



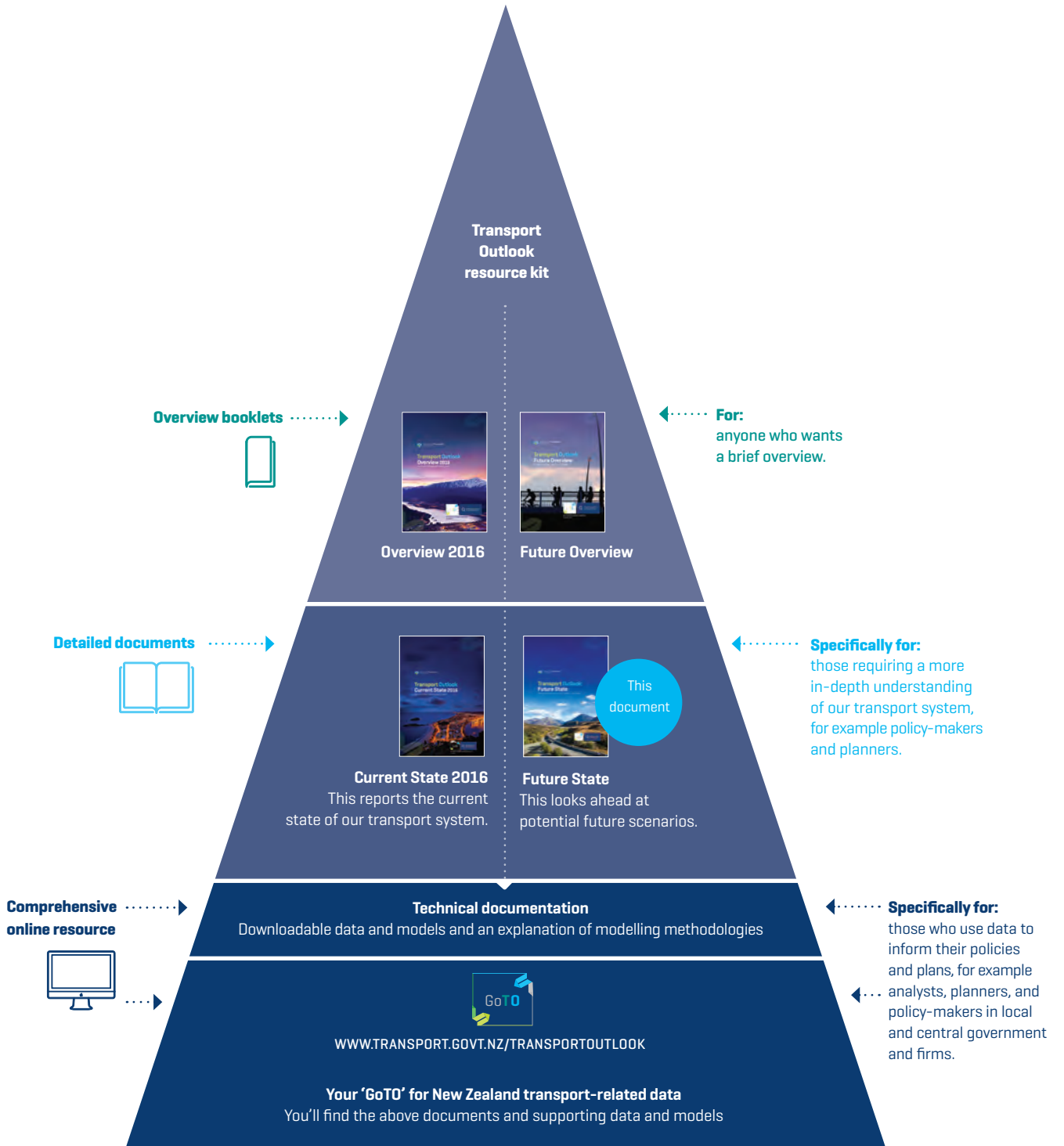
Transport Outlook: Future State

A starting discussion on the future of transport in New Zealand



[TRANSPORT.GOV.T.NZ/
TRANSPORTOUTLOOK](https://transport.govt.nz/transportoutlook)

Your 'GoTO' for future transport-related data
November 2017



Me mātau ki te whetū, i mua i te kōkiri o te haere*

*Before you set forth on a journey,
be sure you know the stars*

In the past, we referred to the stars to help show us the way.

Nowadays, we live in a world full of emerging technology – but knowing how to access the right data to help guide us forward is not easy.

This is why we have created this Transport Outlook.

It gathers, collates, and analyses different clusters of transport-related data to help us navigate where we should go.

We call this Transport Outlook our 'GoTO', as it will play an increasingly pivotal role in helping to steer the New Zealand transport sector forward.

* www.nzte.govt.nz/tools-and-templates/te-kete-tikanga-māori-māori-cultural-kit/whakatauki---proverbs



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Introduction

In this report we aim to start a discussion on our **future transport sector**. We discuss key trends and uncertainties in the sector and project outcomes over the next 25 years.

This report forms part of the Transport Outlook resource kit. The first publication, the *New Zealand Transport Outlook: Current State 2016* report, provides information on the current state of the transport system. This *Future State* report looks to the future and aims to provide an information resource for anyone who participates in the transport policy and planning process. It is intended to provide a base of common information, assumptions, and projections that others in the sector can use for future planning, policy-making, and investment.

This report is intended as a starting discussion for a continuing process of engagement with stakeholders and researchers, to lead to a better understanding of the future opportunities and choices that we face in the New Zealand transport sector. This report does not represent government policy proposals or plans.

Our discussion must be seen in the context of when we wrote this report in mid 2017 and the policies and conditions in place at the time. At the time of writing, New Zealand was experiencing generally favourable economic conditions, oil prices at close to US\$50/barrel, rapid growth in overseas visitor numbers, high levels of permanent and long-term arrivals, and the emergence of new technologies such as electric vehicles.

Much of the information used to form the baseline for our projections comes from the 2013 Census and other studies produced around that time. The end date for our projections is 2042/43.

We welcome your input

We intend to update this document every two to three years. In this first edition we have not been able to cover all aspects of the transport sector. In future editions we aim to widen our analysis to include areas such as tourism flows, traffic congestion, and other transport emissions. Please contact transportoutlook@transport.govt.nz with feedback and suggestions on how our models can be improved and what you may find useful in future editions.

Further information

Refer www.transport.govt.nz/transportoutlook for our models, model outputs, and documentation on the models.



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Your 'GoTO' for future transport-related data

Foreword

I am pleased to welcome the *New Zealand Transport Outlook: Future State* to the range of information sources about our transport system.

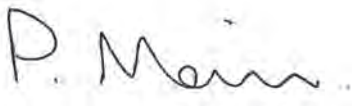


Our transport sector is experiencing a period of rapid technological change and is influenced by many uncertain factors such as consumer preferences and the future size and make-up of our population. The ways in which we travel and move our freight around the country constantly change and will no doubt look much different in 25 years.

That's why it's important to understand the drivers of change and what the future for transport may look like as we head into the mid 21st century.

This document aims to identify some of the key trends and uncertainties that will influence the development of the sector and to offer an initial set of alternative scenarios for how the future might unfold. However, this is just a start. There is no one view of the future but, rather, many possible outcomes. These outcomes will be influenced by changes in the policy environment and in society's expectations and behaviours.

Considering possible futures allows us to identify choices that we may need to make, opportunities that we might be able to capture, and policies that may be more suitable for the challenges ahead. I encourage you to contribute to the discussion on the future of our transport system.



Peter Mersi,
Chief Executive, Ministry of Transport



“I encourage you to **contribute** to the discussion on the future of our transport system.”

Key insights

In this document we project transport demand over the next 25 years for a base case and several alternative scenarios. Here are a few key insights that have emerged from our projections.



With New Zealand's increasing population, economic activity, international trade, and overseas visitor arrivals, there will be growing use of our ports, airports, road and rail networks, and urban public transport.



As our population ages, demand will increase for accessible public transport and safer roads. At the other end of the age spectrum, as fewer young people apply for a driver licence, there is likely to be increased demand for shared forms of mobility such as public transport and ride-sharing, as well as walking and cycling.



Increasing population concentration in the Auckland – Waikato – Bay of Plenty 'golden triangle' will put pressure on transport networks and the ability to move freight to and from the ports at Tauranga and Auckland. Delayed freight deliveries due to congestion could impact on business competitiveness. In Auckland, and possibly also Wellington, demand management road pricing may be a useful tool to reduce congestion.



Forms of urban living have an impact on transport. With the increasing popularity of inner-city living, demand for walking and cycling infrastructure and public transport will increase.



Improved information and communication technologies may allow more New Zealanders to live outside the main urban centres, changing regional travel and freight movement patterns.



New Zealanders are walking and cycling less. If this trend continues, reduced physical activity can cause more deaths and years of life lost.

If New Zealanders walk and cycle more, the positive health impacts are likely to far outweigh any negative safety impacts, especially given safety in numbers: as the numbers of pedestrians and cyclists increase relative to motor vehicles, this reduces the risk of collisions between vehicles and pedestrians and cyclists.



Private light vehicles are our most common form of transport. Almost 80% of household trips are made as a car driver or passenger. This mode is likely to experience the most significant change.

Electric vehicles (EVs) are expected to reach total ownership cost parity with conventional vehicles in the mid 2020s. EV numbers are then projected to rise to become a significant fraction of the vehicle fleet, over 40% in our Base Case projection by 2039/40.

Self-driving vehicles will enable vehicle-sharing services that offer the convenience of a fast-responding taxi service for less than the cost of owning a private vehicle. As New Zealanders increasingly use vehicle-sharing schemes, vehicle ownership is likely to shift to vehicle usership. Self-driving vehicles will also make transport more accessible for those who do not drive.



With more EVs in the vehicle fleet and more fuel-efficient conventional vehicles, road transport emissions are projected to fall. The Government has made an economy-wide commitment to reduce greenhouse gas emissions to 30% below 2005 levels by 2030. Although there is no specific target for road transport emissions, these emissions are not projected to fall 30% by 2030 under any of the scenarios examined here. Additional actions will be required if New Zealand were to target a 30% fall in road transport emissions by 2030.



Public transport as traditionally defined [scheduled buses, trains, and ferries] currently has a small share of all travel [3% of household trips]. Public transport use is projected to increase significantly, especially in Auckland, but its share will remain small [below 10%] in all of the scenarios examined here.



New forms of public transport may appear as new technologies enable shared mobility services such as ride-sharing and small bus services. Shared mobility services could reduce traffic congestion, environmental impacts, and user costs by increasing vehicle occupancy. Private operators could have a key role in providing these services.



Freight tonnage is projected to increase by 54% across all modes [road, rail, and coastal shipping]. Road freight is likely to slightly increase its dominant market share from 91% in 2012/13 to 93% in 2042/43 as the tonnage of some commodities carried by rail and coastal shipping grows only slowly.



Larger vessels visiting fewer ports may increase competition between ports and add to the need for investment in port infrastructure. This could increase pressure on road and rail networks to and from the ports as larger vessels load and unload. Freight may be moved longer distances by land to get to a port, compounding pressure on the road and rail networks.



Domestic passenger departures through our airports are projected to almost double to 23 million while overseas passenger departures are projected to increase from 6 million in 2015 to 15 million in 2042/43 as more international tourists visit and New Zealand residents make more trips. This massive growth will place pressure on airport infrastructure and on land access routes.

Summary

In this report we aim to start a discussion about how the transport sector in New Zealand may evolve over the next 25 years and to understand better the opportunities and choices that we may face.

We examine a base case and four alternative scenarios based on two of the most significant uncertainties for the transport sector: the rate at which New Zealanders adopt new technology and how they prefer to connect with each other.

B The Base Case

- The Base Case is a conservative scenario that assumes slow, non-disruptive technological changes and a continuation of current demographic and economic trends. It is an easy-to-understand scenario as not much new and unexpected has to happen to get us there.
- In the Base Case, population growth follows the Stats NZ medium projections, which sees New Zealand's population rising to 5.9 million by 2042/43¹, compared with about 4.7 million in 2016. Population growth is heavily focused on Auckland and the 'golden triangle' area that includes also Waikato and the Bay of Plenty. Economic growth follows the Treasury's long-term projections, averaging about 2.4% per year in real terms.
- Transport in 2042/43 is easier and more convenient but not much cheaper than today. Fully self-driving vehicles and vehicle-sharing services arrive later during this period. 20% of trips in private vehicles shift to vehicle-sharing by 2042/43. Electric vehicles are assumed to make up a significant share of the vehicle fleet by 2042/43.

Alternative scenarios for future transport demand

🎯 Staying Close to the Action

- The Staying Close to the Action scenario assumes the same population and economic growth as the Base Case.
- A key difference is that people tend to have a strong preference for connecting face to face, resulting in more people living in the central city or inner suburbs.
- Our main centres develop dense urban cores with major improvements in public transport and facilities for walking and cycling.
- It is also assumed that demand management road pricing has mostly eliminated traffic congestion in Auckland and Wellington.
- Technology advances at a moderate pace, with about 40% of private vehicle trips switching to vehicle-sharing by 2042/43.
- Demand management road pricing also provides a strong incentive to use public transport and ride-sharing services (sharing a vehicle with other passengers), as well as walking and cycling.



Less dispersed population growth

▲ Golden Triangle

- The Golden Triangle scenario assumes a more rapid rate of technology advance, resulting in higher economic growth than in the Base Case and the Staying Close to the Action and Metro-Connected scenarios. This would result in a tight labour market, which would tend to draw more people to New Zealand and keep New Zealanders at home.
- The population grows according to the Stats NZ high projections, rising to 6.7 million people by 2042/43.
- People tend to prefer to connect face to face.
- Many employers choose to locate in Auckland and the golden triangle, where they can be relatively close to customers, suppliers, and service providers.
- Population and economic growth are, therefore, concentrated in the golden triangle.
- As improved transport technologies, especially self-driving vehicles, make travel time more productive, employees are more willing to travel longer distances when they do travel to work.
- People are also more willing to live further from their employer and from each other. Sprawling suburbs emerge throughout the golden triangle. Suburban lifestyles are most popular.
- About 60% of private car trips switch to vehicle-sharing by 2042/43.





Metro-Connected

- The Metro-Connected scenario assumes that people prefer to connect using information and communication technologies (ICT) rather than face to face.
- Technology advances at a moderate pace, which means that employers can distribute their operations more widely, resulting in medium population and economic growth in all large towns and cities, not just in Auckland and the golden triangle.
- Most people still have to commute to work, although not necessarily on a daily basis.
- Nationally, population and economic growth are similar to the Base Case and the Staying Close to the Action scenario.
- Like the Staying Close to the Action scenario, about 40% of private car trips switch to vehicle-sharing by 2042/43.



@Home in Town and Country

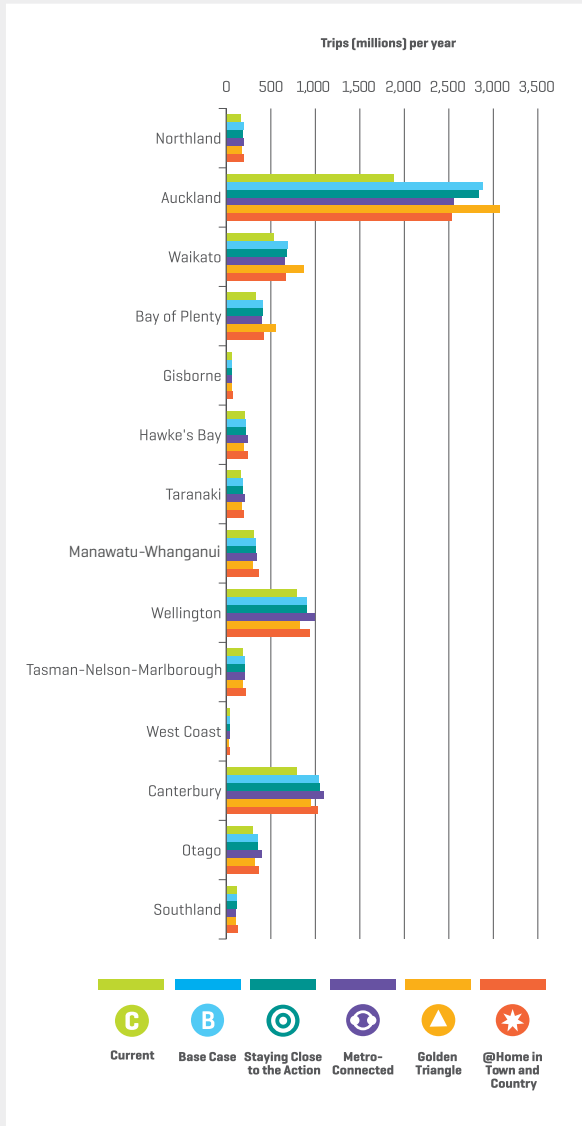
- The @Home in Town and Country scenario assumes the same rapid rate of technology advance and economic and population growth as in the Golden Triangle scenario.
- In this scenario, people tend to prefer to connect through ICT rather than face to face.
- Advances in ICT mean that some employers can offer many of their employees the ability to work from almost anywhere.
- Consequently, many people have more flexibility and choice about where they can work and live. The population spreads out across New Zealand.
- Many people are able to live almost anywhere, including on the fringes of the big cities, or in towns and rural areas.
- With the widespread availability of self-driving vehicles, accessible through a smartphone app, and fewer trips per capita, many people give up on vehicle ownership and rely on vehicle-sharing services. About 80% of private car trips switch to vehicle-sharing by 2042/43.



1 Financial years are used for some of our projections where baseline data is available for financial years

Household travel demand

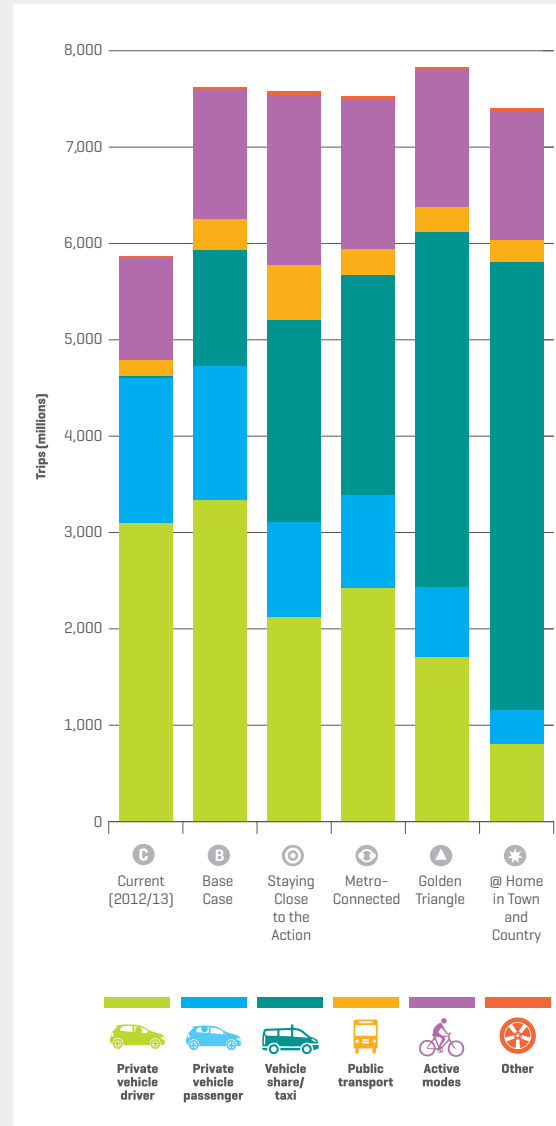
Projected number of trips by region in 2042/43



Differences in the number of trips between scenarios are not large.

- ▲ Population and economic growth are fastest in the Golden Triangle and @Home in Town and Country scenarios but rapid advances in ICT reduce the number of trips per capita as people are able to work and shop from home.
- ▲ The distribution of trips between regions does differ. The share of trips in Auckland, Waikato, and the Bay of Plenty is especially large in the Golden Triangle scenario.

Projected number of trips by mode in 2042/43



- ▲ By mode, vehicle-sharing services take the biggest share of travel in the scenarios with rapid technological advance [Golden Triangle and @Home in Town and Country] since they can use self-driving vehicles.
- ◎ Public transport takes a larger share in the Staying Close to the Action scenario, which assumes that demand management road pricing is introduced in Auckland and Wellington.



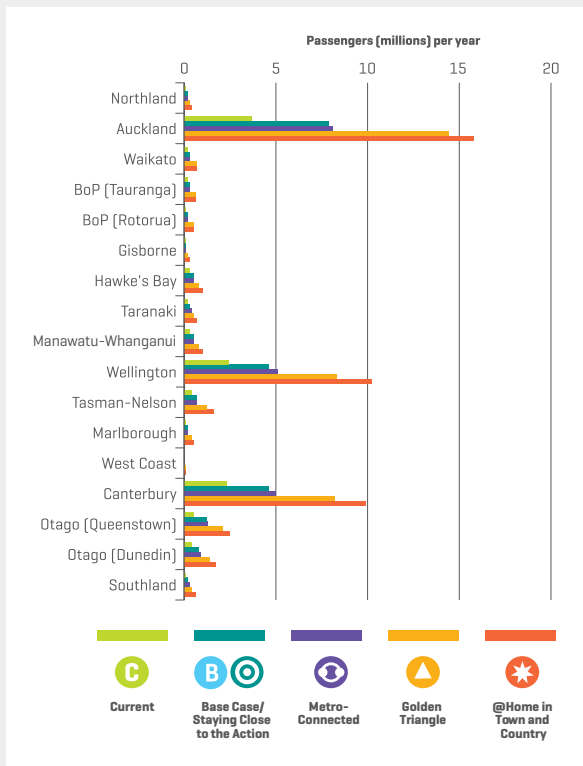
Air travel demand

Domestic passenger departures

- B** Under the Base Case and all alternative scenarios, air travel is projected to increase significantly as New Zealanders travel more domestically and on overseas trips, and as the number of overseas visitors increases.
- C** Under the Metro-Connected scenario, with its more dispersed population, an increase in domestic travel is projected compared with the Base Case as people travel more to connect with friends and family members and for occasional visits to their employers' head offices.
- A** Under the Golden Triangle and @Home in Town and Country scenarios, an even larger increase in domestic travel is projected as a result of faster population and economic growth.
- *** Under the @Home in Town and Country scenario, domestic air travel increases even more as technology allows New Zealanders greater freedom to live and work where they please, resulting in a more dispersed population.



Projected leg-based domestic departures by region of airport [2043]



B There is no difference in the level of air travel between the Base Case and Staying Close to the Action scenario as the only difference between the two is that, in the latter case, people prefer to live in the central city and inner suburbs.

International passenger departures

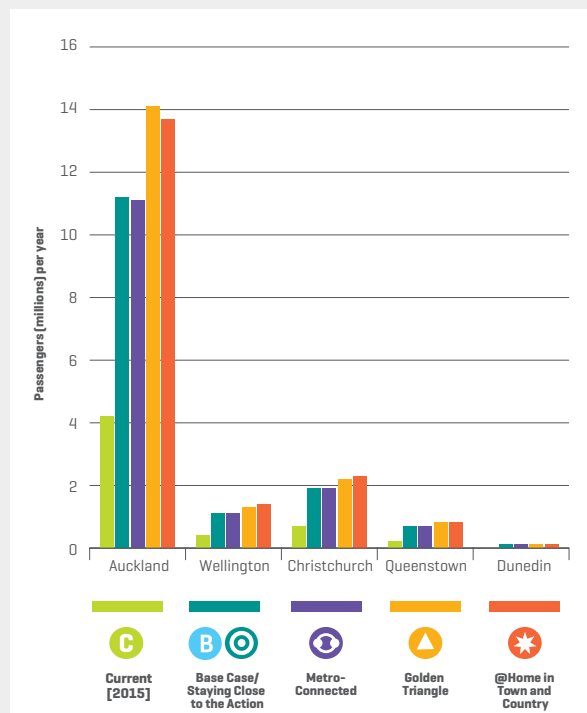
- B** International passenger departures through each international airport are projected to more than double from 2015 to 2043 in the Base Case and all alternative scenarios. This reflects increasing numbers of New Zealanders travelling abroad and increased numbers of overseas visitors.



Projected leg-based departures on international flights (million passengers per year excluding transit passengers) [2043]

C Current [2015]	5.6 million
B Base Case	
C Staying Close to the Action	14.9 million
C Metro-Connected	
A Golden Triangle	18.4 million
* @Home in Town and Country	

Projected leg-based departures on international flights by airport [2043]



Auckland's three-quarter share of international passengers is projected to remain roughly constant.

Freight

- B** Under the Base Case and all alternative scenarios freight tonnages are projected to increase.

Projected freight tonnage (million tonnes per year) [2042/43]

C Current (2015)	237 tonnes
B Base Case	
⊙ Staying Close to the Action	366 tonnes
⊕ Metro-Connected	
▲ Golden Triangle	442 tonnes
* @Home in Town and Country	443 tonnes

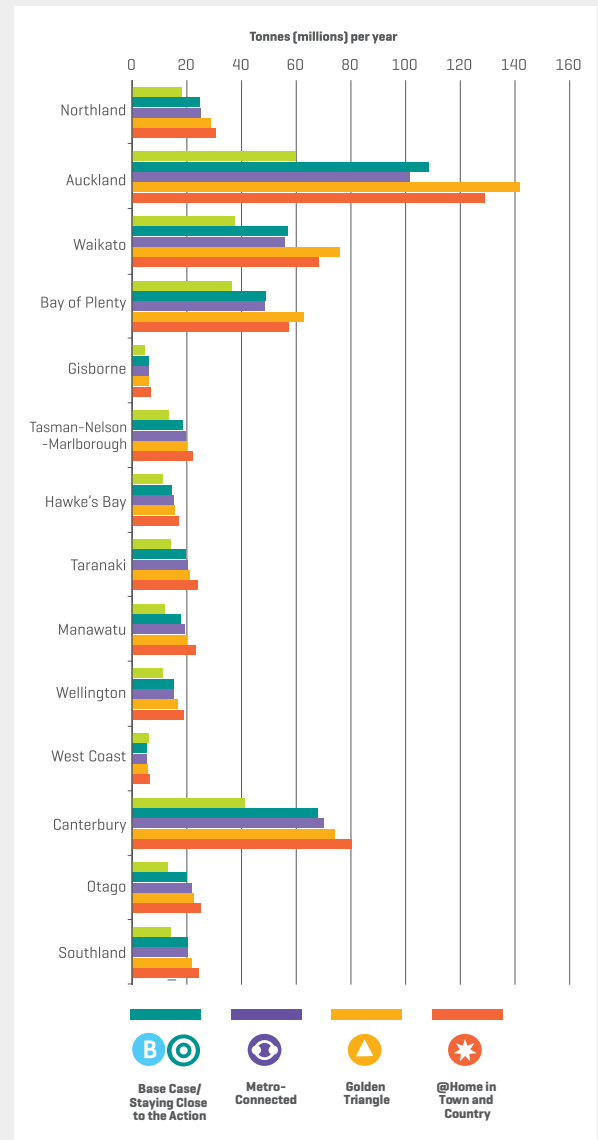
Freight tonnage carried by all modes is projected to increase. Road transport is projected to grow its dominant share of the freight market modestly, although this is largely due to lack of growth in two key commodities for the rail sector: logs and coal.



- *** Freight tonnage is projected to increase in all regions except for the West Coast. Tonnage is projected to fall on the West Coast, except in the @Home in Town and Country scenario. Much of this is due to stagnant or declining coal shipments.



Projected freight tonnage (2042/43)



- ⊙** The Staying Close to the Action scenario assumes the same level of economic and population growth by region as in the Base Case and has the same results for freight as in the Base Case.
- B**

Vehicle kilometres travelled (VKTs)

Projected growth

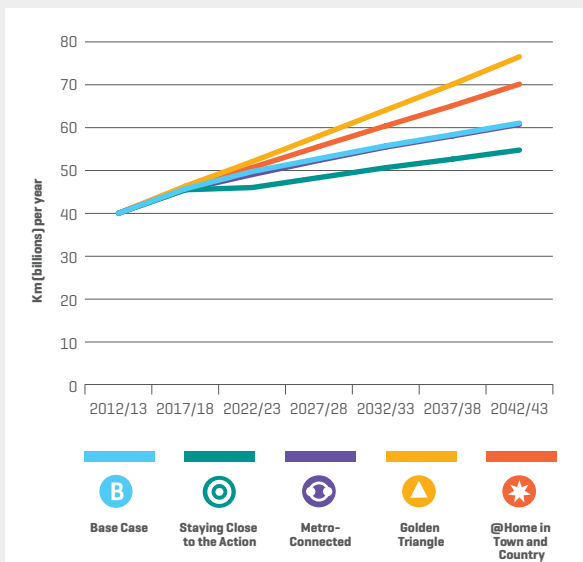


🎯 The lowest projected growth in VKTs is in the Staying Close to the Action scenario, reflecting population growth focused on the central city and inner suburbs and the impact of demand management road pricing in Auckland and Wellington.



▲ The highest projected growth in VKTs occurs in the Golden Triangle scenario due to sprawling land use in this scenario and faster population and economic growth.

Projected vehicle kilometres travelled



🅑 The Base Case and Metro-Connected scenario projections are almost identical.

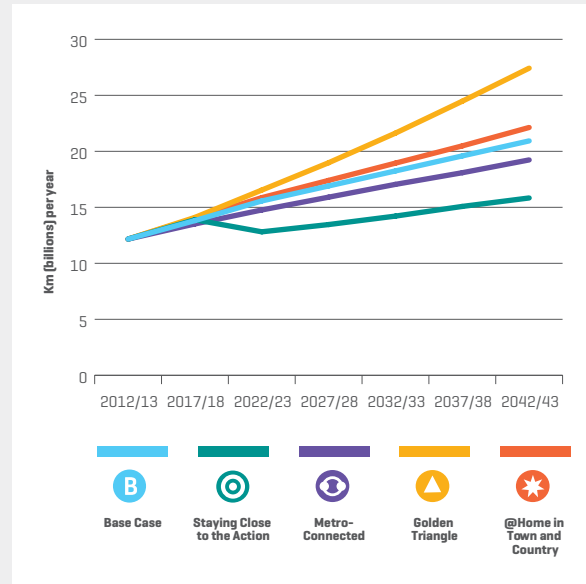
🎯 VKTs grow slowly initially in the Staying Close to the Action scenario due to the introduction of demand management road pricing in Auckland and Wellington.



