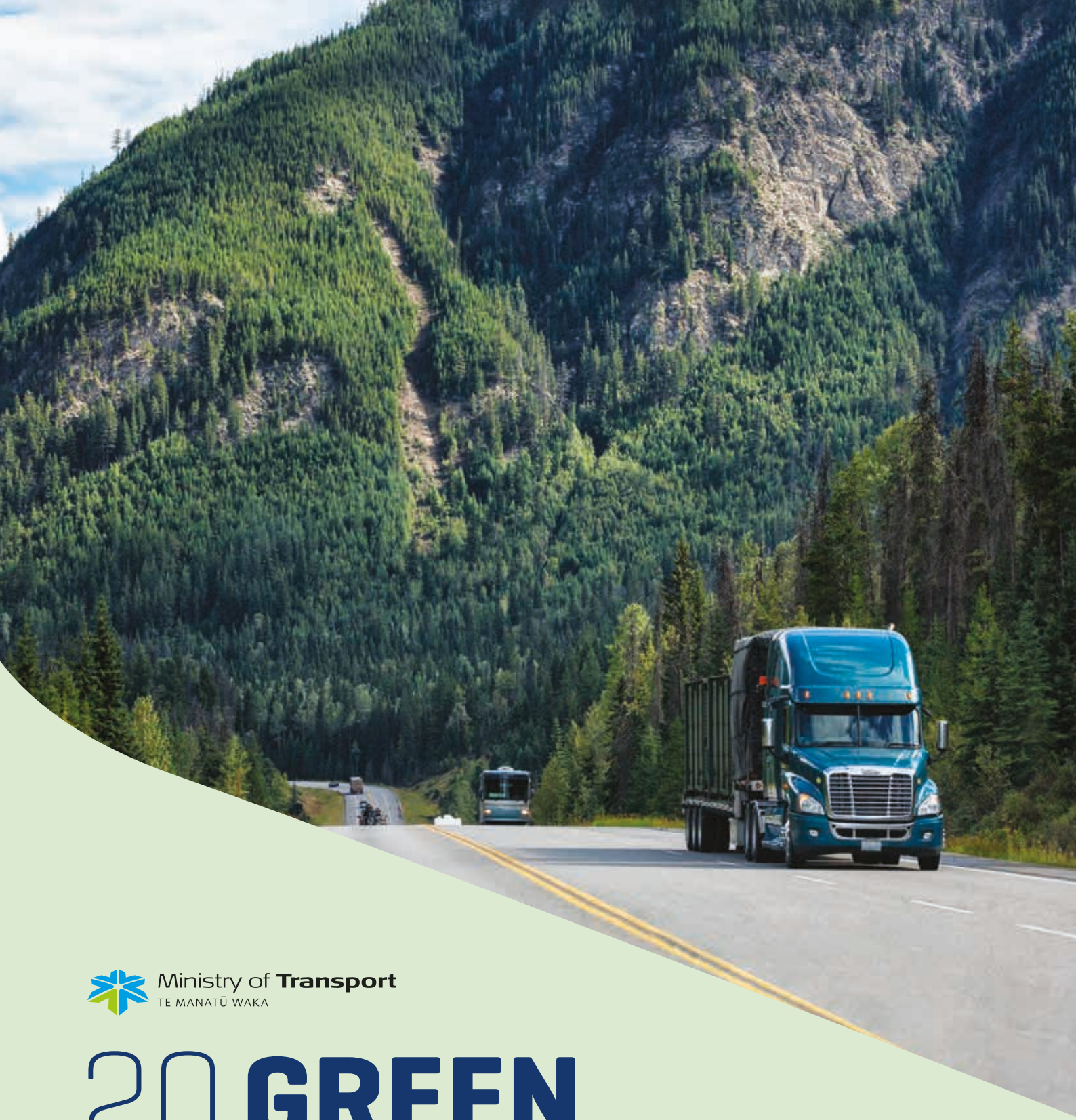


Ministry of Transport
TE MANATŪ WAKA

# 20 GREEN 20 FREIGHT

Strategic Working Paper

**He mahi auaha kia ora ai te marea**

The pursuit of innovation for the benefit of all


## ACKNOWLEDGEMENTS

The Green Freight Strategic Working Paper is a key deliverable of the Ministry of Transport's Green Freight project and the Ministry's wider work programme on reducing GHG emissions from the transport sector. The Ministry is very grateful to those who have contributed to the Green Freight project and shared their views to help inform the contents of this working paper. The Ministry would especially like to thank Ports of Auckland, New Zealand Post, Hiringa Energy and Z Energy for contributing case studies to this paper, and the representatives from the freight and energy sectors, government agencies, and academia, who gave up their time to attend and contribute to workshops and meetings. Thanks also goes to Liz Yeaman from Retyna who provided the external review of this paper and added significant value with her comments. The Ministry looks forward to working with all of you on any future iterations of this work.

# Contents


"Today's decisions will shape New Zealand's future. Our approach to reducing emissions from the transport sector will affect people's lives and livelihoods, and it is critical that we work together to find a pathway forward."

# Foreword

We all know that the transport sector has an important role in responding to climate change, with almost 20 percent of New Zealand's domestic greenhouse gas emissions coming from transport. Reducing transport emissions will be critical for achieving New Zealand's emissions reduction targets and ensuring the wellbeing of New Zealanders. Fortunately, there are many opportunities to reduce transport emissions, while also benefiting public health, access and economic prosperity.

The Ministry of Transport has a programme of work underway that will support the reduction of emissions in the transport sector. This includes our work on supporting the uptake of low-emissions light passenger vehicles and encouraging greater use of low-emissions transport modes, such as rail, public transport, walking and cycling. The Ministry is also participating in the International Maritime Organization's measures to reduce emissions from shipping, and the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation.

The Ministry's Green Freight project is part of this work programme and focuses on opportunities to reduce greenhouse gas emissions from road freight in New Zealand. This strategic working paper is a key output of the Green Freight project. It outlines a range of options that can encourage greater uptake of alternative green fuels, including electricity, green hydrogen and biofuels, in the road freight industry.

What this working paper tells us is that while there are challenges facing the uptake of alternative green fuels in road freight, there are also opportunities. Several New Zealand companies are already taking advantage of these opportunities and leading the way. The Government can play a role in acknowledging and supporting these early movers, and in doing so, encourage the rest of the road freight industry to transition.

We also know that road freight is part of a complex system that includes multiple sectors and players with interdependent relationships. This paper highlights that we need to take a systems approach, where everyone has a role in the transition to a net zero-emissions economy.

We also need to tackle the problem from different angles. This means looking at options to improve the availability and price of alternative green fuels, encourage the uptake of low and zero-emissions vehicles, and address the lack of supporting infrastructure for these new technologies. What is clear is that the transition is achievable despite the challenges, and the Government has a range of options available that it can act on now to start reducing greenhouse gas emissions.

The Ministry has engaged widely on this work, speaking with stakeholders from across Government and the freight and energy sectors. I want to thank everyone who has contributed to this paper, including through workshops and discussions with Ministry officials. Your insights have helped us to develop the options outlined in this paper, and we welcome any further feedback.

Today's decisions will shape New Zealand's future. Our approach to reducing emissions from the transport sector will affect people's lives and livelihoods, and it is critical that we work together to find a pathway forward.

P. Mersi.

**Peter Mersi**
Chief Executive, Ministry of Transport

# Executive summary

Transitioning road freight to alternative green fuels, including electricity, green hydrogen and biofuels, will play an important role in helping New Zealand to meet its climate change targets. The Ministry of Transport has produced this working paper to provide the Government with a range of options to support greater uptake of alternative green fuels in the road freight industry. This is part of the Ministry's wider programme of work to reduce greenhouse gas (GHG) emissions from the transport sector.

The road freight industry in New Zealand is complex. It is driven by domestic and international economic activity and the need to meet customer demands and expectations. Businesses operate in a highly competitive environment with slim profit margins. They also need to meet health and safety requirements, which directs how they deliver on their specific freight tasks. Given this complexity, it is unlikely that a 'one size fits all' approach will have the greatest impact on reducing GHG emissions from road freight. The Government should consider options that provide the freight industry with flexibility to transition to the alternative green fuels that are best suited to their organisations.

The road freight industry operates as a system. Freight operators, vehicle manufacturers, infrastructure developers and fuel producers/operators have an interdependent relationship. Changes in one part of the system will affect other parts of the system. Decision makers need to be cognisant of the impact their decisions have across the whole system, and they need to consider the role each player has in reducing New Zealand's GHG emissions.

Customers are starting to expect greater sustainability and corporate responsibility from freight companies. This is already pushing the freight industry to consider lower emissions options. However, the choice of fuel used by the freight industry is constrained by what is available in New Zealand, as well as its cost and applicability to the freight task.

Biofuels can be used in existing vehicles and infrastructure, and have the potential to reduce GHG emissions from other parts of the transport system (including aviation and maritime). 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 New Zealand in low volumes, and could be scaled up with greater investment. If the Government wants to support the uptake of biofuels, it should also consider options that enable their use by the wider transport sector and in the long-term provide access to advanced biofuels in New Zealand.

Currently, the upfront cost of low and zero-emissions vehicles is a significant barrier to their uptake, as is the uncertainty around their ability to deliver the freight task. If these barriers can be overcome, then the long-term financial advantages of transitioning to new technologies can be significant. At this time, electrification is best suited to medium trucks undertaking urban freight delivery tasks, and heavy trucks with return-to-base operations or delivering niche services across the freight industry. Fuel cell electric vehicles (FCEVs) appear best suited to long-haul freight tasks, along with emerging heavy electric trucks and ultra-fast charging technologies. However, these vehicles are not readily available in New Zealand. The Government should consider options that help to influence vehicle supply chains, and incentivise the uptake of low and zero-emissions vehicle options across the freight industry.

Supporting infrastructure is critical for enabling the transition to both battery electric vehicles (BEVs) and FCEVs. Freight companies are unlikely to invest in vehicles that cannot be easily recharged/refuelled. Any options that the Government decides to pursue should consider how to support market investment in infrastructure, as well as provide clear signals around its support for all three alternative green fuels. This could be achieved through more considered and targeted infrastructure investment.

Clear signals from the Government on policy direction will provide organisations with adequate lead times to incorporate policy changes into business planning and investment decisions. Funding and investment options should also support businesses to take advantage of transition opportunities as they arise. Government investment should be coupled with clear policy intention, and existing funds should be leveraged off and aligned to technology maturity and market driven opportunities. The Government may also need to play a greater role in working with industry to address challenges and exploit opportunities. Building greater understanding around the funding opportunities available to industry, and ensuring funding and policy interventions are packaged together and aligned across different Government agencies, will be important to increase alternative green fuels uptake.

While the intention of this paper has been to provide a wide range of options for consideration, all options presented in this paper require further analysis. In particular, the social impact and costs and benefits of the different options need greater investigation. Some options are also likely to result in costs to industry, but there is equally a cost of not acting now to encourage and support behaviour change. The co-benefits of transitioning to alternative green fuels are also an important element in making the right policy and investment decisions and should form part of the criteria for assessing the options presented.

# Introduction

The transport sector is a significant source of New Zealand's GHG emissions, which means that it will have a critical role in transitioning New Zealand to a net zero-emissions economy. As the Government's lead policy adviser on transport, the Ministry's role includes providing advice about opportunities to reduce GHG emissions from New Zealand's transport sector. This includes opportunities to reduce GHG emissions from transport in the short to medium-term, while preparing for emerging technologies that have the potential to reduce emissions in the longer-term. Ultimately, the Government has a choice about where to focus its efforts to reduce GHG emissions. However, the scale of the challenge means that the transport sector will likely need to play a significant role.

Heavy vehicles, the majority of which are freight vehicles, are responsible for almost a quarter of New Zealand's transport GHG emissions. This means road freight has an important role to play in decarbonising the transport sector. The Ministry has produced this strategic working paper to explore the potential of three alternative green fuels (electricity, green hydrogen and biofuels), to reduce GHG emissions from road freight in New Zealand. Each of these three alternative green fuels is explained in more detail in Chapter 1 of this paper. Nearly all trucks use diesel, and therefore alternative green fuels offer an opportunity to reduce or replace diesel use, and as a result reduce GHG emissions.

Alternative green fuels are a growing area of interest and investment globally, and represented a gap in the Ministry's knowledge about emerging technologies and innovation. As a working paper, this document aims to generate thinking and further discussion around alternative green fuels. It is the second in a series of strategic working papers developed by the Ministry (the first being PT2045).[1] The working paper approach recognises that transport decisions and investments have long-term implications, and that the Government needs to take a strategic approach to transport planning and investment to ensure the best outcomes for New Zealanders.

While this paper focuses on electricity, green hydrogen and biofuels, innovation could also bring new solutions for the challenges New Zealand is facing. New Zealand will need to harness the full potential of innovation, and not rule out future solutions. At the same time, New Zealand needs to reduce GHG emissions in the short term and make the most of the opportunities available to it now.

## OUR APPROACH TO THE PROBLEM

In September 2019, the Ministry produced a background paper on the challenges and opportunities associated with using alternative green fuels, including electricity, green hydrogen and biofuels, in road freight.[2] The Ministry developed the background paper to inform discussions across Government, and with industry, around challenges and opportunities in transitioning road freight to alternative green fuels in the New Zealand context.

As well as helping build understanding around the challenges and opportunities alternative green fuels provide, the background paper highlighted that all three alternative green fuels have a role to play in reducing GHG emissions from road freight. The paper also reflected the barriers to uptake experienced overseas, including the significant up-front costs of alternative green fuel vehicles and supporting infrastructure.

The purpose of this working paper is to provide the Government with a range of options to increase the uptake of alternative green fuels, including electricity, green hydrogen and biofuels, in the road freight sector over the next 15 years. This timeframe aligns with the timeframes for the Climate Change Commission's first three carbon budgets. The working paper has also been designed to provide input into the development of the Government's GHG emissions reduction plan that will be published in 2021.

The working paper draws heavily on the insights gained from engaging with stakeholders in the freight industry, energy sectors, academia and other government agencies on the background paper. The options presented reflect the Ministry's best assessment of what interventions could have the greatest impact on GHG emissions from road freight over the next 15 years. These options reflect the relative maturity of the different technologies and industry readiness to transition, as well as the need to meet the Government's GHG emissions reduction targets. The Government could speed up or slow down each option, depending on its competing policy and investment priorities.

If the Government decides to pursue any of the options in this paper, then further analysis will need to be undertaken to fully understand the potential social, economic and environmental impacts of each option. This paper also acknowledges that some of the options have significant co-benefits. This includes opportunities to reduce air pollution, encourage economic development (through new industry development providing job opportunities), and improve New Zealand's resilience to changes in the international fuel market. Further analysis around the significance of these co-benefits should also be undertaken.

1. The full paper can be found at: https://www.transport.govt.nz/multi-modal/keystrategiesandplans/public-transport-2045/
2. The Green Freight Project Background Paper, Ministry of Transport, September 2019 https://www.transport.govt.nz/multi-modal/climatechange/green-freight-project/

## OUT OF SCOPE OF THIS PAPER

There are a range of ways to reduce GHG emissions from road freight. This includes taking advantage of opportunities to shift road freight to rail and coastal shipping, which produce significantly less GHG emissions per tonne kilometre (tonne-KM) than road freight. There are also opportunities to reduce GHG emissions from changing freight operational models, the location of new processing plants, and improving operational efficiencies. This includes improving fuel efficiency, better optimisation of fleet use, better driving practices and improved aerodynamics. While these approaches to reducing GHG emissions are important, and will form part of any wider approach to reducing GHG emissions from road freight and the transport sector, they are not the focus of this paper.

This paper is focused on reducing GHG emissions from trucks. Reducing GHG emissions from other heavy vehicles, such as buses, heavy assets and equipment are also out of scope. However, some of the options presented could support the decarbonisation of these vehicles as well.

## GUIDE TO READING THIS PAPER

This paper is divided into three chapters. The first chapter provides important contextual information about New Zealand's road freight industry and transport GHG emissions. It also provides an explanation of each of the alternative green fuels (electricity, green hydrogen and biofuels) explored in this paper. The second chapter outlines the key challenges and opportunities associated with each fuel type (drawing heavily on the content from the Green Freight Background Paper and stakeholder conversations). The third chapter presents a range of options to address the challenges, and exploit the opportunities, outlined in Chapter 2. In addition, the paper includes some case studies to highlight the real world challenges facing New Zealand businesses as they aim to transition to lower emissions alternatives.

## CASE STUDIES

In order to provide some real world examples of where organisations in New Zealand have begun their transition, a few stakeholders were asked to describe their journey to transition some part of their business to low or zero-emissions. The case studies presented throughout Chapter 3 reflect some of the real world challenges they have faced, and how they are overcoming them, in their own words. They also help to demonstrate some of the challenges identified above, and reinforce some of the options presented.

## KEY TERMS USED THROUGHOUT THIS PAPER

A list of key terms used throughout this paper can be found at the back, on page 47.

Chapter 1:

# Setting the scene

This chapter provides an overview of the road freight industry, and the GHG emissions profile of road freight in New Zealand. Much of this information is drawn from the Green Freight Background Paper, the Ministry's updated National Freight Demand Study 2017/18,[3] and discussions with freight industry representatives. It also outlines the three alternative green fuels under investigation, before discussing the challenges and opportunities of each in Chapter 2.

3. The National Freight Demand Study 2017/18, published by the Ministry of Transport in September 2019, provides a snapshot of New Zealand's current freight task and a forecast of what New Zealand's future freight task will look like over the next 30 years. The study can be found here: https://www.transport.govt.nz/mot-resources/freight-resources/nationalfreightdemandsstudy/.

1.1

# New Zealand's road freight industry

## AN OVERVIEW OF THE INDUSTRY

Freight enables the movement of goods between producers and consumers. This includes the movement of New Zealand's domestic goods, as well as international imports and exports. The volume of freight moved in New Zealand depends on the total demand for these goods (derived demand). This means that New Zealand's domestic and international economic activity is the primary driver of freight activity. It is influenced by the strength of the New Zealand dollar, population growth and disposable income (among other factors).

