts that reducing emissions (and increasing removals) will have on employees and employers, regions, Iwi/Māori and wider communities, including the funding for any mitigation action.

Discussions with Ministers on Hīkina te Kohupara will inform the transport policies included in the ERP. Transport policies agreed with Ministers will need to be scoped and developed in further detail, including cost benefit analyses and more detailed analysis of the potential level of investment required for their implementation.

The transport policies agreed for the first ERP will **only** be the starting point for the transport system to reduce its GHG emissions. We anticipate that the transport chapter of the ERP will include policies that have already been agreed to by Government, new policies and indicative work that is required to understand how aspects of the transport system will contribute to the emissions budgets. Further effort will be required to identify additional policies that will need to be implemented in the future to support the whole of government response to the Climate Change Commissions' GHG emissions budgets.

The diagram below illustrates the relationship of Hīkina te Kohupara with the Climate Change Commission's advice, the development of an all-of-government Emissions Reduction Plan and a transport strategic action plan.



Hīkina te Kohupara will underpin a 10-15 year strategy and action plan

Hīkina te Kohupara has highlighted that Aotearoa must implement a broad range of policies to achieve meaningful change and reductions in our GHG emissions from the whole transport system. Aotearoa cannot afford to cherry pick policies, nor are there policies that are silver bullets. In addition to informing the policies for the first ERP, Hīkina te Kohupara will be the foundation document from which a 10-15 year time horizon strategy and action plan will be developed. A strategy and action plan will be agreed with Government and used to inform future ERPs and future investment and resource needs.

How can you help?

Thank you for taking the time to read this paper. The Ministry invites your views on the opportunities outlined in this paper to reduce transport emissions and put us on a pathway to zero carbon emissions by 2050. Your views will help us to shape the advice we put forward to Ministers for the ERP, and for the development of transport strategic action plan for the next 10 to 15 years.

Fourteen questions have been asked in this document. These can be found on pages: 11, 27, 31, 44, 56, 64, 72, 76, 79, 86, 97, 104, 108, 122 and 134.

If you would like to submit your views, please email:
transportemissions@transport.govt.nz

Key terminology used throughout this report

Alternative fuels – include low carbon fuels or energy sources that offer an alternative to conventional fossil fuels (e.g. petrol and diesel) to power motor vehicles. Low carbon fuel options include: electricity, green hydrogen and biofuels.

Avoid-Shift-Improve Framework – this is the framework the Transport Emissions: Pathways to Net Zero by 20500 report - Hīkina te Kohupara has used to structure the possible interventions to reduce transport emissions. It is described in detail in Chapter 4.

Battery electric vehicles (BEVs) – are purely electric vehicles that are only powered by batteries, which are charged by connecting to an external electricity source.

Biodiesel – is a form of diesel derived from plants or animals and consisting of long-chain fatty acid esters.

Carbon Dioxide (CO_2) – is a long lived greenhouse gas, which makes up 45 percent of Aotearoa's gross greenhouse gas emissions.

Climate Change Response (Zero Carbon) Amendment Act 2019 – legislates our emissions reductions targets and 5-yearly Emissions Reduction Plans, which will contain carbon budgets. The Act also set up the Climate Change Commissions to provide expert advice and monitoring to ensure we are on track to meet our targets. It is formally known as the Climate Change Response Act 2002.

CO_2-e – stands for "carbon dioxide equivalent" and is a standard unit for expressing the impact of different greenhouse gases, in terms of the amount of CO2 that would create the same amount of warming. CO_2 is the baseline greenhouse gas that is used as a benchmark for other gasses.

Co-benefits – additional outcomes associated with a strategic priority. The Transport Outcomes Framework also acts as a guide to identify key co-benefits that transport policies and measures should aim for.

Conventional biofuels – or 'first generation' biofuels, are produced from a range of feedstocks, including oil crops (such as canola), used cooking oils, and animal fats like tallow (an inedible meat by-product from meat processing). They are produced through well-understood technologies and processes, and are generally blended with diesel to make them compatible with standard diesel engines.

Decarbonisation – is the process by which countries, individuals or other entities aim to achieve zero fossil carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry and transport.

Electric Vehicles (EV) Programme – The EV Programme was launched in March 2016 to help address barriers to EV uptake.

Emissions Reduction Plan (ERP) – The ERP, led by the Ministry for the Environment, will set out how we respond to the Climate Change Commissions' advice and emissions budgets, and how we will make progress towards meeting our 2050 target.

The Aotearoa Emissions Trading Scheme (NZ ETS) – One of the Government's key levers in the transition to a zero carbon economy. The NZ ETS puts a price on our greenhouse gas emissions, and creates a financial incentive for businesses to reduce their emissions and landowners to earn money by planting forests that absorb carbon dioxide as the trees grow. It is described in detail in Chapter 3.

Fuel Cell Electric Vehicles (FCEVs) – a FCEV uses hydrogen gas to power an electric drivetrain. These vehicles combine hydrogen and oxygen to produce electricity, which runs the vehicle's electric motor.