Auckland VKTs

🎯 In Auckland the differences between scenarios are larger, reflecting mainly the impact of demand management road pricing in the Staying Close to the Action scenario.

Projected VKTs in Auckland



Greenhouse gas emissions from road transport

Electric vehicles

New electric vehicles are projected to reach total cost of ownership parity (vehicle cost, fuel, road user charges, repairs, and insurance) with conventional vehicles in the mid 2020s. After this, the number of electric vehicles is projected to increase significantly. However, because of the slow turnover of the vehicle fleet, the transition to electric vehicles will take time, especially given New Zealand's reliance on used vehicle imports.

- * The electric vehicle fleet is projected to grow fastest in the @Home in Town and Country and Golden Triangle scenarios that assume faster technology advance.



Projected emissions

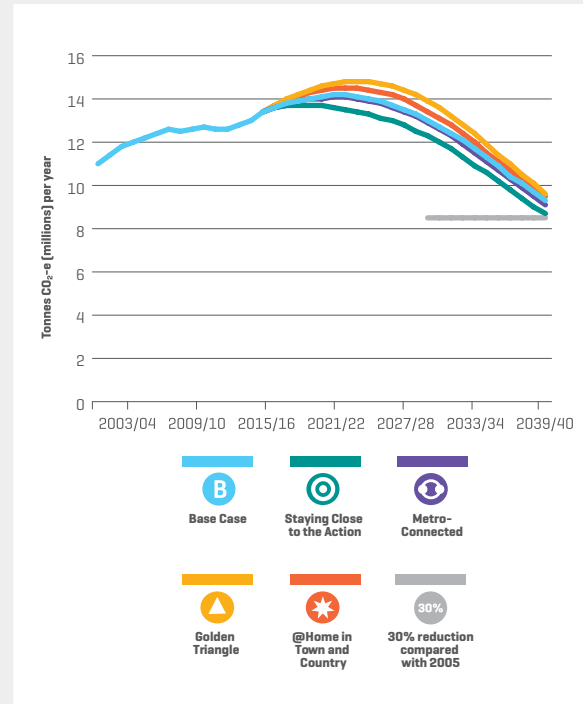
Under all scenarios, greenhouse gas emissions are projected to rise initially but then to fall below current levels. Projected emissions in 2039/40 are lowest in the Staying Close to the Action scenario due to lower VKTs in this scenario.

2016 Paris Agreement

Under the 2016 Paris Agreement, New Zealand has committed to a reduction in greenhouse gas emissions to 30% below 2005 levels by 2030. New Zealand has made no specific commitments with regard to reductions in greenhouse gas emissions in the transport sector. Emissions for transport alone would not achieve this 30% reduction by 2030 under any of the scenarios examined here, but there would be an approximate 30% reduction in road transport emissions by 2040 in the Staying Close to the Action scenario. Additional actions beyond the widespread uptake of electric vehicles would be required if New Zealand seeks a 30% reduction in road transport emissions by 2030.



Projected emissions by scenario



Definition
CO₂-equivalent [CO₂-e] is a measure of total greenhouse gas emissions obtained by converting the emission of all greenhouse gases into equivalent quantities of CO₂ based on their heat-trapping potential.



Setting the scene

There are many uncertainties about what our transport sector may look like in 25 years. Our goal here is to highlight some key trends [especially demographic and economic] that are emerging today and are likely to continue in the future, as well as some key uncertainties [especially technological and social] that could affect future outcomes.



Background information

Assumptions and methodologies

The assumptions and methodologies used to model the Base Case and the alternative scenarios are outlined in the **Model assumptions and methodologies** section on page 76.



Further information and detailed modelling results can be found on our website. www.transport.govt.nz/transportoutlook

Competing or complementary?

Information and communication technologies (ICT) could reduce overall demand for travel as New Zealanders increasingly work, shop, and socialise online. On the other hand, it is equally possible that ICT could increase travel demand as people might want to get out to meet people whom they get to know online while online shopping could provide a boost for local deliveries. For the purposes of this report we have assumed a net reduction in travel demand for those scenarios in which New Zealanders prefer to interact through ICT.



Accessibility

Physical transport is just one part of the access system. People travel because they want or need to access opportunities, but there are many options for how people choose to access things, for example by physical mobility, digital connectivity, and spatial proximity.

The Ministry is working on a project to explore the critical issues for providing access in the future, including the many factors that determine access and how decisions can be made now that will deliver positive future outcomes for New Zealanders.



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Future Demand

The scenarios presented here are an extension of the scenarios developed by the Ministry in 2014 in *Future Demand*. The *Future Demand* project looked at four scenarios to 2042 and their possible impact on travel.



It identified various plausible futures for our society and the demands placed on the transport system.

Future Demand assumed energy prices as a key uncertainty. We consider that recent advances in electric vehicle technology are making the future development of the transport sector much less sensitive to energy prices. Uncertainty is now mostly related to the speed with which electric vehicles and other alternative propulsion technologies are adopted.² At the same time, the potential for other types of disruptive technologies in the transport sector, especially self-driving vehicles, has increased. Therefore, we consider that a greater uncertainty is the speed with which new technology will be adopted in the future.

Compared with *Future Demand*, our scenarios tend to show more growth in transport demand with smaller differences between the scenarios. This primarily reflects the shift in focus from energy price to speed of technology adoption. In *Future Demand*, the impacts of rising energy prices could only reduce the demand for transport. In our scenarios, the impacts of improving technology may go either way, or even both ways at the same time.



www.transport.govt.nz/assets/Uploads/Our-Work/Documents/fd-final-report.pdf



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Projected scenarios

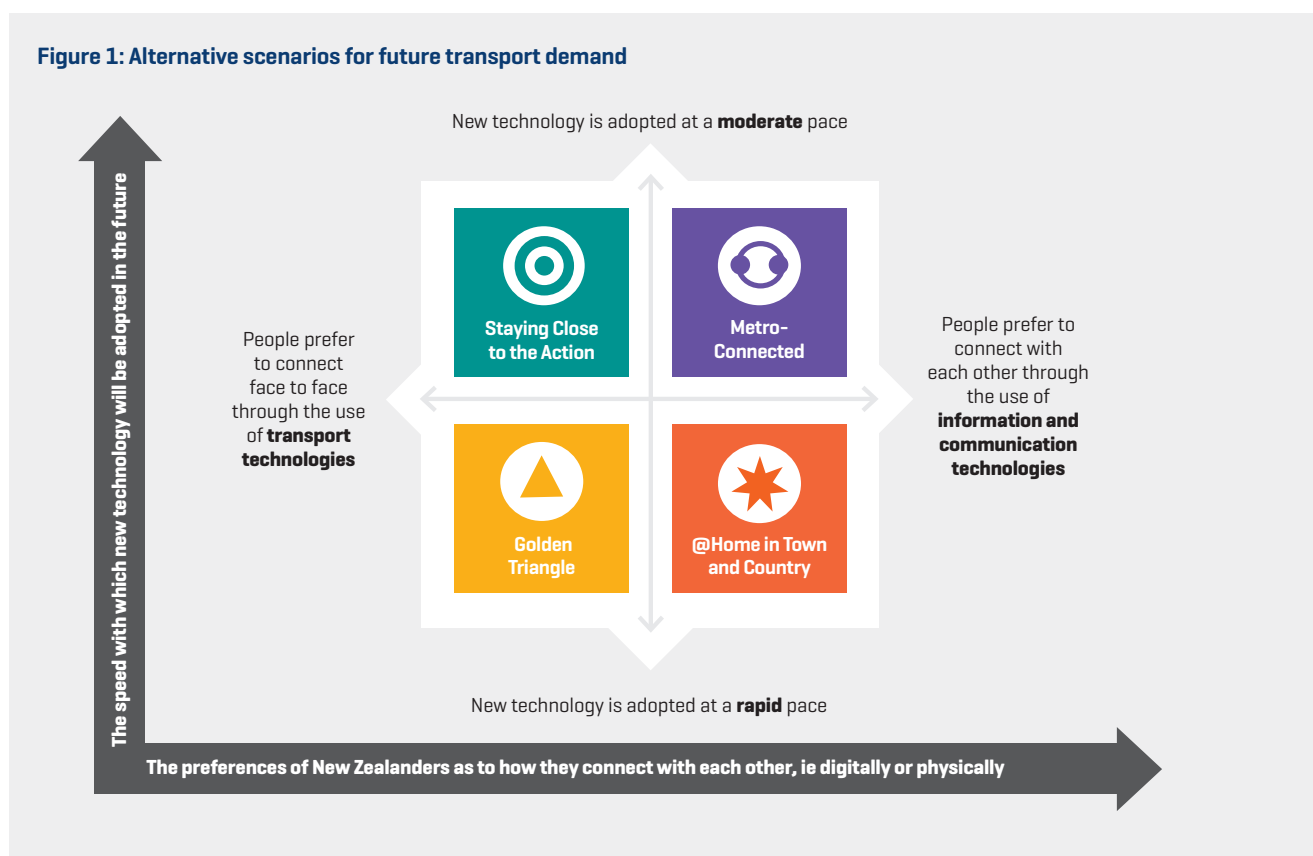
In this report we present projections of transport demand, transport greenhouse gas emissions, and health impacts. Although we also recognise the importance of transport safety, the uncertain impact of new safety technologies makes it challenging to model safety impacts.

We have projected a Base Case based on conservative assumptions that current trends and transport demand patterns will continue with slow, non-disruptive evolution of technology.

We consider the impact of more significant change by looking at a range of alternative scenarios arranged along two axes (shown below) that reflect what we see as the uncertainties most likely to have a significant impact on the future of the transport sector.

In choosing the uncertainties and scenarios on which to focus, we faced difficult choices as there are many other significant uncertainties and interesting alternative scenarios worthy of examination.

Figure 1: Alternative scenarios for future transport demand



Vertical axis: speed of technology adoption

On the vertical axis, there are advances in both transport technology and information and communication technologies (ICT). Historically³, ICT has advanced at a more rapid rate than the mechanical technologies that have been at the heart of the transport sector.

The speed of technology adoption is also a key driver of the speed of productivity improvement that influences the rate of economic growth.⁴ Economic growth is, in turn, a key driver of population growth, since a rapidly growing economy is likely to produce a tight labour market that will keep New Zealanders in New Zealand and create demand for skilled migrants.

Horizontal axis: communication preference

On the horizontal axis, a preference for face-to-face contact would make it likely that demand for transport would continue to grow, despite improvements in ICT. People and firms would likely prefer to locate close to one another. This suggests that population growth would continue to be focused on Auckland and the golden triangle area [Auckland, Waikato, and the Bay of Plenty].

On the other hand, a preference for contact through ICT would mean slower or even negative growth of per capita travel demand. People and firms would be more willing to locate further apart, and economic and population growth would be more dispersed around the country.

2 To see how much has changed, compare the 2014 and 2017 editions of the World Energy Council's *Energy Issues Monitor* (www.worldenergy.org/data/issues/)

3 For example, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0052669> and www.scientificamerican.com/article/moore-s-law-keeps-going-defying-expectations/

4 See speech by Peter Mersi, "Productivity and Economic Growth", 9 December 2005, www.treasury.govt.nz/publications/media-speeches/speeches/productivity-growth

Figure 2: Future scenarios in 2042/2043

Staying Close to the Action


By 2042/43:

- Transport is easy and convenient but not much cheaper than today.
- Technological developments in transport include autonomous vehicles, but their penetration is still relatively low.
- Many people with office jobs prefer face-to-face interactions at the workplace. Regular commuting remains the norm, although working a day or two a week from home is more common.
- Many employers prefer to locate in Auckland where they can be close to customers, suppliers, and service providers.
- Population growth concentrates in Auckland.
- Population growth focuses on the central city and inner suburbs. The central city offers shopping, services and entertainment, and many employment opportunities within walking distance.
- Demand management road pricing has mostly eliminated traffic congestion in Auckland and Wellington. Anyone wishing to use a vehicle on a road that would otherwise be congested must pay a fee, which varies by time and location, and is set automatically to whatever level is required to keep traffic flowing.
- Councils have improved facilities for pedestrians and cyclists.
- Public transport is now more commonly used, and integrated ticketing and scheduling have made things easy. Bus services have become considerably faster and more reliable with reduced road and motorway congestion. New types of bus services such as point-to-point shuttles and on-demand services are more common. Auckland has an extensive rail transit system that provides rapid access to almost all parts of the city.

International example

Many European cities, such as those in Germany and the Netherlands, have efficient public transport systems and facilities that promote the use of walking and cycling. A few cities, such as London and Stockholm, have implemented demand management road pricing, although none as technologically sophisticated as the one envisioned here.

"I've left my security pass at home. I'll pop home to get it now. Should be back in ten minutes."



Golden Triangle

By 2042/43:

- Transport is lower in cost than today and new technologies are widely used and make transport easier.
- Many employers choose to locate in the golden triangle (Auckland, Waikato, and the Bay of Plenty) where they can be relatively close to customers, suppliers, and service providers. Population and economic growth are, therefore, concentrated on the golden triangle.
- Employers and employees value face-to-face interactions, but this does not necessarily take place at a traditional office. As self-driving vehicles make travel time more productive and improving ICT makes regular commuting less common, employees are more willing to travel longer distances when they do travel to work. They are also more willing to live further from their employer and from each other. Sprawling suburbs have emerged throughout the golden triangle. Suburban lifestyles are most popular.
- Many vehicles are electric, which helps to mitigate the environmental impacts of this scenario. A downside is that, despite significant new infrastructure investment and relatively less travel during peak periods, traffic congestion remains a challenge.
- With the widespread availability of self-driving vehicles, many people have given up on vehicle ownership and rely instead on vehicle-sharing services that are now the dominant form of local travel. A vehicle can be hailed using a smartphone and will arrive in just a few minutes. Many people who used to have difficulty travelling on their own by car, such as teenagers, older people, and disabled people, find that self-driving vehicles open a whole new world of opportunities.
- Thanks to self-driving vehicles, transport is no longer seen as a stressful and time-consuming chore. People use this travel time to catch up on work or for relaxation or entertainment.

International example

The San Francisco Bay Area encompasses several major cities and many smaller suburban cities in between. Technology enables many people to work remotely, at least part of the time. Some large employers offer private bus services for their employees, which means that they can use their travel time more productively, while vehicle-sharing and ride-sharing schemes are also growing rapidly.

"I had a big breakfast at home in Thames this morning. Let's meet up for a light lunch on the North Shore."



“Probably working from home tomorrow. Will catch up with you later during the week when I’m in town for our team meeting.”

By 2042/43:

- Transport is easy and convenient but not much cheaper than today.
- There have been technological developments in transport, especially autonomous vehicles, but their penetration is still relatively low.
- A preference for business interaction through ICT means that employers can spread their operations across multiple locations to lower costs and to meet the lifestyle/location preferences of their employees.
- Employees still need to be able to access their place of employment. Regular commuting to work is common, but not necessarily on a daily basis.
- The population grows across New Zealand, but mostly in the larger towns and cities. Although Auckland continues to offer agglomeration benefits, other main centres grow at an equal rate.

- Within those larger towns and cities, people live in various locations: central city, inner or outer suburbs.
- Growth of travel is inhibited not just by cost, but also because New Zealanders prefer to interact through digital technologies, including online shopping and home deliveries.



International example

There has been a recent trend for large companies in the United States to spread their operations across multiple locations. Typically, senior managers and top technical talent are gravitating to the big cities, while supporting functions and middle managers relocate to cheaper locations.⁴

“Welcome to the firm. In our virtual reality conference, I can see the beach behind you. Where are you based?”

By 2042/43:

- Transport is lower in cost than today and new technologies are widely used and make transport easier. Advances in ICT mean that employers can offer many of their employees the ability to work from almost anywhere, where the nature of their work allows it.
- People have more flexibility and choice about where they can work and live. The ‘location’ of the employer’s head office has become less relevant.
- The population has spread out across New Zealand. Many people are able to live almost anywhere – on the fringes of the big cities, or in towns and rural areas.
- Working from home, or from almost anywhere, is now the norm for many people and having to commute to the office is a thing of the past.
- People travel less as they prefer to remain in touch with friends, family, and work colleagues through online technologies. They use online shopping more often.
- With the widespread availability of self-driving vehicles, which can be hailed using a phone app, many people have given up on vehicle ownership and instead rely on vehicle-sharing services.

- Public transport in the bigger cities remains popular on routes serving densely populated areas, but elsewhere traditional fixed-route public transport networks are unable to serve the dispersed population and face increased competition from vehicle-sharing alternatives. Public transport itself is morphing into a variety of shared mobility services.
- A more dispersed population means more frequent flights to regional centres, while the distribution of domestic freight (mostly retail goods) changes as the population is not as concentrated. Regional economies thrive. All this requires a shift in the focus of infrastructure investment, with relatively less spending in the main urban centres.



International example

This situation has not yet developed fully in any country. An emerging example can be seen with some large firms, particularly in North America, where staff members work from home across the country.



⁴ “Leaving for the City”, *The Economist*, 3 September 2016

Staying Close to the Action

Salesi and Melanie

Salesi enjoys life in downtown Auckland. The city centre has become transformed with apartments side by side with offices, shops, restaurants, and entertainment venues.

Salesi used to live in Kumeu, about 25 km from central Auckland. When he and Melanie decided to move in together, they chose to live in downtown Auckland to be in the middle of the action and close to their friends. Salesi hops on his bike and is at work in about ten minutes.

Melanie works part time in retail in central Auckland while she completes her studies in tourism and hospitality. Her work is just a quick bus trip away, although sometimes she uses a ride-sharing app on her smartphone. The car is waiting for her as she leaves her apartment block.

Melanie never felt the need to get her driver licence, while Salesi used to drive a car when he lived in Kumeu but switched to public transport when demand management road pricing came in. When he and Melanie were looking at places to live in central Auckland, they decided that they could do without a car. After all, it is so easy living in the central city without a car, and car-parking is so expensive.



Golden Triangle

Tamati and Miriama

Tamati, Miriama, and their family live in their tribal rohe not far from Hamilton. When Tamati was offered a promotion to head office in Auckland a few years beforehand, the decision to accept it was not at all difficult. Tamati's cousin had made the big move several years ago, which in those days meant having to shift his family to Auckland. On the other hand, when Tamati accepted the new job there was no need to relocate.

Tamati finds that the commute into Auckland is not as bad as it used to be. It is still a long trip but, if he takes a self-driving vehicle-share vehicle or the bus service provided by his firm, he can start work immediately. As the firm has spread out beyond Auckland, he works from the firm's office in Tauranga quite regularly. Sometimes he works from home and can still attend meetings by virtual reality.

Miriama is a home-care nurse and visits bed-ridden patients across the Waikato region. In her self-driving vehicle she can take the time to either rest or update her patient notes. She sometimes feels a little annoyed that her employer has come to expect her to work in the car.

Tamati and Miriama are happy that their children can enjoy a semi-rural lifestyle away from the noise and fast pace of the big city but still just down the road from Auckland airport for an occasional holiday escape.





Karen

Karen recently secured a role with an Auckland-based insurance firm opening up a new processing centre in Dunedin. The firm found that it did not need all its staff to be located in a single building in central Auckland, with the associated high costs. It found that it was able to recruit highly skilled staff members in other centres.

In fact, many years before, Dunedin had become New Zealand's first 'Gigatown'. This demonstrated that Dunedin could overcome distance barriers and connect easily with the rest of the country through high-speed digital technologies.

Many of Karen's colleagues work from home or other locations and visit the office every now and then. Technology means that everyone can be connected and working collaboratively, as if they're sitting side by side in the same office. As building manager, Karen needs to be on site most days. She lives with her mother on the outskirts of Dunedin and catches the bus into work, which is so much quicker now that the dedicated busway has been built. Her mother also takes the bus more often as improvements at the bus interchange have made it easier to get around in her wheelchair.

Karen is thinking about buying one of those new vehicles that drive themselves. Her neighbours have just bought one. However, Karen reckons it's not worth it just yet as she doesn't need to travel that much. She tends to do a lot of her personal business online, such as shopping and social networking.



Lydia and her children

Lydia and her son and daughter moved out of Wellington and relocated to Napier to be closer to family. Rents were also lower in Napier.

Lydia managed to find a job watering and looking after plants in commercial premises but her hours at the moment are only part time and she struggles to make ends meet. Things are looking up, though. She has signed up for a government-sponsored training scheme to learn how to maintain delivery robots used by businesses such as pizza restaurants. There is currently a shortage of these skills, so this training programme would put her in a position to get a much better job.

Lydia prefers to ride her electric bike to work and, when she's taking the family out, she'll order a car from a vehicle-sharing scheme. She needs to be careful with her money, but it doesn't cost too much, unlike when she lived in Wellington and had to maintain a car. She remembers the days of driving across Wellington on the congested roads taking her son and daughter to sporting events. She sold the car when she moved to Napier. When she needs to do a large supermarket shop, she'll use her smartphone to hail a self-driving courtesy van provided by a local shopping mall.



Economic Development and Transport

Economic Development and Transport, a 2014 Ministry project, looked at how our transport system can support New Zealand's economic development. A major product of the project was the Future Options for the New Zealand Economy (FONZE) model, which was used to look at seven possible economic futures for New Zealand.

The major conclusion is that investment in transport infrastructure will not on its own create economic growth in a region that is growing slowly (or is in decline). Instead, transport infrastructure investment decisions must be integrated with a region's development of its human capital and its opportunities for innovation, taking into account the importance of inter-regional linkages. Addressing bottlenecks that are hindering growth should be a priority, especially since the quality of transport links can make a region more competitive for attracting and retaining businesses compared with regions with poor quality links.



[www.transport.govt.nz/ourwork/
keystrategiesandplans/strategic-policy-
programme/economic-development/](http://www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/economic-development/)



Projected household travel

In this section we project how New Zealanders travel locally for daily activities such as work, education, and social activities.

We start by looking at key factors influencing household travel demand. They are the drivers of our model results discussed in the second part of this section.

For air travel between regions, refer to the Projected air travel section on page 45. We do not currently have reliable information to project personal travel between regions by road or rail but can provide projections of total road vehicle travel by type of vehicle by region. These projections are discussed in the Projected vehicle kilometres travelled section on page 66.



Factors influencing household travel demand

Technological advances

Many new technologies under development are likely to change local transport over the next 25 years. They include self-driving vehicles along with apps to match travellers with transport services in real time. The result may be a shift to 'mobility as a service', offering the convenience of private vehicle travel without the need to own a private vehicle or to be able to drive it.

The distinction between 'private', 'shared' and 'public' transport may be blurred. The future shape of 'public transport' could expand to cover any mode that a user can hire, purchase, or share, and not necessarily only from a public sector provider. Vehicle-sharing and ride-sharing fit this definition. In the future, high-frequency services may operate on fixed schedules, as they do today, while other services could be offered on demand using technologies such as a smartphone app.

Some public transport vehicles could become self-driving, making it more economical to operate smaller buses and shorter trains. Smaller buses could be used to serve markets where traditional public transport services may not be viable. These include not only smaller cities and less dense suburbs, but also new point-to-point express services, collector services serving major destinations such as large employers, hospitals and shopping malls, or services that feed into more traditional public transport services.

To avoid confusion, this report uses the term 'public transport' to refer to scheduled buses, trains, and ferries only.



Public Transport 2045

The Ministry's Public Transport 2045 project (PT 2045) considers implications for public transport of new technologies and business models as well as different patterns of urban development. A major conclusion of PT 2045 is that new technologies are enabling the definition of public transport to broaden to include a variety of shared-mobility services, such as ride-sharing and on-demand shuttle services. With the advent of self-driving vehicles, public transport as we know it today will be disrupted. Shared mobility services could complement conventional forms of public transport such as buses and trains, boosting patronage. Alternatively, new services could compete with public transport, leading to increased travel in individual vehicles and higher congestion.

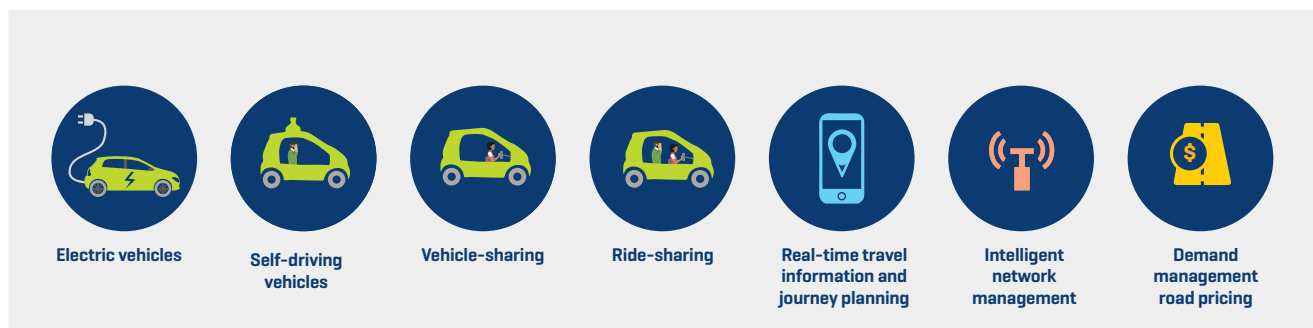
The scenarios used in PT 2045 explore different possible futures compared with the scenarios in this report, as they are based on different approaches. The scenarios used here project past and current trends forwards and consider how the adoption of new technologies and different social preferences for connecting could shape future pathways. In contrast, the PT 2045 scenarios explore the possibilities of much more dramatic disruption to transport and society, driven by emerging technologies. They consider more rapid changes to the vehicle fleet, travel preferences, and living patterns.

The PT 2045 project was under way at the same time as the modelling work for this report. In future editions of the *Transport Outlook: Future State*, we hope to integrate our modelling work more closely with the findings of the PT 2045 project.

 www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/



Emerging technologies in household transport



Electric vehicles

Electric vehicles are powered by electric batteries, some in combination with petrol or diesel engines. New Zealand is suited to the use of electric vehicles for a number of reasons.

- It is likely that an electric vehicle fleet could be powered primarily by renewable energy. In 2016, 88% of our power was generated by renewable sources.⁶
- On average, 95% of daily travel is for less than 120 km, which is generally within the range of today's electric vehicles; this range is likely to increase in the future.
- Electric vehicles can typically be charged at home. About 85% of homes have off-street parking, which makes it easy to plug in electric vehicles for charging overnight.⁷

The number of electric vehicles registered in New Zealand is small but growing rapidly. Toward the end of 2017 there were over 5,000 registered electric vehicles.⁸ There is a government target to increase this to 64,000 vehicles by 2021.⁹ Assumptions about electric vehicle uptake in later years are discussed in the section on **Projected vehicle fleet and transport greenhouse gas emissions** on page 70.



Self-driving vehicles

Autonomous vehicles (also known as driverless, automated, or self-driving vehicles) are able to operate without a driver. **Connected vehicles** communicate directly with road infrastructure, such as traffic signals and other vehicles. Autonomous vehicles and connected vehicles are not the same thing, and it is possible for a vehicle to be one but not the other. However, it is likely that the two technologies will co-evolve, since they can deliver maximum benefits by working together. Sufficient vehicles with both technologies could result in effective increases in road capacity and significant reductions in crashes, since each vehicle can instantly and appropriately respond to road conditions and the actions of surrounding vehicles.

There are various possible levels of vehicle automation, ranging from driver-assistance features that are already becoming common in high-end vehicles today through to full automation.¹⁰ In this report, we assume that self-driving vehicles are fully automated, that is no one in the vehicle is required to drive or even to know how to drive.

Self-driving vehicles are currently being developed and tested around the world. Opinions vary as to when they will be widely available.¹¹ For this reason, our scenarios make varying assumptions about how quickly self-driving vehicles will be adopted.

⁶ www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/new-zealand-energy-quarterly

⁷ www.transport.govt.nz/assets/Uploads/Our-Work/Documents/NZ-Electric-Vehicles-fact-sheet.pdf

⁸ Ministry of Transport

⁹ www.transport.govt.nz/ourwork/climatechange/electric-vehicles/

¹⁰ www.sae.org/misc/pdfs/automated_driving.pdf

¹¹ Refer to www.driverless-future.com/?page_id=384 for a list of forecasts as to when autonomous vehicles will be in use



Vehicle-sharing

Vehicle-sharing [not to be confused with ride-sharing discussed below] refers to the hire of a vehicle for a short time from a vehicle-sharing firm or an individual who wants to hire out his/her private car. Today, vehicle-sharing services already make vehicles available in designated locations where customers can pick them up and drop them off as required.

Self-driving vehicles could be a game-changer for vehicle-sharing. They could drive themselves to a customer's location on demand, becoming more like a taxi service. Once there are sufficient numbers of vehicle-sharing vehicles in operation, the response time could be very fast. With door-to-door service and no time spent searching for parking, overall trip times could often be shorter than in a private vehicle.

For many people, vehicle-sharing services using self-driving vehicles would be an attractive alternative to private vehicle ownership. The overall cost of using vehicle-sharing is likely to be significantly lower than the cost of owning a private vehicle, as there would be no cost for a driver, and the cost of owning and operating the vehicle could be spread across multiple users. Potential vehicle purchasers would need to weigh up the costs of purchasing, maintaining, and parking a vehicle against the advantages of ownership [including the psychological pride factor].

Reduced vehicle ownership would have significant urban planning implications. The need for parking spaces would decline significantly, offset somewhat by more demand for on-street drop-off points in urban centres. Houses could also be built without driveways or garages. However, vehicle-sharing alone would be unlikely to reduce the level of traffic, since the vehicle kilometres travelled would tend to shift from private vehicles to vehicle-share vehicles. In fact, vehicle-sharing with self-driving vehicles may increase traffic, since there will be additional empty vehicle trips to pick up passengers as well as additional trips by people who currently do not drive.