The freight industry is highly competitive, containing a large number of freight operators. The national fleet of road freight trucks in New Zealand is made up of both large fleets of trucks and smaller owner-operated businesses. An owner-operator is someone who owns the transport business and drives a truck in that business as a contract driver. They may operate more than one truck and are essentially small business owners. Owner-operators may work for other fleet operators. Freight operators can either own their own trucks and employ drivers, or contract owner-operators, or have a mixture of both.

The road freight industry is driven by customer demands and expectations, which have an increasing focus on environmental sustainability.

More than 55 percent of the heavy vehicles in the road freight industry operate as part of a small fleet (i.e. five or fewer vehicles). The ease of entry and access to finance is one reason behind the large number of small fleet owner-operators within the industry. However, road freight is a highly price competitive market where the operating costs of a road freight transport business are comparatively high (including road user charges, vehicle lease costs and fuel costs). This limits the potential for freight operators to invest in (often unproven) new technologies, particularly with uncertainty around the effectiveness and ongoing costs of these alternatives.

The road freight industry is driven by customer demands and expectations, which have an increasing focus on environmental sustainability. This includes a focus on the GHG emissions produced by businesses throughout their whole supply chain and the lifecycle of their products. The freight industry must also meet health and safety requirements for its staff, which directs the types of vehicles they use and how their businesses operate.
It is important to understand that the road freight industry is a system. Freight operators, vehicle manufacturers, infrastructure developers and fuel producers/operators have an interdependent relationship, where decisions by one can affect the others.

## THE FREIGHT TASK

The freight task refers to the volume of goods moved and where they are moved. This means freight can travel short or long distances, within or between regions, and on a number of different modes of transport (road, sea, air, or rail).

### Freight modes

Road is the dominant mode for carrying freight in New Zealand, in terms of both total volume of freight (tonnes) transported and tonne kilometres (tonne-KMs).

Figure 1 below shows that in 2017/18, road accounted for 93 percent of the total tonnes of all freight moved in New Zealand.

**Fig 1.** Freight tonnage by mode, 2017/2018

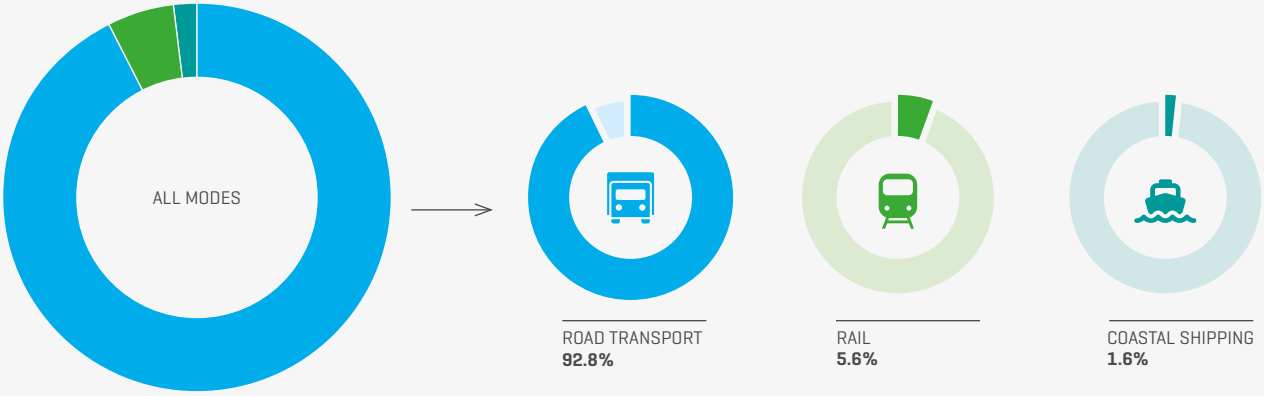
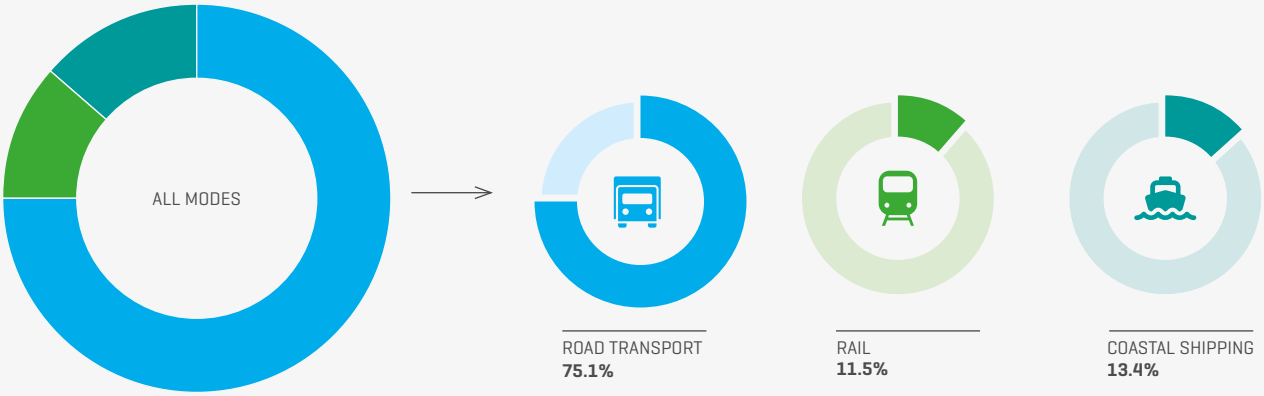



Figure 2 below shows that in 2017/18, road accounted for 75 percent of all tonne-kilometres of freight moved in New Zealand.

**Fig 2.** Freight tonne-KMs, 2017/2018




Road freight needs to be considered within the context of the wider freight and energy systems. For example, rail and marine freight movement is likely to provide shared technology and refuelling/charging sites for road freight (for example, at ports). Developments in the energy sector will also have implications for road freight opportunities.

## Road freight movement

In 2017, there were just over 144,000 trucks on New Zealand's roads, travelling a combined total of nearly 3 billion kilometres. The total distance freight travels in New Zealand varies depending on the commodity being carried (e.g. retail goods, liquid milk, logs or timber) and customer expectations (e.g. next day and home delivery). In New Zealand, the average distance freight moves is 111 kilometres across all types of freight.

The update to the National Freight Demand Study in 2017/18 notes that the majority of all commodities moved within New Zealand is within regions. Road freight movements tend to be localised, with about 77 percent of freight (tonnes) remaining within the region from which it was sourced, and an additional 14 percent being transported to an adjacent region. This means only a small percentage travels long distances, or "long-haul". There is also very little movement of freight by road between the North and South Islands, with most flowing from North to South.

In this paper, trucks are broken down into medium and heavy trucks. Medium trucks are used as a proxy for urban freight delivery tasks, and heavy trucks for regional and inter-regional delivery tasks.[4] Table 1 below shows a breakdown of the truck fleet in 2017, including the contribution of medium and heavy trucks to the freight task and GHG emissions. GHG emissions are shown as carbon dioxide equivalent ($CO_2$-e).

**Table 1:** Key statistics for medium and heavy trucks in 2017[5]

| 2017 | **Medium trucks** (under 10 tonnes) | **Heavy trucks** (over 10 tonnes) |
|---|---|---|
| Number of trucks in New Zealand | 77,252 | 66,999 |
| Percentage of the truck fleet in New Zealand | 54 percent | 46 percent |
| Billion kms travelled | 0.873 | 2.19 |
| Share of billion kms travelled | 28.5 percent | 71.5 percent |
| Grams of $CO_2$-e per km | 530 | 1,420 |
| Kilo tonnes $CO_2$-e | 463 | 3,115 |
| Share of kilo tonnes $CO_2$-e | 13 percent | 87 percent |

This table highlights that heavy trucks overwhelmingly do the greatest number of kilometres in New Zealand (71.5 percent of the 3.1 billion kilometres travelled in 2017). Heavy trucks subsequently contribute the greatest amount of GHG emissions to road freight (87 percent).

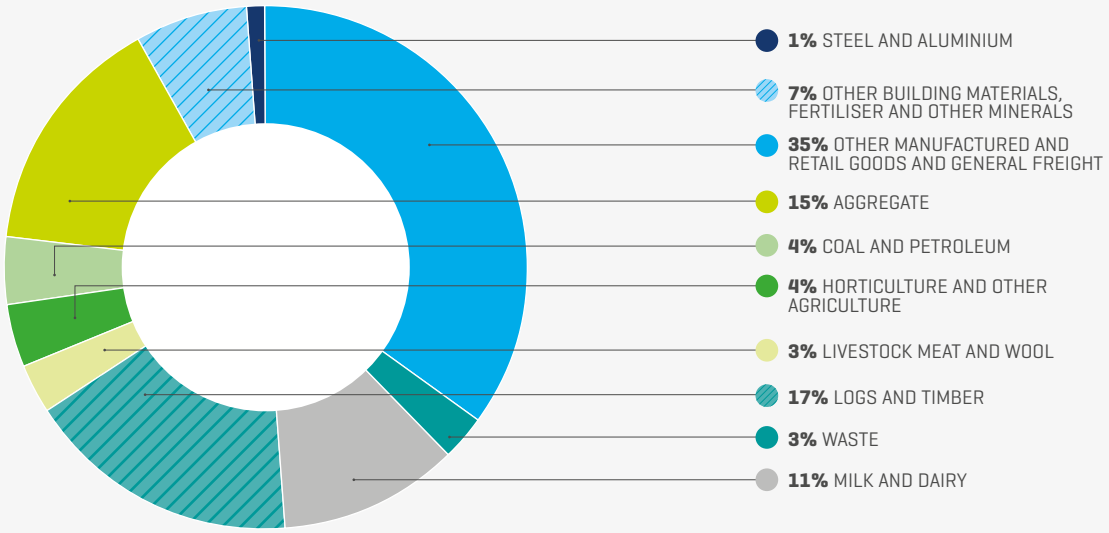
4. While it is acknowledged that some trucks over ten tonnes will undertake urban delivery tasks, data limitations have prevented these trucks from being separated out from the heavy truck group.
5. Ministry of Transport analysis of Motor Vehicle Register (MVR) data.

## Road freight demand

New Zealand shifts a wide variety of freight, including manufactured goods, logs, aggregate, liquid milk and timber. The updated National Freight Demand Study 2017/18 estimated that New Zealand moved approximately 280 million tonnes of freight in 2017/18. This is an increase of about 18 percent compared to 2012.

Figure 3 below uses data from the National Freight Demand Study 2017/18. It shows that manufactured and retail goods made up the greatest volume of freight moved within New Zealand in 2017/18, more than forestry and dairy combined.

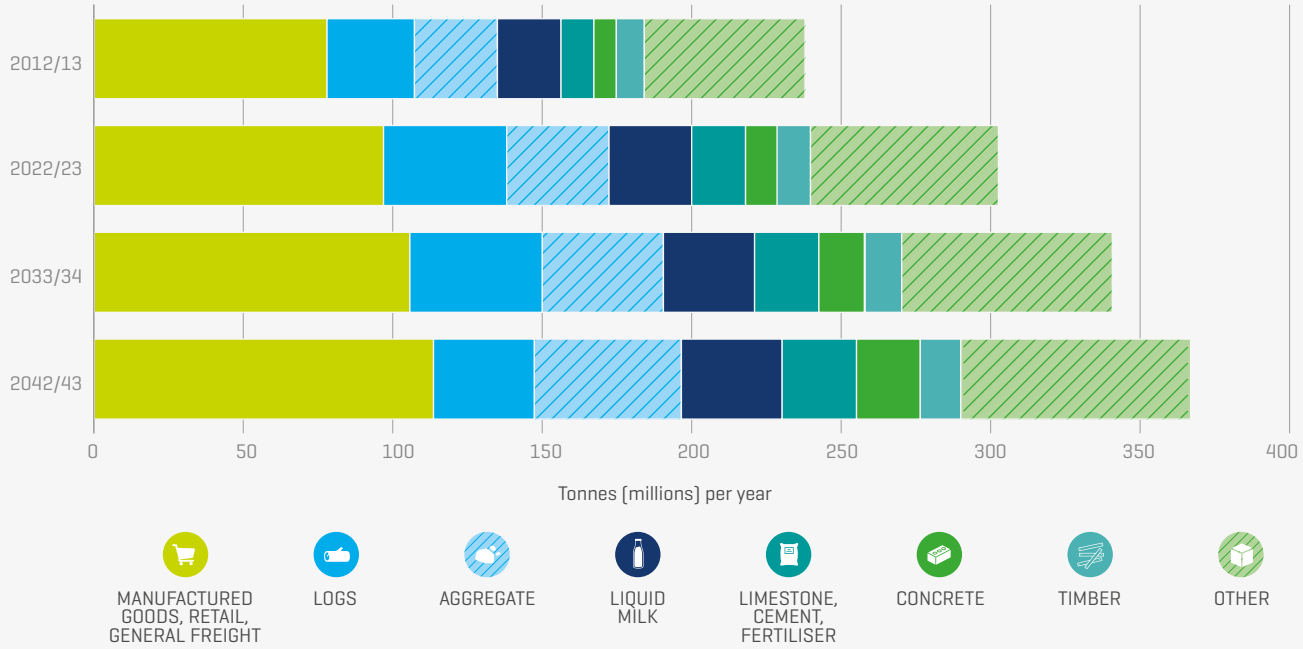
**Fig 3.** Breakdown of total estimated road freight by commodity (in tonnes)




The Ministry's Transport Outlook: Future State report has projected New Zealand's freight task could increase substantially over the next 20 years to 366 million tonnes in 2042/43.[6] This is driven by population growth, demand for New Zealand goods (both domestically and internationally), and the continued challenge of shifting freight to other modes.

Figure 4 below uses data from the National Freight Demand Study 2017/18. It shows that in the base case projections, manufactured goods/retail/other products are expected to contribute the most to the absolute increase in freight tonnage.

**Fig 4.** Base case projected freight



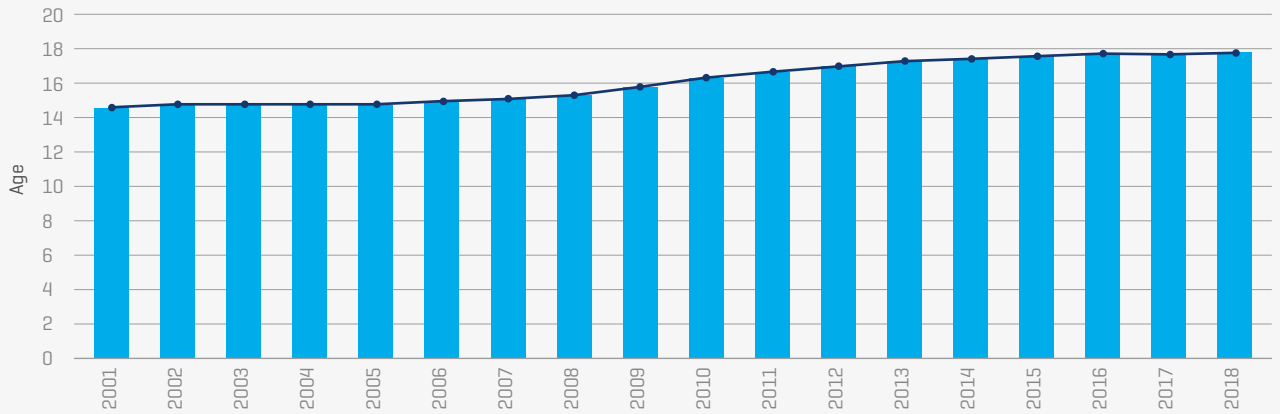

6. This projection assumes slow, non-disruptive technological changes and a continuation of demographic and economic trends. For more information, see the Transport Outlook: Future State report, found here: https://www.transport.govt.nz/news/land/transport-outlook-future-state/

## THE AGE OF THE TRUCK FLEET IN NEW ZEALAND

The freight industry uses new trucks for their most important freight tasks, replacing them on average every 6-7 years. These trucks then move into the second-hand vehicle market, which affects the wider truck fleet profile in New Zealand.

Figure 5 below shows the average age of the truck fleet in New Zealand in 2018 was 17.8 years.[7]

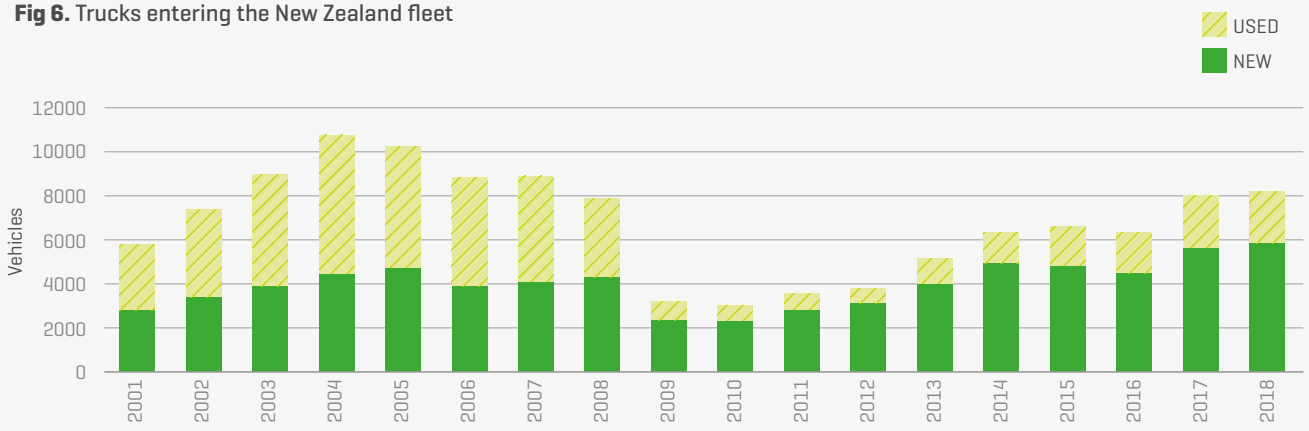
**Fig 5.** Average age of the New Zealand truck fleet




The average age of the truck fleet has been slightly pushed up over the past 18 years primarily due to the older age of used truck imports still in the fleet, with those trucks nearly 22 years of age on average.