Feebate scheme (Clean Car Discount) – The feebate scheme is a demand-side policy. It is designed with the intention of stimulating consumer demand for low emission vehicles.

Fuel efficiency – is the relationship between the amount of fuel a vehicle uses over the distance it travels.

Freight industry – includes all freight companies and those reliant on freight delivery for their business

Greenhouse gas (GHG) emissions – those gases that emit radiant energy, trapping heat in the atmosphere, and warming the planet above what it would be without these gasses.

Green hydrogen – hydrogen produced using renewable energy resources so that it is low-carbon. Blue hydrogen is produced from natural gas, and brown hydrogen is produced from coal. Around 95 percent of the world's hydrogen production is blue or brown hydrogen.

Harmful vehicle emissions - pollutants of concern to human health including nitrogen oxides and particulate matter. These have multiple negative health effects, especially for children. Particulates are known to be carcinogenic, and nitrogen oxides cause respiratory and cardiovascular damage, and can contribute to smog.

Heavy vehicle fleet – the heavy vehicle fleet consists of vans, buses and trucks with a 3.5 tonnes gross vehicle mass or more.

Just Transition – Aotearoa has committed to taking a 'Just Transition' approach to becoming carbon free. A Just Transition is fair, equitable and inclusive. It is described in detail in Chapter 9.

Long-haul road freight – long distance transport, performed mainly on state highways or main roads, typically over 300-400km one-way in distance.

Low-emissions vehicle – refers to an engine, motor, process, or other energy source producing relatively low levels of atmospheric pollutants, such as carbon.

Light vehicle fleet – all vehicles weighing up to 3.5 tonnes (3,500 kg) GVM. Medium trucks – those weighing between 3.5 and 10 tonnes (3,500 kg-10,000 kg) GVM.

Micro-mobility – light, short haul modes of transport such as electric scooters, skateboards, share-bicycles.

Mode Shift – increasing the share of people's travel by public transport, walking and cycling.

Paris Agreement – a global agreement on climate change that was adopted by Parties under the United Nations Framework Convention on Climate Change (UNFCCC) in 2015. It commits all countries to take action on climate change and aims to keep the global average temperature well below 2° C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5° C.

Public transport (PT) – passenger transport infrastructure and services contracted by local and central government which may include shared on-demand services identified in Regional Public Transport Plans as integral to the public transport network. Interregional passenger transport by means of a rail vehicle.

Rapid transit – a quick, frequent, reliable and high-capacity public transport service that operates on a permanent route (road or rail) that is largely separated from other traffic.

Renewable diesel – is a direct substitute for diesel, which is refined from lower carbon and renewable source materials such as used cooking oil and animal fats.

Renewable fuels – include advanced biofuels, recycled carbon fuels, and renewable liquid and gaseous transport fuels of non-biological origin (e.g. green hydrogen).

Road freight – is the transportation of commodities and goods by road between two or more points. Short-haul road freight – short to medium distance transport, primarily within regions or across urban areas.

Road User Charges (RUC) – distance based charges based on weight and axle configuration. They are paid by operators of diesel and heavy vehicles ti fund land transport activities.

Transport Outcomes Framework - The Transport Outcomes Framework is intended to help the Ministry of Transport and Government set priorities for the transport system and measure progress.

Transport sector – the sector of the economy that deals with the movement of people and products. It includes organisations across aviation, maritime and land transport.

Urban Environment – any area of land (regardless of size, and irrespective of local authority or statistical boundaries) that is, or is intended to be, predominantly urban in character; and is, or is intended to be, part of a housing and labour market of at least 10,000 people.

Vehicle kilometres travelled (VKT) – is the total kilometres travelled by motor vehicles during a given period.

Waka Kotahi, the NZ Transport Agency (Waka Kotahi) – The government agency with statutory functions to manage the funding of the land transport system and manage the state highwaynetwork.

Zero-emissions vehicle – refers to an engine, motor, process, or other energy source, that at the point of operation emits no atmospheric pollutants.

Appendix A: How Hīkina te Kohupara was developed

In early 2020 the Ministry commenced work on Hīkina te Kohupara.

This has been both a cross-Ministry and cross-agency project.

The following central government agencies were involved in discussions that have shaped the development of Hīkina te Kohupara: Waka Kotahi the New Zealand Transport Agency, the Ministry for the Environment, the Ministry for Business, Innovation and Employment, the Ministry for Housing and Urban Development and the Energy Efficiency and Conservation Authoirty.

The following sets out a high level overview of the steps taken to develop this report:

Workshop 1 - virtual	Cross agency request to provide list of potential levers and opportunities that could be used to reduce transport emissions. Agencies were also asked to identify data sources and past/current/new work that had commenced. The levers/opportunities were collated into outcome groups – themed. More than 100 opportunities were identified.
Background papers	Information papers were written for each of the outcomes, including on each of the levers/opportunities that were identified. This was an iterative process, and the list of levers/opportunities expanded as more research was completed. The papers were shared with agencies for comment. They were also shared with other groups/sectors as relevant to the paper, for example the paper on public transport was shared with local government in Auckland, Wellington and Christchurch.
Sprint Sessions	To support the development of the background papers the Ministry held a series of 2 hour sprint sessions on many of the papers. Representation at these sessions reflected the audience who were asked to comment on the paper. Discussions at the sprint session and through written submissions were used to revise the background papers as appropriate.
Generational Investment Assessment	The Ministry ran an internal Generational Investment Assessment process which required an assessment of the more than 100 levers/opportunities to reduce emissions from the transport system.