Ride-sharing

Ride-sharing offers cheaper, more environmentally friendly transport for people who are willing to share a vehicle with other passengers. It could also significantly reduce vehicle kilometres travelled and traffic congestion. For example, the results of the New Zealand Household Travel Survey suggest that average vehicle occupancy in Auckland is only about 1.5 passengers on an all-day basis, and only about 1.3 passengers in the morning peak period. If the all-day average could be increased to 2 passengers,

the impact would be to reduce overall vehicle kilometres travelled by about 18%. If the morning peak average could be increased to 2 passengers, the impact would be to reduce peak vehicle kilometres travelled by 25%.¹²

A downside of ride-sharing is that it may require a longer trip to pick up or drop off the other passengers. The result would be a service that, in terms of cost and convenience, sits between private vehicle travel [or private use of a vehicle-share vehicle] and fixed-route public transport.

Ride-sharing could be facilitated through smartphone apps that could match up people wishing to travel between roughly the same locations at roughly the same time, and could use either private vehicles or vehicle-share vehicles. However, vehicle-sharing services could easily add ride-sharing to their service offerings. For this reason, the growth of vehicle-sharing might also facilitate the growth of ride-sharing. However, we have conservatively assumed that ride-sharing becomes popular only in the Staying Close to the Action scenario where demand management road pricing in Auckland and Wellington would provide a strong financial incentive not to travel alone when roads are congested.



Real-time travel information and journey planning

Smartphone apps already provide information on road congestion and incidents, public transport journey planning, real-time arrival or departure times of the next bus or train, and available parking spaces and their cost. These services are likely to become better and more widely used over time.



Intelligent network management

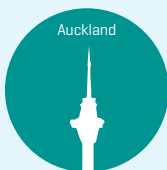
Intelligent network management tools include sensors to monitor traffic movements. They provide traffic managers with a real-time understanding of network use and the ability to intervene to manage travel demand in response to congestion or incidents.



Demand management road pricing

Demand management road pricing would take intelligent network management a step further, providing a financial incentive for vehicles to use less congested routes or to avoid travel at congested times. Vehicles would be charged for the use of roads that would otherwise be congested.

Shared mobility



The International Transport Forum (ITF) [part of the OECD] is carrying out a study on shared mobility in Auckland. This study examines the impact of replacing car and bus trips with fleets of shared taxis and taxi-buses offering ride-sharing services.



37% reduction in VKTs

34% reduction in emissions

This study is being carried out in other cities around the world and is based on a 2015 pilot study in Lisbon. That study showed a 37% reduction in VKTs and a 34% reduction in transport emissions.

 www.itf-oecd.org/sites/default/files/docs/shared-mobility-liveable-cities.pdf

At the time that this report was being finalised, ITF was finalising its study on Auckland.



Regulation 2025

The Ministry's *Regulation 2025* project considers the potential impact of technology on our transport system and the degree to which our society may be willing to adopt new technology. The project investigates whether our current regulatory system is appropriate or whether a new type of regulatory system would be required to respond to the future transport system. The project concludes that there may be a need for a new intermodal regulatory system in addition to the existing regulation. The current regulatory regime would continue to cover the physical aspects of transport while the new regime would cover the regulation of the 'intelligent' aspects of the new transport system.



www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/regulation-2025/



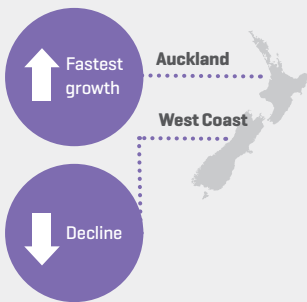
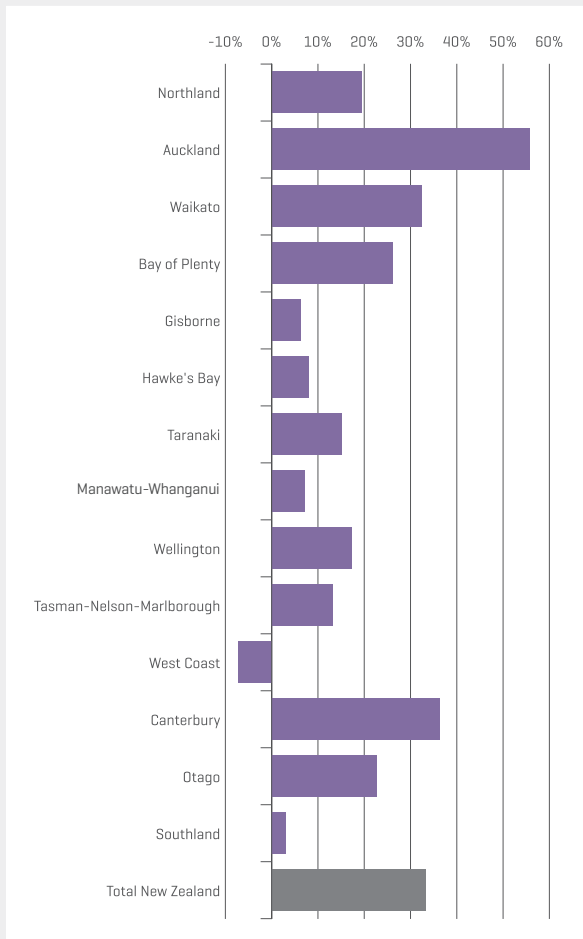
 Ministry of Transport
TE MANATŪ WAKĀ

Overview

Population growth

According to Stats NZ's medium projections, our population is projected to rise to 5.9 million by 2042/43 (compared with 4.7 million in 2016). A rise in population will tend to generate a corresponding increase in demand for transport.

Figure 3: Projected population growth by region (2012/13 to 2042/43)¹³

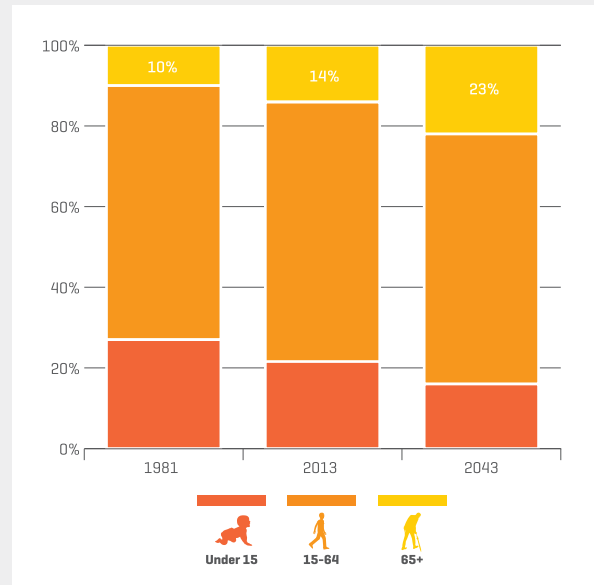


Regional population growth is projected to be highly correlated with urbanisation, with Auckland projected to grow the fastest and rural regions growing the slowest.



Ageing population

Figure 4: Proportion of the population in each age bracket¹⁴



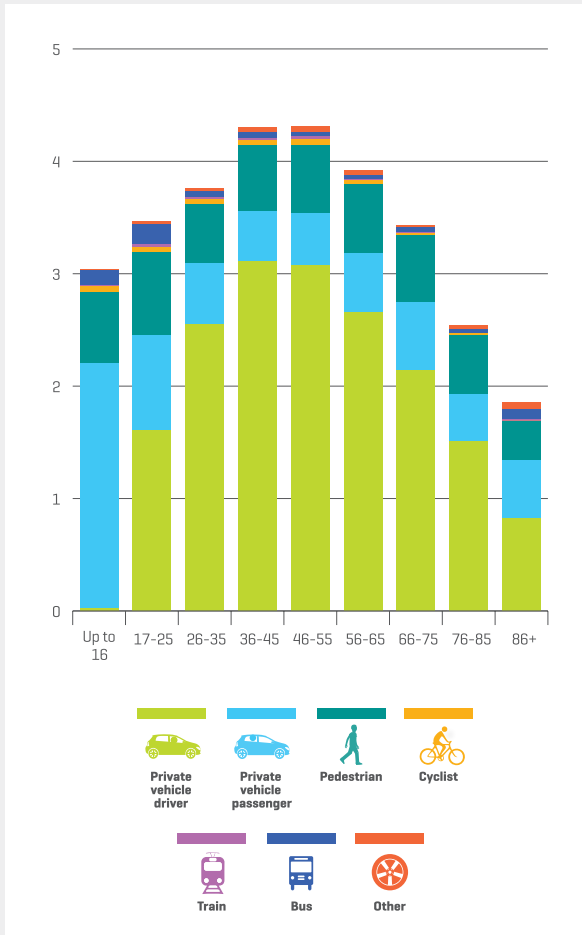
The proportion of New Zealanders aged 65+ is projected to grow from 14% in 2013 to 23% in 2043.¹⁵ This reflects the combined impact of New Zealanders having fewer children, longer life expectancy, and the large number of people born between the 1950s and early 1970s moving into older age brackets.

Older New Zealanders tend to live in secondary and minor urban areas¹⁶ as employment and commuting distance to work become less important.

For example, the regions with the lowest proportion of people aged 65+ are Auckland and Wellington, but the Kāpiti Coast district north of Wellington is the territorial authority with the second highest proportion of people aged 65+ (after Thames-Coromandel).¹⁷



Figure 5: Average daily trips per capita by age bracket (2011/14)¹⁸



Per capita travel demand is lower for the older age groups, especially for vehicle drivers. However, older New Zealanders are remaining active in the workforce for longer: 22% of the 65+ age group in 2013 compared with 11% in 2001.¹⁹ As a result, their demand for travel per capita may increase over time.

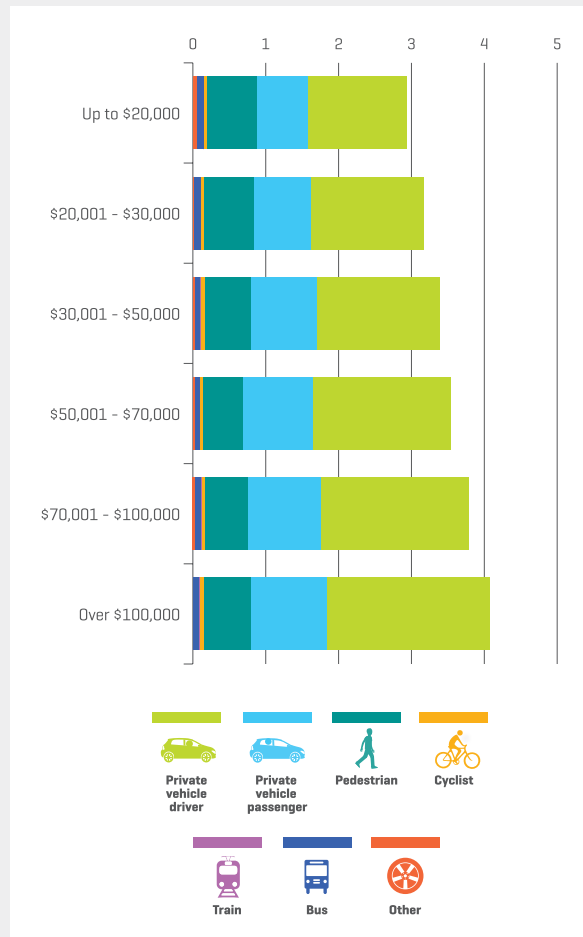


Growing incomes

Increasing household travel is correlated with increasing household incomes, especially as a driver or passenger. The relationship for other modes is less clear although bus travel tends to decline with increasing household income, but not train travel.



Figure 6: Average daily trips per capita [all ages] by household income class (2011/14)²⁰



This figure does not include trips where household income is unknown.

13 www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/SubnationalPopulationProjections_HOTP2013base-2043.aspx [medium projection]

14 www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/qstats-65-plus-infographic.aspx [for 1981 and 2013] and <http://nzdotstat.stats.govt.nz/wbos/index.aspx>, National population projections, by age and sex, 2016[base]-2068, 50th percentile projection [for 2043]

15 www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/qstats-65-plus-infographic.aspx [for 2013] and <http://nzdotstat.stats.govt.nz/wbos/index.aspx>, National population projections, by age and sex, 2016[base]-2068, 50th percentile projection [for 2043]

16 For a definition, refer www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/urban-area/definition.aspx

17 www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-65-plus/geog-location.aspx

18 Ministry of Transport analysis based on data from the New Zealand Household Travel Survey for 2011/12, 2012/13, and 2013/14

19 www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-65-plus/work-unpaid-activities.aspx

20 Ministry of Transport analysis based on data from the New Zealand Household Travel Survey for 2011/12, 2012/13, and 2013/14

Transport and young adults²¹

International literature suggests a trend for increased public transport use and less car travel among young adults. There could be various reasons for this.²²

- More time spent in education delays the entry of young people into the workforce and their ability to afford a car. It also means that they may start their families later, making access to a car less pressing.
- The need for car ownership, or transport in general, may be reduced with the rise of online services.
- Relatively lower or less steady incomes and/or higher rates of unemployment among young people limit travel budgets and make public transport a more attractive option.
- With increased inner-city living, many facilities are within walking distance. Restrictions on inner-city parking and city design make walking and cycling safer and more appealing.
- Travelling by public transport and active modes has gained greater social acceptability, offering benefits in terms of both healthier lifestyles and lower environmental impact, while the frequency and quality of public transport services have improved. Access to technologies to assist with travel planning, real-time information, and smart ticketing options has made public transport easier, particularly among inexperienced users.

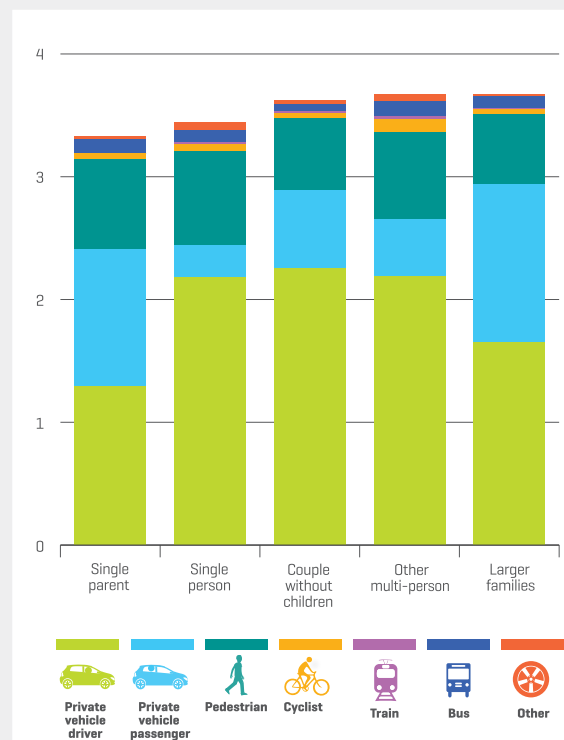


If these travel preferences persist as today's young people grow older, then there is likely to be a corresponding ongoing shift in transport demand toward greater use of public transport and active modes.

Household type

Single-person and single-parent households have lower demand for transport than other household types, as well as differing mode shares. In particular, single-parent households have a significantly smaller share of travel per capita as vehicle drivers, mainly because a larger share of the people in single-parent households (over 50%) are children. Single-person and single-parent households also tend to have lower per capita incomes than other household types, which may explain some of their differing travel behaviour. Given that Stats NZ projects that single-person households will be the fastest growing household type to 2038, this may slow the growth in household transport demand.²³

Figure 7: Average daily trips per capita (all ages) by household type [2011/14]²⁴



Definitions:

'Single parent' refers to single parents living with children.

'Other multi-person' refers to situations such as flatmates who live together without being in a relationship.

'Larger families' refers mainly to couples with children.



Vehicle ownership

People in households that do not own a vehicle walk, cycle, and use public transport more. Transport demand for all modes combined is higher in households that own vehicles, with people in two-vehicle households making almost 60% more trips per capita by all modes combined than people in non-vehicle owning households.



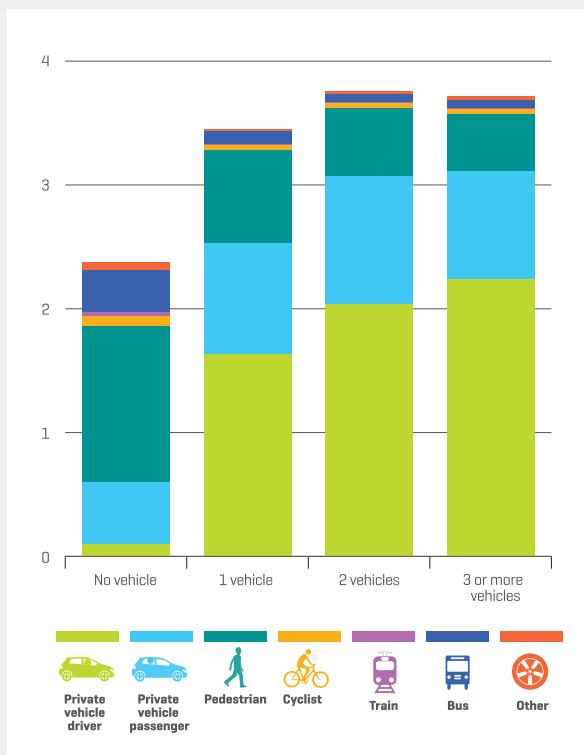
It is not clear whether people tend to travel more because they own a vehicle or whether they are more likely to own a vehicle because they travel more. Both effects are likely to be at work. We assume that vehicle ownership does influence transport demand. Therefore, if vehicle ownership rates rise, this will tend to push up demand, especially for car travel.



Vehicle ownership is influenced by other demographic and social characteristics, mainly household income, age, household type and region. Household income is especially significant. As household income rises over time, vehicle ownership rates tend to rise as well. This may help to explain why household transport demand increases with income [refer **Growing incomes** on page 27].

If vehicle-sharing services in the future are able to offer the same convenience as vehicle ownership to people in households that do not own a vehicle, or the convenience of owning two vehicles to couples that own only one vehicle, such services are likely to boost demand for travel among people in these households.

Figure 8: Average daily trips per capita [all ages] by number of vehicles in household [2011/14]²⁵



The most daily trips per capita are made by people in households that own two vehicles. Two-vehicle households are now the most common form of household in New Zealand.

Urban design

International evidence demonstrates that urban design can have a strong influence on transport demand and vehicle ownership. Cities that are designed in a way that makes public transport and active modes easy to use will tend to have larger mode shares for public transport and/or active modes.²⁶

In New Zealand, residents in central Auckland and Wellington are more likely to walk and less likely to drive or own a vehicle than residents in other parts of the cities.²⁷



21 Further information on Generation Y travel can be found at https://ourarchive.otago.ac.nz/bitstream/handle/10523/5642/Hopkins%26Stephenson_2015_GenYMobilities_Highlights.pdf?sequence=1&isAllowed=y and www.nzta.govt.nz/resources/research/reports/569/

22 Rive G, Thomas J, Jones C, Frith B, and Chang J [2015] 'Public transport and the next generation' (www.nzta.govt.nz/assets/resources/research/reports/569/docs/569.pdf)

23 <http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE8011>

24 Ministry analysis based on data from the New Zealand Household Travel Survey for 2011/12, 2012/13, and 2013/14

25 Ministry analysis based on data from the New Zealand Household Travel Survey for 2011/12, 2012/13, and 2013/14

26 For example <https://files.isecities.net/files/2014/11/LSE-Cities-2014-Transport-and-Urban-Form-NCE-Cities-Paper-03.pdf> and Reid Ewing et al, "Growing Cooler: The Evidence on Urban Development and Climate Change", 2008

27 Carolyn O'Fallon and Ian Wallis, "Living in intensified urban environments: residential self-selection and travel behaviour", NZ Transport Agency research report 468, January 2012

Projected household travel

B Base Case

We have projected household travel to 2042/43 based on travel patterns in the New Zealand Household Travel Survey. The Base Case assumes the continuation of current demographic and economic trends, current transport demand patterns, and slow, non-disruptive evolution of technology. For public transport in Auckland and Wellington, we have used projections from Auckland Transport and the Greater Wellington Regional Council. These reflect the impact of public transport improvements that are already under way, including the City Rail Link in Auckland.

The Base Case assumes a 20% shift of trips and distance travelled to vehicle share by private vehicle drivers and private vehicle passengers by 2042/43, which we consider to be a slow and non-disruptive level of change over 25 years. The alternative scenarios all assume larger shifts to vehicle share.

B Figure 9: Base Case: projected annual trips per capita [all ages] before and after shift to vehicle share

	2012/13	2042/43 before shift to vehicle share	2042/43 after shift to vehicle share
Private vehicle driver	697	704	564
Private vehicle passenger	341	292	234
Vehicle share			199
Pedestrian	222	211	211
Cyclist	16	14	14
Bus	30	42	42
Train	5	11	11
Ferry	1	1	1
Motorcycle	4	4	4
Taxi	4	5	5
Other	2	3	3
TOTAL	1,322	1,287	1,287

To show where demographics and economics alone might take demand for transport, this figure shows demand for travel before and after taking into account a 20% shift to vehicle share by private vehicle drivers and passengers. Numbers may not sum due to rounding.

While self-driving vehicles mean that in the future 'private vehicle drivers' may no longer be driving a vehicle, we continue to consider the first person in a vehicle as the driver, separate from passengers.

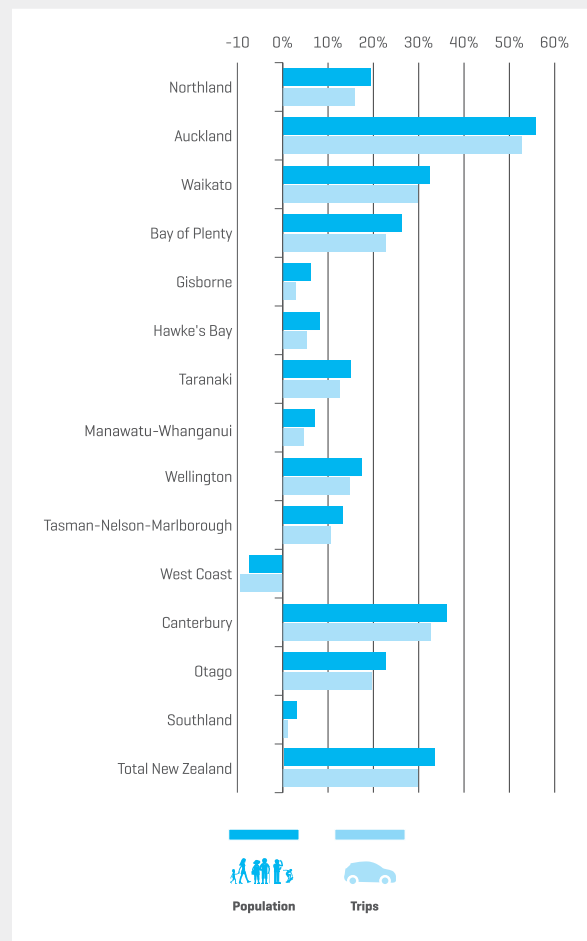


Before the shift to vehicle share, demographics and economics alone would cause the total number of trips per capita to fall slightly between 2012/13 and 2042/43. Trips per capita on public transport [bus and rail] increase significantly, primarily a result of increased patronage in Auckland. Trips per capita as private vehicle passengers decline significantly, due mostly to a reduction in the proportion of children in the population, since children are the most frequent private vehicle passengers.



Trips by region

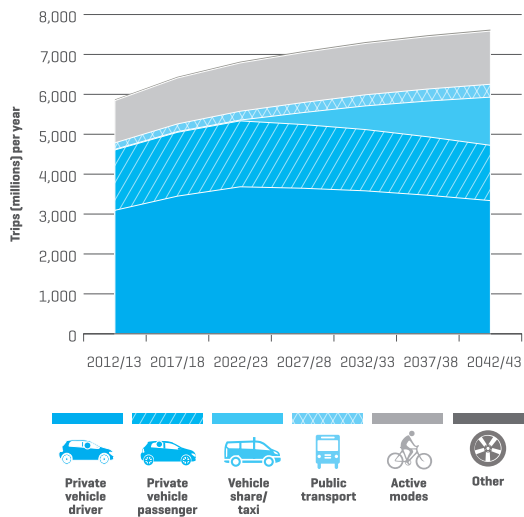
B Figure 10: Base Case: projected change in regional population and number of trips [2012/13 to 2042/43]



In the Base Case, the projected change in the number of trips in each region is slightly lower than the projected growth of the population in each region, consistent with the slight decline in trips per capita as shown in Figure 9. Stats NZ's projections of population growth in each region are very strongly correlated with the degree of urbanisation. As a result, growth in trips is also strongly correlated with urbanisation.

Trips by mode

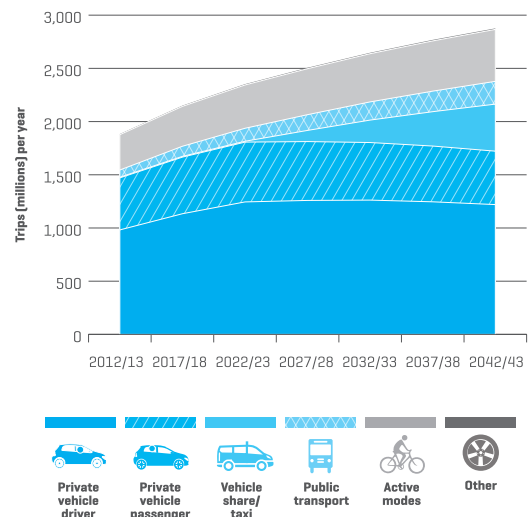
B Figure 11: Base Case: projected number of trips by mode



Active modes combine walking and cycling. Other modes include travel by horse, mobility scooter etc.

- Despite slightly reduced trips per capita [Figure 9], population growth means a projected increase in trips by all modes: a 30% increase from 5.9 billion trips in 2012/13 to 7.6 billion trips in 2042/43.
- Public transport trips roughly double but, as they start from a small share, they still account for only 4% of trips by 2042/43.
- Walking and cycling increase by about 25%, while cycling trips increase by about 20%.

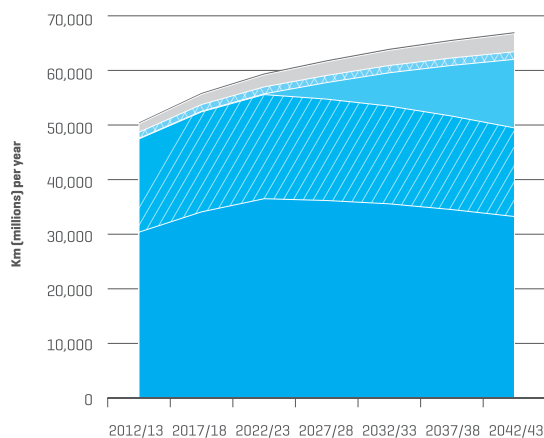
B Figure 12: Base Case: projected number of trips by mode in Auckland



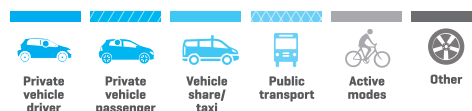
- Auckland is projected to account for more than half [57%] of the increase in the number of trips. This largely reflects its projected share of national population growth.
- The use of public transport in Auckland increases by 210%, and grows from 4% of all trips in 2012/13 to 7% in 2042/43.
- Walking and cycling trips both increase by almost 50%.

Distance travelled

B Figure 13: Base Case: projected distance travelled by mode



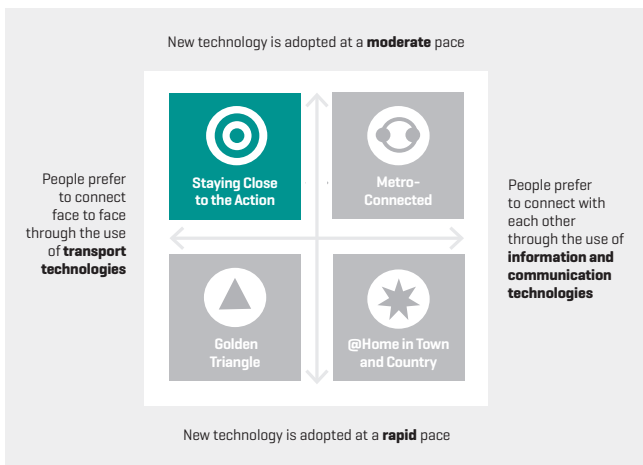
- Distance travelled is projected to increase by 33% [excluding the distance travelled by ferry as this information is not collected], compared with a 30% increase in the number of trips.
- The distance travelled by public transport increases by over 110%.
- Distance walked increases by about 20%, while distance cycled increases by about 40%. The number of cycling trips grows fastest in Auckland, which has an unusually long cycling trip length: 7.9 kilometres vs a national average of 4.4 kilometres in 2012/13.



Alternative scenarios

The scenarios consider different levels and regional patterns of population and economic growth, as well as the introduction of new technologies and changes in travel preferences.

Staying Close to the Action



Under this scenario, regional populations remain the same as in the Base Case but more people in the main centres prefer to live in the central city and inner suburbs. This desire for a more urban, less car-dependent lifestyle is also assumed to be reflected in urban planning policies.

Initial model projections for average trip length, based on demographic and economic change alone, are adjusted downward by 10% in Auckland and 5% in Wellington by 2042/43 to reflect denser future urban development. Initial model projections for walking are adjusted upward by 30%, and for cycling by 200%, to reflect better facilities for walking and cycling, and more walking- and cycle-friendly urban design.



Regular commuting remains the norm, although initial model projections for per capita work trips are

reduced by 10%, and per capita non-work trips by 5%. These are modest reductions that reflect technological advances that allow some people to work from home or from other locations of their choice. The adoption of self-driving vehicles is assumed to allow 40% of travel by private vehicle across New Zealand to shift to vehicle-sharing schemes by 2042/43, with this shift starting in 2027/28 when self-driving vehicles are assumed to start to appear in large numbers.