Figure 6 below shows the noticeable shift to newer truck imports from 2008 after the Vehicle Exhaust Emissions 2007 Land Transport Rule[8] was implemented in 2007. This has helped to improve the quality of vehicles entering New Zealand since 2008.

**Fig 6.** Trucks entering the New Zealand fleet




7. Figure 5 and 6 data from the Ministry of Transport's analysis of Motor Vehicle Register (MVR) data.
8. This rule applies to motor vehicles that are required to be certified for entry into, or operation in, service. It is aimed at achieving improvements in air quality by reducing the levels of harmful emissions from motor vehicles.

1.2

# New Zealand's transport GHG emissions

Climate change threatens the wellbeing of New Zealanders. As warming increases, New Zealand is projected to experience higher temperatures, rising sea levels, changes in rainfall and wind patterns, and more frequent extreme weather events. This will likely have an adverse effect on New Zealand's communities, economy and environment. Substantial and sustained reductions in GHG emissions are required to limit global warming and the impacts of climate change.


## NEW ZEALAND'S GHG EMISSIONS COMMITMENTS

In 2016, New Zealand ratified the Paris Agreement to keep global temperature rise this century below 2 degrees Celsius above pre-industrial levels. As part of the Paris Agreement, New Zealand committed to reduce its GHG emissions by 30 percent below 2005 levels by 2030.

In November 2019, the Government took further action and passed the Climate Change Response Amendment Act (the Act) which sets a target to reduce all GHG emissions (except biogenic methane) to net zero by 2050. The Climate Change Commission (the Commission), established under the Act, will provide the Government with independent advice on climate change mitigation and adaptation. This includes establishing a system of emissions budgets for New Zealand to act as stepping stones towards the long-term target of net-zero by 2050. The Commission is required to make recommendations on the first three emissions budgets to 2035, and advice on the direction of policy required in the emissions reduction plan for the first budget, by 1 February 2021. In response to these recommendations, the Government must set and notify the first three budgets, and publish an emissions reduction plan for the first budget, by 31 December 2021. If the Government does not accept the Commission's recommendation, it must propose an alternative budget and provide reasons for departing from the Commission's advice. The Commission will then monitor and review the progress the Government is making towards their emissions reduction and adaptation targets.

Prior to the passing of the Act, a Climate Leaders Coalition was established in July 2018. This is a group of 118 businesses who have committed to take action to mitigate climate change. There are two levels of the pledge that organisations can commit to. The first is to measure and publicly report their GHG emissions, set an emissions reduction target and work with their suppliers to reduce their emissions. The second is to adopt emissions reduction targets to contribute to New Zealand's Zero Carbon targets, assessing climate risks in their business and supporting both their people and suppliers to reduce their emissions. The 118 businesses that have joined the coalition represent 60 percent of New Zealand's gross emissions, highlighting the power of having such a large cohort pledging to make change.

New Zealand has several greenhouse gas emissions reductions targets.

Our international targets are:

- 5 percent reduction below 1990 gross emissions for the period 2013-2020
- 30 percent reduction below 2005 (or 11 percent below 1990) gross emissions for the period 2021-2030.

Our domestic targets are:

- net zero emissions of all greenhouse gases other than biogenic methane by 2050
- 24 to 47 percent reduction below 2017 biogenic methane emissions by 2050, including 10 percent reduction below 2017 biogenic methane emissions by 2030.[9]

9. https://www.mfe.govt.nz/climate-change/climate-change-and-government/emissions-reduction-targets/about-our-emissions

## TRANSPORT'S CONTRIBUTION TO GHG EMISSIONS

Transport will need to play a major role in helping the Government to achieve its GHG emissions reduction targets and help New Zealand transition to a net zero-emissions economy. The transport emissions story is outlined below.

New Zealand's gross GHG emissions have increased by 23 percent since 1990 and transport has been by far the biggest contributor to this rise.

Figure 8 below shows transport GHG emissions increased by 82 percent between 1990 and 2017 and road transport GHG emissions rose 93 percent.

**Fig 8.** Domestic transport GHG emissions by sector since 1990

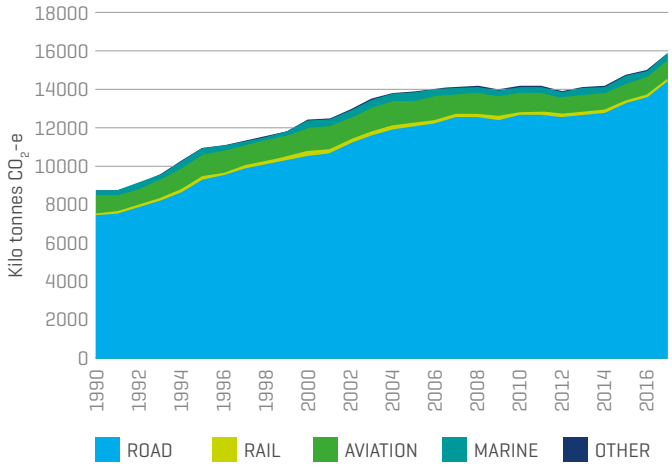



Figure 7 below shows that transport is New Zealand's second biggest source of GHG emissions, making up 19.7 percent of New Zealand's GHG emissions.

**Fig 7.** New Zealand's Greenhouse Gas Inventory 1990-2017[10]

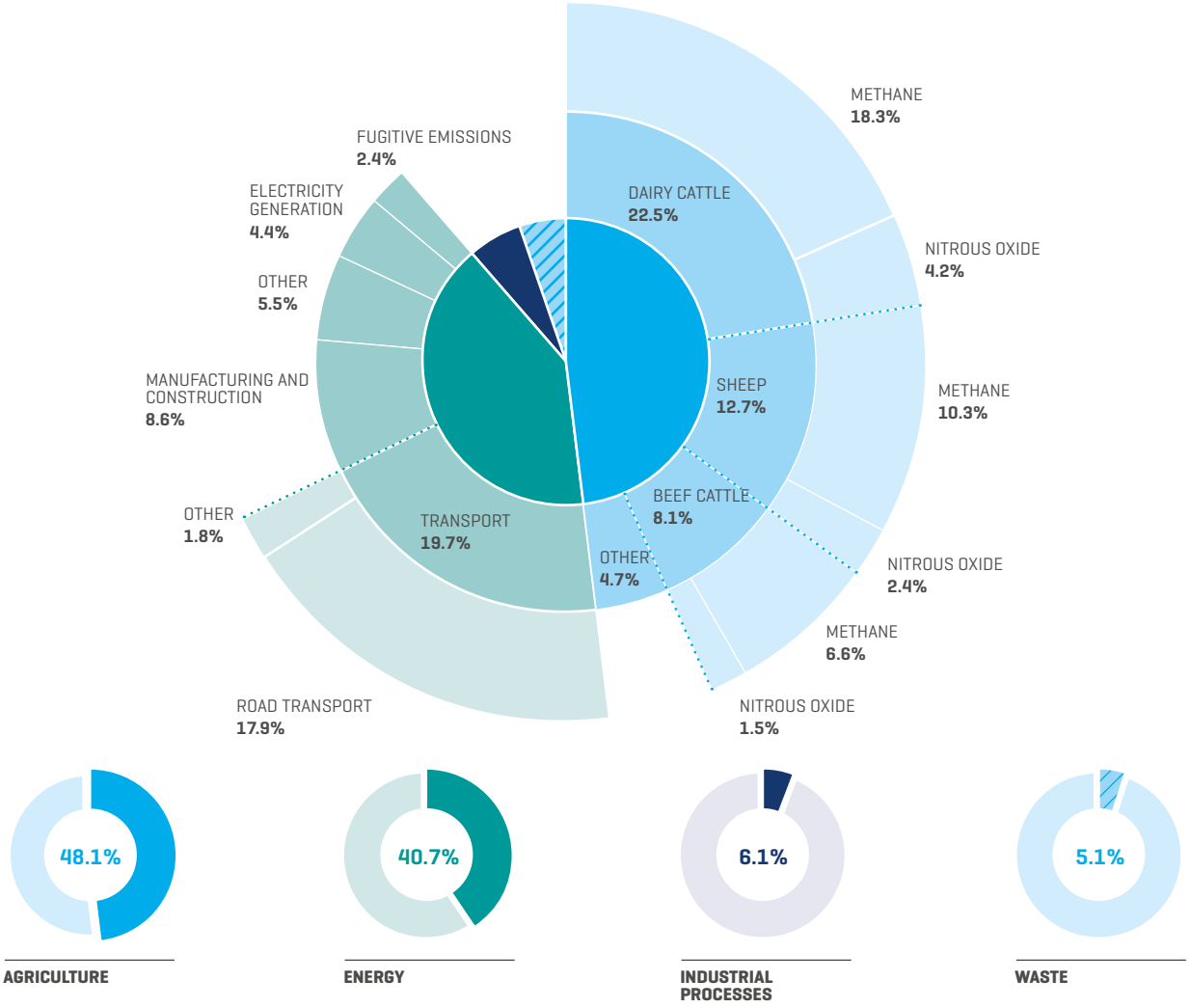


Figure 9 below shows domestic transport GHG emissions by mode in 2017. It highlights that over 90 percent of New Zealand's domestic transport GHG emissions in 2017 came from road transport.

**Fig 9.** Domestic transport GHG emissions by mode in 2017

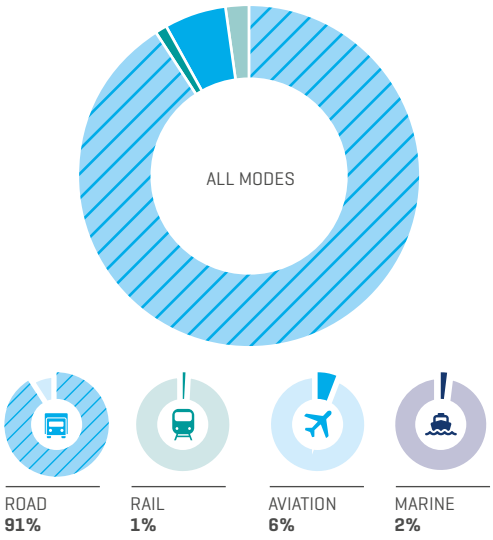



Figure 10 below shows that most road transport GHG emissions (55.9 percent) come from light passenger vehicles (LPVs), with light commercial vehicles (LCVs) contributing 17 percent to GHG emissions.[11] However, nearly a quarter of road transport GHG emissions came from trucks. This is despite trucks representing only six percent of total vehicle kilometres travelled on New Zealand's roads.

**Fig 10.** Domestic road GHG emissions by mode in 2017

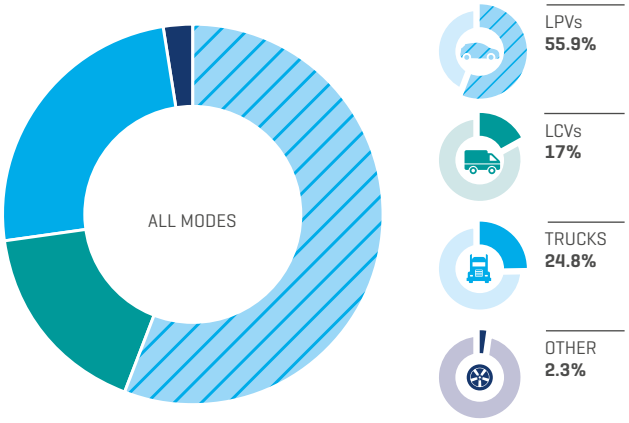
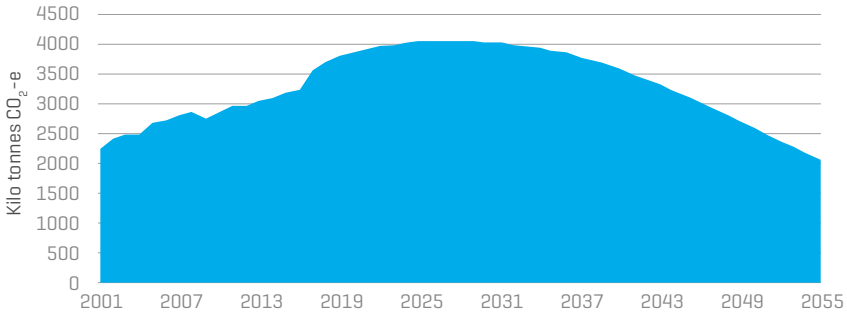


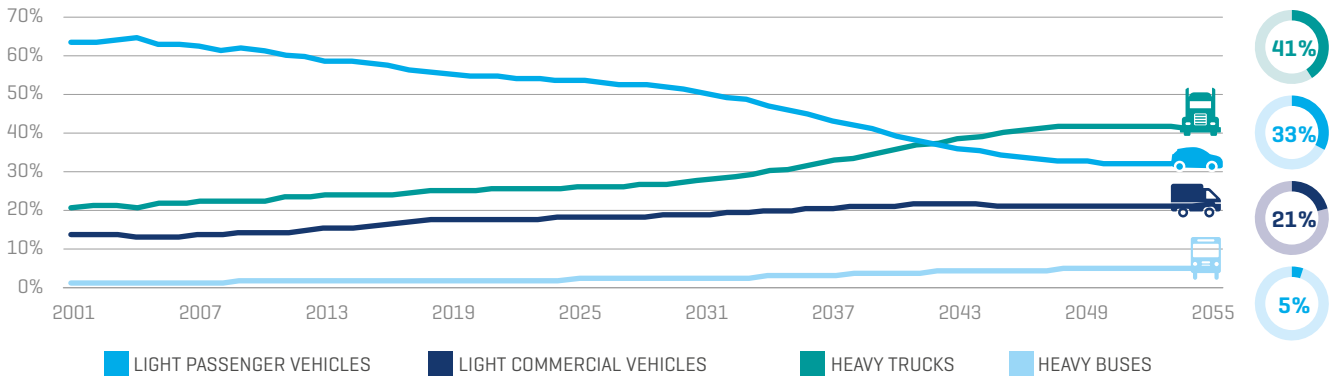

Figure 11 shows the projected GHG emissions from trucks over the next 30 years. This projection assumes that there will be some reduction in GHG emissions as a result of developments in electric truck technology, such as improvements to battery density and weight. However, given the projected increase in freight demand, and without any new interventions, it is estimated trucks could still contribute up to 2,255 kilo tonnes of GHG emissions in 2055.[12]

**Fig 11.** Projected GHG emissions from the truck fleet in New Zealand




In addition, figure 12 below shows that without any new interventions, GHG emissions from trucks will be the main contributor to road transport GHG emissions by 2055.

**Fig 12.** Projected percentage of GHG emissions from road transport



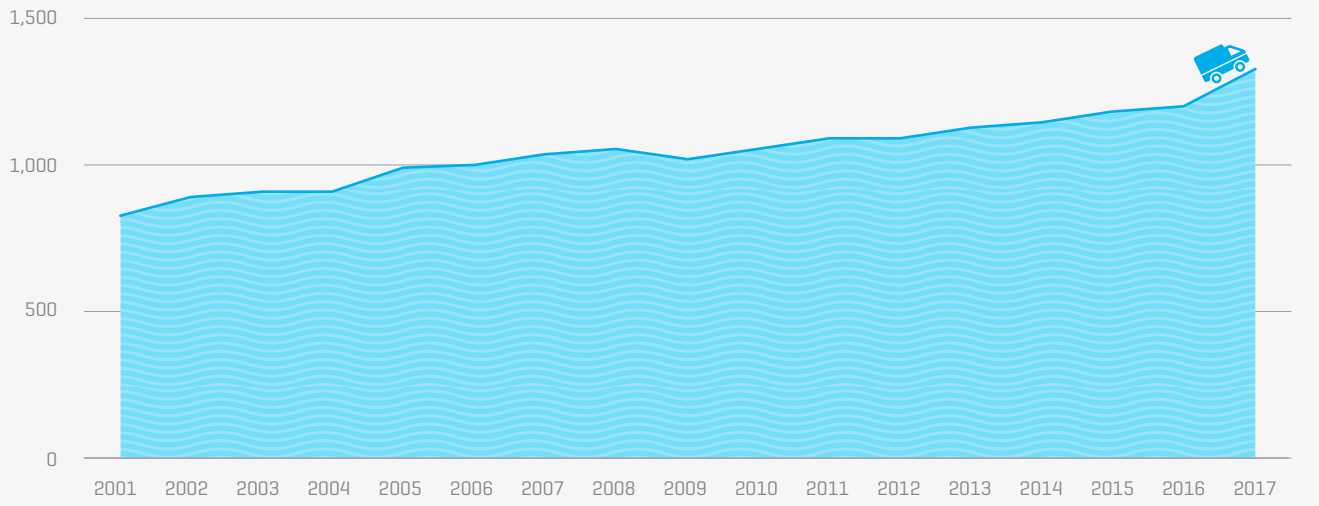

10. Amended from the Ministry for the Environment's New Zealand's Greenhouse Gas Inventory 1990-2017, 2019. Available here: https://www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory
11. The classification for Light Commercial Vehicles (LCVs) is based on vehicle body type, rather than their actual ownership or usage e.g. goods vans and utes.
12. These projections assume there would be no significant uptake of biofuels. Detailed assumptions underpinning figures 11 and 12 can be found on page 79 of the Transport Outlook: Future State report: https://www.transport.govt.nz/assets/Uploads/Research/Documents/b41c266676/GOTO-Future-State-A4.pdf

## GHG EMISSIONS AND FUEL EFFICIENCY

Nearly all trucks in New Zealand 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.

Figure 13 below shows the consumption of diesel by trucks in New Zealand has increased steadily since 2001. In 2017, trucks used about 1,330 million litres of diesel.