	This process assessed and ranked the levers including assessing how/what contribution they might make against the Ministry of Transport's transport outcomes framework.
Workshop 2 - virtual & in person (restricted numbers due to Covid-19 requirements)	A full day workshop was held with representatives from central and local government to discuss the development of the pathways for the report. This workshop was to gather information on what are identified as priority levers/opportunities, how fast these should be implemented, and discuss what advice we should provide to Government to assist with the task ahead.
Steering Group oversight	A Steering Group of Ministry and Waka Kotahi managers was set up for the 2nd half of the process to maintain oversight of the direction and content of the paper.

Appendix B: Modelling Assumptions for Hīkina te Kohupara

The model calculates Theme 1, 2 and 3 impacts in terms of GHG emission reductions

For each theme, the model calculates the change in transport GHG emissions relative to a reference case of emissions from the road fleet from 2021 to 2050. This projection assumes some uptake of electric vehicles over time – particularly in the light vehicle fleet. The reference case is the Ministry's base case from the 2021 update of the Vehicle Fuel Emissions Model (VFEM) (see Chapter 2).

The four themes change either the total amount of vehicle kilometres travelled (through reducing distances or number of vehicles) or the fuel used by the remaining fleet. The model reflects this by first applying all the factors that reduce vehicle kilometres travelled, then by changing the fuel used by the remaining fleet. Where integrating VKT and fuel changes was not possible, we applied the changes in terms of a percentage change in emissions.

Pathways differ in the model based on assumption settings for avoid and shift

The model has different settings (very high, high, medium and low) for how much we reduce VKT or change fuel. We have used these settings to develop the four pathways. The figure below illustrates the different settings between for each pathway.

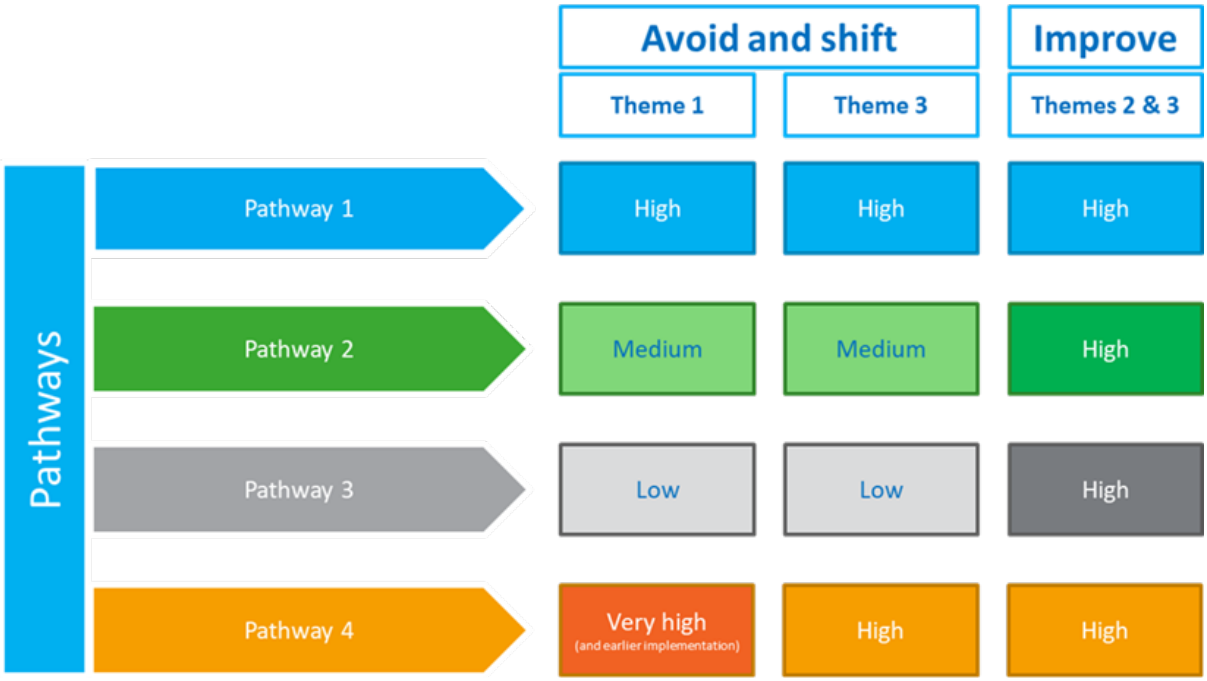


Figure 11 Pathway assumption settings

For each of the pathways, we have applied highly optimistic settings for most themes. This reflects the commitment and level of actions required to achieve as close to zero transport GHG emissions as possible.