Demand management road pricing starting in 2022/23 largely eliminates congestion in Auckland and Wellington. It is assumed that vehicle kilometres travelled [VKTs] in Auckland in 2022/23 will fall by about 17% compared with the Base Case. After this, VKTs grow by 1% per year, reflecting increases in road capacity.

The increases in road capacity may reflect either new road infrastructure construction or new technology, such as self-driving vehicles, allowing greater capacity on existing infrastructure. A 17% reduction in VKTs is an average across all roads at all times, although demand management road pricing applies only to certain roads and at times when there would otherwise be congestion. This is likely to be a minority of roads and mainly during peak hours; the reduction in VKTs on these otherwise congested roads at congested times is likely to be considerably larger than 17%.

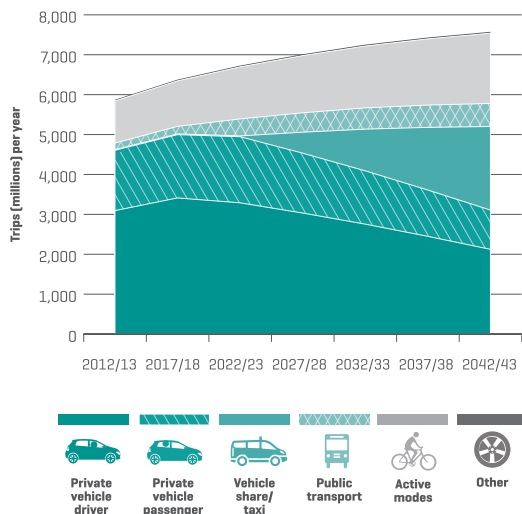


In Wellington, the corresponding figures are a VKT reduction in 2022/23 of about 15%, and growth in VKTs by about 1% per year after that. The VKT reduction is lower in Wellington which is not initially as congested as Auckland. The lower subsequent growth in VKTs reflects lower infrastructure investment due to slower population growth.

Cities that have implemented demand management road pricing so far, which include several European cities and Singapore, are all relatively compact and had an already high public transport mode share when road pricing was started. Demand management road pricing has not yet been tried in a sprawling, car-oriented city like Auckland. Therefore, we have no hard data to draw on as to how travellers might respond. There are likely to be many people for whom public transport might not be a satisfactory alternative to driving a car. We assume that, in Auckland and Wellington, ride-sharing would become a popular alternative to driving alone. Many former drivers would become a passenger in another driver's car, which could be either a private vehicle or a vehicle-share vehicle. We assume that entrepreneurs would create apps and other services to match up drivers and passengers. Given that the average vehicle occupancy in Auckland is only 1.5 passengers, and only 1.3 passengers during the morning peak, the potential passenger-carrying capacity of ride-sharing in Auckland would be huge.²⁸

We have assumed that 45% of drivers in Auckland and Wellington who choose not to drive due to demand management road pricing, along with their accompanying passengers, will shift to ride-sharing. The remaining diverted drivers and accompanying passengers would switch to travel by bus [40%], rail [10%], walking [3%], or cycling [2%]. Although demand management road pricing would make driving alone considerably more expensive, especially during peak hours, travel times and travel time reliability should improve significantly for those travelling by car (including ride-sharing) or bus. Therefore, we assume no overall decrease in travel demand due to demand management road pricing.

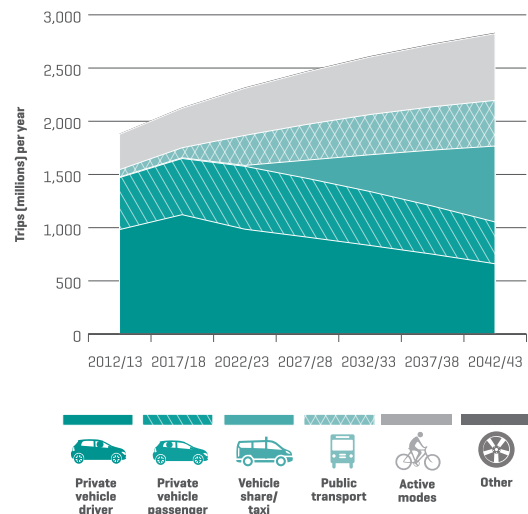
Figure 14: Staying Close to the Action scenario: projected number of trips by mode



- Trips by all modes are projected to increase by about 30%, from 5.9 billion trips in 2012/13 to 7.6 billion trips in 2042/43, very similar to the Base Case.
- Public transport trips increase by about **260%**, compared with about 100% in the Base Case, with most of the increase in Auckland and Wellington. By 2042/43 public transport accounts for 8% of all trips, compared with 4% in the Base Case.
- Walking trips increase by about 50%, compared with about 25% in the Base Case.
- Cycling trips increase by about 250%, compared with about 20% in the Base Case.



Figure 15: Staying Close to the Action scenario: projected number of trips by mode in Auckland



- In Auckland, trips by all modes are projected to increase by about 50%, an increase from 1.9 billion trips in 2012/13 to 2.8 billion trips in 2042/43, slightly less than the Base Case increase to 2.9 billion trips.
- The share of public transport is projected to rise with the introduction of demand management road pricing in 2022/23. Public transport trips increase by about **530%**, compared with about 210% in the Base Case. By 2042/43 public transport accounts for 15% of all trips, compared with 7% in the Base Case.
- There is also a parallel shift of vehicle drivers to vehicle passengers (ride-sharing) which is less obvious in this figure. Average vehicle occupancy (for both private vehicles and vehicle share) in Auckland in 2042/43 in this scenario rises to about 1.6 people, compared with about 1.5 people in the Base Case.
- Walking trips increase by about 80%, compared with almost 50% in the Base Case.
- Cycling trips increase by about 450%, compared with almost 50% in the Base Case.

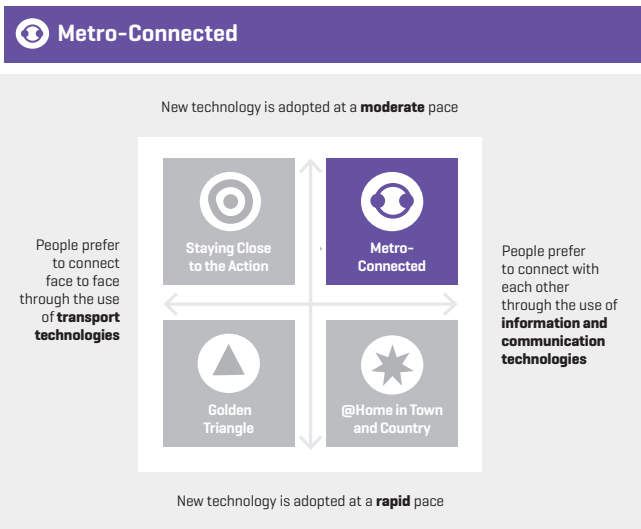


Staying Close to the Action 2042/43

Salesi and Melanie, apartment dwellers in central Auckland, don't own a car. To visit family in Northland every now and then, they use a smartphone app to book a car from a vehicle-sharing scheme. This could be a self-driving vehicle, or an older vehicle that Salesi drives.

Melanie never applied for a driver licence as there was no need. Most of her friends, like her, live in the central city. When she needs to get out to the suburbs, she usually takes the train, or sometimes the bus. Without congestion on the motorways, her bus trip is quick.





The national population is assumed to grow in line with the Stats NZ medium projection used in the Base Case and the Staying Close to the Action scenario. However, the regional distribution of the population will differ by 2042/43. Auckland continues to offer agglomeration benefits in some lines of activity and its population continues to grow, but the population will grow just as rapidly in other main centres, since advances in ICT mean that employers are able to split their operations between multiple locations.

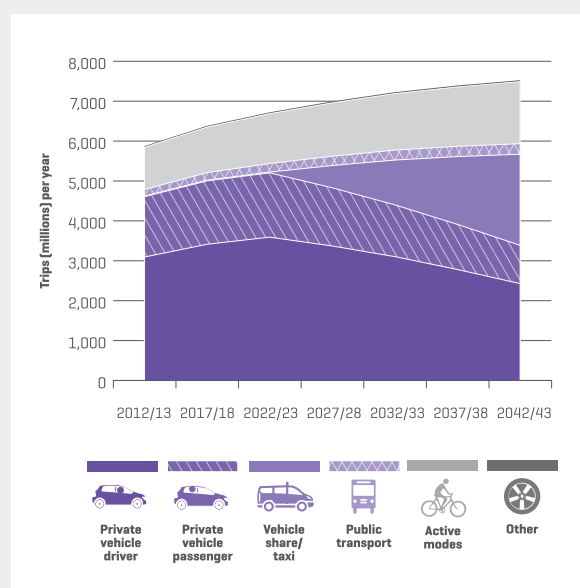


Population growth will be at the same percentage rate [42% between 2012/13 and 2042/43] in the following 11 territorial authorities that had populations close to or greater than 75,000 in 2013: Auckland, Christchurch, Wellington, Hamilton, Dunedin, Tauranga, Lower Hutt, Whangarei, Palmerston North, New Plymouth, and Hastings. In the original Stats NZ medium projection, the population growth rate would be fastest in Auckland, Tauranga, and Hamilton, with the other eight territorial authorities growing considerably more slowly. In territorial authorities other than the 11 specified, growth rates are the same as in the Base Case.

There is no adjustment to the initial model projections for average trip length. Initial model projections for walking are adjusted upward by 20%, and for cycling by 100% by 2042/43, to reflect better facilities for walking and cycling and interest in more health-conscious lifestyles.

Regular commuting remains the norm, although initial model projections for per capita work trips are reduced by 10%, and per capita non-work trips by 5% by 2042/43. These are modest reductions that reflect technological advances, which allow some people to work from home or from other locations of their choice. 40% of travel by private vehicle across New Zealand is assumed to shift to vehicle-sharing schemes by 2042/43, with this shift starting in 2027/28.

Figure 16: Metro-Connected scenario: projected number of trips by mode

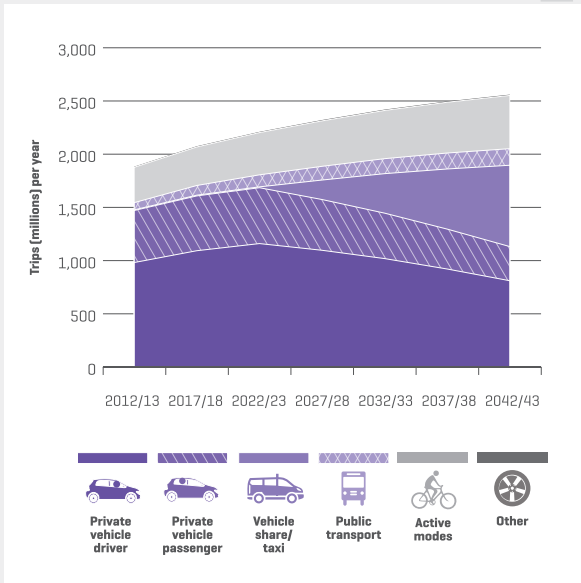


- The number of trips by all modes is projected to increase by just under 30%, an increase from 5.9 billion trips in 2012/13 to 7.5 billion trips in 2042/43, slightly less than the Base Case increase to 7.6 billion trips.
- Public transport trips increase by only about 60%, compared with about 100% in the Base Case, reflecting slower population growth in Auckland. By 2042/43 public transport accounts for 3.5% of all trips, compared with about 4% in the Base Case.
- Walking trips increase by about 40%, compared with about 25% in the Base Case.
- Cycling trips increase by about **130%**, compared with about 20% in the Base Case.





Figure 17: Metro-Connected scenario: projected number of trips by mode in Auckland



- In Auckland the population is projected to increase to 2.1 million by 2042/43, compared with 2.3 million in the Base Case.
- The number of trips by all modes is projected to increase by about 35%, an increase from 1.9 billion trips in 2012/13 to 2.6 billion trips in 2042/43, significantly less than the Base Case increase of about 50% to 2.9 billion trips. Projected growth is slower in Auckland compared with the Base Case as population growth is spread more evenly across New Zealand.
- Public transport trips increase by about 130%, compared with about 210% in the Base Case. By 2042/43 public transport accounts for about 6% of all trips, compared with about 7% in the Base Case.
- Walking trips increase by about 50%, similar to the Base Case, as slower population growth in Auckland offsets the assumed increase in the popularity of walking.
- Cycling trips increase by about **150%**, compared with about 50% in the Base Case.

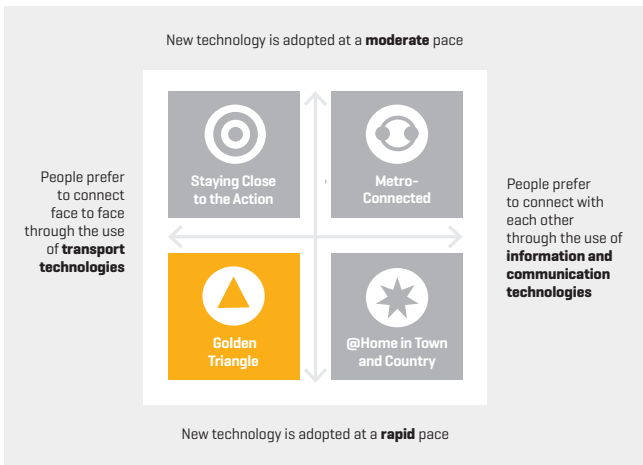


Metro-Connected 2042/43

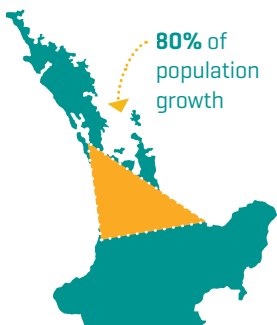
Things are buzzing in Dunedin. Karen is pleased to see many old friends from school return to live in the city. They used to head north to the bright lights, but now Dunedin and similar cities are experiencing steady growth with a good supply of jobs. Paradoxically, although her friends live nearby, Karen tends to catch up with them most often on online social networking sites. Some of her friends don't get out much nowadays as they work from home.



Golden Triangle



Under this scenario, the population grows more quickly, in line with the Stats NZ high projection. Under this projection, the New Zealand population will be 6.7 million by 2042/43, compared with 5.9 million in the medium projection.



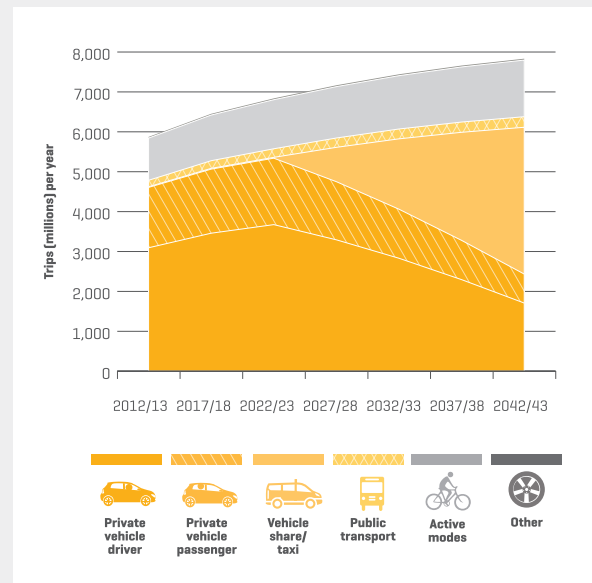
About **80%** of this population growth is in the 'golden triangle' regions of Auckland, Waikato, and the Bay of Plenty. GDP per capita increases at a rate of 1% per year higher than in the Base Case, due to increased productivity from rapid technology advances.

Initial model projections for average trip length are adjusted upward by 10% nationwide to

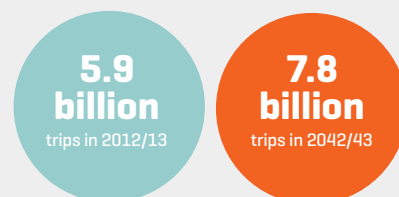
reflect a more spread-out land development pattern compared with the Base Case. Initial model projections for walking are adjusted upward by 10%, and for cycling by 50%, to reflect better facilities for walking and cycling and more health-conscious lifestyles.

Initial model projections for per capita work trips are reduced by 20%, and per capita non-work trips by 10%, to reflect technological advances that allow some people to work from home or from other locations of their choice. 60% of travel by private vehicle across New Zealand is assumed to shift to vehicle-sharing schemes by 2042/43, with this shift starting in 2027/28. This shift reflects rapid technology advances assumed in this scenario, which make self-driving vehicles common by 2042/43.

Figure 18: Golden Triangle scenario: projected number of trips by mode



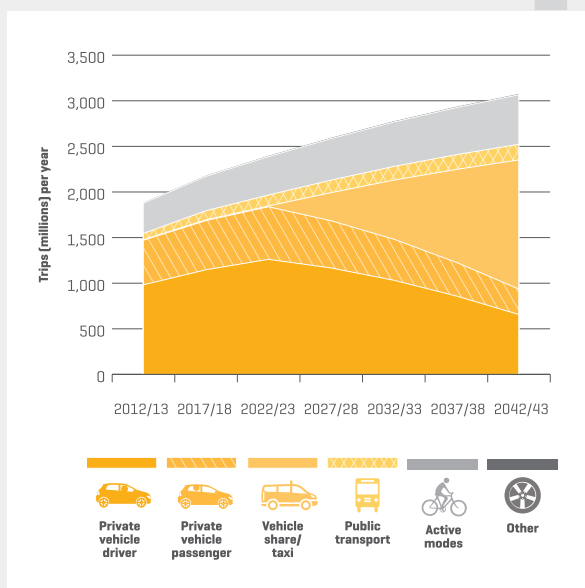
- The number of trips is projected to increase by about 35%, an increase from 5.9 billion trips in 2012/13 to 7.8 billion trips in 2042/43, compared with an increase to 7.6 billion trips in the Base Case.



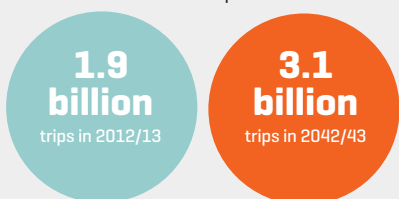
- Public transport trips increase by only about 60%, compared with about 100% in the Base Case, reflecting fewer work trips and higher incomes (which reduces bus travel), somewhat offset by faster population growth in Auckland. By 2042/43 public transport accounts for about 3.5% of all trips, compared with about 4% in the Base Case.
- Walking trips increase by 30%, compared with about 25% in the Base Case.
- Cycling trips increase by 75%, compared with about 20% in the Base Case.



Figure 19: Golden Triangle scenario: projected number of trips by mode in Auckland



- In Auckland under this scenario the population is projected to increase to 2.8 million by 2042/43, compared with 2.3 million in the Base Case.
- The number of trips by all modes is projected to increase by about 60%, an increase from 1.9 billion trips in 2012/13 to 3.1 billion trips in 2042/43, more than the Base Case increase of about 50% to 2.9 billion trips.



- Public transport trips increase by about 150%, compared with about 210% in the Base Case. By 2042/43 public transport accounts for about 6% of all trips, compared with 7% in the Base Case.
- Walking trips increase by about 60%, compared with about 50% in the Base Case.
- Cycling trips increase by about 130%, compared with about 50% in the Base Case.

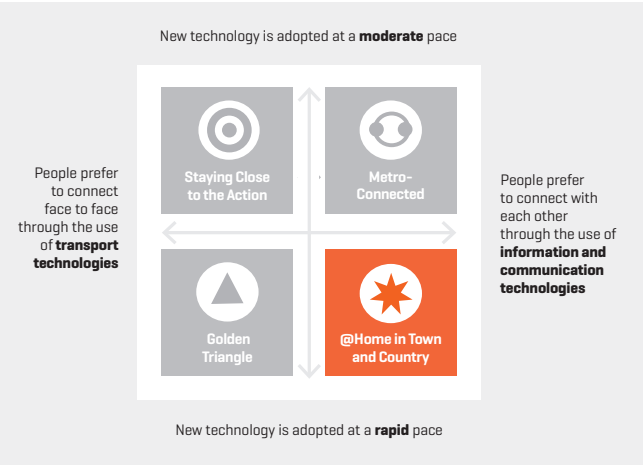
Golden Triangle 2042/43

In the Waikato, Miriama now sees a lot more of her mother, Ngaire. Ngaire is retired and lives about 100 km away, but Miriama bought her a smartphone and taught her how to order a self-driving vehicle. Ngaire was a bit reluctant at first, but now it's a breeze and it doesn't cost much. She visits Miriama and her grandchildren regularly and on the way either has a nap or reads a book, so that she arrives relaxed.

Tamati also gets to spend more time with his mother-in-law. His business card says that he works in Auckland, but he's either there, at the branch office in Tauranga, or logging in from home.

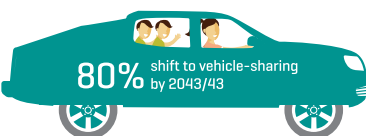


@Home in Town and Country



Under this scenario, the population also grows in line with Stats NZ’s high projection. However, population growth is assumed to be at the same rate in every region, reflecting advances in technology and a preference for the use of ICT, which allows many people to live wherever they wish. GDP per capita increases at 1% per year higher than in the Base Case, due to increased productivity from rapid technology advances.

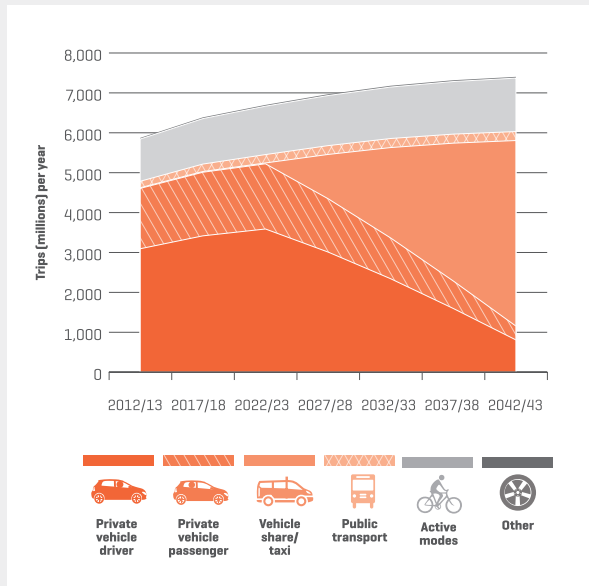
There is no adjustment to initial model results for average trip length. Initial model projections for walking are adjusted upward by 10%, and for cycling by 50%, to reflect better facilities for walking and cycling and more health-conscious lifestyles.



Initial model projections for per capita work trips are reduced by 30%, and per capita non-work trips by 15%. 80% of

travel by private vehicle across New Zealand is assumed to shift to vehicle-sharing schemes by 2042/43, with this shift starting in 2027/28. This shift reflects rapid technology advances making self-driving vehicles common by 2042/43 as well as fewer work and non-work trips reducing the perceived advantages of owning a private vehicle.

Figure 20: @Home in Town and Country scenario: projected number of trips by mode

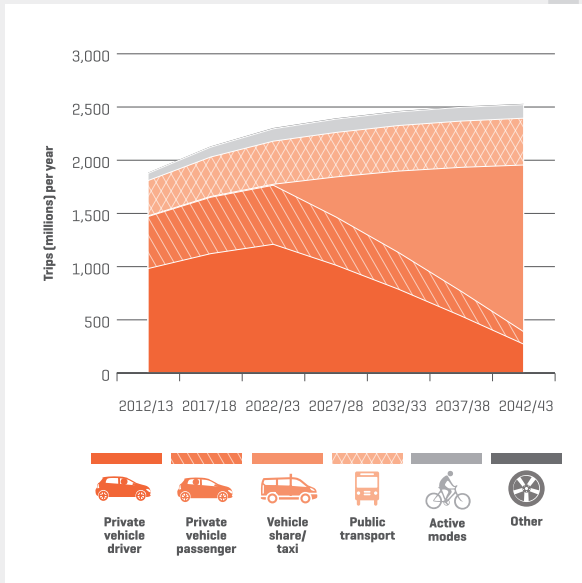


- The number of trips by all modes is projected to increase by about 25%, an increase from 5.9 billion trips in 2012/13 to 7.4 billion trips in 2042/43, compared with 7.6 billion trips in the Base Case.
- Public transport trips increase by only about 40%, compared with about 100% in the Base Case, reflecting reduced numbers of work trips and higher incomes (which reduces bus travel). By 2042/43, public transport accounts for about 3% of all trips, compared with about 4% in the Base Case.
- Walking trips increase by about 25%, similar to the Base Case.
- Cycling trips increase by about 80%, compared with about 20% in the Base Case.

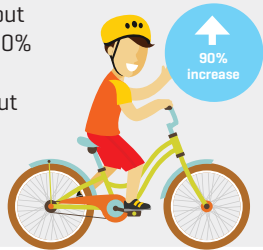




Figure 21: @Home in Town and Country scenario: projected number of trips by mode in Auckland



- In Auckland, the population would be 2.4 million by 2042/43, compared with 2.3 million in the Base Case.
- The increase in trips by all modes would be about 35%, an increase from 1.9 billion trips in 2012/13 to 2.5 billion trips in 2042/43, somewhat less than the Base Case increase of about 50% to 2.9 billion trips.
- Public transport trips increase by 90%, compared with 210% in the Base Case. By 2042/43 public transport accounts for 5% of all trips, compared with about 7% in the Base Case.
- Walking trips increase by about 30%, compared with about 50% in the Base Case.
- Cycling trips increase by about **90%** compared with about 50% in the Base Case.



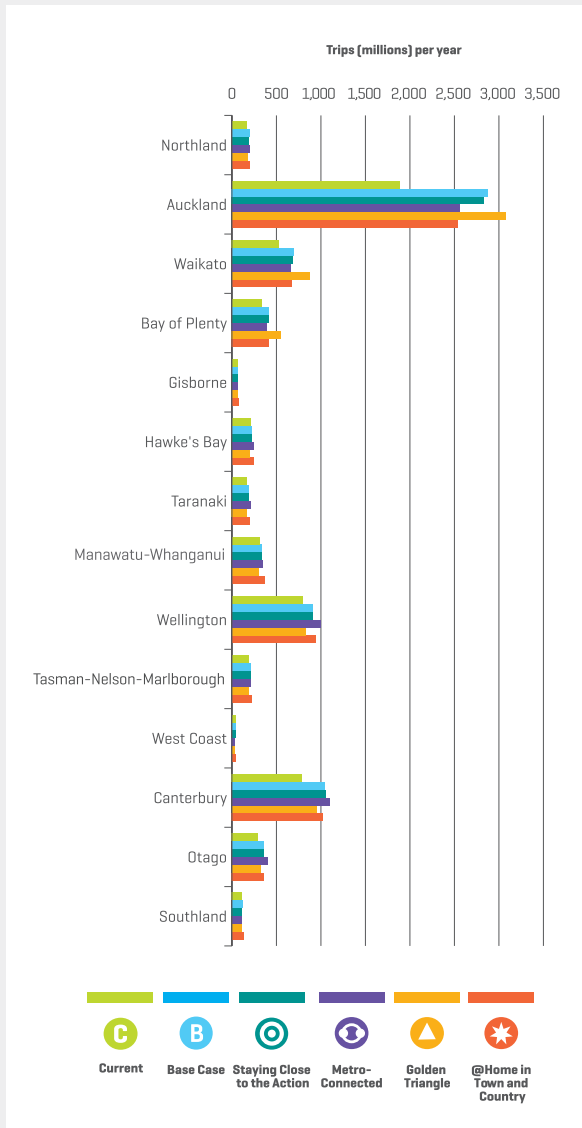
@Home in Town and Country 2042/43

Lydia's son, Xavier, has taken over the garage. When Lydia and her family relocated to Napier from Wellington, she found an art deco flat for rent. With no car, the garage was empty, so Xavier uses it for his school band practice.

Between the jumble of the drums and keyboards his sister, Mary, struggles to find her bike. When she's cycling in the centre of Napier, she feels relatively safe. Her bicycle transmits a signal that warns self-driving vehicles of her presence even if she's behind something and can't be seen.