**Fig 13.** Diesel use by truck fleet, million litres




Fuel efficiency, in real terms, is primarily dependent on the freight task.[13] This includes the total vehicle kilometres travelled, the gross vehicle mass (GVM) of the vehicles (including the freight on board), as well as the fuel efficiency of the vehicle itself. In terms of distance, while trucks account for three percent of all vehicles on the road, they account for six percent of total vehicle kilometres travelled. Trucks also use a lot more fuel for every kilometre travelled than light passenger vehicles.

It is however more complex than this. Heavy trucks contribute the most to overall GHG emissions as they travel the greatest distance and carry the most freight by weight. Transitioning heavy trucks to low or zero-emissions options will therefore have the greatest impact on overall GHG emissions. However, in absolute terms, medium trucks generate more than three times the GHG emissions, on average, per tonne kilometre than heavy trucks. This is primarily down to the fact that they can carry less freight in comparison with the weight of the vehicle, than larger vehicles. Trucks operating in urban or congested environments are also less fuel efficient due to the stop-start nature of urban freight delivery (resulting in a greater amount of time burning fuel accelerating from stationary). Transitioning medium trucks (which are primarily engaged in urban freight delivery) could therefore have an immediate impact on GHG emissions in the near-term and provide co-benefits. This is because it is currently more feasible to transition medium trucks (as opposed to heavy trucks) to low and zero-emissions vehicle options. In addition, transitioning medium trucks to alternative fuels would reduce local air pollution, which could improve public health in urban areas where people live and work.

Heavy trucks can also have inefficiencies, in particular in relation to payload. For example, some trucks do not travel at full capacity for most of their journey within regions, or sometimes return at less than capacity (or even empty) on long-haul journeys. This reduces their fuel efficiency as well.

Overall, fuel efficient vehicles help reduce the amount of GHG emissions produced, but the freight they carry and the distance they travel create limitations on the impact they can have on overall emissions. The importance of alternative green fuels to address GHG emissions from road freight should not be understated, and transitioning New Zealand's truck fleet to alternative green fuels should be a key objective for the transport sector.

13. Not discounting the impact of New Zealand's steep and winding roads, the inconsistency in road surfaces, variability in weather and the efficiency of the road network, including congestion.

1.3

# Alternative green fuels for road freight

Given the need to reduce the amount of diesel consumed by the road freight industry, the three alternative green fuels under investigation (electricity, green hydrogen and biofuels) are seen as having the greatest potential to reduce GHG emissions from road freight over the medium to long-term. The descriptions below help explain how each fuel type can be applied in the transport sector.

## ELECTRICITY 

Electricity can be used as a low-carbon energy source to drive an electric motor, through directly charging a battery pack within the vehicle. BEVs use electricity stored in a battery pack within the vehicle to power an electric motor and turn the wheels. BEVs produce no tailpipe emissions; however, GHG emissions can be produced through the generation of electricity if it does not come from renewable sources. When depleted, the batteries are recharged using the electricity grid via a charging unit, either at a private premises, a public charging station, or a charger installed at a truck stop. The speed of charging depends on both the rate of charge the vehicle can accept, and the power of the charging unit.

## GREEN HYDROGEN 

Hydrogen can be used as a transport fuel source by storing it under pressure in cylinders in the vehicle and converting it to electricity to drive an electric motor. FCEVs convert hydrogen into electricity by combining hydrogen stored in the vehicle's on-board cylinders, with oxygen from the air. The electricity is then used to continuously drive an electric motor and recharge the truck's electric battery. FCEVs only produce water vapour at the tailpipe. Refuelling a FCEV is the same as refuelling a conventional fossil fuel vehicle, but with pressurised hydrogen replacing diesel at refuelling stations. The speed of refuelling is dependent on the pressure of the hydrogen at the fueling stations, and is comparable to fueling a vehicle with compressed natural gas (CNG) as was common in New Zealand in the 1980s.

Green hydrogen is generated using electricity. Overall GHG emissions from green hydrogen are dependent on the GHG emissions from electricity generation. This is because the electricity is used to separate water into its components of oxygen and hydrogen, in a process known as electrolysis, before recombining it back into electricity in the fuel cell to then run the electric motor. The process is currently very inefficient, using around three times the electricity per tonne-KM as direct charging BEVs. Only a small percentage of global hydrogen is currently produced from electricity. This paper discusses green hydrogen produced from electricity, and not by gasification of natural gas or coal, which are the main global production methods.

## BIOFUELS 

The term 'biofuel' typically refers to liquid fuels that are produced from renewable biological materials or organic waste. Biofuels can be produced from a range of different feedstocks (the materials used to make biofuels), with different processes used to make them. Biofuels can be divided into two categories: 'conventional' and 'advanced' biofuels. Conventional biofuels can be used either in low-level blends with diesel in existing vehicles, or on their own in biofuel compatible engines. Advanced biofuels can be used to replace diesel (or petrol), without the need to be blended. There are two main technology pathways for advanced biofuels. The first one uses cellulosic based biomass (such as agricultural and forest residues, forest and non-food energy crops, municipal solid wastes and algae), which is still in the pilot or demonstration phase. The second pathway utilises fats and oils, which is proven at a commercial scale and available in the market now (particularly in Singapore, the United States and Europe) to produce synthetic renewable diesel, petrol or jet fuel.

Trucks that run on conventional biofuel are considered 'net low-emission' because the GHG emissions they produce are balanced out by the carbon emissions absorbed by the biomass they are made from. Because using conventional biofuels reduces the consumption of fossil fuel, it reduces the GHG emissions that would have otherwise been produced. Conventional biofuels still create tailpipe emissions, and the overall net GHG emissions reduction depends on the energy used to process the feedstocks, and the percentage blend with diesel (i.e. the higher the percentage of biofuel, the lower the emissions). Refuelling a truck with biofuel is comparable to refuelling with diesel and uses the same infrastructure.

Chapter 2:

# Challenges and opportunities

Alternative green fuels have the potential to transition the road freight industry away from diesel as a fuel source. They come with a number of challenges, as well as opportunities, which need to be fully understood in order to target interventions where they have the greatest potential to reduce GHG emissions.

This section summarises the challenges and opportunities with using electricity, green hydrogen and biofuels in road freight. It draws heavily on the Green Freight background paper and discussions with the freight industry, energy sectors, government agencies, and academia. It is broken down into themes under three key areas: fuel, vehicles and infrastructure.

2.1

# Fuel

## CHALLENGES

### The supply of green hydrogen and biofuels is limited

New Zealand does not currently have a commercial supply of green hydrogen, or a nationally available supply of biofuels, although there is ample supply of electricity generation and feedstock potential for making both. New Zealand would need to develop a commercial scale supply of green hydrogen to support a transition to FCEVs. Work is underway across the private sector to build hydrogen plants and develop a hydrogen refuelling network. This is costly and has required Government funding to de-risk private sector investment. New Zealand currently produces a small amount of conventional biofuels at commercial scale, which are blended in low percentages with fossil fuel. However, this is not sufficient to supply New Zealand's entire heavy vehicle fleet. Increasing domestic production of biofuels (either conventional or advanced) would require large quantities of feedstock and increased commercial scale production facilities. However, New Zealand could have sufficient low-value marginal land to grow feedstock to meet the entire transport sector's needs. Work is ongoing across Government to confirm what feedstocks are feasible and where they could be grown to achieve this. Alternatively, New Zealand could import conventional or advanced biofuels from overseas.

### Green hydrogen and biofuels cost more than diesel

Green hydrogen and biofuels are currently more expensive to produce than fossil fuels. Green hydrogen is also more expensive than more direct uses of electricity. This is in part due to process inefficiencies involved in producing hydrogen from electricity. The location of electricity supply for hydrogen and whether it is surplus power or off-peak power will have a significant impact on the price of green hydrogen. There is also uncertainty around the impact on the domestic price of green hydrogen if New Zealand develops an export market for it. Biofuels also cost more to produce than fossil fuels, and as a result are sold as a premium product in New Zealand. To overcome these challenges, green hydrogen and biofuels will need to become more cost-competitive with fossil fuels and direct uses of electricity in BEVs.

### Increased electricity demand could impact the network

Electrifying the heavy vehicle fleet and producing green hydrogen using electricity could have a significant impact on the electricity network. Discussions with stakeholders indicate that the key challenge is not the capacity of the network, or the potential to increase electricity generation. The challenge lies in the management of increased demand for electricity, especially during peak periods, and in specific areas of the country with less developed infrastructure (e.g. the East Cape of the North Island). Managing demand is going to be critical for enabling the widespread electrification of transport required to address GHG emissions. This includes flattening demand peaks through time-of-use pricing, smart charging technology and potentially stationary battery storage.

### Sustainability is still a concern with some biofuel feedstocks

The sustainability of biofuel feedstocks has received substantial scrutiny over the past decade. Poorly developed biofuel supply chains can pose risks to food production, water and soil quality, and biodiversity. Greater awareness of these activities is forcing producers to rethink how they source raw materials, and sustainable certification schemes are now in place in some countries to help ensure that biofuel production is sustainable. In addition, several companies are producing advanced biofuels from waste products and by-products, such as used cooking oil, tallow, and municipal waste. There is also a greater push in the industry to source feedstocks from existing processes, like wood biomass from forestry. The challenge with any initiative to encourage greater use of biofuels is to ensure their environmental sustainability over their full life-cycle.

2.2
# Vehicles

## OPPORTUNITIES

### New Zealand already has a high level of renewable electricity

New Zealand is well placed to decarbonise transport through electrification. Over 80 percent of New Zealand's electricity comes from renewable sources. This means that decarbonising heavy transport through electrification early could bring greater GHG emissions reductions than is immediately achievable in other countries. In 2019, the Ministry of Business, Innovation and Employment (MBIE) modelled electricity demand and generation scenarios and showed that higher rates of transport electrification will result in higher levels of renewable electricity generation.[14] Electricity prices are also not expected to rise as a result of high levels of electricity use in transport, as wind is now the country's cheapest source of new generation. Increasing electrification of transport, when charging can occur overnight, improves the economics of wind generation further.

### New Zealand could produce green hydrogen for transport

The Government has been investigating the potential of producing green hydrogen in New Zealand, including for use in transport. With a high percentage of electricity produced from renewable sources in New Zealand, this provides an opportunity to create green hydrogen for use across a number of sectors, as well as increasing energy security. In 2019, MBIE released a green paper entitled "A vision for hydrogen in New Zealand".[15] This consultation paper investigated the potential of hydrogen in New Zealand, and posed questions about the challenges and opportunities associated with hydrogen. The paper, alongside its submissions, will feed into a wider renewable energy strategy for New Zealand. This strategy will outline a pathway to a clean, green, carbon neutral energy sector for New Zealand by 2050.

### Biofuels could have an immediate impact on GHG emissions

A key benefit of biofuels is that they can be used in existing diesel vehicles and refuelling infrastructure. Conventional biofuels can be used in existing diesel vehicles at lower blends (e.g. five percent biodiesel and 95 percent diesel). Advanced biofuels are 'drop-in', which means that they do not have to be blended with diesel to be used in existing vehicles. Advanced biofuels can also be blended with fossil fuels to offset some of the cost difference. If New Zealand can increase its supply of biofuels, then this could have an immediate impact on GHG emissions from road freight, as it does not require new vehicles or infrastructure.

## CHALLENGES

### New vehicles are expensive

The upfront cost of BEVs and FCEVs is a significant barrier for freight operators to transition their fleets. Low and zero-emissions heavy vehicles currently cost substantially more than their diesel equivalents. In part, this is driven by a lack of production line off-the-shelf vehicles to choose from and the small size of New Zealand's market. For electric trucks, the current practice of retrofitting individual existing diesel vehicles also contributes to the high cost per vehicle. The upfront cost of low and zero-emissions heavy vehicles is likely to remain a significant barrier for the next five years, and it will take even longer for many of them to reach price parity with their diesel equivalents.

### Early adoption is risky

There are risks associated with being the first to invest in technologies that are untested, especially in the New Zealand context. For example, operators are concerned that new low and zero-emissions trucks will not be as reliable as their diesel equivalents, and that they will not have the expertise to maintain and service them. There is also some uncertainty about how well diesel vehicles perform using higher blends of conventional biofuels, and significant uncertainty about their total lifetime cost of ownership and the return on initial investment for BEVs and FCEVs. Early movers also risk investing in technologies that are quickly superseded by something better. These risks are likely to remain a barrier for the next five years until more of these technologies have been tested and trialled in the New Zealand context.

### New vehicles have limitations

New vehicle technologies, such as BEVs and FCEVs, face limitations compared to diesel vehicles. Currently, BEVs are limited by the weight of their batteries, the time it takes to recharge them, and their limited range. FCEVs offer greater range and faster refuelling than today's BEVs, and therefore potentially are better suited for long-haul operation and high-utilisation requirements. FCEVs are a new technology in New Zealand and will need clear compliance pathways and assurance around the safety and handling of hydrogen as a hazardous substance. Some parts of the freight industry are likely to struggle to transition their fleets due to these limitations, depending on their business models and freight task.

### New vehicles are not widely available

Vehicle availability and supply of trucks into New Zealand could remain a major challenge for the next 15 years. The last five years have seen significant growth in the types and volumes of hydrogen-powered trucks and BEVs being tested and trialled globally. However, the availability and supply of zero-emissions

14. MBIE Electricity Demand and Generation Scenarios https://www.mbie.govt.nz/dmsdocument/5977-electricity-demand-and-generation-scenarios
15. The consultation paper can be found here: https://www.mbie.govt.nz/have-your-say/a-vision-for-hydrogen-in-new-zealand-public-consultation/

trucks is currently very limited in New Zealand. This is because new vehicle technologies are still not fully developed and sold in large numbers internationally. New Zealand is also a small market player with little influence over the international vehicle market. It is likely that the high demand for these vehicles will see availability in New Zealand only once these technologies are widely available elsewhere.

New Zealand is also in the minority of countries that has right-hand drive, which limits vehicle supply. The majority of trucks entering New Zealand are new, and come from a number of different markets including Europe, Scandinavia, Asia, and the United States (often via Australia). In addition, New Zealand's unique road user charges also limit the supply of some vehicle types, which have to be modified to operate here. New Zealand's road user charges increase the cost for vehicles with higher axle weights, which encourages the fitting of an extra set of axles to heavy vehicles.

All of these factors combined make it difficult for freight operators in New Zealand to access new vehicle technologies. However, over the next five years, New Zealand is likely to see more medium trucks become electrified and available from overseas. Towards the end of the period between 2025 and 2030, more production-line BEVs and FCEVs are likely to become available at the heavier end of the scale, which are suitable for long-haul freight.

### There are sustainability concerns with batteries

There are also some concerns with the environmental sustainability of batteries, in particular with their production and disposal. The Government, as well as the private sector, is tackling this issue as part of a transition towards a 'circular economy'.[16] The Battery Industry Group, a cross-industry collaboration, is developing a circular stewardship scheme for large batteries.[17] There are also reported examples of human rights concerns with battery manufacture. For example, Amnesty International has highlighted the exploitative conditions in cobalt mines in the Democratic Republic of Congo, which use child labour.[18] Companies are now investigating alternatives to cobalt and other ways to improve their supply chains. The challenge with encouraging the greater uptake of electric trucks is to ensure their environmental sustainability over their full life-cycle, including the production and disposal of batteries. There may also be issues with the sustainability of the production and disposal of fuel cells (from FCEVs), which may create future challenges. However, it is important to note that oil production and its resulting GHG emissions remains the largest global sustainability challenge of all.

## OPPORTUNITIES

### Electrification is viable for some vehicles now

There are opportunities for BEVs to deliver a number of freight tasks now. Trucks at the lighter end of the scale, with regular routes and the potential to use stop/start regenerative braking and return to "depot" operations, have the potential to be electrified early. This includes short-haul freight delivery and service vehicles such as courier companies and waste or recycling trucks. Globally, there is an increasing selection of electric trucks weighing less than 16 tonnes reaching the market. Major postal and package delivery companies in the United States, including DHL, UPS, and FedEx, are expanding their fleets of electric vehicles as a result. In New Zealand, there have also been cases of companies using diesel trucks that have been retrofitted with electric motors (including Countdown and Waste Management). The speed of charging using fast charging stations is increasing, with public fast charging entering the market in New Zealand last year, and charging at speeds comparable to hydrogen fuelling anticipated over the next five to eight years. Further improvements to battery energy density and fast charging infrastructure will make it more viable to use BEVs for freight operations.

### Some Government funding is already available

Several companies are trialling BEVs and investing in charging infrastructure with support from the Energy Efficiency and Conservation Authority's Low Emission Vehicles Contestable Fund (LEVCF). The Provincial Growth Fund (PGF) and Green Investment Finance (GIF) also have scope to support the procurement of low and zero-emissions vehicles.

16. The New Zealand Government has identified a 'circular economy' approach as an important principle for addressing resource and waste issues. The Ministry for the Environment defines a circular economy as "an alternative to the traditional linear economy in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life." https://www.mfe.govt.nz/waste/circular-economy
17. New Energy Futures paper: batteries & the circular economy https://blob-static.vector.co.nz/blob/vector/media/vector/vector_new_energy_futures_paper_batteries.pdf
18. Amnesty International, 'Amnesty challenges industry leaders to clean up their batteries.' https://www.amnesty.org/en/latest/news/2019/03/amnesty-challenges-industry-leaders-to-clean-up-their-batteries/

2.3

# Infrastructure

## CHALLENGES

### Supporting infrastructure is not established in New Zealand

Supporting infrastructure will be essential to support the transition of the truck fleet to alternative fuels. Freight companies are generally not willing to invest in vehicles that cannot reliably be serviced/fuelled because the infrastructure is not fully established. BEVs and FCEVs require a recharging/refuelling network, except for some return to base operations that could have their own recharging/refuelling infrastructure onsite. For example, for long-haul electric trucks, a fast-charging public network would be needed that can refuel a long-haul truck in under half an hour. This would require charging speeds in the 300kW-3MW range, with truck sized parking spaces. Currently there is only a 50kW charging network throughout New Zealand, set up to charge light passenger vehicles.