Pathways 1 to 3 have the same ‘high’ settings for improve initiatives covered in Theme 2 and Theme 3. This setting reflects strong EV and biofuel uptake and is to reduce as much emissions as possible from all remaining vehicles in each pathway. Even though ‘improve’ initiatives convert remaining vehicles to low emissions options at the same ‘high’ setting, more weight on avoid and shift initiatives reduces this task burden.

Pathway 4 has the same high settings as Pathways 1 to 3 but it assumes less of a supply constraint on incoming electric vehicles. Japan remains Aotearoa’s primary source of vehicles and has limited EV availability. Relaxing the supply constraint implicitly assumes Japan will achieve much higher EV production and car sales (a turn around from current trends) or that Aotearoa is able to set up substantially more alternative supply from other right-hand drive countries such as Korea, UK and India.

The model does not cover everything

The table below highlights at a high level what is included and excluded in the model by theme:

	In the model	Not in the model
Modes	 Walking, cycling, working from home, cars, SUVs, vans, utes, buses, passenger rail (excluding fuel changes), trucks	 Motorcycles, micromobility, freight rail, aviation, ships and boats
Fuels	 Petrol, diesel, hybrid-electric, electric, conventional ethanol (up to 10% blend), conventional biodiesel (up to 7%), ‘ drop-in’ renewable diesel (up to 100%)	 Heavy fuel oils and sustainable fuels used in shipping, aviation fuels – including sustainable alternatives, hydrogen
Initiatives (categorised ...	1 Land-use changes Public transport improvements Congestion, parking, and VKT pricing	1 Placemaking/urban design Shared mobility and MaaS Parking management (except pricing) Low emission zones Working from home / flexible working policies
	2 Fuel efficiency standard for light vehicles Feebate scheme for light vehicles Phase out of ICE light vehicle imports by 2035 Ban on all ICE vehicles in 2050 Biofuels in light vehicles and buses All PT buses electric by end of 2035	2 Rolling age ban for light ICE vehicles Other subsidies or tax incentives for light vehicles Government procurement of electric vehicles Vehicle scrappage schemes Decarbonising passenger rail initiatives Aviation policies

3	Freight routes optimisation, freight consolidation, improved last mile efficiency Energy saving and logistic improvements[111] Mode-shift from road freight to rail Mode shift from road to coastal shipping Biofuels for road freight More electric medium trucks

3	Hydrogen truck initiatives Heavy electric truck initiatives Decarbonising maritime initiatives

There are some key assumptions underpinning the model

Theme 1: Changing the way we travel

- For Theme 1, the model includes the combined impacts of land-use changes (including increased densification), public transport improvements, and transport pricing (including congestion pricing, parking pricing and distance pricing) on GHG emissions from the light vehicle fleet and buses.

- Land use and public transport impacts amplify one another. The model reflects this by using the evidence for the combined effect land use and public transport changes which is larger. In contrast, pricing mechanisms may partially offset one another. To adjust for this offsetting, the model incorporates congestion, parking, and distance pricing multiplicatively which slightly erodes the combined effect.

- Pricing is often supportive of land use and public transport changes. However, we are cautious about overstating the combined change of all these types of initiatives without further analysis so have also incorporated pricing multiplicatively (which reduces the overall effect).

- These public transport, pricing, and land use changes drive and increase in car sharing, walking, cycling, and working from home in the model.

- The model draws on information compiled from studies of VKT changes in response to these types of initiatives in the United States and Europe.[112]

Theme 2: Improving our passenger vehicles

- For Theme 2, we considered what it could take to transition all of New Zealand's light vehicle fleet to cleaner vehicles/fuels by 2050. To reach that target in the model, we have included initiatives that increase the fuel efficiency of vehicle imports, phase out ICE vehicle imports by 2035, increase the use of bioethanol, and introduce a complete ICE vehicle ban in 2050.

- The model takes into account the impact of Theme 1 on Theme 2 for all pathways, which provide a cumulative impact on emissions. The initiatives outlined in Theme 1 help to reduce car ownership and VKT (through improved access, better transport options, and mode shifts), in turn reducing the number of vehicles and the amount of energy/fuel that needs to be decarbonised by 2050.

[111] e.g. driver training, load sharing, retiming urban delivery for medium trucks

[112] The model does not account for the impact of these policies on trucks, buses, rail or ferries.

Theme 3: Supporting a more efficient freight system

- For Theme 3, the model includes policies that support the optimisation of freight, shifting road freight to rail and coastal shipping, and increasing the uptake of biofuels and electrifying medium trucks.

- We have taken into account the impact that optimisation will have on the number of vehicles and vehicle kilometres travelled that needs to be decarbonised.

- While we have not modelled the impact of electrifying large trucks or using hydrogen to fuel trucks, we acknowledge that both of these technologies could play a significant role in reducing GHG emissions.[113] We discuss this in more detail in the policy implications section of Chapter 10.