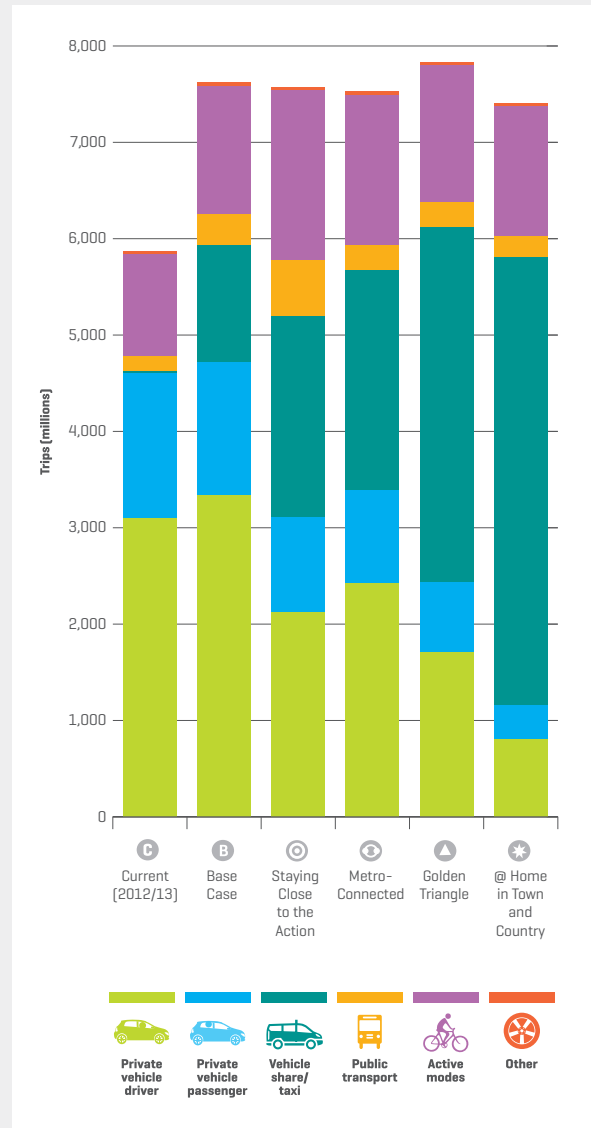


Figure 22: Projected number of trips by region [2042/43]



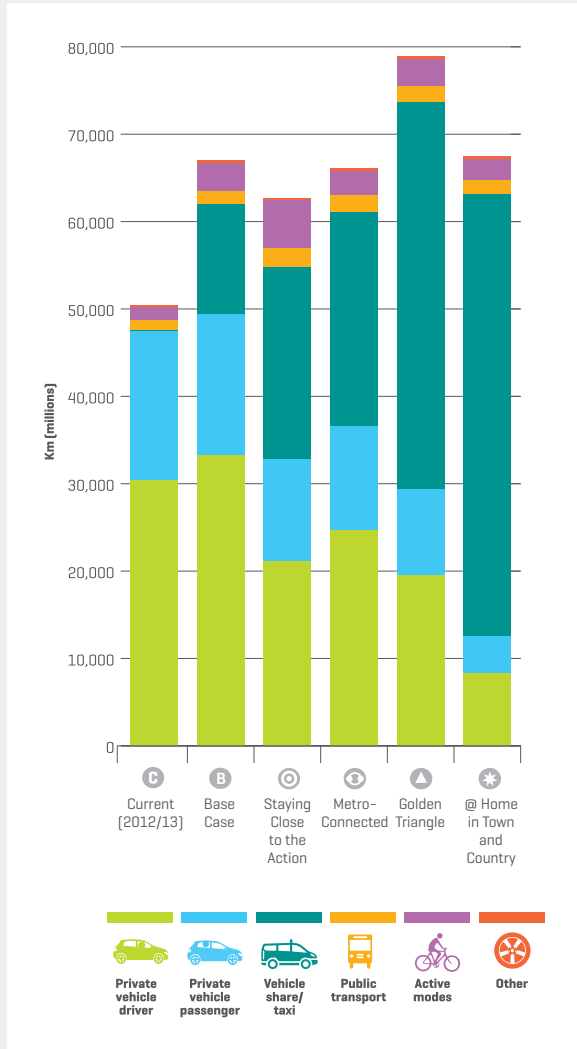
- There is not a lot of difference in the overall number of trips between the Base Case and the Staying Close to the Action and Metro-Connected scenarios as these scenarios do not assume the rapid technological change that might be required to reduce demand for travel.
- Population and economic growth are fastest in the Golden Triangle and @Home in Town and Country scenarios, but rapid advances in digital technology reduce the need for trips on a per capita basis, especially in the @Home in Town and Country scenario.
- The distribution of trips between regions differs somewhat between scenarios, with Auckland, Waikato and Bay of Plenty having a particularly large share in the Golden Triangle scenario.

Figure 23: Projected number of trips by mode [2042/43]



- Vehicle-sharing services take the biggest share of travel in the scenarios with rapid technology advance [Golden Triangle and @Home in Town and Country]. Public transport takes a larger share in the Staying Close to the Action scenario that assumes the introduction of demand management road pricing in Auckland and Wellington.

Figure 24: Projected distance travelled by mode [2042/43]



Distance travelled will vary under each scenario as a result of differences in the number of trips and distance per trip.

- Under the Staying Close to the Action scenario, the distance per trip will be 10% lower in Auckland and 5% lower in Wellington compared with the Base Case as population growth focuses on the central city and inner suburbs.
- The distance per trip in the Golden Triangle scenario is 10% higher than the Base Case projection due to sprawling suburban development.

This figure refers to the distance travelled by individuals, not by vehicles. Private vehicle passengers travel in the same vehicle with private vehicle drivers.



Health benefits of walking and cycling

Physical activity through walking and cycling reduces the number of deaths from diseases of inactivity. With more pedestrians and cyclists, there may be more traffic-related deaths but this increase in the number of deaths is outweighed by more lives saved through increased physical activity.



Low physical activity is associated with increased risk for a range of diseases, including cardiovascular disease (heart attacks and strokes), diabetes, dementia, breast and colon cancer, and depression. Low physical activity was estimated to cause about 1,400 deaths in New Zealand in 2015. In comparison, accidents across all modes of transport were responsible for about 400 deaths. Those who die from diseases of inactivity tend to be considerably older than the victims of transport accidents. As people who die when they are older have fewer years of life lost compared with people who die when they are younger, estimates of the number of years of life lost are roughly the same from both causes: about 19,000.²⁹

Increases in the use of motorised transport have been associated with declining levels of physical activity³⁰, but transport can also play a role in combating them. Active modes – walking and cycling – provide opportunities for exercise while travelling and, therefore, help to reduce the risk of diseases resulting from low physical activity.

To illustrate the impact that active modes might have on health, we have projected the change in the number of deaths and years of life lost due to diseases of inactivity based on changes in distances walked and cycled in the Base Case and alternative scenarios. This work was based on a model of the health impacts of active modes developed by the University of Otago.³¹ The analysis assumes that people’s non-transport physical activity does not change between scenarios. However, the scenarios might have other impacts on physical activity not considered here. For example, it is possible that, if improved ICT reduces the need for travel, people will spend some of the time saved engaging in sports or in other non-transport-related physical activities.

Figure 25: Distance walked or cycled per capita per year

	Average km per capita per annum	
	Walking	Cycling
Current (2012/13)	182	70
Scenarios (2042/43)		
Base Case	161	74
Staying Close to the Action	216	226
Metro-Connected	182	147
Golden Triangle	164	110
@Home in Town and Country	141	102

The projected change in average distance walked or cycled each year in the Base Case and alternative scenarios is small. Although distance cycled roughly trebles in the Staying Close to the Action scenario compared with the Base Case, the average distance cycled per day is still only about two thirds of a kilometre.

However, the benefit of even a small amount of exercise is large enough that differences in health outcomes between the scenarios are significant.



Figure 26: Change in deaths and years of life lost due to changes in transport-related physical activity [2042/43 compared with 2012/13]

	[A] Assuming same population as in 2012/13		[B] Assuming projected population in 2042/43	
	Change in the number of deaths	Change in the number of years of life lost	Change in the number of deaths	Change in the number of years of life lost
B Base Case	+23	+303	+58	+608
🎯 Staying Close to the Action	-125	-2,338	-266	-4,147
🚶 Metro-Connected	-41	-947	-79	-1,552
📍 Golden Triangle	+11	+70	+35	+227
🌟 @Home in Town and Country	+50	+656	+131	+1,362

Column A provides a direct comparison as it assumes that population size and age/sex distribution in 2042/43 are the same as in the base year (2012/13) under all scenarios.

Column B uses the projected 2042/43 population sizes for each scenario and thus reflects more accurately the expected outcomes. In 2042/43, the population is not only larger than in 2012/13, but also older, and, therefore, more subject to increases in deaths and years of life lost from reduced physical activity.

- B** In the Base Case in 2042/43, walking declines significantly while cycling increases only slightly compared with 2012/13, resulting in an increase over time in the number of deaths and years of life lost due to low physical activity.
- 🎯** In the Staying Close to the Action scenario, on the other hand, both walking and cycling increase compared with 2012/13, resulting in a significant decrease in deaths and years of life lost due to low physical activity.
- 🚶** In the Metro-Connected scenario, walking remains the same in 2042/43 as it was in 2012/13, but cycling increases significantly, also resulting in a fall in the number of deaths and years of life lost due to low physical activity.
- 📍** In the Golden Triangle and @Home and Town and Country scenarios, walking declines compared with 2012/13, but cycling increases. In both scenarios, the decline in walking dominates as it has a greater impact on hours of physical activity than the increase in cycling. On balance, deaths and years of life lost increase in both scenarios, with the increase especially large in the @Home in Town and Country scenario, which has the largest reduction in walking.

Reductions in deaths from diseases of inactivity due to increased walking and cycling may be offset by increases in deaths and years of life lost due to motor vehicle collisions involving pedestrians and cyclists.

Figure 27: Change in deaths and years of life lost for pedestrians and cyclists due to collisions with motor vehicles [2042/43 compared with 2012/13]

	[A] Assuming same population as in 2012/13		[B] Assuming projected population in 2042/43	
	Change in the number of deaths	Change in the number of years of life lost	Change in the number of deaths	Change in the number of years of life lost
B Base Case	-1	-46	-2	-61
🎯 Staying Close to the Action	+6	+300	+8	+400
🚶 Metro-Connected	+6	+298	+8	+397
📍 Golden Triangle	+4	+182	+6	+276
🌟 @Home in Town and Country	-9	-310	-13	-469

- 🎯** Deaths from collisions generally rise with increases in walking or cycling. However, the relationship is not a simple proportionate one, as the rate of collisions tends to decline as there are more cyclists or pedestrians on the streets relative to cars ('safety in numbers').³² This explains why deaths from collisions for cyclists and pedestrians are about the same in the Staying Close to the Action scenario as in the Metro-Connected scenario despite the higher levels of walking and cycling in the Staying Close to the Action scenario. There is less motor vehicle traffic in the Staying Close to the Action scenario, increasing the ratio of pedestrians and cyclists to vehicles.

Figures 26 and 27 show that any increase in deaths and years of life lost due to motor vehicle collisions (figure 27) as walking or cycling increases is small compared with the reduction in deaths and years of life lost due to diseases of inactivity (figure 26).

29 <http://ghdx.healthdata.org/gbd-results-tool>

30 www.who.int/dietphysicalactivity/factsheet_inactivity/en/

31 Michael Keall, Ed Randal, Jagadish Guria, Alistair Woodward, *Health outcomes projected from Transportation Modelling for the New Zealand Transport Outlook*, August 2016, available at www.transport.govt.nz/transportoutlook

32 Peter L. Jacobsen, "Safety in numbers: more walkers and bicyclists, safer walking and bicycling", *Injury Prevention*, September 2003, 2003;9: 205–209, www.ncbi.nlm.nih.gov/pmc/articles/PMC1731007/

🎯 Staying Close to the Action 2042/43

Melanie and Salesi get a lot of exercise. Not only do they go to the gym regularly, just across the road from their apartment block, but they also walk or use their bikes to visit friends in other apartment buildings in central Auckland. Melanie sometimes walks to her work or study if it's a fine day while Salesi hops on his bike. Occasionally during the weekend they'll go for a long walk or a bike ride. The infrastructure for walking and cycling in Auckland has improved significantly and they feel that it's much safer.



🚇 Metro-Connected 2042/43

Karen has recently taken up cycling. She doesn't do a lot, usually less than half an hour a week, but at least it's a start. As building manager for her firm in Dunedin, Karen has recently ordered some bike stands for staff members who prefer to bike into work.

For her next holiday, Karen has booked on the Central Otago Rail Trail. A lot of tourists from around New Zealand and the world use the trail and Karen hopes to get the opportunity to practise her Japanese with any visiting cyclists from Japan.



📍 Golden Triangle 2042/43

Tamati and Miriama are slightly concerned that they spend so much time in the car, whether it's in a self-driving vehicle or behind the wheel of Tamati's classic Morris Minor that he lovingly restored. When they go out and socialise, their friends and family members are all over the region – Ngaruawahia, Morrinsville, and Karapiro – so using a vehicle makes most sense.

They live on the outskirts of Hamilton and, when they first moved there, they used to be surrounded by cows. Now there are sprawling housing developments going up everywhere around them, but public transport networks have not yet extended out to where they live. The shops are still a bit far, so it's not as if they can walk there easily. They're using their bikes a bit more for an occasional ride, although not often. They know that they need to do more exercise.



🌟 @Home in Town and Country 2042/43

Lydia has just returned from visiting her brother, James, in hospital. He has just suffered a stroke. Unfortunately, this came as no surprise to the family.

James moved out of Wellington about 20 years ago and relocated to Feilding. As he was an online magazine editor, he could work from almost anywhere. He also felt that in Feilding he could walk and cycle everywhere given that it was flat, unlike his previous home on the hills in Wellington. However, he ended up spending most of the time in front of his computer at home or sometimes at a local coffee shop. He also ordered in all his groceries, so he really had no need to get out as much as he had expected. As a result, his health deteriorated.



Projected air travel



Introduction

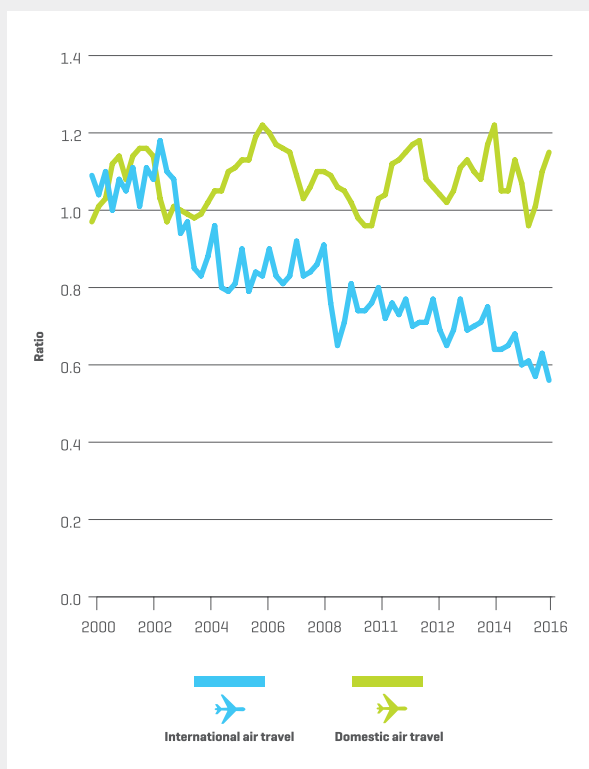
Domestic air travel is important in New Zealand due to our geography, while international air travel is important for tourism and for some freight.

In projecting the demand for air passenger travel, we have taken into account several factors that influence demand.

- Rising populations and incomes generally lead to an increase in demand for air transport.
- Lower fares generally raise demand.

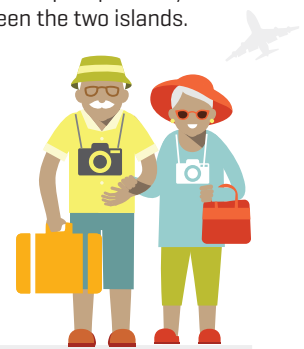


Figure 28: Cost of travel relative to salaries and wages³³



The relative cost of international air travel has fallen significantly over time. The relative cost of domestic travel has fluctuated.

- Demand may be induced if an airline offers a more frequent service or even more convenient flight times. However, the relationship may not be linear: going from no direct service to one daily non-stop flight is likely to have a bigger effect on demand than going from 3 to 4 daily non-stop flights. As an example, early indications are that Jetstar’s new regional routes, introduced in early 2016, have helped to boost traveller numbers³⁴, although it is still to be seen whether this growth is sustainable over the long term.
- Technological advances may make air travel more attractive by lowering cost, reducing travel time, or generally improving the travel experience. Some emerging technologies include improved cabin environments, self-service passenger and baggage check-ins, and speedier immigration processing with smart gates and scanning technologies.
- Over short distances (up to about 300 km or approximately four hours’ travel), road transport is generally a viable alternative to air travel. For distances above this threshold, air travel becomes more competitive. The barrier to road transport posed by Cook Strait also encourages air travel between the two islands.
- Both international and domestic air travel in New Zealand grow with the popularity of New Zealand as a destination for overseas visitors. Domestic air travel may be used by overseas visitors for connecting flights between their airport of arrival (typically Auckland) and other destinations or around New Zealand.



We make two types of projection for air travel.

- ✈️ **Origin-to-destination departures:** departures from one region to another that could involve a connection. For example: Hokitika – connection in Christchurch – Napier is one departure from the West Coast to Hawke’s Bay.
- ✈️ **Leg-based departures:** actual departures from an airport, including connecting travel. For example: Hokitika – connection in Christchurch – Napier is two departures: West Coast to Canterbury, Canterbury to Hawke’s Bay.

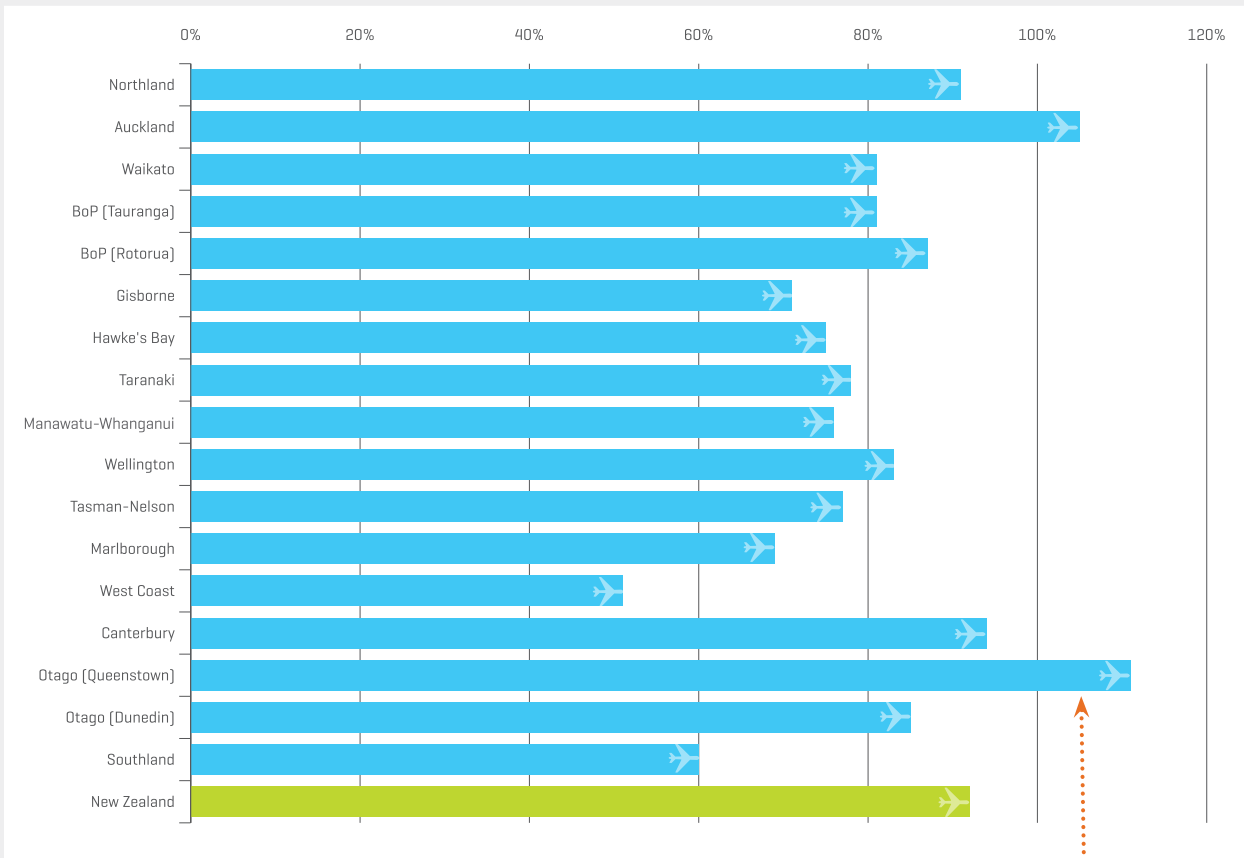
Projected origin-to-destination domestic air travel

B Base Case



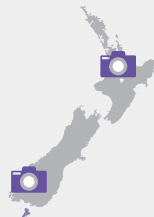
Under the Base Case, we project a **92%** increase in origin-to-destination departures between 2015 and 2043.

B Figure 29: Base Case: projected increase in domestic passenger departures from each region [2015 to 2043]



The Bay of Plenty and Otago regions have been split into:

- Tauranga and Rotorua, and
- Queenstown and Dunedin, given the distinctive market characteristics of Rotorua and Queenstown as tourism destinations.



33 www.transport.govt.nz/ourwork/tmif/transportpriceindices/am002/ and www.transport.govt.nz/ourwork/tmif/transportpriceindices/am003/
 34 www.scoop.co.nz/stories/BU1602/S00005/jetstar-expands-regional-network-with-three-new-routes.htm

Alternative scenarios

The main differences between the scenarios that affect air travel are rates of regional population growth and national rates of GDP and tourism growth.

- For the Base Case and Staying Close to the Action scenario, these assumptions are the same. Although people prefer to live in the central city and inner suburbs in the Staying Close to the Action scenario, this does not affect their demand for air travel.
- In the Metro-Connected and @Home in Town and Country scenarios, there may be additional air travel as people who work remotely from their colleagues may occasionally travel to meet with them in person. Therefore, initial model projections

in the Metro-Connected scenario, based on economic and population projections only, are adjusted upward by 5% and in the @Home in Town and Country scenarios by 10% by 2043.

- Tourist arrivals in all scenarios follow MBIE projections to 2023 and subsequently grow at 3.5% per year to 2025. After 2025, tourist arrivals grow at 3.0% per year in the Staying Close to the Action and Metro-Connected scenarios.
- After 2025, tourist arrivals grow at 4% per year in the Golden Triangle and @Home in Town and Country scenarios, reflecting higher worldwide economic growth.



Figure 30: Projected growth in domestic passenger departures from each region [2015 to 2043]

	B Base Case Staying Close to the Action	 Metro-Connected	 Golden Triangle	 @Home in Town and Country
Northland	91%	103%	264%	339%
Auckland	105%	111%	301%	344%
Waikato	81%	99%	288%	323%
Bay of Plenty (Tauranga)	81%	93%	314%	322%
Bay of Plenty (Rotorua)	87%	99%	326%	335%
Gisborne	71%	77%	217%	310%
Hawke's Bay	75%	97%	221%	313%
Taranaki	78%	102%	226%	316%
Manawatu-Whanganui	76%	89%	227%	317%
Wellington	83%	104%	239%	322%
Tasman-Nelson	77%	89%	218%	331%
Marlborough	69%	77%	211%	276%
West Coast	51%	65%	165%	289%
Canterbury	94%	113%	258%	337%
Otago (Queenstown)	111%	140%	297%	385%
Otago (Dunedin)	85%	112%	241%	323%
Southland	60%	75%	178%	303%
INCREASE FROM 2015	92%	108%	265%	334%

- Demand for air travel under the Golden Triangle and @Home in Town and Country scenarios is higher than in the other scenarios mainly due to their higher projected growth in population, GDP, and tourism.

- In the Golden Triangle scenario, people are assumed to live close to their work colleagues and visit each other regularly by land transport, whereas in the @Home in Town and Country and Metro-Connected scenarios they are more dispersed around the country and often work at different locations.

🕒 Staying Close to the Action 2042/43

Melanie occasionally visits her sister in Christchurch. Flying from Auckland to the South Island for the weekend is so easy nowadays. There's an express train to Auckland airport from right outside Melanie's apartment and the airport experience has improved a lot. Check-in, baggage drop, and security clearance are speedy. The airport is extremely busy, and Melanie notes that there are a lot more overseas tourists on domestic flights to and from Auckland as Auckland is the main gateway for overseas flights. Boarding announcements are given in a variety of languages. Fortunately, the flights to Christchurch are on bigger planes to accommodate the large number of passengers.



🚇 Metro-Connected 2042/43

Dunedin airport is a lot busier and has expanded. With more people living in the city and, in many cases, working for firms headquartered in Wellington or Auckland, there are a lot more flights for business travellers and for people visiting family members across New Zealand. Of course, a lot more tourists are also coming to Dunedin, and some are using it as their first destination before they visit Queenstown.

Karen's firm is based in Auckland. While she often catches up with her manager by virtual reality, occasionally she needs to visit head office. She orders a self-driving vehicle-share vehicle to get to the airport and uses that time to read through her notes for the day's meetings.



📍 Golden Triangle 2042/43

When it comes to heading off on holiday, Tamati and Miriama are spoilt for choice. They're close to the airports at Hamilton, Tauranga, and Auckland and there are easy road connections to each airport. There's even a smaller airport at Ardmore to the south of Auckland. When passing through Tauranga airport, they see a lot more business travellers as more and more businesses are based in Tauranga to serve the upper North Island, while the port is also extremely busy.

Miriama travels occasionally to Wellington for training courses to learn new procedures with patients. Access to downtown Wellington is now easier as land transport options have improved to cope with the increase in airport users.



📶 @Home in Town and Country 2042/43

Lydia occasionally does work at the airport in Napier. She has found that the airport has expanded as it seems that more and more people are passing through. The airport recently converted its parking building into a hotel as most people now travel to the airport by public transport or in a vehicle-share vehicle. Fewer people own their own cars nowadays.

Lydia can't afford to fly often but every now and then she'll accompany her son to a school band competition. She finds that they always need to make connections in Auckland, Wellington, or Christchurch as there are no direct flights from Napier to places such as Whangarei, Dunedin, or Nelson.



Passenger Numbers

We have projected air travel in the form of passenger departures. Historical data shows that the number of arrivals closely matches the number of departures.

For example, a New Zealand resident leaving his/her place of origin will generally return. An international tourist will arrive in New Zealand and will generally depart New Zealand. Therefore, to work out the total number of passengers using an airport, the number of departures needs to be doubled.

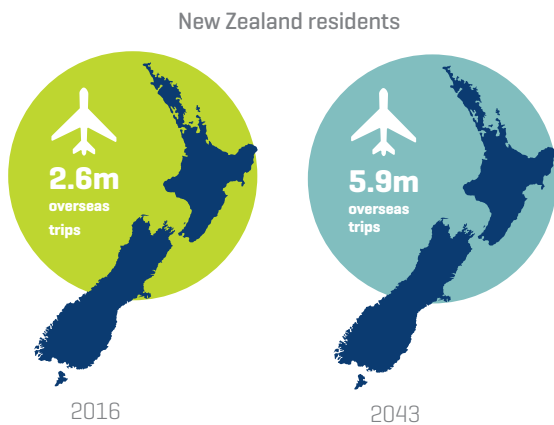
Projected departures of international passengers by region

B Base Case

These projections show overseas tourists leaving New Zealand and New Zealand residents departing on overseas trips based on their region of origin. New Zealand residents leaving for permanent/long-term migration are not included due to lack of data.

New Zealand residents are projected to make more overseas trips, up from the current level of 2.6 million trips in 2016³⁵ to 5.9 million in 2043, as a result of population growth and rising incomes. The number of tourist arrivals and departures rises with worldwide economic growth, which makes travel to New Zealand affordable for more of the world's population.

The number of departures from each airport depends on factors including regional population size and airport choice. For example, not all residents of the West Coast start their trips from Hokitika airport as some may choose to drive to Christchurch or other South Island airports. The large number leaving from Auckland airport reflects departures by overseas visitors, local Aucklanders, and also residents of surrounding regions who use land transport to Auckland to start their air trip there.



B Figure 31: Base Case: projected international departures by region

Starting region	Current (2015) [thousand]		Projected (2043) [thousand]	
	New Zealand residents	Overseas visitors	New Zealand residents	Overseas visitors
Northland	7	7	15	20
Auckland	1,559	1,527	4,025	4,323
Waikato	5	4	10	13
Bay of Plenty [Tauranga]	10	10	23	28
Bay of Plenty [Rotorua]	7	7	13	20
Gisborne	6	6	11	16
Hawke's Bay	19	19	36	54
Taranaki	18	18	38	50
Manawatu-Whanganui	20	20	37	56
Wellington	259	254	519	718
Tasman-Nelson	22	22	44	61
Marlborough	8	8	14	22
West Coast	1	1	1	1
Canterbury	373	365	851	992
Otago [Queenstown]	59	213	151	663
Otago [Dunedin]	32	31	60	83
Southland	6	6	11	18
TOTAL	2.4 million	2.5 million	5.9 million	7.1 million

This table refers to the airport from which a New Zealand resident or overseas visitor starts his/her overseas journey, either leaving directly on an international flight from an international airport, or travelling to make a connection at an international airport.

Annual per capita international departures for New Zealand residents are projected to almost double from 0.5 in 2015 to almost 1 trip by 2043. At the same time there is an increase in the number of incoming overseas visitors and, therefore, a corresponding increase in departures by overseas visitors, who will outnumber departures by New Zealand residents.

Figure 32: By scenario: projected international departures by New Zealand residents

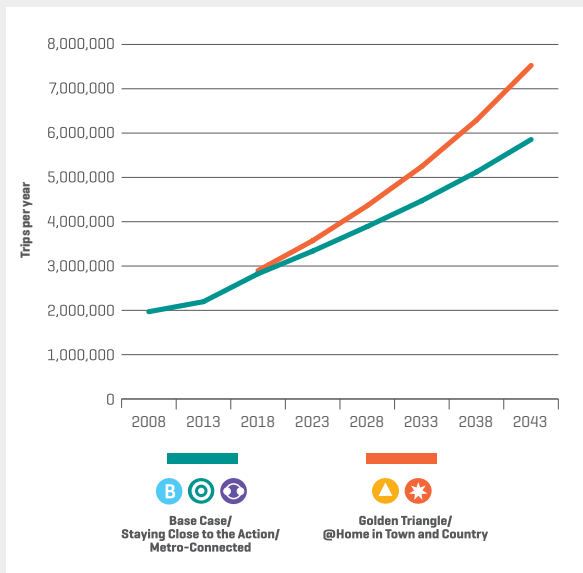
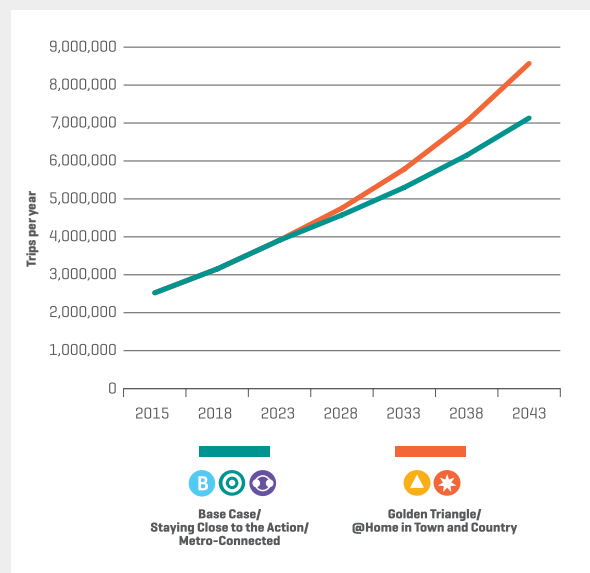


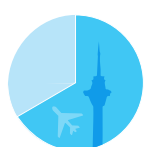
Figure 33: By scenario: projected international departures by overseas visitors



- At a national level, the population, GDP, and tourism assumptions for the three moderate growth scenarios (Base Case, Staying Close to the Action, and Metro-Connected) are identical and their results at a national level are also identical.
- Similarly, the two high-growth scenarios (Golden Triangle and @Home in Town and Country) also give identical results at the national level.