Due to the long lead-times in building and developing either a fast charging network (suitable for trucks) or a refuelling network for hydrogen, it could take up to a decade to develop the infrastructure required to support a transition to each. Choosing when and where to build supporting infrastructure also requires a good understanding of major freight routes and hubs, as well as the industries fuel demands to predict usage. This information needs to be collated and analysed to project future transport patterns and future-proof investment decisions.

### Infrastructure requires significant investment

The infrastructure required to support BEVs and/or FCEVs will require significant investment. Infrastructure needs to be reliable and provide assurance to businesses that they can maintain existing service levels. Challenges remain around who pays for the infrastructure and what role Government has in this.

## OPPORTUNITIES

### Biofuels can be used in New Zealand's existing refuelling network

A key benefit of biofuels is that they are compatible with New Zealand's existing refuelling infrastructure. Significant work has also already been undertaken, and continues to be undertaken, to assess the viability of a biofuels industry in New Zealand, including where best to locate new infrastructure, and which feedstocks to pursue. Z Energy's commercial scale biodiesel plant has been operating since 2018 in Auckland, significantly under its design capacity due to lack of demand.

### New Zealand has a network of charging infrastructure for light vehicles

Electric charging stations are relatively quick to deploy, as is evidenced by the nationwide network of 50kW vehicle charging stations that is now in place. There are opportunities to leverage off the existing network to develop fast-charging hubs for trucks.

2.4

# Summary table for challenges and opportunities

This table summarises the key challenges and opportunities outlined.

| | FUELS | VEHICLES | INFRASTRUCTURE |
|---|---|---|---|
| **Challenges** | ▸ New Zealand currently has a limited supply of green hydrogen and biofuels, which makes it challenging to transition trucks to these alternatives.<br>▸ Green hydrogen and biofuels are more expensive to produce than fossil fuels, and therefore they are not cost competitive for the freight industry.<br>▸ Electrifying the heavy vehicle fleet could have a significant impact on New Zealand's electricity network, especially if demand is not managed well.<br>▸ There are still sustainability concerns with some biofuel feedstocks, and any initiative to encourage greater biofuel uptake should consider their sustainability over their full life-cycle. | ▸ The high upfront cost of new vehicle technologies is prohibitive.<br>▸ There are high levels of risk associated with early adoption of new vehicle technologies.<br>▸ New vehicle technologies have limitations that affect their ability to deliver a number of freight tasks.<br>▸ New vehicle technologies are not widely available in New Zealand.<br>▸ There are sustainability concerns with batteries, in particular their production and disposal. | ▸ The uptake of BEVs and FCEVs relies on New Zealand having recharging/ refuelling infrastructure. This supporting infrastructure does not exist yet, and will take time to build and develop.<br>▸ Supporting infrastructure requires significant investment but questions remain around who pays for it and what role Government should play. |
| **Opportunities** | ▸ New Zealand already has a high level of renewable electricity, which means that early electrification of medium trucks could bring substantial GHG emissions reductions in the near-term.<br>▸ New Zealand has the potential to produce green hydrogen for transport.<br>▸ Biofuels could have an immediate impact on GHG emissions as they can be used in existing vehicles and infrastructure. | ▸ There are opportunities to electrify the lighter end of the heavy vehicle fleet, particularly for vehicles that operate short-haul operations in urban areas. These vehicles are becoming more readily available overseas.<br>▸ The LEVCF, PGF and GIF already provide some funding for low and zero-emissions vehicles, which supports early movers. | ▸ Biofuels can be used in New Zealand's existing refuelling infrastructure, which means they could have an immediate impact on GHG emissions in the near-term without the need for significant infrastructure investment. |

Chapter 3:

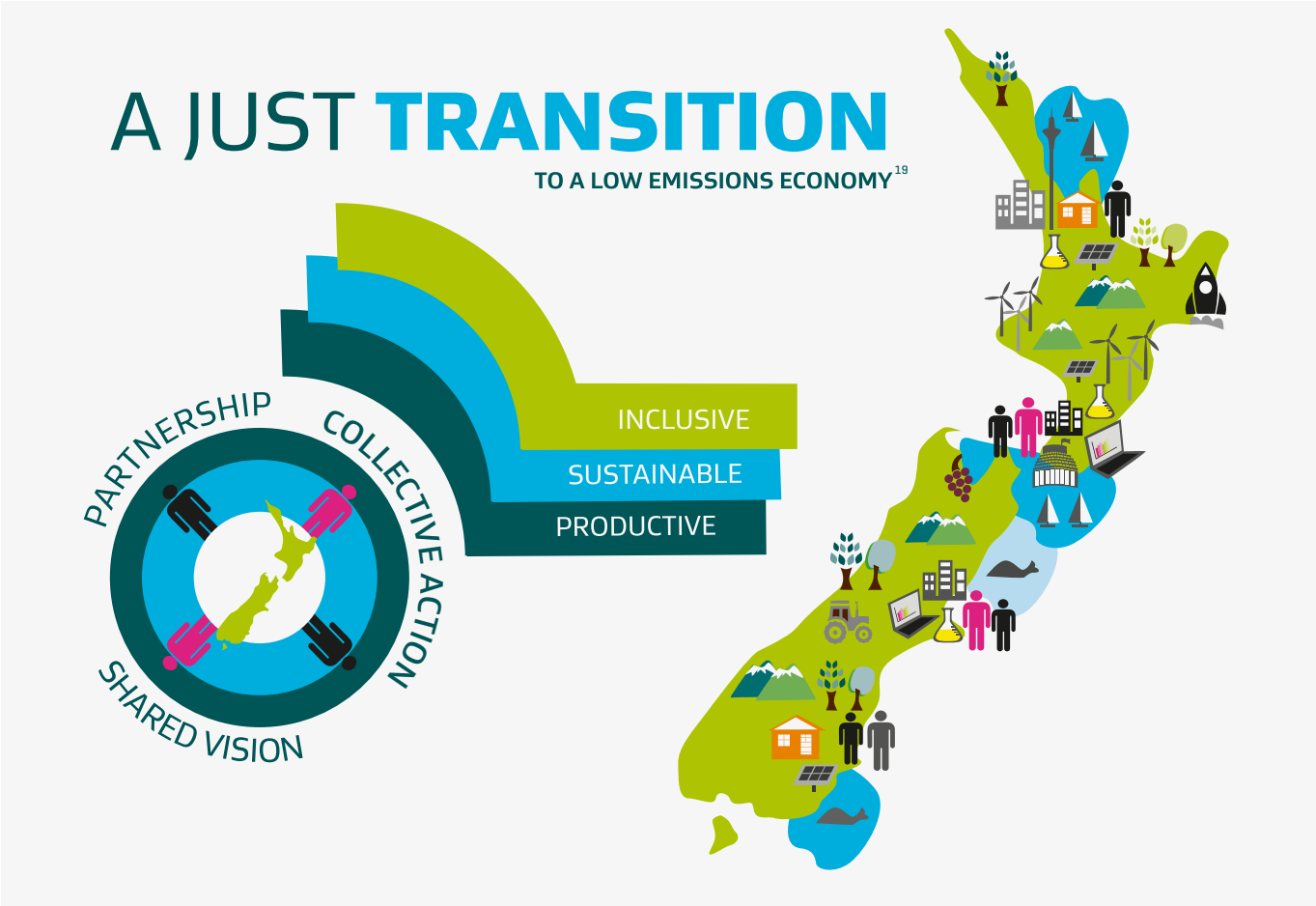
# Transitioning road freight in New Zealand to alternative green fuels

This chapter discusses two pathways to transition road freight to alternative fuels. One pathway looks at options to reduce the carbon intensity of the fuel New Zealand uses in the existing truck fleet, and the other discusses options to support the replacement of existing fuels with low-carbon energy fuels. The options are framed around a series of principles to guide decisions around which options to pursue further, and are discussed in the context of the current Government's 'Just Transition' approach to becoming a low-emissions economy.

The chapter also highlights the co-benefits of reducing GHG emissions from road freight, and includes several case studies that highlight the real world challenges facing New Zealand businesses as they aim to transition to lower emissions alternatives.

3.1

# Supporting a Just Transition




As New Zealand takes steps towards becoming a low-emissions economy, the current Government is committed to ensuring this is a 'Just Transition'. This is one underpinned by fairness, equity and inclusivity and needs to be a partnership between Government, Māori, business, the workforce and communities. Like all transitions, there will be costs involved that will need to be clearly understood and shared amongst those most likely to benefit from the transition.

Across the freight sector, stakeholders have signalled they want to have some choice over how they transition to alternative green fuels (e.g. choosing which fuel will best suit their specific situation and business model). This does not preclude the potential need for businesses to adapt the way in which they deliver their services in the future, but it reinforces the need for Government and industry to work together to develop and implement solutions that support a Just Transition.

As part of this approach, $27 million was allocated from the 2019 Wellbeing Budget to establish a National New Energy Development Centre (NNEDC). The NNEDC will serve as a hub for new energy knowledge, connecting stakeholders with expertise, emerging technology and funding opportunities. It will be supported with ongoing funding of $7 million per year, with a focus on helping stakeholders through the demonstration and commercialisation stages of the innovation lifecycle, where there is the greatest risk of business failure. Stakeholders include energy companies, infrastructure and supply firms, new energy start-ups, research institutions, investors, iwi, communities, and local and central government.

19. Image from the MBIE website at: https://www.mbie.govt.nz/business-and-employment/economic-development/just-transition/

## TRANSITION IS ABOUT MORE THAN GHG EMISSIONS

Before looking at options to reduce GHG emissions, it is worth considering some of the co-benefits that could come with transitioning New Zealand's truck fleet to alternative green fuels. Some of these co-benefits could arise from reducing the amount of diesel used across the truck fleet, others from replacing diesel with a cleaner energy source, like electricity or green hydrogen. Some of the potential co-benefits from transitioning to low and zero-emissions options are identified below. These should be considered alongside the objective of reducing GHG emissions when deciding the best course of action New Zealand should take.

### Public health

Diesel exhaust fumes contribute to air pollution, which can exacerbate health conditions such as asthma and lead to more severe cardiovascular and respiratory issues such as heart attack, stroke and emphysema. Decreasing the number of diesel vehicles on New Zealand roads could have benefits for the health and wellbeing of the public, particularly in densely populated parts of the country, and in areas where children go to school and play. Zero-emissions vehicles can also reduce noise pollution. Diesel trucks are noisy, with noise pollution having negative health impacts including disturbed sleep, affecting cognitive function and increasing risk of cardiovascular disease.

Domestic production and supply of alternative green fuels could reduce New Zealand's reliance on international diesel supply, and increase its energy security.

### Industry and regional development

Increasing domestic production of alternative green fuels would require New Zealand to scale up its current supply chains, create new facilities and develop new skills across the industry to support ongoing maintenance and development. Training and employment of specialist staff could be particularly beneficial for employment in the regions, where new technologies are established. This could be realised, if these regions become hubs for alternative fuel production. For example, regional development from hydrogen fuel research and production is already being realised in Taranaki with the H2 Taranaki initiative, aided by PGF investment. Additionally, the New Zealand Biofuels Roadmap, produced by Scion,[20] identifies a number of possible scenarios under which New Zealand can develop its own biofuels industry, including biodiesel for trucks.

### Improving resilience to global fuel changes

New Zealand currently imports the majority of its vehicle fuel. Domestic production and supply of alternative green fuels could reduce New Zealand's reliance on international diesel supply, and increase its energy security. New Zealand is well positioned to show global leadership in pursuing energy self-sufficiency, with renewable energy sources already dominating New Zealand's electricity supply, and opportunities to produce green hydrogen and biofuels domestically. International policy direction in some countries to reduce fossil fuel and vehicle use, and the subsequent response from the manufacturing industry, is also likely to impact on the availability of zero-emissions trucks in New Zealand over the next 20 years. This would further support alternative green fuel production in New Zealand.

### Supporting New Zealand's clean green image

New Zealand's tourism industry relies on New Zealand's clean, green image as a point of difference in the international travel market. The promotion and use of low-carbon transport fuels supports this image, and can be developed across other modes, decarbonising inter-city coaches, local bus networks, and passenger ferries.

20. Biofuels Roadmap, Scion, https://www.scionresearch.com/__data/assets/pdf_file/0005/63293/Biofuels_summary_report.pdf

3.2

# Options to transition road freight

All three alternative green fuels (biofuels, electricity, and green hydrogen) are seen as contributing to the GHG emissions solution. There are a number of ways to facilitate the uptake of these fuels that could be implemented in New Zealand over the next 15 years. These options seek to tackle GHG emissions from road freight, whilst supporting a Just Transition and supporting the additional co-benefits to society mentioned above.

When thinking about the role of alternative green fuels in reducing the GHG emissions produced by the New Zealand truck fleet, there are two pathways that should be considered. The first pathway acknowledges that transition takes time and therefore aims to reduce the carbon intensity of the fuel currently used by the existing truck fleet (i.e. diesel), so that it produces less GHG emissions. The second pathway aims to replace diesel altogether with viable alternative green fuels. This comes with a number of challenges for all three alternative green fuels under investigation. Under each pathway, options have been presented to encourage and incentivise a reduction in GHG emissions. The options focus on either supporting an opportunity or helping to overcome a challenge identified in the previous chapter. Both pathways are important and should be developed concurrently.

The time period within which the initiative could commence has been indicated under each option. These take into account technology maturity, financial costs associated with each option, industry readiness and the New Zealand context.[21] These time periods align with the Climate Change Commission's first three carbon budgets (2025, 2030, and 2035).

Although the Ministry is the Government's principal transport adviser, a number of other government agencies and departments have strong linkages with the transport sector. The options discussed below include policy options or actions that sit within other agencies.

New Zealand should also be thinking about how it harmonises its approach with that of overseas jurisdictions. Alignment to some of these approaches allows New Zealand to learn from overseas experience, and 'keep pace' with international developments.

## PRINCIPLES TO GUIDE TRANSITION CHOICES

Underpinning the options presented in this section are a number of principles. The intention of these principles is to help guide decisions around which options to pursue further, and which to prioritise. The principles are:

- Options that provide the greatest impact on GHG emissions, at the least cost, should be prioritised.
- Co-benefits should be assessed and considered for each option.
- Options should support a Just Transition.
- Where possible, options should be considered as a package.
- Early-movers should be supported to create momentum for change.
- Proposed changes should be signalled early to allow businesses to plan for transition.

21. While it is acknowledged that understanding the social impacts of options presented is important, this analysis will be undertaken once the list of options has been narrowed down and prioritised.

Pathway one:

# Reduce the carbon intensity of fuel in the existing fleet

Diesel is likely to remain a fuel option for the freight industry for at least the next ten years. Most trucks in New Zealand are diesel powered as diesel provides more torque for towing and is more fuel efficient than petrol. Even with the replacement of all new trucks entering the fleet from now with low or zero-emissions options, the majority of the current truck fleet will still be in operation in 2030. This means that it is important to consider opportunities to reduce the carbon intensity of the fuel trucks currently in use.

Pathway one aims to reduce the GHG emissions from the existing diesel vehicle fleet by using lower carbon fuels. The indicative timeframe for pursuing these options is over the next five years. There are a number of options available to the Government to achieve this goal.

**10 YEARS** Diesel is likely to remain a fuel option for the freight industry for at least the next ten years.

### Mandating biofuels (2020-2025)

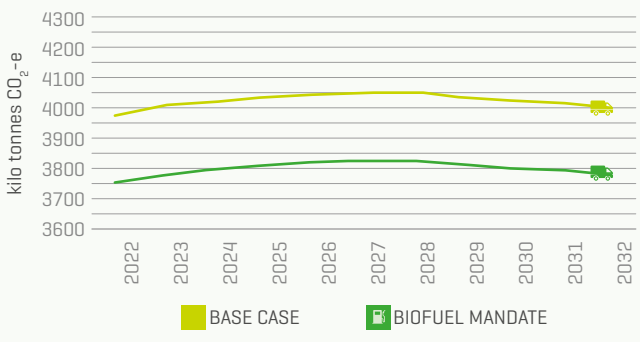
The *introduction of a biofuel mandate* would have an immediate impact on reducing GHG emissions from road freight. The advantage of biofuels is that they can be used in New Zealand's existing truck fleet, without the need to replace existing vehicles or distribution infrastructure. Replacing vehicles can be a significant cost for businesses and also has implications for new GHG emissions associated with the manufacture and supply of new vehicles. Utilising biofuels can keep truck replacement costs down until affordable zero-emissions options become available, while reducing GHG emissions in the short to medium-term. A biofuel mandate should ensure that biofuels are derived from sustainable feedstocks.

Biofuel mandates have been introduced in a number of countries overseas (often supported by national policies). Mandates either focus on reducing net GHG emissions, or setting the percentage of biofuel required to be blended with diesel, or the amount of biofuel required to be sold as a proportion of transport fuel sales (without mandating a specific blend). Blending mandates in Europe have seen a steady increase over the past few years, with countries like the Netherlands, Germany and the UK increasing the percentage of biofuel required to be blended with fossil fuels in 2020 from 2019 levels. Countries with a GHG emissions mandate, like Sweden and Czechia, have also increased the percentage of emissions that need to be reduced from fossil fuels from 2019 levels. Typically, if these targets are not met, then there is a penalty, which acts as an incentive for compliance.

New Zealand briefly had a biofuel sales obligation in 2008 (under the Biofuel Bill). This was enacted in September 2008, but was repealed later that year. The Bill would have required petrol and diesel suppliers to also supply biofuels with an initial level of 0.53 percent of all fuel sales in 2008 increasing to an upper level of 3.4 percent of all fuel sales in 2012.[22] At the time, it was estimated that the requirement would reduce GHG emissions by more than a million tonnes between 2008 and 2012, as well as decrease New Zealand's dependence on imported oil and improve energy security.