It must be stressed that many of the policies would either be extremely difficult or expensive to implement within the timeframes. They would also require a number of supporting and complementary measures to support individuals, businesses and transport industry players in transitioning to reduce transport GHG emissions.

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[113] The use of renewable diesel in the model (which reduces GHG emissions by 80 percent for every litre it replaces) gives some indication of the impact that electrification or hydrogen could also have on reducing emissions from road freight.

Pathway 1						
	2035			2050		
Theme 1						
	VKT reduction		**Emissions impact**	**VKT reduction**		**Emissions impact**
	Combined theme 1 effects	19.7%	1.5Mt reduction (10% of 2035 emissions)	Combined theme 1 effects	28.9%	0.5Mt reduction (7% of 2050 emissions)
	Land use and public transport	3.9%		Land use and public transport	8.1%	
	Combined pricing effects	16.4%		Combined pricing effects	22.6%	
	Parking pricing	*1.5%*		*Parking pricing*	*1.4%*	
	Congestion pricing	*2.6%*		*Congestion pricing*	*3.0%*	
	Distance pricing	*14.2%*		*Distance pricing*	*20.4%*	
	Fleet snapshot			**Fleet snapshot**		
	• 3.8m vehicles (VKT reduction is equivalent to removing 20% of the light fleet) • 10,300 additional PT buses (260% increase)			• 3.5m vehicles (VKT reduction is equivalent to removing 29% of the light fleet) • 16,900 additional PT buses (291% increase)		
Theme 2						
	Fleet snapshot		**Emissions impact**	**Fleet snapshot**		**Emissions impact**
	• 670,000 EVs • 3.0m petrol, diesel, and hybrid vehicles • Light fleet is 18% electric • 13,800 EV PT buses • 400 non-EV PT buses • PT bus fleet is 97% electric • All petrol and diesel vehicles running on 10% ethanol or 16% biodiesel blends respectively		3.0Mt (21% of 2035 emissions)	• 3.2m EVs • 290,000 petrol, diesel, and hybrid vehicles • Light fleet is 92% electric • 22,700 EV PT buses • Zero non-EV PT buses • PT Bus fleet is 100% electric • All petrol and diesel vehicles running on 10% ethanol or 100% biodiesel blends respectively		3.6Mt (44% of 2050 emissions)

Notes

1) We combined all VKT reductions for Theme 1 multiplicatively, resulting in the total VKT change being less than the sum of all the VKT changes
2) Theme 1 effects account for different initiatives applying in different parts of the country. Congestion pricing applies to only Auckland and Wellington. Parking pricing, land use, and public transport applies to main centres. Distance pricing applies to all of New Zealand.

<table>
<tr><th colspan="6">Pathway 1</th></tr>
<tr><th colspan="3">2035</th><th colspan="3">2050</th></tr>
<tr><td colspan="6">Theme 3</td></tr>
<tr><td colspan="6">Avoid and shift initiatives</td></tr>
<tr><td colspan="2">VKT reduction</td><td>Emissions impact</td><td colspan="2">VKT reduction</td><td>Emissions impact</td></tr>
<tr><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">0.8Mt
(6% of 2035 emissions)</td><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">1.3Mt
(15% of 2050 emissions)</td></tr>
<tr><td>Optimisation of freight routes etc.</td><td>5.8%</td><td>5.8%</td><td>Optimisation of freight routes etc.</td><td>12%</td><td>12%</td></tr>
<tr><td>Energy saving and logistic improvements</td><td>0.6%</td><td>4.8%</td><td>Energy saving and logistic improvements</td><td>1.2%</td><td>10%</td></tr>
<tr><td>Mode-shift to rail</td><td>12.5%</td><td>NA</td><td>Mode-shift to rail</td><td>20%</td><td>NA</td></tr>
<tr><td>Mode-shift to coastal shipping</td><td>7.5%</td><td>NA</td><td>Mode-shift to coastal shipping</td><td>15%</td><td>NA</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td colspan="3">Fleet snapshot</td></tr>
<tr><td colspan="3">• Marginal decrease in medium truck fleet
• 61,700 heavy trucks (down 20% from reference case)</td><td colspan="3">• Marginal decrease in medium truck fleet
• 53,700 heavy trucks (down 32% from reference case)</td></tr>
<tr><td colspan="6">Improve initiatives</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td>Emissions impact</td><td colspan="2">Fleet snapshot</td><td>Emissions impact</td></tr>
<tr><td colspan="3">• 3,200 EV medium trucks (48% increase)
• Medium truck fleet is 4% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 16% biodiesel blends respectively</td><td>0.4Mt
(3% of 2035 emissions)</td><td colspan="2">• 22,000 EV medium trucks (100% increase)
• Medium truck fleet is 25% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 100% biodiesel blends respectively</td><td>1.8Mt
(22% of 2050 emissions)</td></tr>
<tr><td colspan="6">Total all themes</td></tr>
<tr><td colspan="3">Emissions Impact</td><td colspan="3">Emissions Impact</td></tr>
<tr><td colspan="3">5.7Mt (40% of 2035 emissions)</td><td colspan="3">7.2Mt (88% of 2050 emissions)</td></tr>
</table>