Figure 34: By scenario: projected international departures by region [thousand per year, 2015 to 2043]

	🕒 Current [2015]	Projected [2043]			
		🏠 Base Case	🚇 Metro-Connected	📍 Golden Triangle	🏡 @Home in Town and Country
		🎯 Staying Close to the Action			
Northland	14	35	36	41	45
Auckland	3,087	8,349	8,133	10,614	10,159
Waikato	9	23	23	32	29
Bay of Plenty [Tauranga]	20	52	52	74	66
Bay of Plenty [Rotorua]	15	34	34	47	45
Gisborne	11	26	27	31	35
Hawke's Bay	38	90	96	106	119
Taranaki	35	85	91	100	111
Manawatu-Whanganui	40	93	97	109	124
Wellington	513	1,238	1,320	1,454	1,611
Tasman-Nelson	44	105	107	124	137
Marlborough	15	36	36	42	48
West Coast	1	2	2	2	3
Canterbury	738	1,843	1,929	2,160	2,344
Otago [Queenstown]	272	814	820	969	1,001
Otago [Dunedin]	63	143	163	168	189
Southland	13	29	30	34	39
TOTAL	4.9 million	13 million	13 million	16 million	16 million



International departures by 2043

The breakdown of departures by region is not projected to vary significantly between the Base Case and each alternative scenario, with Auckland accounting for about **two thirds** of departures by 2043.

Projected leg-based domestic departures

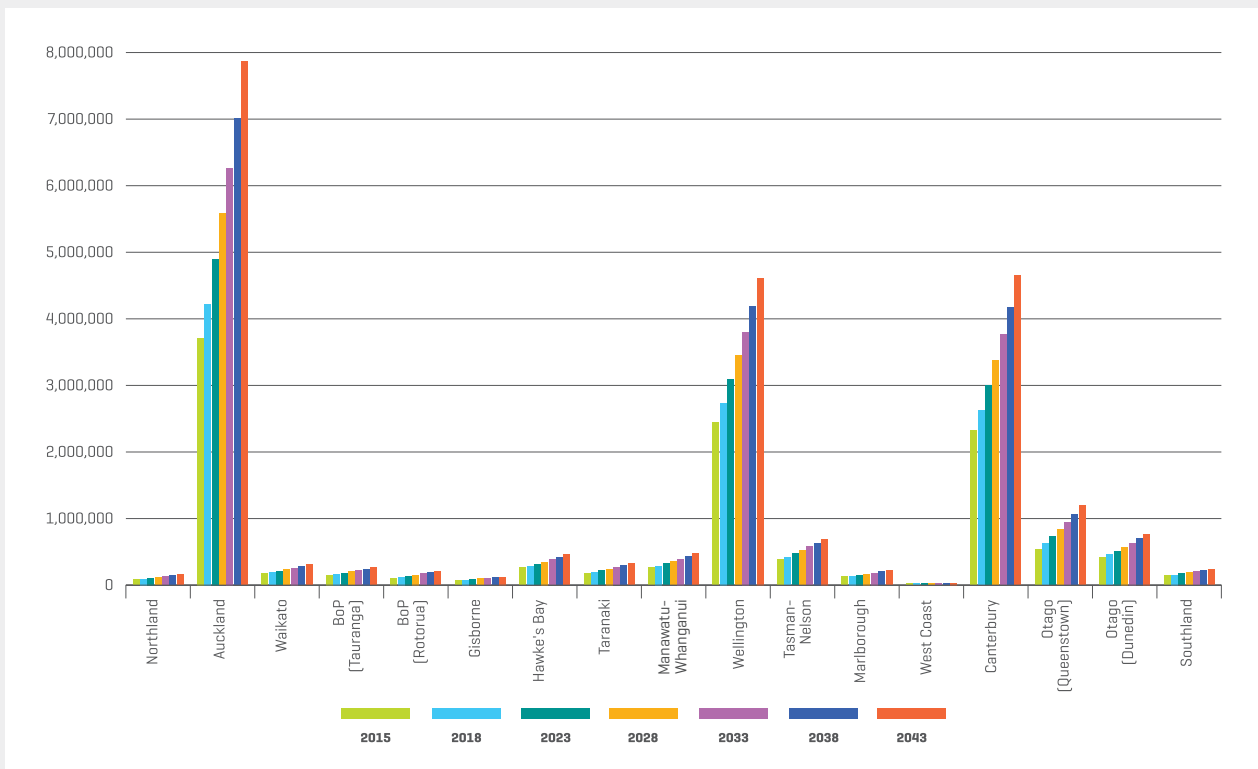
B Base Case

These leg-based projections show actual domestic departures, including connecting passengers, from every airport and, therefore, indicate the true level of activity at each airport. They are based on the origin to destination domestic air travel projections previously discussed.

This information is relevant for New Zealand given the hub and spoke models that Air New Zealand and Jetstar operate, whereby many passengers from regional airports pass through an

intermediate hub airport [Wellington, Christchurch, or Auckland]. For example, a passenger from Hokitika to Palmerston North requires a change of plane in Christchurch. In this case, such a trip counts as two airport departures or leg-based flights [West Coast to Canterbury, and Canterbury to Manawatu-Whanganui] but only one origin-to-destination trip [West Coast to Manawatu-Whanganui].

B Figure 35: Base Case: projected leg-based departures by region of airport per year³⁶



- Northland = Kaitiaki, Kerikeri, and Whangarei
- Waikato = Hamilton and Taupō
- BOP [Tauranga] includes Whakatane
- Manawatu-Whanganui = Palmerston North and Whanganui
- Wellington = Wellington and Paraparaumu

- Tasman-Nelson = Nelson
- Marlborough = Blenheim
- West Coast = Hokitika and Westport
- Canterbury = Christchurch and Timaru

Under the Base Case, leg-based departures are projected to roughly double between 2015 and 2043. This exceeds the projected 92% increase in origin-to-destination travel [see Figure 29] suggesting an increase in the number of trips requiring a transfer. However, our model may marginally overstate the increase in leg-based departures since, as air traffic grows, airlines may choose to offer more direct flights between regional centres.

Queenstown airport is projected to experience the largest growth of about 120%, followed by Auckland with about 110% growth. Auckland, Wellington, and Christchurch airports are projected to continue to account for about three quarters of all passengers given local residents starting their trips from those cities and regional passengers travelling on connecting flights through those hub airports.



³⁶ 2015 figures: Ministry analysis based on published passenger data from airports

Alternative scenarios

- Under the Metro-Connected scenario, population and economic growth are still moderate, but there is some dispersal of the population as employers are able to spread their operations across multiple locations. Population growth in the regional centres is faster, and population growth in Auckland is slower, relative to the Base Case. As a result of a more dispersed population, an increase in travel is projected compared with the Base Case as people travel more to connect with friends and family members and for occasional visits to their employers' offices.
- Under the Golden Triangle and @Home in Town and Country scenarios, an increase in travel is projected as a result of faster population and economic growth.
- Under the @Home in Town and Country scenario, the increase in travel is higher as technology allows New Zealanders greater freedom to live and work where they please, resulting in a more dispersed population.

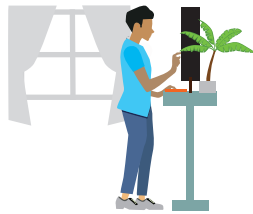
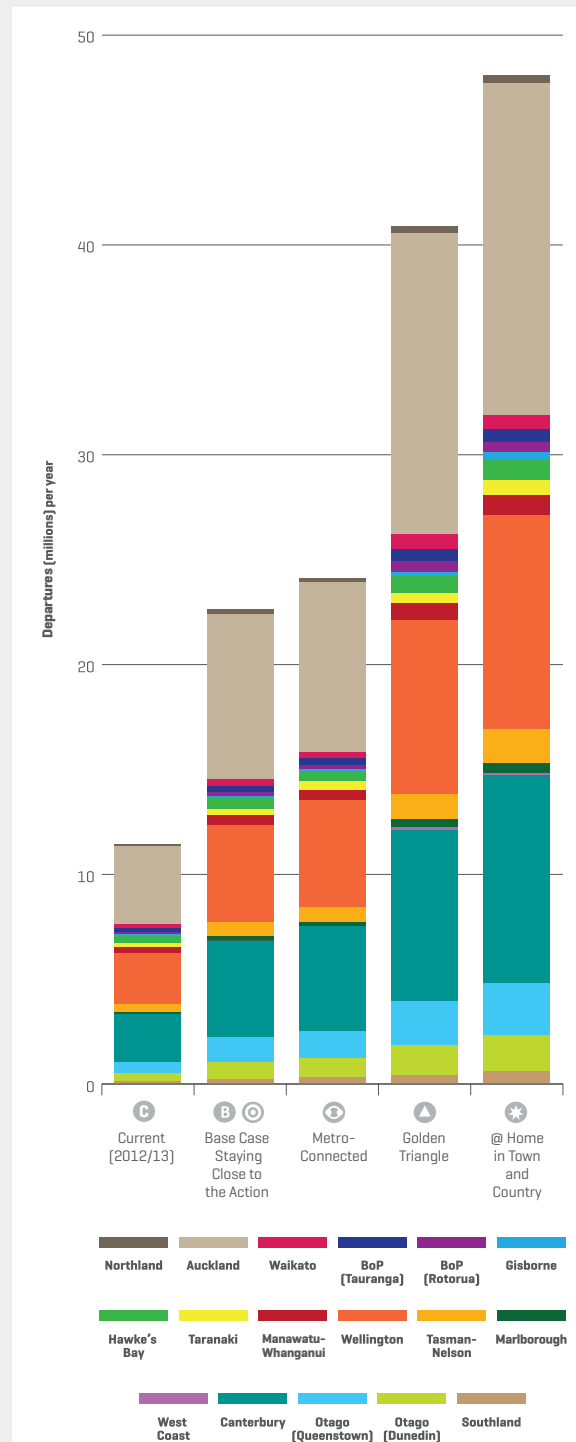


Figure 36: By scenario: projected leg-based domestic departures by region of airport (2043)



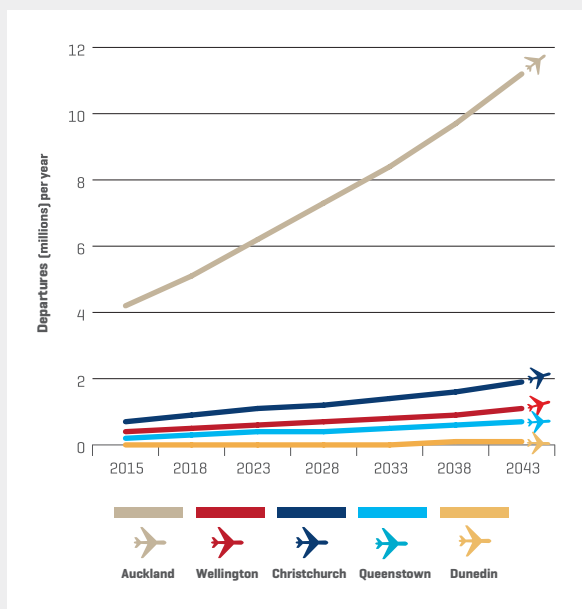
Projected leg-based international departures

B Base Case

These Base Case projections show international departures from New Zealand's five international airports by overseas tourists and by New Zealand residents on short-term trips.

These leg-based projections differ from **Projected departures of international passengers by region** that shows the starting point of an international departure. That information shows, for example, that an international trip might start in the Taranaki region with a flight from New Plymouth to Wellington International Airport. The projections here show actual passenger numbers passing through passport control at Wellington International Airport regardless of the starting point of a passenger's journey.

B Figure 37: Base Case: projected leg-based passenger departures on international flights³⁷



International departures through all international airports are projected to increase. However, international airlines generally prefer to maintain Auckland as their main destination in New Zealand as it provides easy access to the biggest market and its multi-cultural population provides a larger potential market for international travel.

Growth will imply in many cases the need to upgrade airport facilities and land transport links to and from airports.

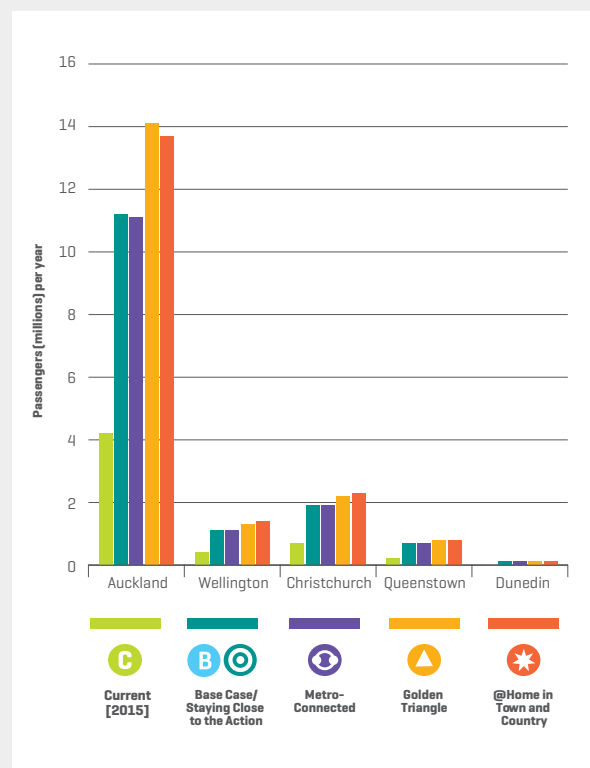
Alternative scenarios

The results suggest that Auckland will maintain its three-quarter share of departing passengers under all scenarios. The shares of other airports do not change much compared with 2015.



International passengers

Figure 38: By scenario: projected leg-based departures on international flights (excludes transit passengers) [2015 to 2043]



37 Ministry of Transport analysis based on published current passenger data from airports

Projected freight movements

In this section we project freight movements, as measured in tonnes, in each region and between regions by rail, road, and maritime (coastal shipping) modes for 19 commodity groups. This analysis excludes commodities that move by air freight or pipeline and freight carried by consumers for their own use.

This analysis extends the latest version of the National Freight Demand Study (NFDS)³⁷, released in 2014, which analysed freight flows for 2012. The NFDS data and methodology have been used to create a model that can be applied to the Base Case and alternative scenarios.

Nine commodity groups (liquid milk, manufactured dairy, meat, livestock, horticulture, wool, other agriculture, fish, and coal) are primarily exported or processed for export, and their production was projected based on an analysis of expected supply, taking into account constraints on available resources. These projections did not vary by scenario. For the remaining commodity groups, projections are based mainly on growth in population and GDP by region, as well as world GDP growth (which influences demand for exports).

We have used the same Base Case and alternative scenarios for freight that we have used elsewhere in this report. For freight, the only differences between them are the rates of economic growth by region, by commodity, and nationwide.

Although the retail industry is currently experiencing a shift to online shopping and home deliveries, the implications for freight transport are relatively minor. In 2012, couriers and post accounted for only 0.4 million tonnes out of total freight shipments of 236 million tonnes, ie 0.2% of tonnes shipped.³⁸ Even a major increase in online retailing would have only a minor impact on freight tonnage. Although not explicitly addressed in our model, there may be more significant implications for traffic generated by local deliveries, including the role of new technologies such as delivery robots and airborne drones.

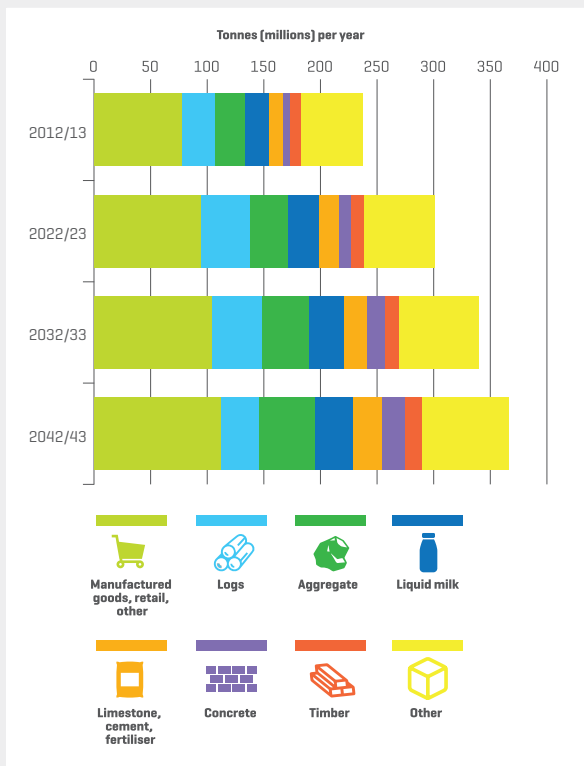


B Base Case

Freight tonnage

Freight tonnage is projected to increase under the Base Case by 55%, from 237 million tonnes in 2012/13 to 366 million tonnes in 2042/43.

B Figure 39: Base Case: projected freight



Manufactured goods/retail/other products are expected to contribute most to the absolute increase in freight tonnage. However, the % share of these products is projected to fall, while the % share of aggregates, concrete, limestone/cement/fertiliser, and liquid milk is projected to increase. The tonnage of all commodities is projected to increase, except for coal, which is projected to fall slightly.



Manufactured goods/retail/other products are transported mostly by road (94% in 2012/13). Most of these products [81%] remain within the region in which they are sourced. They are projected to increase from 72 million tonnes in 2012/13 to 111 million tonnes in 2042/43 with no change in mode split.



Logs are transported mostly by road (91%) as the rail network generally does not extend to many areas where the logs are harvested, although rail is used in the Bay of Plenty to take logs to the Port of Tauranga. Logs are sourced from all regions, the main regions being the Bay of Plenty (26% of tonnage in 2012/13), Northland (12%), and Waikato (14%). Log tonnages are projected to increase from 29 million tonnes in 2012/13 to 44 million tonnes in 2032/33, but to then fall to 34 million tonnes in 2042/43. This reflects the maturation and harvesting of a large number of trees in the late 2020s and 2030s (the so-called 'wall of wood'). The log production profile is, however, highly uncertain as forest owners have considerable discretion over when to harvest. Therefore, the rate of decline in exports at certain ports may not be as significant as illustrated. Currently, about half of all logs (49%) are exported, but this percentage is expected to decline to 27% by 2042/43, reflecting growth in domestic demand.



Aggregate (crushed pieces of rock) is used for building, for example in concrete and for roads. Because of high transport costs, quarries are located throughout New Zealand close to where there is demand. Aggregate is transported entirely by road and mostly within the region from which it is sourced (86% in 2012/13). Some aggregate is transported to Auckland from Northland and Waikato. Aggregate tonnage is projected to increase from 27 million tonnes in 2012/13 to 50 million tonnes in 2042/43.



Liquid milk is transported mostly by road (96%) from farms to dairy plants (rail may be used in some cases for these transfers). Liquid milk does not include processed dairy products. Large amounts of liquid milk are sourced from the Waikato region (26% of tonnage in 2012/13), Canterbury (18%), Southland (11%), Taranaki (10%) and Manawatu (9%). By 2042/43 the tonnage of liquid milk is projected to increase from 21 million tonnes in 2012/13 to 34 million tonnes. The mode split is projected to remain unchanged, but the region of origin will vary: Canterbury (29%), Waikato (21%), Southland (11%), Manawatu (8%) and Taranaki (7%) in 2042/43, partly due to the rate of dairy conversions.



Other includes these remaining 12 commodity groups in 2012/13:

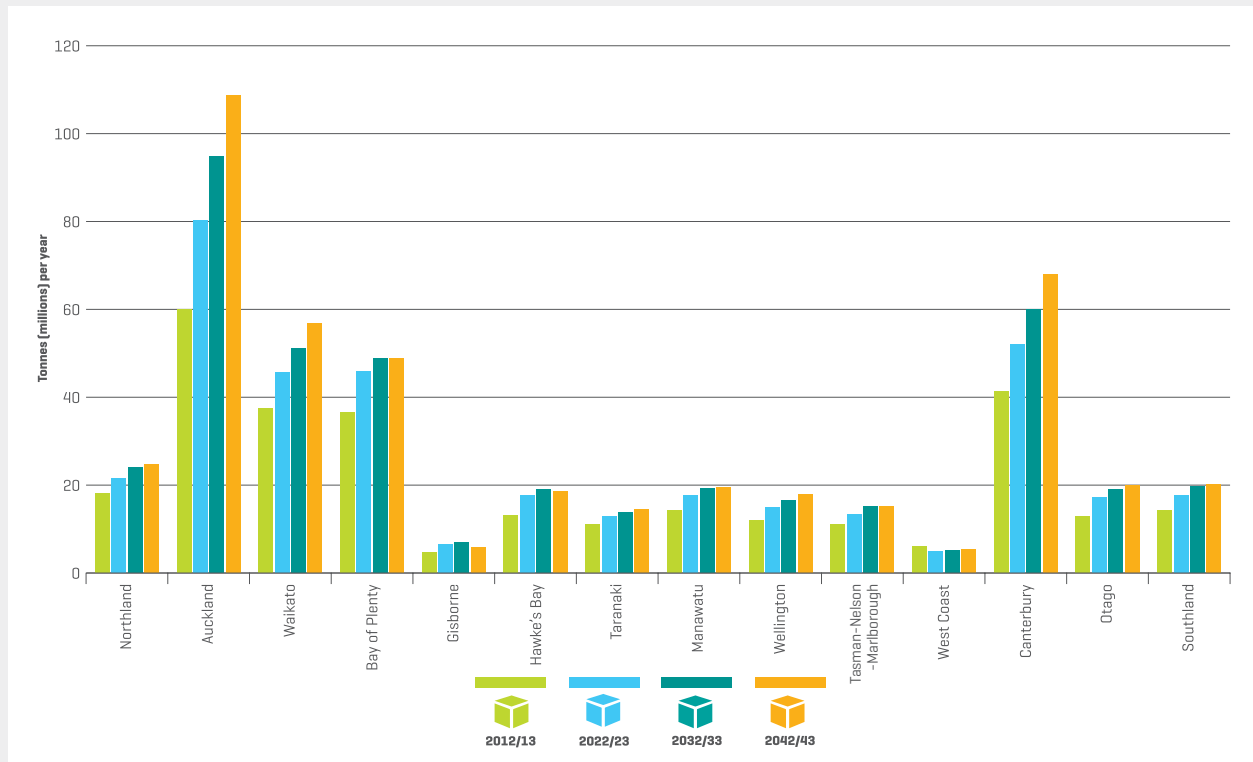
Agricultural commodities	Manufactured dairy products	29 million tonnes
	Meat and by-products	
	Livestock	
	Horticultural products	
	Wool	
Energy commodities	Other agricultural products	13 million tonnes
	Fish	
Waste	Coal	7 million tonnes
	Petroleum	
Steel & aluminium		4 million tonnes
Other minerals		1 million tonnes

37 www.transport.govt.nz/research/nationalfreightdemandsstudy/

38 See the National Freight Demand Study 2014 (www.transport.govt.nz/research/nationalfreightdemandsstudy/), Tables 3 and 3.97

Freight movements by region

B Figure 40: Base Case: projected regional freight tonnage



This graph shows the sum of freight on the roads, rail lines, or sea lanes in each region.

The numbers are a sum of the freight that moves within a region and the freight into and out of the region. Regional numbers do not add up to the national total as flows between regions are counted twice.



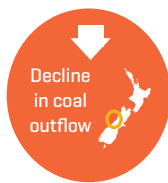
Regions

All regions are projected to experience an increase in freight tonnage except for the West Coast, due primarily to a decline in coal outflow.

Auckland has the largest tonnage of freight. This includes local products produced for the local market, additional freight movements into Auckland to cater for local needs or to consolidate at national distribution centres for further distribution, movement of goods manufactured in Auckland or shipped from Auckland distribution centres, and the movement of goods for export to the port of Auckland. Canterbury has a large amount of freight for similar reasons, as it is the main population and distribution centre for the South Island.

Localised freight movement

Freight movements tend to be localised: about 77% of tonnage [2012/13] remains within the region from which it is sourced, with an additional 14% being transported to an adjacent region. By 2042/43 this is not expected to change significantly. Most of what goes to non-adjacent regions is manufactured goods/retail/other products, mostly from Auckland and Canterbury given their role as major distribution centres.



Inter-island freight

There is relatively little movement of freight between the North and South Islands [2.2% of tonnage in 2012/13 and a projected 2.1% in 2042/43], most flowing from north to south. Most inter-island freight is in the form of petroleum from Northport [Whangarei/Marsden Point] to the South Island, followed by manufactured goods/retail/other products from Auckland to Canterbury.

Golden triangle freight flows

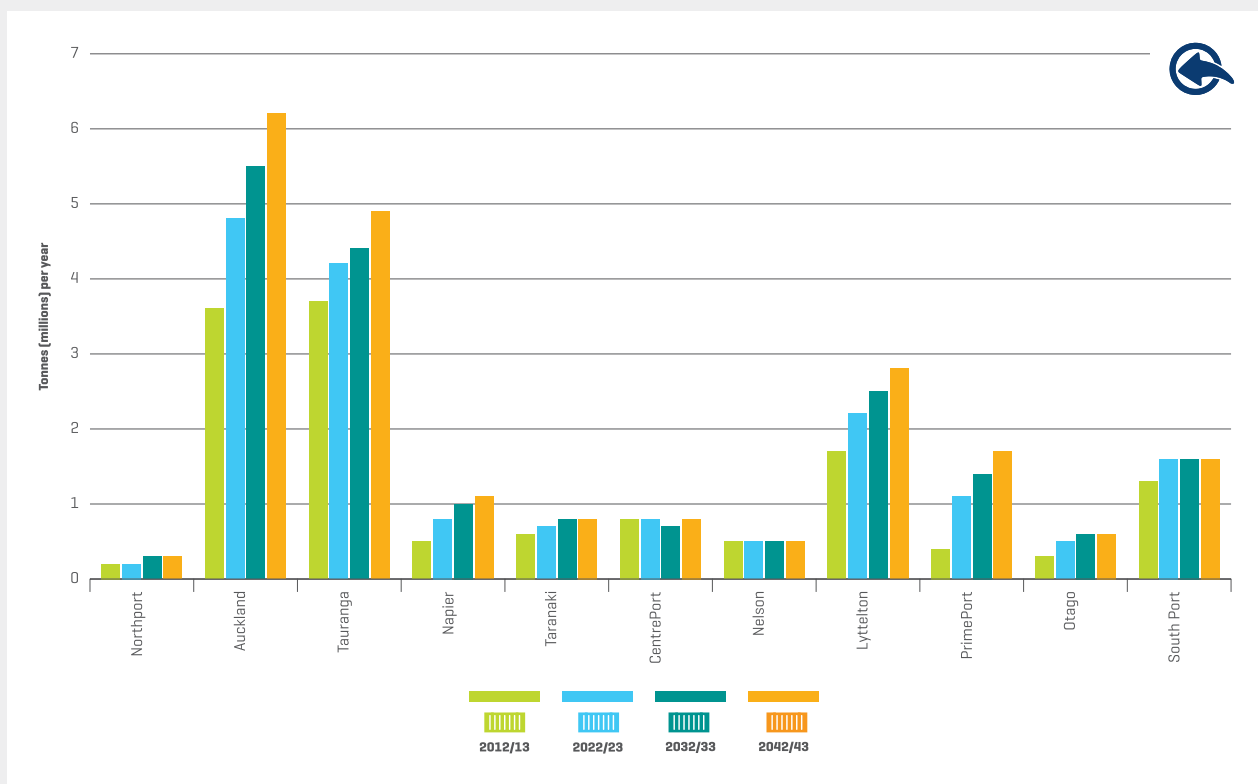
Freight flows in the golden triangle regions [Auckland, Waikato, Bay of Plenty] are projected to account for an increasing share of freight, rising from 42% in 2012/13 to 45% in 2042/43. These percentages are lower than the golden triangle's share of population. This is likely due to the large production of primary products relative to population in other regions, for example logs, dairy products, and coal. However, by 2042/43 the golden triangle area is projected to account for 52% of total tonnage of manufactured goods/retail/other products. This is consistent with the size of its population and industry concentration.

Freight flows through ports

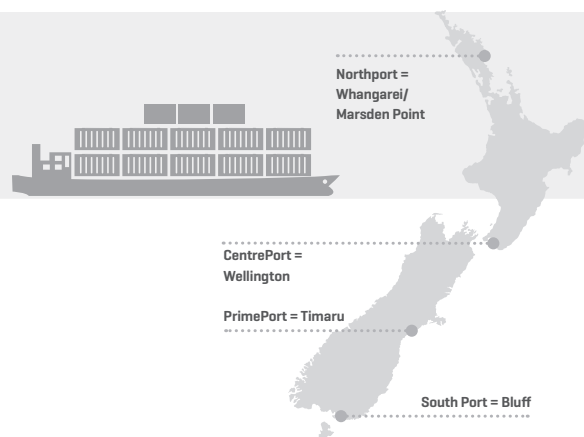
Import and export tonnage through all ports is projected to increase from current levels. In general, our import projections for each port tend to be driven by increases in regional demand less expected domestic supply, while export projections tend to be driven by increases in regional supply less expected domestic demand. However, in reality, New Zealand's ports serve surrounding regions as well as their own region.

For example, the ports of Auckland, Tauranga, and Northport all serve the upper North Island. The outcome of this competition depends upon several factors that are difficult to model, including investments in port infrastructure and road and rail access to/from ports, and the choices by international shipping lines of which ports to service. Therefore, projections for individual ports are highly uncertain.