If New Zealand introduced a blended biofuel mandate, this could have an immediate impact on GHG emissions. Based on projected fuel use for the truck fleet in 2022 (and the GHG emissions produced as a result), a seven percent biofuel blended mandate (using conventional biofuels) could reduce the amount of carbon produced by the truck fleet by about 220 kilo tonnes $CO_2$-e in 2022 (a six percent reduction in truck GHG emissions). If the same mandate was to remain in place from 2022 through to 2032, this could equate to nearly 2.5 million tonnes of $CO_2$-e reduced over that period.[23] Figure 14 (below) shows the potential impact a biofuels mandate could have on existing base case GHG emission projections.[24]

**Fig 14.** GHG emissions reductions from biofuel mandate




22. This could have been achieved through 100 percent blends to a small number of customers or low blends to all.
23. Figures are based on the Ministry of Transport's Vehicle Fleet Emissions Model and transport data.
24. This modelling is based on Ministry of Transport data and analysis

Conventional biofuels exist in New Zealand and are already being blended at low percentages with diesel at the pump. The obligation would fall on fuel suppliers to ensure adequate supply of biofuels, either from existing domestic production, or international markets. Adequate lead times would be required to facilitate this, but a low blend (B7 – seven percent biofuel, 93 percent diesel) could be implemented relatively quickly (building on the work done in 2008).

Many existing heavy vehicles are capable of taking 20 percent or 30 percent biofuel blends and some even 100 percent biofuel. Having higher percentage biofuel blends available would speed up the reduction in GHG emissions. One hundred percent tallow/used cooking oil biofuel has the potential to reduce GHG emissions by more than 80 percent.[25] Additional pumps and fuel storage would need to be installed at truck fuel stops to offer these higher blends, or blending pumps would need to be installed which mix diesel and biodiesel to create the highest biodiesel blend suitable for each vehicle. In addition, an education and information campaign would need to be developed to assure vehicle operators that there would be no negative impacts on their engines through using higher biofuel blends.

The use of advanced biofuels (such as renewable diesel) that can be directly substituted for diesel has the potential to significantly reduce GHG emissions. However, advanced biofuels are currently not commercially available in New Zealand. They do exist in international markets but are a higher price per litre than diesel. The GHG emissions to import these fuels are no different to the GHG emissions to import diesel. The relative increase in cost of fuel at the pump could be reduced by using a lower blend of advanced biofuel initially, and building up to a 100 percent replacement for diesel. No new infrastructure would be needed to store, distribute or dispense advanced biofuels, and they are fully compatible with all existing diesel vehicles.

Mandating biofuels (at any level) would have a positive impact on reducing GHG emissions from light diesel vehicles as well, which numbered just over 700,000 in 2017. It would also reduce GHG emissions generated by other vehicles using diesel that operate off-road in New Zealand like fishing boats, and heavy machinery used in construction, forestry and agriculture. It is estimated that around 30 percent of all diesel consumed in New Zealand is off road, so the emissions reduction impact would be far reaching. Further analysis would be required to understand the full impact across these sectors of a blanket blending mandate.

### Supporting the development of a domestic biofuels industry (2020-2035)

An area where there is a gap in infrastructure investment is in biofuels. One option is to *support infrastructure investment in a domestic biofuels industry in New Zealand.* There was a Biodiesel Grant Scheme administered by the Energy Efficiency and Conservation Authority (EECA), which operated from 2009 to 2012 and provided a 42.5 cents per litre subsidy on biodiesel sales. It saw the start-up of a number of biodiesel plants, but the funding for the scheme was withdrawn, resulting in the ceasing of operation of many of these start-up companies. As discussed above, the development of New Zealand's existing biofuels industry, using sustainable feedstocks produced in New Zealand (like biomass and tallow), and expansion into advanced biofuels, could support energy security, create jobs and build expertise that can be applied across other parts of the transport sector (e.g. maritime and aviation). Substantial work has already been undertaken (and is ongoing) to assess whether a domestic biofuels industry is feasible, including which sustainable feedstocks could be used. However, without financial or policy support, growth in this industry is unlikely.

Two challenges to building a domestic industry around biofuels centre on whether the demand will be adequate to ensure the commercial viability of an industry, and whether New Zealand can compete with biofuels being produced internationally. Biofuels are currently more costly to produce than fossil fuels, and significant upfront capital investment is required to begin biofuel production. The profitability of making biofuel depends primarily on the price difference between the international price of biofuel feedstocks and the international oil price. Both of these fluctuate, making investment risky for new biofuel plants competing against the sunk costs of oil production and refining. For example, by the end of February 2019 the price of tallow in New Zealand was $794.38 per tonne. By the end of February 2020, it was $1091.25 per tonne. The price of diesel also decreased over this same period, creating a greater price gap between diesel and biofuels. Some countries, like Singapore, subsidise their domestic biofuels industry to address this price gap.

As well as providing an option to reduce GHG emissions immediately, the value in building knowledge and experience around how to make and use biofuels successfully, and to build general public confidence that they can be successfully used, should not be underestimated. What is yet to be established is the most appropriate suite of policies to reduce investment risk associated with the expansion of conventional biofuel production, and address the price difference with diesel. In addition, this needs to be weighed against the cost of reducing GHG emissions through electrification and green hydrogen, and the timescales all these low-carbon options take to introduce.

25. From the EECA website https://www.eecabusiness.govt.nz/technologies/renewable-energy/biofuels/sustainable-biofuels-information/

# CASE STUDY ONE:

## Z ENERGY

Z Energy (Z) is a New Zealand owned company and New Zealand's largest retail and bulk fuel supplier. Z is focused on reducing its carbon footprint, and has successfully reduced its operational GHG emissions by ten percent since 2017. Z voluntarily offsets the remainder of its operational emissions by purchasing credits from Permanent Forests NZ (who manage forests protected under the Government's Permanent Forest Sink Initiative).

Z has taken a number of steps to support low-carbon options for its customers, including investing over $30m to establish and operate a biodiesel production plant at Wiri in Auckland.

Z decided to focus on domestic biodiesel production after carefully evaluating the availability of local sustainable feedstock, as well as considering the transport use cases that would be harder to electrify. Producing biodiesel from inedible tallow met Z's requirements of being locally available at scale, not competing with food production, and presenting an option that could meet the need of freight operators trying to immediately decarbonise (one litre of pure biodiesel (B100) has an emissions factor of 0.000125kg $CO_2e$/unit, compared to mineral diesel at 2.69 $CO_2e$/unit).

Z's biodiesel plant was the first biofuels plant in the world built without any policy incentives, subsidies or mandates. A memorandum of understanding with key foundation customers, including Fonterra and NZ Post, was subsequently necessary to ensure a minimum level of demand. Z would not have committed to the plant without this commitment from foundation customers.

As a first-mover, Z faces a number of ongoing challenges to make the plant commercially viable. The greatest challenge has been that while some customers are willing to pay a (limited) premium price for biodiesel, the majority are not. This, combined with the lack of real incentives for companies to reduce their carbon footprint, has kept demand low. Additionally, Z has recently been forced to compete for local tallow feedstock supply with foreign renewable biodiesel producers who access government subsidies in overseas markets (such as Singapore). This has made the economics of the plant even more difficult.

Z remains committed to co-creating low-carbon solutions for the New Zealand market. However, the complexity and cost of doing so means that Z may not be able to sustain production at its biodiesel plant without a change in the economics, and clear signals from the Government in the near-term around its future support for renewable fuels.

### Introducing a carbon intensity standard (2020-2025)

A more fuel agnostic policy option is to *introduce a carbon intensity standard* for all transport fuels. The standard would take into account the GHG emissions associated with production, transportation and consumption of the fuel. This approach has been taken overseas with a Fuel Quality Directive (FQD) implemented in Europe in 2009. The FQD set an obligation on fuel suppliers to reduce the GHG emissions intensity of automotive fuels in 2020 by six percent compared with 2010.

California has also implemented a carbon intensity policy to obligate oil refineries and producers to reduce the carbon intensity (CI) of the fuels they produce. The Californian Low Carbon Fuel Standard (LCFS) uses a credit-based system, where credits are awarded to producers who reduce their CI below the set targets and deficits are generated when fuel is above the CI standard. Fast-charging of electric vehicles also generates credits under the scheme. CI standards are steadily increased overtime.

The UK have implemented a similar carbon intensity programme to encourage the use of renewable fuels, specifically focussing on biofuels and hydrogen as alternative fuel options. Similar to the LCFS, the Renewable Transport Fuel Obligation (RTFO) would provide fuel suppliers with credits for supplying renewable fuel, and imposes monetary penalties when fuel does not meet the renewable standard. Some fuels are also allocated additional credits to further incentivise their production. For example, every kilogram of renewable green hydrogen supplied receives 4.58 credits, with every kilogram of biofuels (that have used waste or residue feedstocks) receiving two credits.

A carbon intensity standard could be implemented as early as 2025 in New Zealand.

Leveraging off the experience from overseas jurisdictions, a carbon intensity standard could be implemented as early as 2025 in New Zealand. This would provide fuel producers and distributors with enough lead-in time to meet new requirements. Renewable fuel subsidies could be aligned to the level of anticipated support required in the early stages of the standard.

Pathway two:

# Replace existing fuels with low-carbon energy fuels

This is the key objective of the Green Freight project, but the most challenging. The price of diesel at the pump is relatively low in New Zealand compared to overseas.[26] This is in part due to New Zealand not having a diesel tax (as a result of Road User Charges). This low diesel fuel price lessens the imperative for energy efficiency and lower carbon energy. As a result, many companies that have begun their transition to lower-emissions options have done so at their own expense, and because of internal drivers.

The challenges to achieving a transition to alternative green fuels quickly lies primarily around the price and availability of those fuels, the price of electric or hydrogen vehicles, and adequate supporting infrastructure.

## ADDRESSING PRICE PARITY AND THE AVAILABILITY OF ALTERNATIVE GREEN FUELS

While most organisations are currently thinking about what low and zero-emissions options might be available to them in the future, a key barrier to uptake is the current price of alternative green fuels, compared to diesel, and the reliable supply and availability of those fuels.

There are a number of options available to encourage a transition to alternative green fuels.

### Increasing the price of carbon (2020-2025)

New Zealand already has an Emissions Trading Scheme (ETS) as its primary mechanism for reducing GHG emissions. The ETS creates a market-driven price for emissions units by placing compliance obligations on emitters. These are New Zealand Units (NZUs), each representing one tonne of $CO_2e$. They are only traded within New Zealand, and under current rules, emitters have the option of paying $25 for each tonne of GHG emissions instead of surrendering a NZU. Putting a price on emissions is intended to create a financial incentive for businesses and consumers to invest in technologies and practices to reduce emissions.

The New Zealand Productivity Commission has indicated that the ETS will have a very limited role in reducing transport GHG emissions, since the current GHG emissions price is a small component of fuel prices (compared to the total costs of importing and distributing fuel and the total taxes on fuel).[27] At the beginning of March 2020, the ETS component of diesel was 6.675 cents per litre.[28] The New Zealand Productivity Commission has suggested that even with a significant increase to the GHG emissions price, additional measures will be needed to achieve large GHG emissions reductions from transport. This is because transport fuel is a relatively inelastic product, which means that changes in prices have little influence on demand.

The Ministry for the Environment (MfE) has recently released a document for consultation looking at the ETS, entitled "Reforming the New Zealand Emissions Trading Scheme: Proposed Settings".[29] The document discusses New Zealand's current emissions reduction targets, potential ways to deliver efficient emissions abatement, and the impacts of an increasing NZU price. It also discusses the quantity of NZUs available to auction annually, with the aim being to reduce the overall number of NZUs on the market so these become more expensive, bringing a stronger incentive for participants to reduce their GHG emissions. There is also a desire to increase transparency of the ETS to allow the public to access information about the scheme and see the GHG emissions profiles of ETS participants.

26. The average price of diesel in New Zealand between 23-Dec-2019 and 30-Mar-2020 was $1.46 NZD. The average price of diesel in the world for this period was $2.08 NZD. Dollar. https://www.globalpetrolprices.com/New-Zealand/diesel_prices/
27. The New Zealand Productivity Commission Low-emissions Economy August 2018 report. The report can be found here: https://www.productivity.govt.nz/inquiries/lowemissions/
28. This is a non-weighted weekly average provided by Hale & Twomey based on the prevailing carbon price from the New Zealand Carbon Market.
29. This document can be found at: https://www.mfe.govt.nz/consultations/nzets-proposed-settings

Although price inelasticity and the small impact of the ETS on fuel prices pose a challenge to the effectiveness of an emissions price in the transport sector, higher and sustained GHG emissions prices could drive more meaningful changes. *Increasing the price of a tonne of $CO_2e$* could help to narrow the price gap between alternative green fuels and conventional fossil fuels. This could form part of the overall solution to reducing GHG emissions from road freight, and could be put in place relatively quickly as part of current reforms. It also sends a clear signal to industry around Government intentions.

### Expediting the uptake of renewable fuels (2020-2025)

As discussed above, advanced biofuels exist in international markets. The barrier to supply into New Zealand is primarily around price, with some products as much as one dollar a litre more expensive than diesel. In the early stages of green hydrogen production in New Zealand, similar price challenges will exist for green hydrogen as an alternative fuel source. The speed at which New Zealand can transition to renewable fuels will depend on how quickly they reach price parity with fossil fuels. New Zealand could accelerate GHG emissions reductions by providing funding support to *expedite the uptake of renewable fuels like green hydrogen and biofuels*.

International experience shows that creating price parity affects the production and consumption of biofuels. Supportive policies are needed to facilitate the technology learning and production scale-up necessary to reduce costs and achieve this. Providing financial support to increase the uptake of renewable fuels is an approach being taken by a number of countries, notably by the Japanese Government, to lower the price of hydrogen as a fuel source. There are also examples of this approach being taken in conjunction with other policies to encourage the use of renewable fuels, such as biofuel based national mandates. Germany is one such country where both approaches are being applied concurrently.

New Zealand could take a tiered approach to the level of financial support provided to fuel producers and suppliers, potentially based around the amount of GHG emissions the fuel reduces. For example, a 100 percent replacement fuel would receive the greatest financial support, with renewable fuel blends (that reduce a smaller percentage of GHG emissions) receiving less support. Focussing financial support on the GHG emissions reduction potential of the fuel, as opposed to specific fuels, helps to future-proof policy for new renewable fuels that may become commercially available over the next 15 years. The level of support could also be related to the price of diesel at the time. It would be highly likely therefore that it would be reduced (and eventually phased out) over time, as technology improvements reduce the costs to produce renewable fuels, and businesses become commercially viable as they begin to operate at scale.

Further investigation would be required around the implications of this approach to existing international trade agreements and World Trade Organization (WTO) agreements.

### Setting renewable fuel targets (2025-2030)

In order to shift the entire freight industry towards alternative green fuels, New Zealand could *introduce renewable fuel targets*. While a carbon intensity standard places the onus on fuel producers and distributors, renewable fuel targets would focus on the percentage of renewable fuels used across the freight industry itself. A target-based approach provides flexibility for freight operators to choose how to meet those targets. The first target could be set to coincide with the second Climate Change Commission carbon budget in 2030, and would steadily increase through to 2050.

The Renewable Energy Directive recast (REDII) is the framework guiding European Union member states in their use of renewable transport fuels from 2021-2030. It will raise renewable energy requirements year after year, with the initial onus on fuel suppliers to supply a minimum of 14 percent of the energy consumed in road and rail transport by 2030 as renewable energy. REDII also includes minimum targets for advanced biofuels at 0.2 percent in 2022, to reach 3.5 percent by 2030.

The United States has introduced the Renewable Fuel Standard (RFS) programme, which requires a quantity of the fossil fuel supply to be replaced by renewable fuels. The programme is focussed primarily on biofuels, with all eligible fuels needing to achieve a reduction in GHG emissions as compared to a 2005 petroleum baseline. It also includes consideration of lifecycle emissions. For example, biomass-based diesel must meet a 50 percent lifecycle GHG reduction, and qualifying advanced biofuels can only be produced from qualifying renewable biomass, excluding corn starch. Advanced biofuels are seen as holding the greatest promise for GHG emissions reductions over the longer-term.

In New Zealand, there may be challenges around administration costs and enforcement of the targets. This type of target-based approach requires careful management and monitoring to ensure it delivers the desired outcomes, without creating unnecessary burdens across the freight industry and energy sector.

# CASE STUDY TWO:

## PORTS OF AUCKLAND

Ports of Auckland operates a sea port on the Waitematā Harbour and freight hubs in South Auckland, Manawatu, Waikato and Bay of Plenty. It also has a subsidiary trucking company with a fleet of 23 trucks. Ports of Auckland is a founding member of the Climate Leaders Coalition and has set the goal of being zero-emissions by 2040.

Ports of Auckland's catalyst for tackling GHG emissions arose in 2015 when the public protested about their construction activities in the harbour. Ports of Auckland realised they had been putting operations and business at the forefront of decision making and not balancing those drivers with the social and environmental impacts. So they re-wrote their business strategy to address that.

Ports of Auckland will use a mix of technology and fuel type solutions to achieve their carbon reduction targets. The approach they are taking is to implement demonstration projects and trials of zero-emissions technologies in the near-term, while concurrently using low-emissions fuel alternatives such as biofuels or renewable diesel to achieve near and medium-term emissions reductions, and phasing in the adoption of the preferred zero-emissions technologies in the medium-term through to 2040. As part of this approach, they are building a hydrogen demonstration plant to support hydrogen refuelling for container handling equipment, FCEVs, buses and cars.

To compare specific options, Ports of Auckland has developed a long-term financial model that includes a detailed cash flow analysis. They have developed metrics for comparing the annual capex and opex costs of each emissions reduction project, against the carbon reductions for that project (in kilograms of carbon emissions saved for the project). They have also developed a supply chain carbon calculator to support their customers to understand their emissions profile.

A significant challenge Ports of Auckland face as a first mover, is that zero-emissions technology is relatively new and expensive, requiring large capital investment. There is a significant financial burden on first movers, as well as a high level of risk without certainty around Government policy direction. Supporting industry to identify the decarbonisation path best suited to them is seen as the best option for the Government to support transition.

### Make diesel more expensive (2030-2035)

If the approaches above are not delivering the required GHG emissions reductions by 2030, an option still available is to *make diesel more expensive*, and therefore, alternative fuel options more attractive. The ETS is New Zealand's primary mechanism to achieve this, but as discussed above, it would require a significant increase in the price of carbon to achieve the behavioural changes necessary to influence purchasing decisions in the transport sector.