Pathway 2					
	2035			**2050**	
Theme 1					
	VKT reduction		**Emissions impact**	**VKT reduction**	**Emissions impact**
	Combined theme 1 effects	13.3%	1.0Mt reduction (7% of 2035 emissions)	Combined theme 1 effects 17.1%	0.4Mt reduction (5% of 2050 emissions)
	Land use and public transport	2.7%		Land use and public transport 5.9%	
	Combined pricing effects	10.8%		Combined pricing effects 11.9%	
	Parking pricing	*1.1%*		*Parking pricing* *1.1%*	
	Congestion pricing	*0.9%*		*Congestion pricing* *1.3%*	
	Distance pricing	*9.9%*		*Distance pricing* *10.8%*	
	Fleet snapshot			**Fleet snapshot**	
	• 4.1m vehicles (VKT reduction is equivalent to removing 13% of the light fleet) • 6,900 additional PT buses (175% increase)			• 4.0m vehicles (VKT reduction is equivalent to removing 17% of the light fleet) • 10,000 additional PT buses (172% increase)	
Theme 2					
	Fleet snapshot		**Emissions impact**	**Fleet snapshot**	**Emissions impact**
	• 730,000 EVs • 3.3m petrol, diesel, and hybrid vehicles • Light fleet is 18% electric • 10,500 EV PT buses • 300 non-EV PT buses • PT bus fleet is 97% electric • All petrol and diesel vehicles running on 10% ethanol or 16% biodiesel blends respectively		3.1Mt (22% of 2035 emissions)	• 3.7m EVs • 340,000 petrol, diesel, and hybrid vehicles • Light fleet is 92% electric • 15,800 EV PT buses • Zero non-EV PT buses • PT Bus fleet is 100% electric • All petrol and diesel vehicles running on 10% ethanol or 100% biodiesel blends respectively	3.7Mt (45% of 2050 emissions)

Notes

1) We combined all VKT reductions for Theme 1 multiplicatively, resulting in the total VKT change being less than the sum of all the VKT changes
2) Theme 1 effects account for different initiatives applying in different parts of the country. Congestion pricing applies to only Auckland and Wellington. Parking pricing, land use, and public transport applies to main centres. Distance pricing applies to all of New Zealand.

<table>
<tr><th colspan="6">Pathway 2</th></tr>
<tr><th colspan="3">2035</th><th colspan="3">2050</th></tr>
<tr><td colspan="6">Theme 3</td></tr>
<tr><td colspan="6">Avoid and shift initiatives</td></tr>
<tr><td colspan="2">VKT reduction</td><td>Emissions impact</td><td colspan="2">VKT reduction</td><td>Emissions impact</td></tr>
<tr><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">0.5Mt
(4% of 2035 emissions)</td><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">1.0Mt
(12% of 2050 emissions)</td></tr>
<tr><td>Optimisation of freight routes etc.</td><td>4.8%</td><td>4.8%</td><td>Optimisation of freight routes etc.</td><td>10%</td><td>10%</td></tr>
<tr><td>Energy saving and logistic improvements</td><td>0.5%</td><td>3.6%</td><td>Energy saving and logistic improvements</td><td>1%</td><td>7.5%</td></tr>
<tr><td>Mode-shift to rail</td><td>7.5%</td><td>NA</td><td>Mode-shift to rail</td><td>15%</td><td>NA</td></tr>
<tr><td>Mode-shift to coastal shipping</td><td>3.5%</td><td>NA</td><td>Mode-shift to coastal shipping</td><td>10%</td><td>NA</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td colspan="3">Fleet snapshot</td></tr>
<tr><td colspan="3">• Marginal decrease in medium truck fleet
• 68,500 heavy trucks (down 11% from reference case)</td><td colspan="3">• Marginal decrease in medium truck fleet
• 60,900 heavy trucks (down 23% from reference case)</td></tr>
<tr><td colspan="6">Improve initiatives</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td>Emissions impact</td><td colspan="2">Fleet snapshot</td><td>Emissions impact</td></tr>
<tr><td colspan="3">• 3,200 EV medium trucks (48% increase)
• Medium truck fleet is 4% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 16% biodiesel blends respectively</td><td>0.4Mt
(3% of 2035 emissions)</td><td colspan="2">• 22,000 EV medium trucks (100% increase)
• Medium truck fleet is 25% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 100% biodiesel blends respectively</td><td>2.0Mt
(24% of 2050 emissions)</td></tr>
<tr><td colspan="6">Total all themes</td></tr>
<tr><td colspan="3">Emissions Impact</td><td colspan="3">Emissions Impact</td></tr>
<tr><td colspan="3">5.1Mt (36% of 2035 emissions)</td><td colspan="3">7.1Mt (87% of 2050 emissions)</td></tr>
</table>