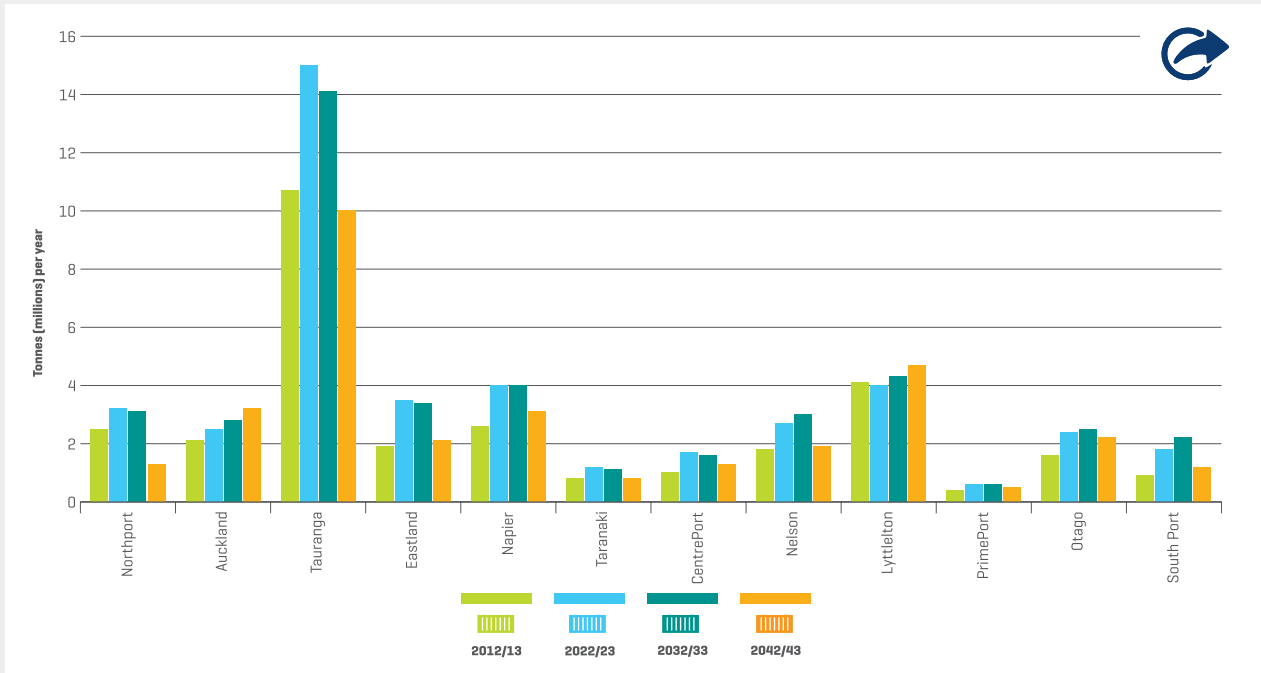
B Figure 41: Base Case: projected imports



These figures exclude crude oil imported into Northport. Much of that oil is subsequently moved by pipeline and, therefore, does not create a demand on the road or rail infrastructure.



B Figure 42: Base Case: projected exports

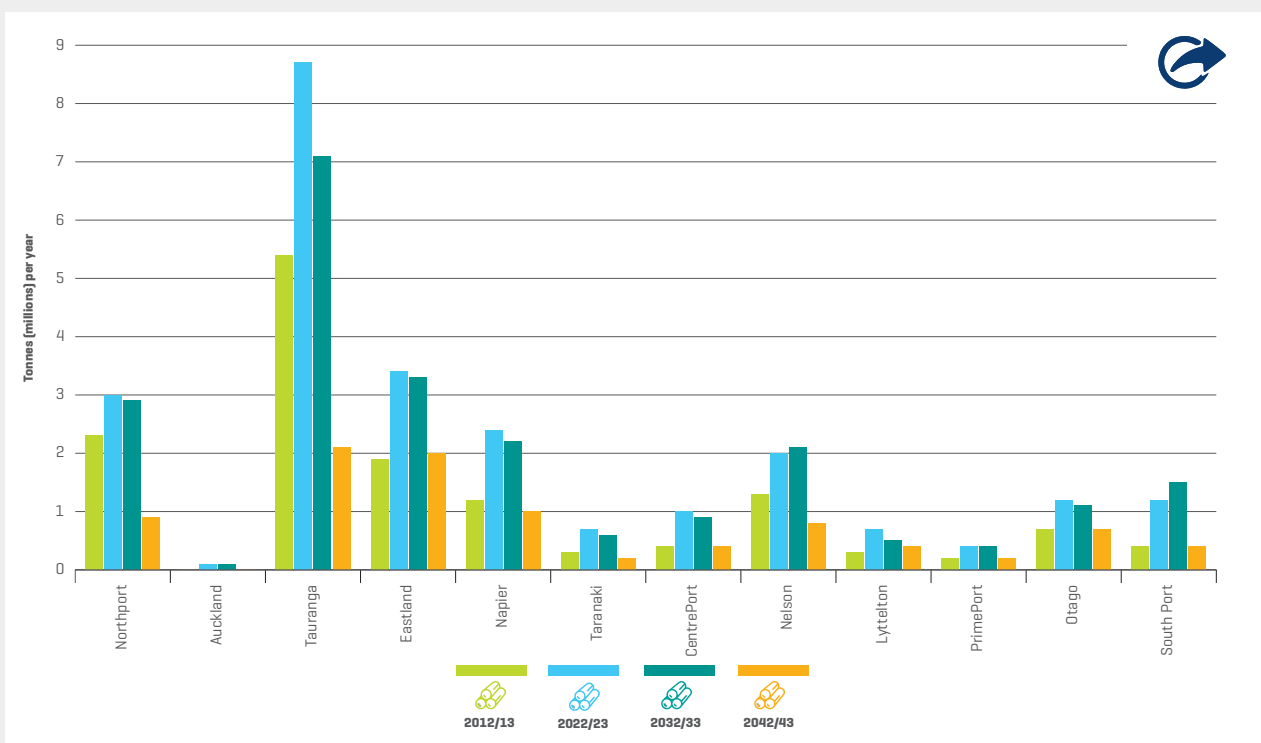


This figure excludes crude oil from Northport and Taranaki, methanol from Taranaki, and iron sands from Taharoa.

Reduced tonnages in some ports from 2022/23 or 2032/33 are explained mostly by a projected decline in log exports as forests planted in the 1990s are harvested and those logs are not immediately replaced.³⁹



B Figure 43: Base Case: projected log exports

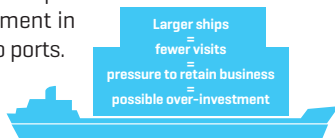


Congestion considerations

As trade flows increase, traffic congestion and limited land available for development at some ports may pose challenges. Congestion at ports and on land transport routes is also affected by the increasing capacity of vessels visiting New Zealand, requiring freight volumes to be loaded or unloaded within short periods. While technological developments may enable more efficient loading and unloading, land shortages, restrictions on operations (such as night-time operations), and public preferences for waterfront access may encourage the further development of inland ports, port relocations (as proposed in Auckland, for example), or the growth of other ports with fewer restrictions. The development of inland ports and switches by exporters between ports show that these changes are happening already where there are adequate road and/or rail networks into ports.

Port investment

Larger ships potentially making fewer visits to New Zealand also means increasing pressure on port companies to retain or attract business.⁴⁰ This may lead to heavy investment in port and harbour facilities and a potential risk of nationwide over-investment and/or the decline of those ports that are unable to compete. At the same time, the uncertainty about which ports shipping companies will service poses challenges for decisions about investments not only for the ports themselves, but also for investment in rail and roading infrastructure to ports.



Future Freight Scenarios

The Future Freight Scenarios Study published in November 2014 looked at the impact of larger container vessels on the freight system. The study found that fewer, larger ships were likely to call at a smaller number of New Zealand ports. This would lead to a need for investment in port infrastructure such as deeper channels and larger berths to accommodate larger vessels and increasing freight volumes. Potential gains from the use of larger vessels would be outweighed by increased port and domestic freight transport costs, and capital costs on the road, rail, and coastal shipping networks.

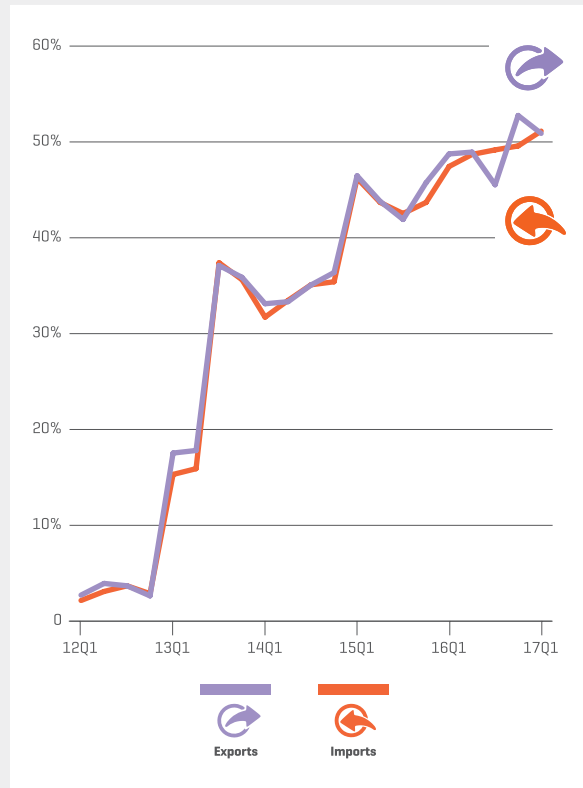


www.transport.govt.nz/assets/Uploads/Research/Documents/Future-Freight-Scenarios-Study.pdf



Ministry of Transport
TE MANATŪ WAKA

Figure 44: % of imports and exports carried on container vessels with 4,000+ TEUs⁴¹






Worldwide, there has a trend for container vessels to increase in size to reduce cost through economies of scale. Containerised vessels carry about one third of New Zealand's seaborne exports by tonnage but over 80% of export value.⁴² Bulk products represent the remaining two thirds of tonnage. Bulk vessels include ore carriers (iron sands) and crude oil tankers.

Large ships produce cost savings and a reduced carbon footprint, but also require expanded port infrastructure (for example, longer and stronger quays). This is relevant not just for freight: cruise operators also require improved infrastructure. Large ships also create peaks in port (un)loading and transport to/from the port. These peaks may generate impacts for the road and rail networks, or even an increased need for coastal shipping to move merchandise between primary and secondary ports.

39 http://m.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11692463
 40 www.transport.govt.nz/assets/Uploads/Research/Documents/Future-Freight-Scenarios-Study.pdf
 41 www.transport.govt.nz/assets/Uploads/Sea/FIGs-report-April-2015-March-2016.pdf
 42 www.transport.govt.nz/sea/figs/trade/trade-trends/

Freight movements by mode

Figure 45: Base Case: projected freight by mode

	Million tonnes 2012/13	% share 2012/13	Million tonnes 2022/23	Million tonnes 2032/33	Million tonnes 2042/43	% share 2042/43
 Road	217	91.4%	277	315	340	92.8%
 Rail	16	6.8%	19	20	21	5.6%
 Coastal shipping	4	1.8%	5	5	6	1.6%
Total	237		301	340	366	

Numbers may not sum due to rounding.






Mode comparisons



Freight tonnages carried by all modes are projected to increase significantly. All modes are likely to see significant technological advances, but there is no obvious reason why one mode might gain more from technology advances than others. Our model generally assumes that each mode maintains its current market share for each commodity between regions and for transport within each region. We have not looked at policies or investments that would encourage major freight mode shifts.

Under these assumptions, road transport is projected to remain the largest transport mode for all commodities. The share of other modes varies depending on the commodity. For example, in 2012/13, 46% of manufactured dairy products and 29% of meat products were transported by rail. Coastal shipping accounts for 31% of petroleum movements, with road taking the remainder.



-  Road is projected to maintain its dominant share of the freight market, accounting for 95% of growth in tonnage between 2012/13 and 2042/43. Its share rises from 91% [by tonnage] in 2012/13 to almost 93% in 2042/43.
-  The main reason for the projected fall in rail's mode share is a lack of growth in total shipments of two major classes of rail traffic over this period: coal from the West Coast and logs [with the passage of the 'wall of wood'].
-  The main reason for the projected fall in coastal shipping's mode share is that shipments of petroleum products from Marsden Point, which account for almost 60% of coastal shipping tonnage, are projected to grow relatively slowly over this time period.
-  Projected increases in import and export flows may contribute significantly to rail traffic given rail's competitive advantage in serving the concentrated volume of traffic at ports. Visits by larger container ships may add to this advantage.
-  Coastal shipping may become more common if international shipping services reduce their number of port visits, requiring transshipment of freight from hubs to other ports [for items that are not time-sensitive] and container repositioning.

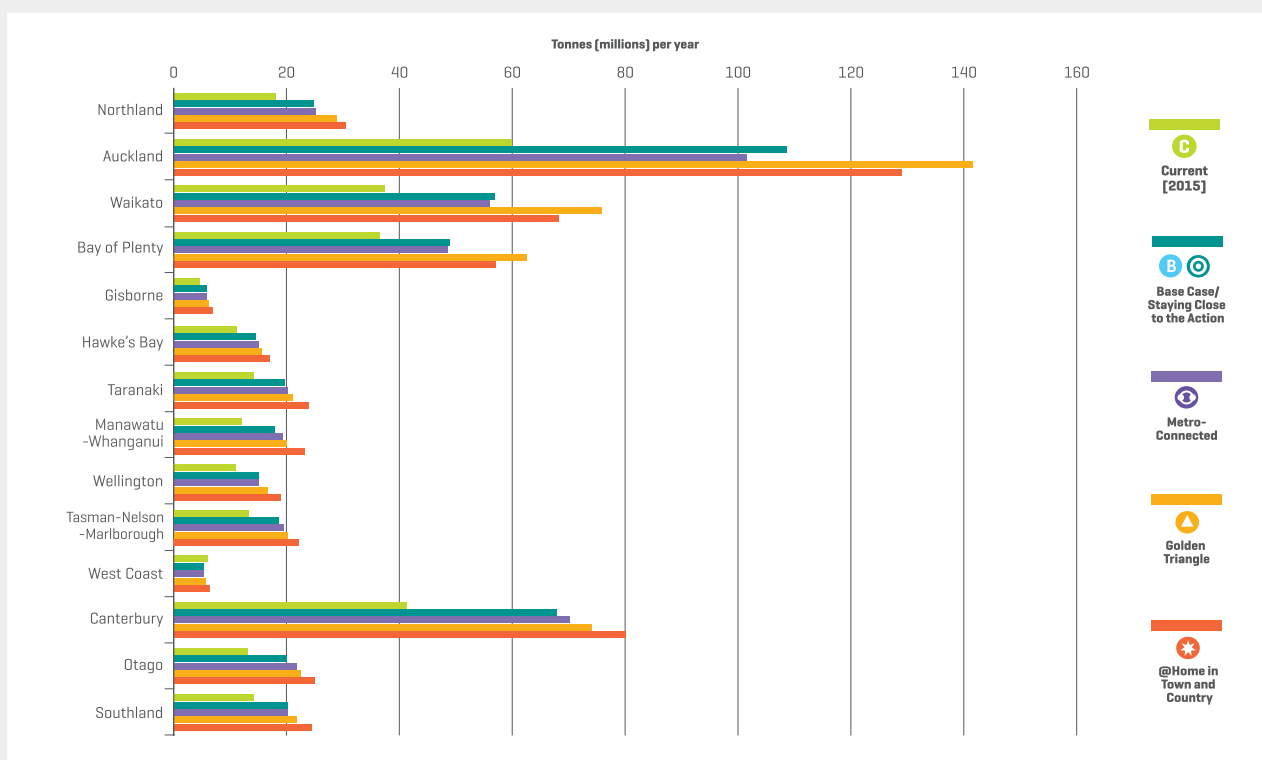
Alternative scenarios

Rates of economic and population growth by region are the largest uncertainties facing the freight sector. Other factors include the growth rates of various industries and potential changes in their supply chains, as well as the competitive position of the various transport modes, which will depend on both advances in technology and government policies.

The only differences between the scenarios in the case of freight are in the rates of economic growth by region, by commodity,

and nationwide. Economic growth in each region in each scenario is modelled by initially assuming that GDP in each region grows with the population. These initial estimates of economic growth are then scaled to force them to match the assumed national economic growth under the scenario. Based on relationships identified in the National Freight Demand Study, some commodities are assumed to grow more slowly than the rate of regional economic growth, while others grow at rates faster than the rate of regional economic growth.

Figure 46: All scenarios: projected freight tonnage [2042/43]



The numbers in this figure for each region are the sum of the freight that moves within the region and the freight into and out of the region. Regional numbers do not add up to the national total as flows between regions are counted twice.

- Under all scenarios freight tonnages are projected to increase compared with 2012/13 in all regions except for the West Coast where projected tonnage falls [except in the @Home in Town and Country scenario].
- The Staying Close to the Action scenario assumes the same level of economic and population growth by region as in the Base Case, and hence gives the same results as the Base Case.
- Under the Metro-Connected scenario, New Zealand-wide population and economic growth are the same as in the Base Case. However, population and economic growth are assumed to be more dispersed, with higher population growth in main centres other than Auckland, Hamilton, and Tauranga. Therefore, freight movements are also more dispersed.
- The Golden Triangle scenario is a high-growth scenario and freight tonnages are projected to be higher than in the Base Case, and substantially higher in Auckland, Waikato, and the Bay of Plenty.
- The @Home in Town and Country scenario is also a high-growth scenario, although growth is more evenly dispersed than in the Golden Triangle scenario.

Figure 47: All scenarios: projected inter-island freight [2042/43]

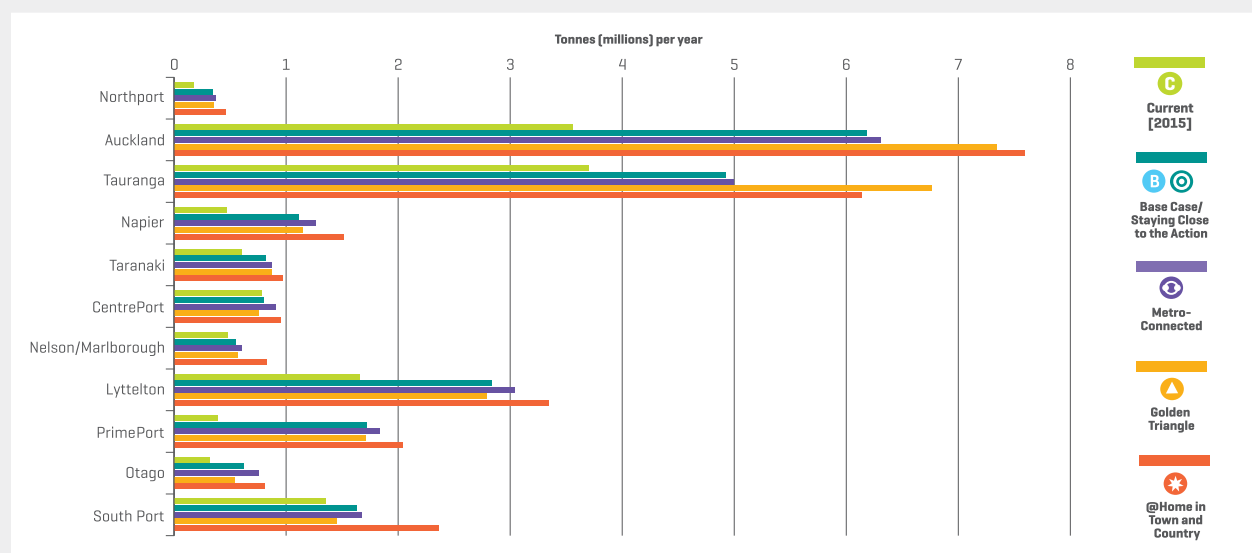
	National tonnage	Inter-island freight	
	Million tonnes per year	Million tonnes per year	% of national tonnage
C Current (2012/13)	237	5	2.2%
Scenarios [2042/43]			
B Base Case			
C Staying Close to the Action	366	8	2.1%
D Metro-Connected			
A Golden Triangle	442	8	1.8%
* @Home in Town and Country	443	9	1.9%

Freight tonnages between the North and South Islands are projected to increase under the Base Case and all scenarios.

However, the share of inter-island tonnage in the national total is projected to fall.



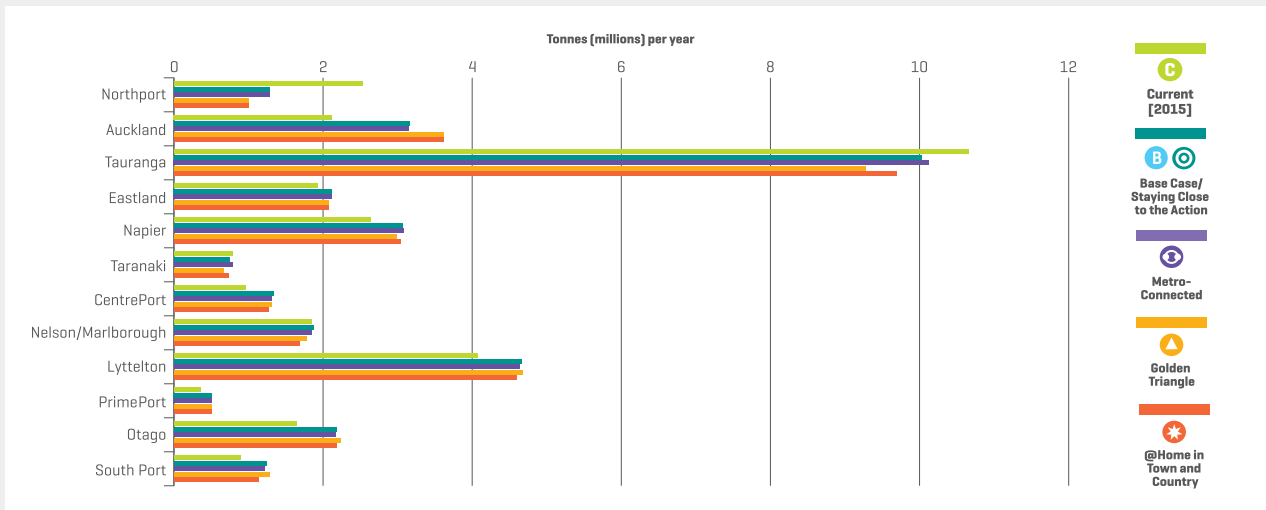
Figure 48: All scenarios: projected import tonnage [2042/43]



Imports increase under all scenarios due to population and economic growth, but increase most under the Golden Triangle and @Home in Town and Country scenarios that assume higher economic growth rates. In the @Home in Town and Country scenario, the mostly rural Southland region experiences a big increase in consumption

compared with the Base Case as the population disperses across New Zealand. Due to its remote location from New Zealand’s centres of production, a large share of the growth in consumption is supplied by imports as opposed to domestic production.

Figure 49: All scenarios: projected export tonnage [2042/43]



After rising to 2032/33, export tonnages are projected to fall in Northport and Tauranga in all scenarios by 2042/43 as a result of reduced log exports. However, these projections are uncertain as forestry owners have discretion over when to harvest.

- ▲ Under the Golden Triangle and @Home in Town and Country scenarios, higher growth levels boost demand for timber products for domestic use. Therefore, logs available for export fall even more in these scenarios.

Staying Close to the Action 2042/43

Melanie and Salesi notice more trucks and delivery vans around Auckland. The city's population has grown and there are deliveries everywhere to and from factories, shops, and distribution centres. Some deliveries are made by drones and robots.

Auckland's port has definitely got busier. It seems like there aren't as many ship visits as before, but the ships that do visit are huge. It makes for a very impressive sight, particularly when the cruise ships are also in town.



Metro-Connected 2042/43

Karen has spent all her life in Dunedin and has noticed how things have got gradually busier in the city and the surrounding area. Definitely in neighbouring Southland there are a lot more milk tankers on the roads and endless lines of trucks taking goods into Queenstown for all the tourists there. Quite a few products seem to come out of Christchurch. That's where many of the main warehouses for the South Island are located.



Golden Triangle 2042/43

Miriama and Tamati's young grandson is fascinated by trucks and trains, particularly the new ones where there's no driver. When he's out with his grandparents he likes to point to the trains and trucks criss-crossing the district going to and from places such as the factories in Auckland and the port at Tauranga. There aren't as many logging trucks as there used to be, although that's probably just temporary until the next generation of trees is harvested.

Sometimes Tamati and Miriama get frustrated with all the heavy traffic, but at least they can work from home sometimes or, if they're stuck behind a truck, it doesn't really matter as they can use the time productively in their self-driving vehicle.



@Home in Town and Country 2042/43

Lydia's cousin works at the port in Napier. With more people living in Napier and the Hawke's Bay region in general, it seems that there are a lot more imports coming in. The port is still busy with exports but it's quieter compared with a decade ago when there were always huge piles of logs waiting to be loaded. The port is also considerably quieter as new automated technologies are being used for loading and unloading vessels.



Projected vehicle kilometres travelled

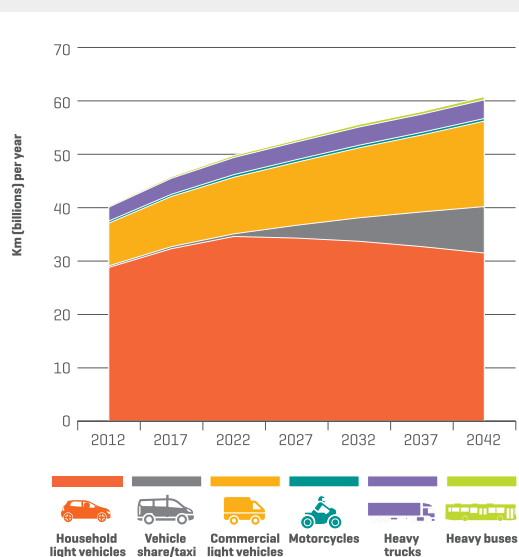


Vehicle kilometres travelled (VKTs) have an influence on New Zealand’s road infrastructure requirements, levels of traffic congestion, and greenhouse gas emissions.

B Base Case

In the Base Case, VKTs are projected to increase by about 50% from 2012/13 to 2042/43.

B Figure 50: Base Case: projected vehicle kilometres travelled by vehicle type



Household light vehicles make up the largest component of VKTs in 2042/43. Their VKTs are projected to grow by about 10% by 2042/43 in line with projected increases in household distance travelled by private vehicle drivers and an assumed 20% shift from private vehicles to vehicle-sharing.



Vehicle-share vehicles/taxis are projected to make up the third largest component of VKTs in 2042/43. Their VKTs grow very rapidly in percentage terms as 20% of private vehicle travel is assumed to shift to vehicle-sharing.



Commercial light vehicles make up the second largest component of VKTs in 2042/43. They include light vehicles such as light trucks, vans, and utes used for making deliveries and providing services of all types, as well as rental cars commonly used by overseas tourists and business travellers. Commercial light VKTs are projected to grow by about 100% by 2042/43 in line with growth in GDP. Our model does not take into account the possibility that in the future footpath-going robots and flying drones could potentially be used to make many deliveries.



Heavy trucks make up the fourth largest component of VKTs in 2042/43. Heavy truck VKTs grow in line with the growth in road freight. We assume that the average amount of freight carried in each truck will increase by 15% between 2012/13 and 2042/43, reflecting continued growth in the portion of the road network open to high-productivity motor-vehicles (HPMVs), as well as increases in freight carrier operational efficiencies. This growth in freight per truck can reduce some of the growth in heavy truck VKTs that would otherwise occur through increasing demand for freight transport.

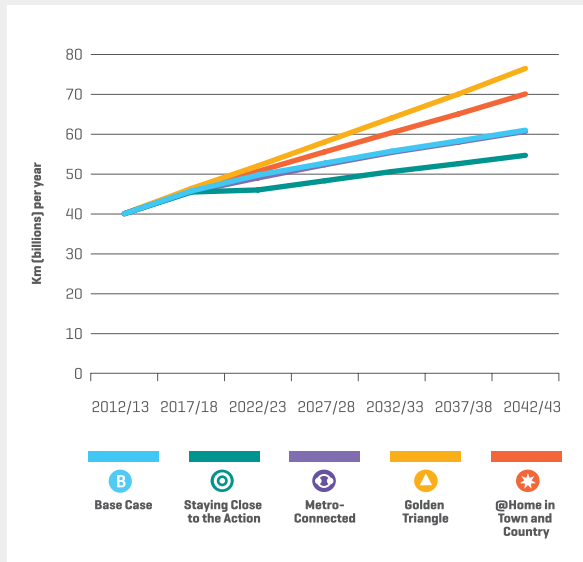


Heavy buses may be used either for public transport or tourism. We assume that demand for heavy buses for public transport grows in line with growth in public transport demand as discussed in the section on **Projected household travel** on page 21, while demand for heavy buses for tourism purposes grows with the projected growth in tourism.



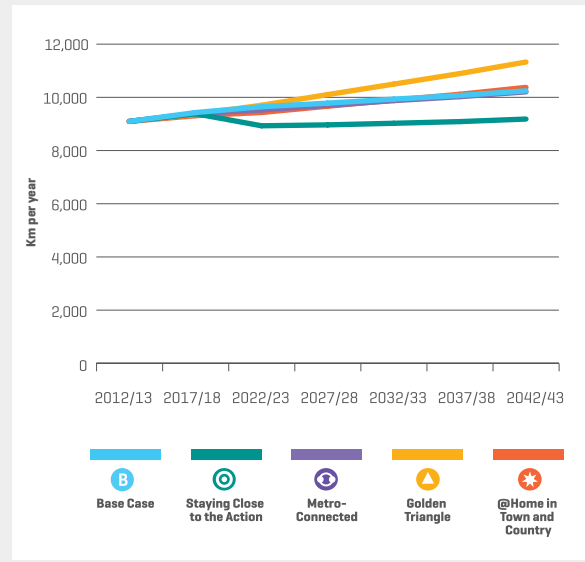
Alternative scenarios

Figure 51: All scenarios: projected vehicle kilometres travelled



In this figure, the Base Case and Metro-Connected scenario projections are almost identical.