While excise duties or other taxes on diesel fuel exist in most other developed countries, placing a tax on diesel in New Zealand has previously been seen as imposing an unfair burden on sectors that use diesel off-road. This includes farms, manufacturing, industrial and commercial ventures, and ships, and amounts to between 30 to 40 percent of all diesel used in vehicles in New Zealand. Excluding off-road diesel use from an excise duty is also challenging, with a refund system potentially being costly and cumbersome to administer and compliance monitoring costs seen as potentially outweighing the benefits.

Currently, road users with a petrol vehicle contribute to the funding of our land transport system through petrol excise duty. Road users with a diesel vehicle (or any vehicle that weighs over 3.5 tonnes) pay Road User Charges (RUC), which go toward the National Land Transport Fund. Adding an excise duty on diesel would also incur additional costs to diesel vehicle owners (if RUC were to be retained), but this could be used to provide funding for other initiatives discussed above (such as expediting the uptake of renewable fuels). Any excise duty should be signalled early to provide diesel vehicle owners and operators with enough time to transition to low or zero-emissions alternatives.

Any consideration of an excise duty would need to consider how it aligns with other mechanisms in place to discourage diesel use. It also needs to be reviewed in relation to its impact on the freight industry in New Zealand (and smaller operators in particular), as well as other diesel users (e.g. light commercial vehicle owners and off-road vehicles). It also needs to consider the likelihood of the additional costs simply being passed onto customers, and the flow-on effects this might have on New Zealand's economy and society.

There are currently no fuel efficiency standards in place for trucks in New Zealand.

## ENCOURAGING THE UPTAKE OF ALTERNATIVE FUEL VEHICLES

As well as the price and availability of the fuel itself, a key challenge to transitioning to alternative green fuels is the cost of alternative fuel vehicles. This is a common challenge across a number of different vehicles types, including trucks, buses, light passenger vehicles and even e-bikes.

There are a number of options available to the Government to increase the number of low and zero-emissions vehicles in the New Zealand truck fleet.

### Introducing fuel efficiency standards for trucks (2020-2025)

There are currently no fuel efficiency standards in place for trucks in New Zealand.[30] New Zealand could *introduce a fuel efficiency standard for trucks* entering the fleet, which aligns with the standards introduced in other countries (in particular, truck manufacturing countries). Fuel efficiency standards are intended to reduce GHG emissions from the vehicle itself. Trucks that are more fuel-efficient will burn less fuel per kilometre and therefore produce less GHG emissions than trucks with poorer fuel efficiency. While targeting fuel efficiency will not have the same impact on GHG emissions as transitioning to low and zero-emissions fuels and vehicles (as discussed in Chapter 1.2), it will support emissions reductions in the interim.

Internationally, a number of countries have fuel efficiency/economy standards to reduce GHG emissions from trucks, including China, the EU, Canada, Japan, India and the US. For example, the European Council have set GHG emissions reduction targets (or 'carbon' targets) for new heavy vehicles being added to the EU's vehicle fleet over the coming decade. Under the targets, manufacturers will be required to cut carbon emissions from new trucks on average by 15 percent from 2025 and by 30 percent from 2030, compared with 2019 levels. The approach uses a credit-based system, similar to the Californian Low Carbon Fuel Standard (LCFS).

There is evidence, however, to suggest that diesel engine technology has reached its fuel efficiency potential, and that the fuel efficiency of trucks in on-road conditions has not improved significantly over the past 20 years.[31] Fuel efficiency gains are now more likely to come from the technology improvements in newer trucks, such as improvements in aero dynamics in the new design features (like low drag mirror cameras), intelligent power control and driver assist technology. Trucks that meet Euro VI standards tend to have these newer features (i.e. if a truck is still using Euro V emissions technology it is much less likely to have the latest fuel efficiency innovations). The newer vehicle technologies also provide the co-benefits of lower engine noise, reduced driver fatigue and added safety features. Trucks adhering to Euro VI standards should be encouraged into New Zealand for all of these reasons.

New Zealand could immediately investigate implementing a fuel efficiency standard across the truck fleet, to assess the impact it would have on GHG emissions (remembering that New Zealand mainly imports new trucks, and it is these trucks that tend to contribute the most to GHG emissions).

30. There are emissions standards in place, but these concern air quality, not GHG emissions.
31. See section 3.3 below – "Options considered, but not pursued".

## Pathway two continued

### Extending and/or changing the RUC exemption for electric trucks (2020-2025)

Another mechanism already in place to promote the uptake of zero-emissions trucks is the current Road User Charges (RUC) exemption for heavy electric vehicles.[32] Put in place in 2016, the exemption was intended to support the uptake of electric heavy vehicles (including buses and trucks). The exemption runs through until electric heavy vehicles are two percent of the heavy vehicle fleet, or until the end of 2025, and is only available to heavy battery electric vehicles. To date, vehicle availability and high purchase price has limited the impact of the exemption. It is anticipated that these will remain challenges for electric vehicles through to 2025.

There are three potential options around RUC. The first is to extend the exemption (potentially through to 2030). The second is to modify the exemption to cover all zero-emissions heavy vehicle options. And the third option is to leave the exemption as it currently stands. It is important to note that the Road User Charges Act 2012 (the RUC Act) was established to recover costs for the disproportionate damage to roads caused by heavy vehicles such as trucks and buses. Its purpose is not to support low-emissions vehicle uptake, and other mechanisms should be considered before making further changes to the RUC Act to achieve this.

Under option one, it is highly likely that *extending the current RUC exemption for electric trucks* would support greater uptake, with more vehicle options becoming available towards the end of the decade, particularly for medium trucks. This would give freight companies greater certainty for their fleet replacement planning but would require an Order in Council to be made just prior to the expiry of the current exemption, in order to extend it out to 2030. The unknown with this option is the potential cost in forgone revenue for the Government that this results in, and its implications for expenditure on New Zealand road infrastructure. Estimates of total cost over the period of any future exemption would need to be made, to ensure sufficient revenue can still be collected to maintain New Zealand roads.

The second option to *modify the current RUC exemption* would also support the greater uptake of zero-emissions trucks, notwithstanding vehicle availability and cost challenges. However, there are difficulties applying a RUC exemption to trucks using biofuels, due to challenges in identifying what fuels are used in any given vehicle. Modifying the current RUC exemption would also require a change to the RUC Act. Any changes to the Act would also need to future-proof the exemption for other zero-emissions technologies that emerge during the period. This cannot be achieved easily and other mechanisms might be more effective in supporting wider uptake of zero-emissions options over the next decade.

The third option, particularly if alternative funding mechanisms can be made available over the next decade, is to *leave the exemption as it currently stands*. This will continue to support early movers in the industry to capitalise on the exemption over the next five years. It may also act as a catalyst to encourage earlier further transition throughout the industry.

### Expanding existing low-emissions technology funding (2020-2025)

Providing access to funding to support the trialling and testing of new technologies helps de-risk early movers to invest in alternative options. Demonstration cases also provide organisations with an opportunity to better understand the benefits and challenges of new technologies, and to test new ways of working with their staff (e.g. changes to their shift patterns due to the recharging schedule required by new electric trucks).

The EECA Low-emissions Vehicle Contestable Fund (LEVCF) supports organisations through co-funding the purchase of low and zero-emissions technologies, including trucks. Among a number of truck projects the LEVCF has supported are the first two heavy electric freight trucks in New Zealand. Companies Alsco and ContainerCo commenced operations with their new heavy electric trucks in early 2020. Both trucks are in excess of 20 tonnes, and are being operated as part of the wider fleet. The Alsco heavy electric truck will travel 284 kilometres every day, five days a week, between Rotorua, Taupō and Tauranga. It is estimated that this will save Alsco at least 25,000 litres of diesel, and the environment 67,610 kilograms of $CO_2e$, per year. Early indications from the truck owners are that the trucks are performing as expected and that the total cost of ownership will be well below their diesel equivalents.

There is value in *expanding the LEVCF both in size and scope*. The fund is currently oversubscribed, with over half of all submissions unable to be supported each round. Increasing the size of the fund, in monetary terms, would allow for a greater number of initiatives to be supported. Expanding the scope of the fund, to include all low-emissions options and even low or zero-emissions fuel trials, would further improve the impact the fund could have in transitioning trucks to alternative green fuels. Focussing funding rounds on freight could also speed up uptake of alternative green fuels demonstration projects. Expanding the existing fund is also seen as better than creating a new fund, as it leverages off the expertise already developed in this area, and the structures and processes already in place.

Providing access to funding to support the trialling and testing of new technologies helps de-risk early movers to invest in alternative options.

32. All diesel vehicles in New Zealand pay RUC to support the maintenance of New Zealand roads. Charges are based on the weight of the vehicle and the kilometres it travels.

### Providing up-front grants for low and zero-emissions trucks (2020-2025)

The up-front capital costs of low and zero-emissions vehicles has been identified as a key barrier to uptake, especially for small freight operators that make up the bulk of the industry. This is reflected in the volume of heavy electric vehicles registered in New Zealand (as at 23 February 2020 there were 180 heavy electric vehicles registered, with the majority of these being buses).

One option to speed up the uptake of zero-emissions trucks over the next decade is to allocate funding dedicated to support the diffusion of low and zero-emissions options across the fleet. Up-front grants are one mechanism to achieve this. Early movers, Alsco and ContainerCo, both conveyed the significance of LEVCF support in their decision to procure heavy electric trucks. *Providing up-front grants for low and zero-emissions trucks,* that are broader than technology demonstrations for the first trial of new technologies, could support the purchase of larger numbers of low and zero-emissions trucks as they become available. This would support the LEVCF to encourage innovation and trialling, by creating a mechanism to support early movers who wish to employ proven technologies.

In the medium truck space, a few production-line zero-emissions models are already available from companies like BYD in China, and Daimler/FUSO in Europe and Japan. Fuso has already showcased a 7.5 tonne e-Canter model in New Zealand, and is potentially bringing in a 6 tonne production line e-truck to New Zealand in early 2021. The creation of production-line vehicles will be a step-change in the volume of vehicles available on the market, and provide organisations with an opportunity to transition, if they can overcome the up-front capital cost. Some estimates are that medium electric trucks will reach price parity with diesel equivalents by 2025 due to battery prices continuing to reduce. However, New Zealand may be slower to secure a supply of these electric trucks than European, North American and some Asian markets due to our small market size. In the near-term, there will also be opportunities to electrify heavy trucks that operate within regions, if they travel shorter distances on one-way journeys or have return to base operations.

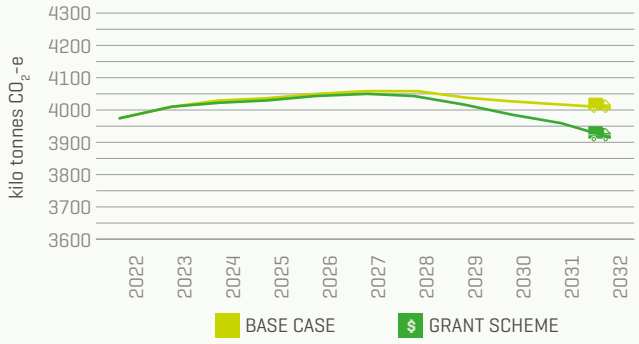
As well as reducing GHG emissions more quickly, accelerating the transition to low and zero-emissions trucks is likely to result in a number of co-benefits. For example, increasing the number of low and zero-emissions trucks is likely to improve New Zealand's resilience and security by reducing our reliance on imported fuels. It is also likely to support better public health outcomes by reducing the number of vehicles producing harmful particulates (produced from burning diesel). Increasing the uptake of BEVs is likely to increase electricity demand and subsequent investment in new wind farms, which could accelerate the retirement of coal-powered generation, reducing GHG emissions from the electricity sector.

There are a number of ways to approach up-front grants for trucks. Ideally, the funding mechanism should be flexible and responsive enough to support vehicle procurement in line with availability in the New Zealand market. This means having grants available as soon as possible, particularly where niche opportunities already exist. There needs to be more thinking about the total amount of funding required (e.g. starting small and increasing as more options become available), how it will be managed (e.g. through a contestable process), and the length of time the grant scheme should operate.

The impact of a grant scheme could be significant on GHG emissions in New Zealand in the long-term. For example, just looking at electric trucks, if a grant scheme increased the procurement of electric trucks between 2022 and 2032, even by a small percentage, it could reduce GHG emissions by as much as 228 kilo tonnes of $CO_2$-e over that period. This figure is based on up-front grants increasing the projected uptake of medium electric trucks by 100 percent by 2032, as well as increasing the projected uptake of heavy electric trucks by 50 percent by 2032. This would result in 10 percent of all medium trucks being electric by 2032 (approximately 9,000 trucks), and five percent of all heavy trucks being electric by 2032 (approximately 4,000 trucks).[33] Based on these percentages, the GHG emissions savings in the year 2032, over base case projections, would be 84 kilo tonnes of $CO_2$-e from the truck fleet (69 percent of these savings coming from heavy trucks).[34] These savings would increase exponentially into out-years as heavier BEV options become more readily available.

Figure 15 below shows the impact up-front grants could have to existing base case GHG emissions projections, and demonstrates the impact early investment can have.[35]

**Fig 15.** Potential GHG emissions reductions from grant scheme




33. Due to the lead times required to get trucks to New Zealand, the additional increase in uptake for heavy trucks has only been modelled to commence from 2028, and gradually increase through to 2032. The additional increase in uptake for medium trucks begins in 2024, as more options are likely to be available earlier.
34. Figures are based on the Ministry of Transport's Vehicle Fleet Emissions Model and transport data.
35. This modelling is based on Ministry of Transport data and analysis

# CASE STUDY THREE:

## NEW ZEALAND POST


New Zealand Post (NZ Post) is a New Zealand-based delivery and e-commerce logistics company, with a stated purpose of delivering what people care about. NZ Post is committed to sustainable practice and working to reduce the environmental impact of its delivery network.

NZ Post's catalyst for tackling GHG emissions was a strong goal set by its Board to be carbon neutral from 2030. They plan to achieve this by reducing their carbon emissions by 32 percent (from 2018 levels) and offsetting their remaining emissions.

NZ Post has developed a decarbonisation roadmap, outlining the key milestones the organisation needs to meet to stay on track. By 2025, the aim is for 100 percent of NZ Post owned vehicles to be electric, and for 25 percent of their "last mile" contractors to be using electric vehicles. By 2025, NZ Post aims to be at the forefront of low-carbon heavy truck transition, and to have leveraged low-carbon action with their people and their brand.

To support the roadmap, NZ Post has also established a decarbonisation fund to invest in (and accelerate) low-carbon activities across their organisation. The value of this fund will equate to the cost of being carbon neutral (i.e. the cost to NZ Post if they had purchased carbon credits to offset their emissions).

In the eyes of NZ Post, taking action now is necessary to minimise the risks in transitioning to a low-carbon economy in the future. They have the support of their Board and customers in this, and they see that to be an important factor of success.

One of the challenges NZ Post faces in achieving its goals is access to low-carbon technology, especially trucks and vans. The difficulty in acquiring these heavier vehicles could hinder the achievement of their 2025 roadmap milestones. A second challenge they see is the ability of their partners in domestic and international air freight to provide low-carbon freight options, as part of NZ Post's wider supply chain.

### Investigate the case for investing in diesel truck refurbishments (2025-2030)

Another option to help address vehicle supply challenges is to invest in building up a domestic industry that can *refurbish used diesel trucks with zero-emissions options*. New trucks generally enter New Zealand as a cab and chassis and have freight bodies and other equipment fitted locally. This has created a small skill base in New Zealand with expertise in truck assembly. Refurbishing trucks in New Zealand is one mechanism to remove diesel trucks from the existing fleet, help address vehicle supply chain concerns, and support industry growth and development.

While expertise exists in New Zealand to support this option, the challenge will be making the economics of this approach work. For example, current heavy electric truck fabricators indicate that it is not viable to convert used trucks, depending on age, to EVs as the remaining running gear is highly deteriorated in older diesel vehicles. This creates reluctance to provide warranties. Newer existing diesel trucks would need to be the target market for refurbishment as a result. These are the diesel trucks being brought in today and over the last couple of years, and once they have been operating 6-7 years undertaking front-line freight tasks. These do not have deteriorated running gear and operate in the fleet longer than used trucks being purchased, and so can justify the investment.

It will also be costly to establish an industry at scale to make this commercially viable, and would probably need funding support to establish. There would need to be some economic analysis around the proportions each component of the truck costs to replace, and how much "life" is left in the vehicle after it is refurbished. However, it would support the Government's objective of building a circular economy and it would reduce not only the emissions produced from the vehicle, but also the emissions created by replacing the vehicle with another one being brought into New Zealand. Building this capability in New Zealand could also lead to additional options for the final assembly of newer zero-emissions vehicles in New Zealand, with the requisite investment in innovation. It would also support the development of skills that will be necessary to repair and maintain electric trucks, once they start to be imported in greater numbers.

### Penalising high GHG emitters (2030-2035)

Once New Zealand gets a better understanding around how it is delivering against the first two carbon budgets set by the Climate Change Commission, there may be a need to increase the speed with which the truck fleet transitions to alternative green fuels. Post 2030, the option to *impose penalties on high GHG emitters* operating truck fleets in New Zealand could be an option. Prior to this, supply and cost challenges may prevent viable alternatives from being available. However, by the 2030s there are likely to be more alternative green fuel vehicle options available to purchase in New Zealand, and more biofuel options for the diesel trucks remaining in the fleet.

Decisions would need to be made around what the penalties would look like for the existing fleet (taking into account other mechanisms such as the ETS), as well as vehicles entering New Zealand. However, signalling policy intentions early would allow fleet operators time to transition. Penalties could steadily increase throughout the 2030s, with the aim of creating a truck fleet consisting of predominantly low and zero-emissions trucks by 2040.