Pathway 3						
	2035			**2050**		
Theme 1						
	VKT reduction		**Emissions impact**	**VKT reduction**		**Emissions impact**
	Combined theme 1 effects	6.0%	0.5Mt reduction (4% of 2035 emissions)	Combined theme 1 effects	7.8%	0.3Mt reduction (4% of 2050 emissions)
	Land use and public transport	1.1%		Land use and public transport	2.5%	
	Combined pricing effects	4.9%		Combined pricing effects	5.5%	
	Parking pricing	*0.4%*		*Parking pricing*	*0.3%*	
	Congestion pricing	*0.6%*		*Congestion pricing*	*1.0%*	
	Distance pricing	*4.4%*		*Distance pricing*	*4.8%*	
	Fleet snapshot			**Fleet snapshot**		
	• 4.4m light vehicles (VKT reduction is equivalent to removing 6% of the light fleet) • 3,100 additional PT buses (80% increase)			• 4.5m light vehicles (VKT reduction is equivalent to removing 8% of the light fleet) • 4,600 additional PT buses (80% increase)		
Theme 2						
	Fleet snapshot		**Emissions impact**	**Fleet snapshot**		**Emissions impact**
	• 790,000 EVs • 3.6m petrol, diesel, and hybrid vehicles • Light fleet is 18% electric • 6,900 EV PT buses • 200 non-EV PT buses • PT bus fleet is 97% electric • All petrol and diesel vehicles running on 10% ethanol or 16% biodiesel blends respectively		3.2Mt (23% of 2035 emissions)	• 4.1m EVs • 370,000 petrol, diesel, and hybrid vehicles • Light fleet is 92% electric • 10,400 EV PT buses • Zero non-EV PT buses • PT Bus fleet is 100% electric • All petrol and diesel vehicles running on 10% ethanol or 100% biodiesel blends respectively		3.7Mt (46% of 2050 emissions)

Notes

1) We combined all VKT reductions for Theme 1 multiplicatively, resulting in the total VKT change being less than the sum of all the VKT changes
2) Theme 1 effects account for different initiatives applying in different parts of the country. Congestion pricing applies to only Auckland and Wellington. Parking pricing, land use, and public transport applies to main centres. Distance pricing applies to all of New Zealand.

<table>
<tr><th colspan="6">Pathway 3</th></tr>
<tr><th colspan="3">2035</th><th colspan="3">2050</th></tr>
<tr><td colspan="6">Theme 3</td></tr>
<tr><td colspan="6">Avoid and shift initiatives</td></tr>
<tr><td colspan="2">VKT reduction</td><td>Emissions impact</td><td colspan="2">VKT reduction</td><td>Emissions impact</td></tr>
<tr><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">0.4Mt
(3% of 2035 emissions)</td><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">0.7Mt
(9% of 2050 emissions)</td></tr>
<tr><td>Optimisation of freight routes etc.</td><td>3.9%</td><td>3.9%</td><td>Optimisation of freight routes etc.</td><td>8%</td><td>8%</td></tr>
<tr><td>Energy saving and logistic improvements</td><td>0.4%</td><td>2.4%</td><td>Energy saving and logistic improvements</td><td>0.8%</td><td>5%</td></tr>
<tr><td>Mode-shift to rail</td><td>3.5%</td><td>NA</td><td>Mode-shift to rail</td><td>10%</td><td>NA</td></tr>
<tr><td>Mode-shift to coastal shipping</td><td>3.5%</td><td>NA</td><td>Mode-shift to coastal shipping</td><td>5%</td><td>NA</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td colspan="3">Fleet snapshot</td></tr>
<tr><td colspan="3">• Marginal decrease in medium truck fleet
• 71,600 heavy trucks (down 7% from reference case)</td><td colspan="3">• Marginal decrease in medium truck fleet
• 68,100 heavy trucks (down 14% from reference case)</td></tr>
<tr><td colspan="6">Improve initiatives</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td>Emissions impact</td><td colspan="2">Fleet snapshot</td><td>Emissions impact</td></tr>
<tr><td colspan="3">• 3,200 EV medium trucks (48% increase)
• Medium truck fleet is 4% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 16% biodiesel blends respectively</td><td>0.4Mt
(3% of 2035 emissions)</td><td colspan="2">• 22,000 EV medium trucks (100% increase)
• Medium truck fleet is 25% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 100% biodiesel blends respectively</td><td>2.2Mt
(27% of 2050 emissions)</td></tr>
<tr><td colspan="6">Total all themes</td></tr>
<tr><td colspan="3">Emissions Impact</td><td colspan="3">Emissions Impact</td></tr>
<tr><td colspan="3">4.6Mt (32% of 2035 emissions)</td><td colspan="3">7.0Mt (86% of 2050 emissions)</td></tr>
</table>