### Banning diesel trucks in certain cities (2030-2035)

Internationally, concerns over air quality are driving a call to completely *ban diesel vehicles in certain cities* (or densely populated areas). This is particularly so in European cities, with Madrid restricting access to diesel vehicles made prior to 2006 in 2018, Rome pledging to ban diesel vehicles from the city centre by 2024, and Athens by 2025. In Hamburg a ban on older diesel vehicles affected around 214,000 cars, more than two-thirds of all diesel vehicles registered in the city.

New Zealand does not have nearly the market penetration of diesel vehicles as Europe (although it is increasing), and the focus of these policies is largely around diesel cars rather than trucks. In heavily populated cities, bans can have a significant impact on air quality as well as GHG emissions (as long as they do not simply displace GHG emissions through the alternative use of diesel vehicles outside cities). However, there are very few parts of New Zealand outside of Auckland (and some parts of Wellington and Hamilton), where removing heavy freight vehicles would significantly improve air quality. This may of course change over time as the population grows.

A targeted policy, that identifies cities where diesel vehicles are contributing to poorer air quality, would still have merit. Policies of this nature also send clear signals around Government thinking. Banning diesel trucks in some cities would send a clear signal around the Government's commitment to reduce emissions from the transport sector, while supporting the liveability and wellbeing of New Zealand cities.

### Ban on registering heavy diesel vehicles 2035+

Beyond 2035, if further disincentives are required to meet carbon budget targets, *a ban on registering heavy diesel vehicles* could be implemented. Such a ban does not have to be limited to trucks, and could include buses as well. Any heavy diesel vehicles that operate off-road could also be required to use conventional biofuel blends or advanced biofuels.

The impact on the New Zealand domestic vehicle market would again have to be assessed, as well as the cost to the industry of alternative options if a ban was to be put in place, along with any barriers to supply and availability of suitable alternative vehicles.

Pathway two continued

## ADDRESSING A LACK OF SUPPORTING INFRASTRUCTURE

Supporting infrastructure has been identified internationally as essential to support a transition to alternative green fuels. The uptake of new vehicle technologies requires a reliable network of hydrogen refuelling stations and ultra-fast charging stations. The Nikola Motor Company intends to build a network of 700 hydrogen refuelling stations across the United States and Europe to build up a base of supporters to invest in the hydrogen vehicles it is developing. This approach will provide the required backbone of refuelling infrastructure for commercial vehicles, as well as privately owned passenger vehicles. Tesla is also planning a network of ultra-fast charging stations that can charge the Tesla Semi in under 30 minutes during a driver's compulsory rest breaks.

While New Zealand will not need the scale of infrastructure required in larger countries, providing fuel "supply assurance" to fleet operators will be key to drive demand and uptake in New Zealand. The "chicken-and-egg" dilemma means that it can be difficult to secure private investment for alternative fuel infrastructure, without the requisite demand for the fuel itself. This in turn requires access to vehicles and the challenges this brings (as discussed in Chapter 2). Supporting infrastructure development, particularly over the next 10 years through to 2030, is seen as essential to de-risk market investment (by transferring some of that risk to the Government/taxpayer), and to provide certainty to freight vehicle owners looking to transition.

Infrastructure generally needs to be built at a large enough scale to provide commercial returns once operating at full capacity in order to secure investment and financing. The California Low Carbon Fuel Standard (LCFS) also supports infrastructure development through awarding credits to refuelling station and vehicle charging developers to support commercial scale development.

There are a number of options available to Government to develop supply assurance through targeted infrastructure development. This can be achieved a number of ways, including by prioritising infrastructure investment on key freight routes, supporting private investment that encourages alternative green fuel uptake, and reducing investment uncertainty through providing clear signals around the Government's direction.

### Targeted infrastructure investment for alternative green fuels (2020-2035)

Consideration could be given to *targeting infrastructure investment* to alternative green fuels where the greatest GHG emissions potential exists. This should look at the impact of these investments over the medium and longer-term, and across multiple sectors. This could be supported by Government co-investing in infrastructure builds, and/or investment in charging infrastructure in a manner analogous to that provided via Crown Infrastructure Partners for the rollout of fibre and rural broadband. Public-private partnerships could also help de-risk investment decisions and help provide clear signals from Government. Incremental investment in fast-charging infrastructure will help spread the costs over time, and should be prioritised around use cases that maximise patronage.

The Provincial Growth Fund, run by the Ministry of Business, Innovation and Employment, provides funding support for regional infrastructure projects that will lift productivity and grow jobs. The fund has already provided a $950,000 grant to support a hydrogen supply infrastructure feasibility study to inform investment decisions on the establishment of hydrogen supply infrastructure in the Taranaki region. The fund is also considering further requests to support building a hydrogen plant in Taranaki and establishing a hydrogen refuelling network across the North Island. Currently the fund is due to end in June 2021, and it is unknown whether it will be extended or replaced.

Another source of financing that exists that can support infrastructure development is Green Investment Finance (GIF). This supports commercially viable initiatives that are focussed on reducing GHG emissions but find it difficult to get finance elsewhere. The GIF was set up to be enduring, with Minister Shaw indicating the need for it to last over the three decades to 2050 that it is going to take to transition the economy. The GIF has strict criteria around what to invest in, and is expected to make a return on its investments.

### Developing fast-charging infrastructure (2020-2035)

As mentioned under pathway one, there is a gap in infrastructure investment in the biofuels area. A second gap is in the development of fast-charging infrastructure for electric trucks in New Zealand. The charging network for light vehicles is now well established and growing, due in part to the Government's support through the EECA LEVCF fund. However, electric trucks have different charging infrastructure requirements to light vehicles and only a small number of fast-charging stations for trucks have been supported to date.

*Supporting the development of fast-charging hubs* on key routes will help the uptake of electric trucks. This includes fast-charging hubs around key truck-stops on main highways, which are capable of charging a number of electric trucks (including larger long-haul trucks) at the same time. Incremental investment in fast and ultra-fast charging infrastructure, over the next twenty years, is seen as the best approach to building capacity. This should begin in the very near-term, as BEV options and availability increase, and continue through to 2040. In the future, all new light charging infrastructure projects, which are co-funded by the Government, should consider opportunities to support electric trucks as well.

The advantage for freight is that truck routes and schedules along state highways are known, allowing some behaviour to be predicted around recharging, and planning around where best to locate supporting infrastructure. The strategic location of ultra-fast charging hubs will allow electric trucks to compete on long distance routes, as they can recharge within 30 minutes while truck drivers take compulsory rest breaks. Within regions, more information needs to be collated to better understand where optimal charging hubs could be located. The more transparent the information is around freight movement patterns, the easier it will be to identify hubs where freight operators can refuel or recharge. This will require collaboration between central and local government, freight operators and the energy sector.

There are also questions around how infrastructure should be funded and the merits of different ownership models. There are a number of freight companies already looking to build charging infrastructure on-site at their warehouses and yards (which will be more cost effective for them as they can utilise off-peak power). Consideration should also be given to how charging infrastructure could be harmonised across different truck types, to maximise investments in infrastructure.

# CASE STUDY FOUR:

## HIRINGA ENERGY


Hiringa Energy is a Taranaki based New Zealand energy company with a mission to supply New Zealand with zero-emissions hydrogen. They are establishing a green hydrogen refuelling network across New Zealand, focused on fuelling commercial and heavy vehicles including trucks and buses. Their initial goal is to establish four refuelling stations in the North Island, supplying 95 percent of the North Island's heavy freight routes. The intention is to expand this network to 24 stations across the country by 2025, providing coverage for 95 percent of all heavy transport.

Hiringa see leveraging New Zealand's natural strengths, careful planning and strategic partnerships as key to creating a commercially viable clean refuelling network, and to support fuel self-sufficiency for New Zealand.

Hiringa has established key partnerships with the fuel retailer Waitomo and other fuel retailers, to leverage existing refuelling infrastructure in key locations and accelerate roll-out. Taking a network approach to supply and distribution helps minimise the potential for supply disruption. This is seen as key to the widespread adoption of alternative green fuels.

Hiringa has also established strong partnerships with the transport industry, including with TIL Group, one of New Zealand's largest freight operators, and other major fleet operators such as TR Group, Hiltons Haulage and Envirowaste. These relationships have ensured substantial vehicle demand can be aggregated and enough market potential demonstrated to attract leading OEMs like Hyzon Motors, Hyundai and Cummins to supply vehicles into New Zealand.

Hiringa is working with the vehicle service industry to upskill established service and supply chain channels as this is also critical to maximise vehicle uptake.

A key challenge faced by Hiringa and their partners is the high capital costs of being a first mover. Targeted support for early fleet adopters can support taking early risks and catalyse further uptake, but only with the supporting infrastructure being developed in parallel. This can help to bridge the early gap between the incumbent diesel technology and zero-emissions technology during its introduction phase.

3.3

# Summary table for options considered

This table summarises the options outlined.

| | FUELS | VEHICLES | INFRASTRUCTURE |
|---|---|---|---|
| 2020-2025 | • Introduce a biofuel mandate*<br>• Introduce a carbon intensity standard*<br>• Increase the price of a tonne of $CO_2e$<br>• Expedite the uptake of renewable fuels like green hydrogen and biofuels | • Introduce a fuel efficiency standard for trucks<br>• Extend or modify the RUC exemption for electric trucks<br>• Expanding the LEVCF both in size and scope<br>• Providing up-front grants for low and zero-emissions trucks | • Support infrastructure investment in a domestic biofuels industry in New Zealand*<br>• Targeting infrastructure investment for alternative green fuels<br>• Supporting the development of fast-charging hubs |
| 2025-2030 | • Introduce renewable fuel targets<br>• Make diesel more expensive | • Refurbish used diesel trucks with zero-emissions options | |
| 2030-2035+ | | • Impose penalties on high GHG emitters<br>• Ban diesel trucks in certain cities<br>• A ban on registering heavy diesel vehicles | |

* The options with an asterisk beside them are from pathway one. The remaining options are from pathway two.

3.4

# Options considered, but not pursued

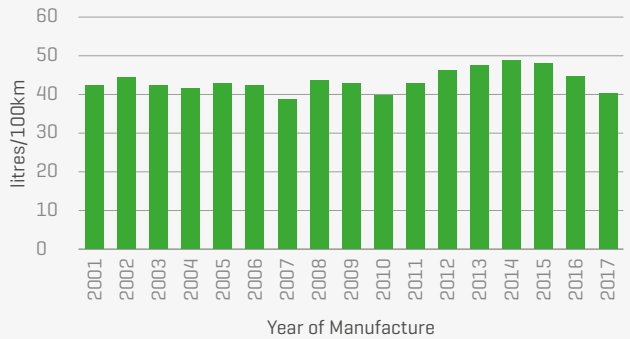
### Introducing a truck scrappage scheme or rolling age ban

There are two options that have been identified which, after some consideration, this paper does not suggest pursuing. This includes a *truck scrappage scheme* and a *rolling age ban for diesel trucks.* Previous experience in 2007 around a voluntary scrappage scheme for light vehicles saw only vehicles being brought forward that would have otherwise been scrapped anyway. This indicates that any scheme would need to be mandatory to get the desired vehicles off the road, imposing compliance and administration costs to monitor age and/or condition, and requiring funding to pay for vehicles brought forward. While there are strong benefits for safety, air quality and health that come from removing older diesel vehicles from the fleet, there are also challenges around what to do with scrapped vehicles, and who has responsibility for overseeing their sustainable disposal.

A rolling age ban on used trucks was also proposed in 2007 (but not implemented). The concerns raised were that it was too blunt a tool to ensure the right vehicles were both being kept out of New Zealand and let in. This was primarily down to the lack of evidence that age accurately correlates to fuel efficiency. As discussed above, there is evidence to suggest that diesel engine technology has reached its fuel efficiency potential, and that the fuel efficiency of trucks in on-road conditions has not improved significantly over the past 20 years.

Figure 16 below shows little difference in fuel efficiency of trucks in the New Zealand truck fleet manufactured over the past 17 years. The median GVM of all trucks in each year was around 24 tonnes.

**Fig 16.** Median fuel efficiency for New Zealand truck fleet by year of manufacture




3.5

# Where else could Government play a greater role?

### Greater collaboration with industry

This project has helped create visibility around options for the freight industry and uncover some of the key areas where industry and the Government could work together more closely. A greater role could exist for the Government to work alongside industry to put in place mechanisms to address challenges and opportunities. This could include working to put in place 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. Greater collaborative work programmes with groups like the Climate Leaders Coalition, Business Energy Council and Sustainable Business Council could be a good starting point.

### Implementing stricter Government third party contractor rules

The Government may also have the option to implement stricter third party contractor rules for organisations seeking Government contracts (e.g. organisations that deliver freight services for or on behalf of the Government). This could be based around the GHG (and potentially harmful) emissions profile of these companies, and could provide a preference for organisations who have emissions reduction initiatives in place or underway. This could be supported with *low and zero-emissions vehicle procurement practices* for the Government's vehicle fleet, to send the right signals and lead by example. An assessment would need to be made around the administrative and enforcement burden this approach could create, to ensure the benefits of such an approach outweigh the costs.

### Building understanding around funding support and priorities

Supporting companies to understand and access the funds available to support alternative green fuel options could be a potential role for the Government. For example, there are a number of funds across government agencies that have the potential to support alternative green fuel infrastructure development for heavy vehicles (as well as vehicle procurement and fuel trials). There is probably a need to take stock of these funds and to better understand whether barriers to accessing them exist.

Building visibility around available funds, and the impact they have had for early-movers, could also demonstrate how other freight companies could benefit from accessing them too. There are already a number of success stories from the LEVCF that could be given greater visibility, as well as the funding available and how to access it to. The same could be said for Green Investment Finance. This may be particularly important for the large number of smaller freight companies in New Zealand, without the resources to find and capitalise on opportunities, both domestically (through available funding and policy mechanisms) and internationally, as market opportunities arise. Working with existing bodies, like the Road Transport Forum, National Road Carriers, Automobile Association and Motor Industry Association (for example) to build this understanding could support faster industry uptake.

# Where to next?

This paper was produced to help inform the Government's strategic approach to reducing GHG emissions from road freight in New Zealand. There is more work to do to understand how to achieve this, including through mode-shift and improving freight operational models and efficiency. Alternative green fuels are only one piece of the solution.

This paper has not explored options to transition road freight vehicles under 3.5 tonnes (such as 'last mile' freight carried in vans and courier vehicles) to alternative green fuels. These vehicles form a critical part of the freight supply chain, and the Ministry needs to undertake more work to understand the contribution they could make to reducing GHG emissions.

The options outlined in this paper will also require further analysis to understand their potential economic, social and environmental impacts. To support this analysis, the Ministry may need to address some of the key gaps in the available data and research about New Zealand's road freight and transport GHG emissions.

The Ministry invites your views on how the options presented in this paper can assist with transitioning New Zealand's truck fleet to alternative green fuels. The Ministry is also interested in understanding your views on the level at which these options could be implemented, given the need for the transport sector to change the way it operates over the next 15 years. This will help the Ministry with future policy development and ensure that the Government receives the best possible advice on how to support the road freight industry to reduce its GHG emissions going forward.

Thank you for taking the time to read this strategic working paper. If you would like to share your views, please email the Green Freight project team @ **greenfreight@transport.govt.nz.**

## KEY TERMS USED THROUGHOUT THIS PAPER

**Advanced biofuels** – or 'second generation' or 'drop-in' biofuels, are liquid bio-hydrocarbons that are functionally equivalent to petroleum fuels and are fully compatible with existing petroleum infrastructure. They are produced using non-food crops, agricultural and forest residues (including waste materials, stalks of wheat and corn), and wood. Advanced biofuels require a different extraction process from conventional biofuels (defined below) because they are made from different feedstocks. Advanced biofuels can be blended with diesel, or used as a full replacement for diesel.

**Alternative green 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. This paper focuses on three low-carbon fuel options – electricity, green hydrogen and biofuels.

**Battery electric vehicles (BEVs)** – are purely electric vehicles that are only powered by batteries, which are charged by connecting to an external electricity source. In this paper we are referring to battery electric trucks when talking about BEVs.

**Biodiesel** – is a form of diesel derived from plants or animals and consisting of long-chain fatty acid esters.

**$CO_2$-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 $CO_2$ that would create the same amount of warming. Carbon dioxide ($CO_2$) is the baseline greenhouse gas that is used as a benchmark for other gasses.

**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.

**Diesel** – is a fossil fuel, which means that it is distilled from crude oil, or petroleum. It is the most commonly used fuel for trucks, boats, buses, trains, and heavy machinery.

**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. In this paper we are referring to fuel cell electric trucks when talking about FCEVs.

**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

**Freight task** – refers to the total amount of freight being transported across the country, and where it is moved. This can be broken down into mode and specific commodity types.

**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.

**Gross Vehicle Mass (GVM)** – this is the maximum operating weight of a vehicle as specified by the manufacturer. It includes all components of the vehicle, fuel and the cargo.

**Heavy trucks** – those weighing in excess of 10 tonnes (10,000 kg) GVM. In this paper, heavy trucks are used as a proxy for regional and inter-regional freight tasks.

**Life-cycle analysis** – evaluates the GHG emissions from a good or service over its full life-cycle e.g. the GHG emissions associated with raw material extraction, manufacturing or processing, transportation, use, and end-of-life management.

**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** – 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. In this paper, medium trucks are used as a proxy for urban freight delivery. This is because the majority of trucks under 10 tonnes are used in this capacity.

**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,[36] 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.

**Tonne kilometre (tonne-KM)** – a unit of measure of freight transport which represents the transport of one tonne of goods over a distance of one kilometre. It can be used to represent a number of different transport modes (road, rail, air, sea).

**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.

**Trucks** – includes all trucks weighing over 3.5 tonnes (3,500 kg) GVM. Trucks have been broken into "medium" and "heavy" in this paper.

**Vehicle kilometres travelled** – is the total kilometres travelled by motor vehicles during a given period.

**Zero-emissions** – refers to an engine, motor, process, or other energy source, that emits no atmospheric pollutants.

36. Recycled Carbon Fuels are produced from liquid or solid waste streams of non-renewable origin, including fossil waste such as plastics.

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