Pathway 4						
	2035			2050		
Theme 1						
	VKT reduction		**Emissions impact**	**VKT reduction**		**Emissions impact**
	Combined theme 1 effects	38.8%	2.5Mt reduction (19% of 2035 emissions)	Combined theme 1 effects	56.8%	1.2Mt reduction (15% of 2050 emissions)
	Land use and public transport	8.6%		Land use and public transport	10.9%	
	Combined pricing effects	33%		Combined pricing effects	51.5%	
	Parking pricing	*3.4%*		*Parking pricing*	*3.6%*	
	Congestion pricing	*2.9%*		*Congestion pricing*	*3.2%*	
	Distance pricing	29.5%		*Distance pricing*	48.7%	
	Fleet snapshot			**Fleet snapshot**		
	• 2.9m vehicles (VKT reduction is equivalent to removing 39% of the light fleet) • 17,200 additional PT buses (436% increase)			• 2.1m vehicles (VKT reduction is equivalent to removing 57% of the light fleet) • 28,300 additional PT buses (487% increase)		
Theme 2						
	Fleet snapshot		**Emissions impact**	**Fleet snapshot**		**Emissions impact**
	• 758,000 EVs • 2.1m petrol, diesel, and hybrid vehicles • Light fleet is 27% electric • 20,600 EV PT buses • 600 non-EV PT buses • PT bus fleet is 97% electric • All petrol and diesel vehicles running on 10% ethanol or 16% biodiesel blends respectively		2.6Mt (19% of 2035 emissions)	• 2.0m EVs • 126,000 petrol, diesel, and hybrid vehicles • Light fleet is 94% electric • 34,100 EV PT buses • Zero non-EV PT buses • PT Bus fleet is 100% electric • All petrol and diesel vehicles running on 10% ethanol or 100% biodiesel blends respectively		3Mt (37% of 2050 emissions)

Notes

1) We combined all VKT reductions for Theme 1 multiplicatively, resulting in the total VKT change being less than the sum of all the VKT changes
2) Theme 1 effects account for different initiatives applying in different parts of the country. Congestion pricing applies to only Auckland and Wellington. Parking pricing, land use, and public transport applies to main centres. Distance pricing applies to all of New Zealand.
3) Pathway 4 assumes importation of ICE vehicles will phase out in 2032 and has a higher percentage of working from home assumption. In addition, it also assumes the clean car policies (part of the baseline) are very successful in accelerating the uptake of electric vehicles and therefore slightly reduce the mitigation needs. Due to changes in the baseline, the emissions impact expressed in percentages are not directly comparable with other pathways.

<table>
<tr><th colspan="6">Pathway 4</th></tr>
<tr><th colspan="3">2035</th><th colspan="3">2050</th></tr>
<tr><td colspan="6">Theme 3 (same as Pathway 1)</td></tr>
<tr><td colspan="6">Avoid and shift initiatives</td></tr>
<tr><td colspan="2">VKT reduction</td><td>Emissions impact</td><td colspan="2">VKT reduction</td><td>Emissions impact</td></tr>
<tr><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">0.8Mt
(6% of 2035 emissions)</td><td></td><td>Heavy trucks</td><td>Medium trucks</td><td rowspan="6">1.3Mt
(16% of 2050 emissions)</td></tr>
<tr><td>Optimisation of freight routes etc.</td><td>5.8%</td><td>5.8%</td><td>Optimisation of freight routes etc.</td><td>12%</td><td>12%</td></tr>
<tr><td>Energy saving and logistic improvements</td><td>0.6%</td><td>4.8%</td><td>Energy saving and logistic improvements</td><td>1.2%</td><td>10%</td></tr>
<tr><td>Mode-shift to rail</td><td>12.5%</td><td>NA</td><td>Mode-shift to rail</td><td>20%</td><td>NA</td></tr>
<tr><td>Mode-shift to coastal shipping</td><td>7.5%</td><td>NA</td><td>Mode-shift to coastal shipping</td><td>15%</td><td>NA</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td colspan="3">Fleet snapshot</td></tr>
<tr><td colspan="3">• Marginal decrease in medium truck fleet
• 61,700 heavy trucks (down 20% from reference case)</td><td colspan="3">• Marginal decrease in medium truck fleet
• 53,700 heavy trucks (down 32% from reference case)</td></tr>
<tr><td colspan="6">Improve initiatives</td></tr>
<tr><td colspan="3">Fleet snapshot</td><td>Emissions impact</td><td colspan="2">Fleet snapshot</td><td>Emissions impact</td></tr>
<tr><td colspan="3">• 3,200 EV medium trucks (48% increase)
• Medium truck fleet is 4% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 16% biodiesel blends respectively</td><td>0.4Mt
(3% of 2035 emissions)</td><td colspan="2">• 22,000 EV medium trucks (100% increase)
• Medium truck fleet is 25% electric – no difference between pathways
• Remaining petrol and diesel trucks running on 10% ethanol or 100% biodiesel blends respectively</td><td>1.8Mt
(22% of 2050 emissions)</td></tr>
<tr><td colspan="6">Total all themes</td></tr>
<tr><td colspan="3">Emissions Impact</td><td colspan="3">Emissions Impact</td></tr>
<tr><td colspan="3">6.2Mt (46% of 2035 emissions)</td><td colspan="3">7.2Mt (89% of 2050 emissions)</td></tr>
</table>