Figure 52: All scenarios: projected vehicle kilometres travelled per capita



In this figure, the Base Case, @Home in Town and Country, and Metro-Connected scenario projections are almost identical.

- ⊙ The lowest growth in VKTs is in the Staying Close to the Action scenario, reflecting population growth focused on the central city and inner suburbs and the impact of demand management road pricing in Auckland and Wellington.
- ▲ The highest growth in VKTs occurs in the Golden Triangle scenario, due to the assumed sprawling land-use pattern in this scenario, as well as faster population and economic growth, leading to increased VKTs by all classes of vehicles.
- ★ The @Home in Town and Country scenario has higher growth in VKTs than the Base Case, mainly due to faster population growth and increased use of commercial vehicles as a result of faster economic growth.

- ⊙ The Staying Close to the Action scenario is the only scenario in which growth in VKTs per capita is not significant.
- ▲ The Golden Triangle scenario shows the **fastest** growth in VKTs per capita. The other three scenarios show a modest increase in VKTs per capita, driven by the growth in commercial light VKTs.
- ★ On a per capita basis, growth in the @Home in Town and Country scenario is similar to the Base Case and the Metro-Connected scenario, as faster growth in total VKTs is offset by faster growth in population in this scenario.



Figure 53: All scenarios: projected vehicle kilometres travelled in Auckland

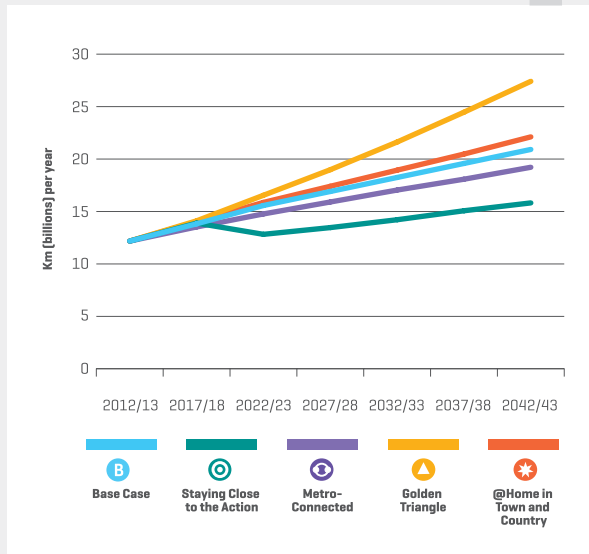
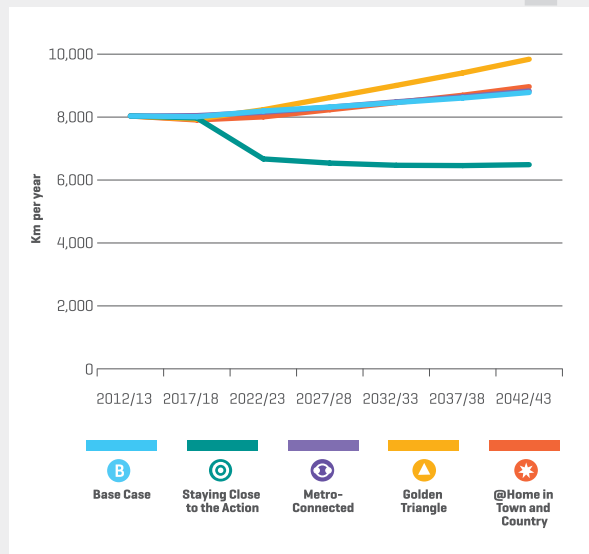


Figure 54: All scenarios: projected vehicle kilometres travelled in Auckland per capita



The Base Case, @Home in Town and Country and Metro-Connected scenario projections are almost identical.

- ⊙ In Auckland, the pattern for VKTs is similar to the national pattern, but the differences between the scenarios are larger. This reflects mainly the impact of demand management road pricing in Auckland in the Staying Close to the Action scenario.
- * Growth in VKTs in the @Home in Town and Country and the Metro-Connected scenarios is lower relative to the Base Case, reflecting the slower growth of population in Auckland in these scenarios.
- ⊙ Our VKT projections do not take into account constraints on network capacity and the impact that traffic congestion might have on travel demand, as future increases in capacity may potentially not keep up with future demand. The exception is the Staying Close to the Action scenario that limits VKT growth in Auckland and Wellington after 2022/23 to the assumed uncongested capacity of the network.

- ⊙ VKTs fall initially in the Staying Close to the Action scenario due to the introduction of demand management road pricing in Auckland and Wellington.



- ⊙ In Auckland, the pattern for VKTs per capita is again similar to the national pattern for VKTs per capita, but the differences between the scenarios are larger. In particular, the Staying Close to the Action scenario shows a significant decline in VKTs per capita due to the impact of demand management road pricing.

Projected vehicle fleet and transport greenhouse gas emissions



Transport is New Zealand's third largest greenhouse gas (GHG)-emitting sector and contributes about 18% of New Zealand's gross greenhouse gas emissions. Greenhouse gases trap heat in the Earth's atmosphere, producing environmental effects such as desertification, adverse weather events, increased melting of snow and ice, and sea level rise. **90%** of New Zealand's domestic transport emissions come from road transport, mostly from light passenger vehicles.⁴³

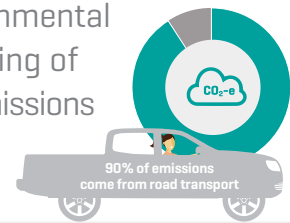


Figure 55: Composition of GHG emissions in the road transport sector⁴⁴

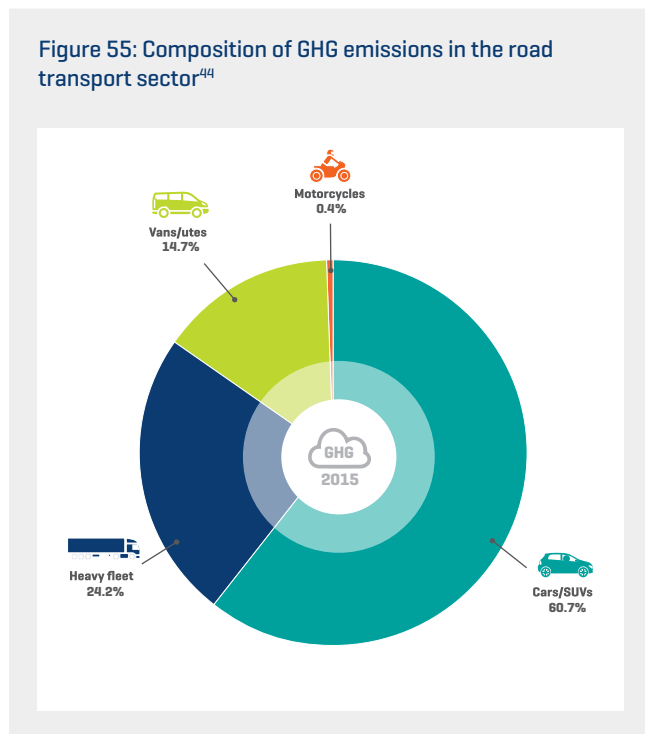
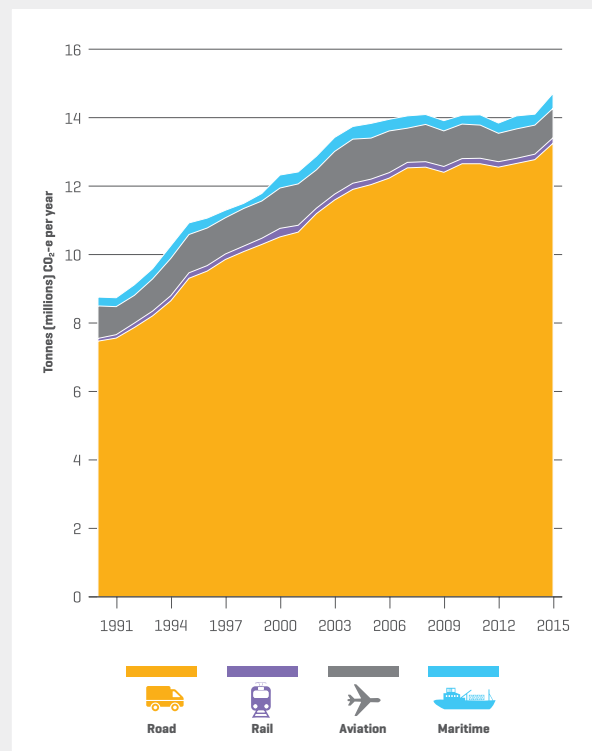


Figure 56: Transport emissions⁴⁵



CO₂-equivalent (CO₂-e) is a measure of total greenhouse gas emissions obtained by converting the emission of all greenhouse gases into equivalent quantities of CO₂ based on their heat-trapping potential.

Coastal shipping and rail have significantly lower emissions than road per tonne-kilometre of freight. Transport of freight by rail typically produces on average only about a third of the emissions of road freight (based on the current locomotive and truck fleet).⁴⁶

By the end of 2015, transport emissions had grown by 68% since 1990, and emissions per capita by 27%. 99% of the increase in transport emissions was due to increased road transport emissions. Although the rate of increase has tapered off on average in the last 10 years, there was a 4% increase in 2015.

43 www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory

44 Ministry of Transport analysis

45 www.transport.govt.nz/ourwork/tmif/environmental/ei001/

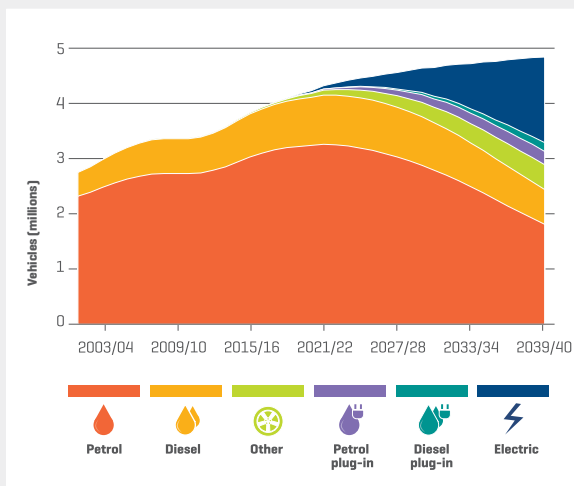
46 <https://royalsociety.org.nz/what-we-do/our-expert-advice/all-expert-advice-papers/climate-change-mitigation-options-for-new-zealand/sectoral-mitigation-options/transport/>

Projected vehicle fleet and emissions

B Base Case

Vehicle emissions are projected based on the size and composition of the vehicle fleet, distance travelled, and energy consumption factors for different vehicles.

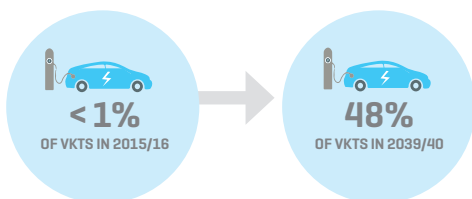
B Figure 57: Base Case: projected number of vehicles by fuel type⁴⁷



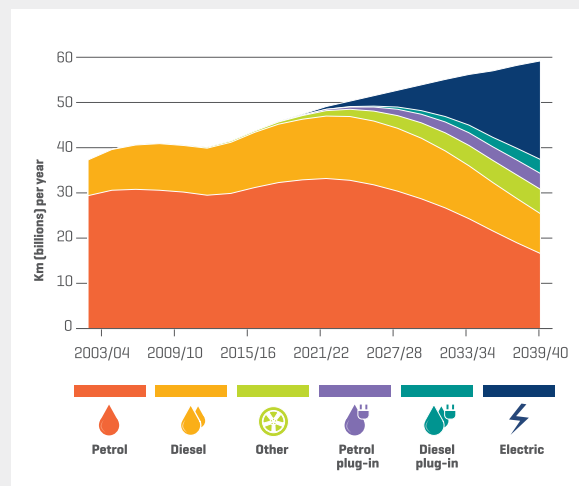
'Other' includes conventional hybrids and a very small number of LPG and CNG vehicles.

Petrol and diesel vehicles currently account for over 99% of the vehicle fleet but, by 2039/40, they are projected to fall to about half of the fleet and their number falls from 3.8 million in 2015/16 to 2.4 million. Electric vehicles (including plug-ins) are projected to account for about 40% of the vehicle fleet in 2039/40 [1.9 million vehicles] compared with less than 0.1% in 2015/16. The total ownership costs for electric vehicles are projected to reach parity with conventional vehicles in the mid 2020s. That would be the main driver for electric vehicle uptake.

In line with their increased presence in the vehicle fleet, electric vehicles (including plug-ins) are projected to account for 48% of VKTs by 2039/40 compared with under 1% in 2015/16.

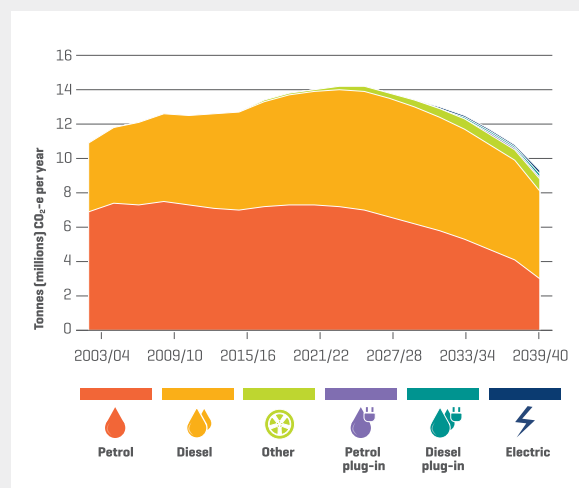


B Figure 58: Base Case: projected vehicle kilometres travelled by fuel type



Due to model limitations, VKT projections by fuel type and emissions extend to 2039/40 only.

B Figure 59: Base Case: projected vehicle fleet emissions by fuel type



Electric vehicle emissions include emissions from generating electricity used by electric vehicles.

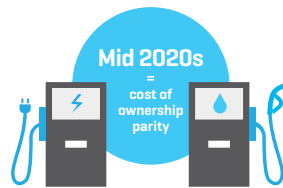
Emissions are projected to fall by 31% from 2015/16 to 2039/40, despite an increase in the size of the vehicle fleet and distance travelled. This reflects the presence of more electric vehicles in the vehicle fleet and, for non-electric vehicles, improved vehicle fuel efficiency. As a large proportion of electricity generation is from renewable sources [more than 80% in 2015],⁴⁸ this has resulted in a low emission intensity for electricity. It is expected that this emission intensity will fall further over time.



Alternative scenarios

The vehicle fleet is projected to grow in all scenarios. The projected number of private vehicles is a function of the number of households, household type, household income and, for the alternative scenarios, the assumed shift from private vehicle ownership to use of vehicle-share services. For other types of vehicles, including vehicle-share vehicles, the size of the fleet is a function of VKTs travelled.

New electric vehicles are projected to reach **cost of ownership parity** (vehicle cost, fuel, road user charges, repairs, and insurance) with conventional vehicles in the mid 2020s. Thereafter, in all cases



- Base Case and alternative scenarios
- the number of electric vehicles increases to become a significant fraction of the vehicle fleet. However, because of the slow turnover of the vehicle fleet, the transition to electric vehicles will take some time, especially given New Zealand's historically heavy reliance on used imported vehicles. The electric vehicle fleet is projected to grow fastest in the @Home in Town and Country and Golden Triangle scenarios that assume faster technology advance. This shift would likely be accelerated if oil prices were to spike again, as they did in the 2000s.

Figure 61: All scenarios: projected electric vehicles as % of vehicle fleet

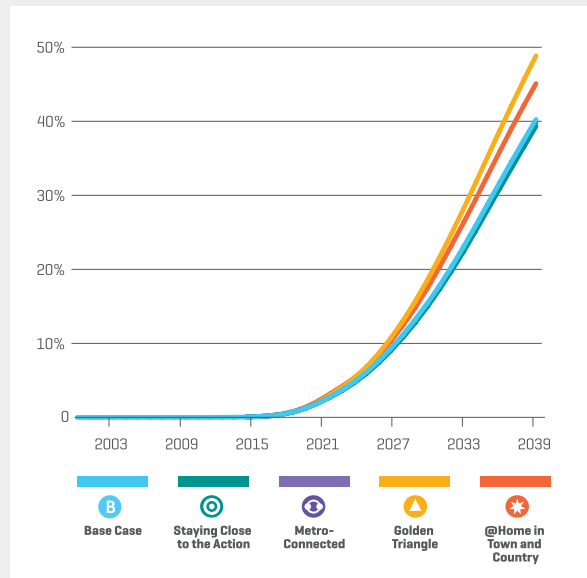
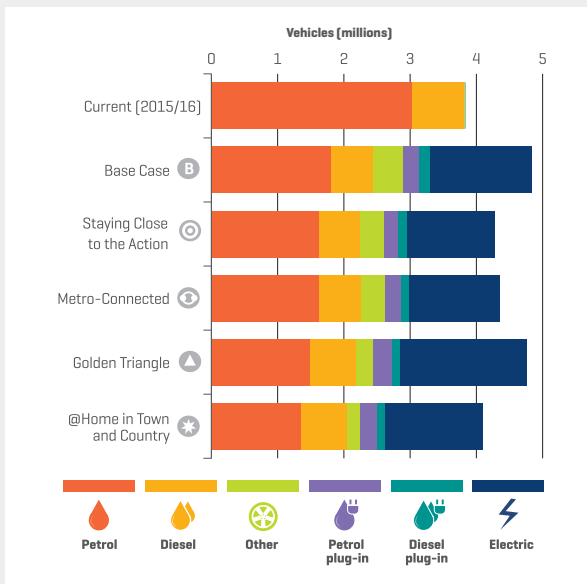


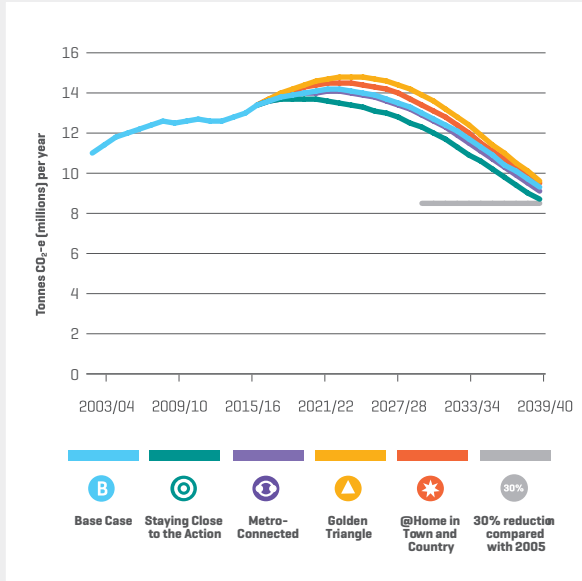
Figure 60: All scenarios: projected vehicle fleet [2039/40]



47 This information is slightly different from that in earlier Ministry of Transport publications (for example, fleet statistics and transport indicators) which is in calendar years and based on earlier extracts. The vehicle fleet numbers and VKTs used in this publication are extracted from a later version of the Motor Vehicle Register database and presented for financial years.

48 Ministry of Business, Innovation and Employment (2016), Energy in New Zealand, 2015 Calendar Year Edition

Figure 62: All scenarios: projected vehicle emissions



Emissions are projected to rise initially before falling, as EV registrations and improvements in fuel efficiency remain low in relation to growth in VKTs. Subsequently, VKTs continue to rise, but emissions begin to fall as EVs and newer, more fuel-efficient vehicles form a larger part of the vehicle fleet. Thus, emissions per vehicle, per VKT, and per capita are projected to fall.

New Zealand has made no greenhouse gas reduction commitments specifically related to transport. However, under the 2016 Paris Agreement, New Zealand has committed to an economy-wide reduction in greenhouse gas emissions to 30% below 2005 levels by 2030.⁴⁹

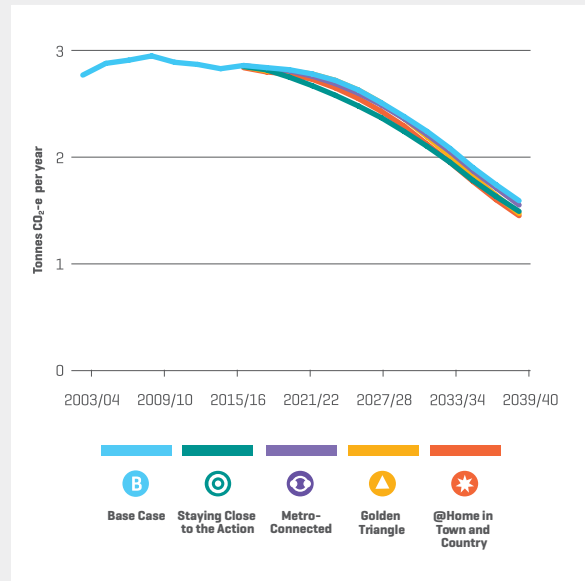


New Zealand would not meet this target for road transport under any of the scenarios examined here. However, it would achieve roughly a 30% reduction in road transport emissions compared with 2005 by 2040 in the Staying Close to the Action scenario.



Additional actions, beyond the widespread uptake of electric vehicles, would be required if New Zealand were to target a 30% reduction in road transport emissions by 2030.

Figure 63: All scenarios: projected vehicle emissions per capita



Electric vehicles [EVs]: what's the difference?⁵⁰

There are two main types of electric vehicle.

- Battery electric vehicles** are purely electric vehicles, fuelled only by a battery that is charged by plugging into an electric power point. Examples include the Nissan Leaf, Renault Zoe, and Tesla S. Renault Kangoo and Nissan eNV200 vans are also available in New Zealand.
- Plug-in hybrid electric vehicles** have two engines, one fuelled by a battery charged by plugging into an electric power point, the other fuelled by petrol or diesel. Their range is not limited by the batteries as they can be powered by the petrol or diesel engine even when their batteries have run down. Examples include the Mitsubishi Outlander PHEV, BMW i3 [range extender model], and Audi e-tron.

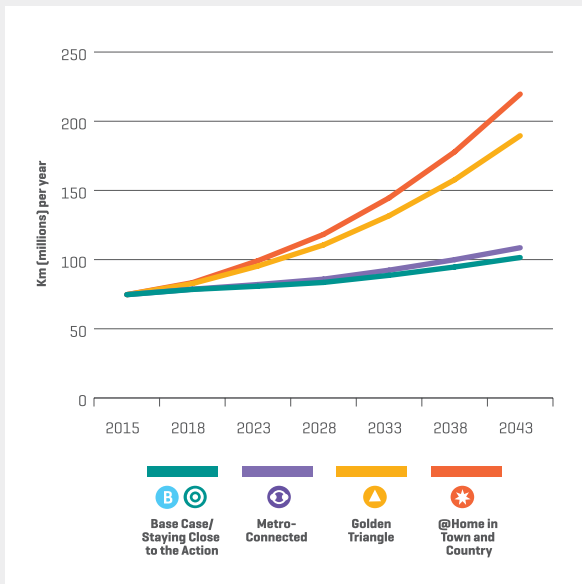
Conventional hybrids are similar in concept to plug-in hybrid electric vehicles, but they cannot be plugged in for recharging. Their batteries are small, and are charged only by re-capturing energy when braking or from electricity generated by the petrol or diesel engine. Although they are more fuel-efficient than a conventional petrol or diesel vehicle, they are not electric vehicles. Examples include the non-plug-in versions of the Toyota Prius and Honda Civic Hybrid.



Aviation emissions

Projected emissions from domestic air travel are based on distance travelled, the number of flights, and future aircraft fuel efficiency improvements.

Figure 64: All scenarios: projected aircraft distance flown



The distance travelled for the Base Case and the Staying Close to the Action scenario are the same as the only difference between the two scenarios is that, in the latter scenario, people prefer to live in the central city and inner suburbs.

Growth in aircraft distance flown is projected to increase moderately as a significant rise in passenger numbers is only partly offset by the use of larger aircraft.

Current jet fuel use (2015) is about 269 thousand tonnes. Jet fuel use is assumed to grow with the projected increase in aircraft distance travelled, although growth in distance travelled will be offset by improved fuel efficiency. Due to model limitations, these projections do not take into account the potential for additional fuel savings through improvements in flight operations, such as New Zealand's New Southern Sky National Airspace & Air Navigation Plan.⁵¹ We assume no biofuel uptake at this stage.

Figure 65: All scenarios: projected jet fuel use

2043 – Jet fuel use	Thousand tonnes
B Base Case	376
⊙ Staying Close to the Action	376
⊕ Metro-Connected	402
▲ Golden Triangle	651
* @Home in Town and Country	755

Figure 66: All scenarios: projected GHG emissions

2043 – GHG emissions	Thousand tonnes CO ₂ -e
B Base Case	1,198
⊙ Staying Close to the Action	1,198
⊕ Metro-Connected	1,281
▲ Golden Triangle	2,075
* @Home in Town and Country	2,405

As distance flown and jet fuel use increase, emissions are projected to increase from the current 856 thousand tonnes in 2015.



Further reductions in emissions may be possible through measures at airports such as additional taxiways, gates, and aircraft parking to reduce congestion and taxiing times and provision of ground power to aircraft to avoid the use of aircraft auxiliary power units that burn aviation fuel. Further changes in flight operations such as route optimisation, continuous descent paths, and tailored arrivals and departures can also help reduce the use of aviation fuel.⁵²

49 www4.unfccc.int/submissions/INDC/Published%20Documents/New%20Zealand/1/New%20Zealand%20INDC%202015.pdf

50 www.energywise.govt.nz/on-the-road/electric-vehicles/#Typesofelectricvehicles

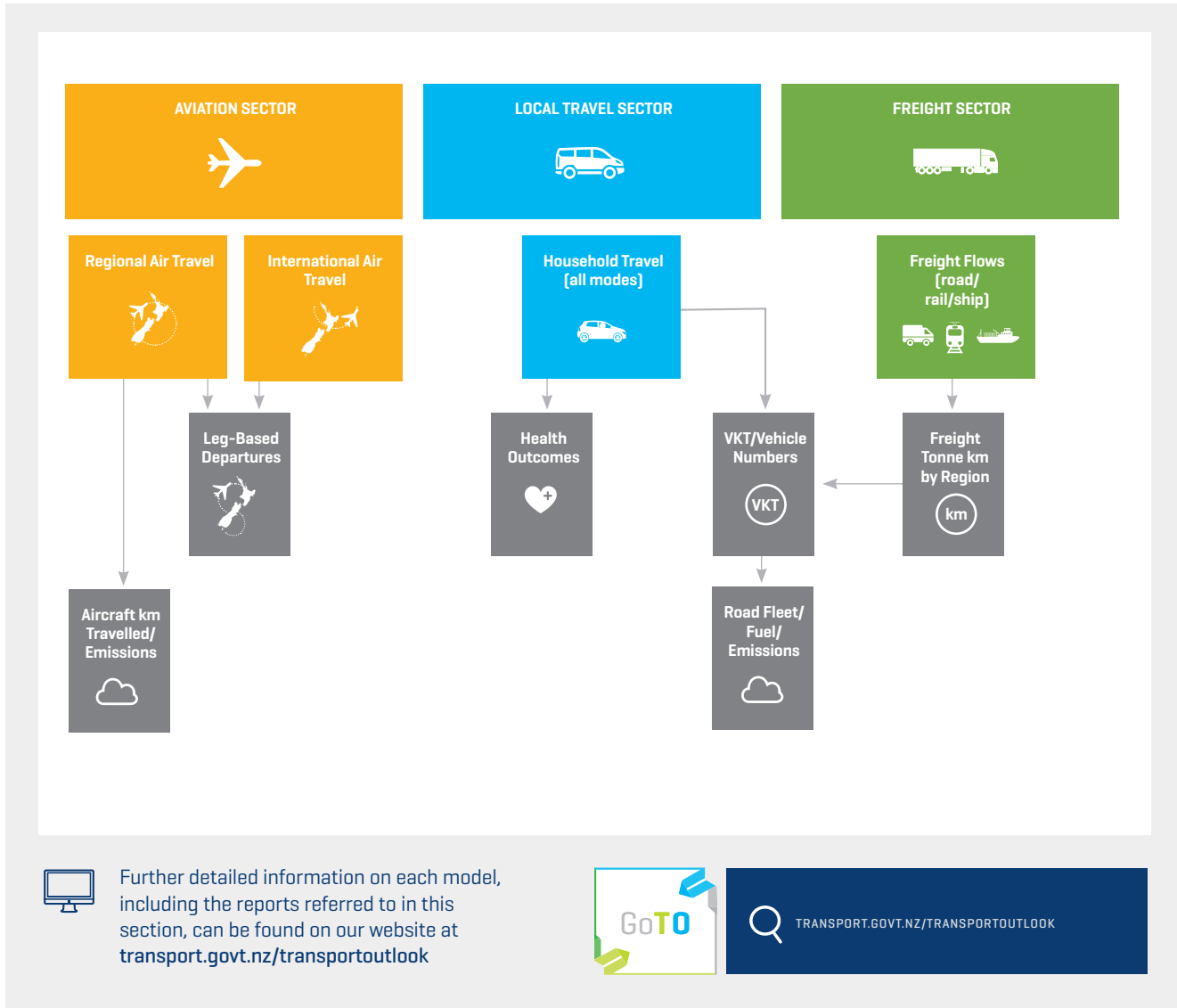
51 www.nss.govt.nz

52 www.transport.govt.nz/assets/Uploads/Air/Documents/Aviation-Emissions-Reduction-Plan.pdf

Model assumptions and methodologies



The projections in this report are based on a suite of models designed to be consistent with each other and, where possible, with the projections of other government agencies.



Freight flows

The freight model projects region-to-region and intra-regional freight flows by mode for 19 commodity classes in tonnes and tonne kilometres. This model extends the latest version of the National Freight Demand Study (NFDS), released in 2014, which analysed freight flows for 2012. All of the extensions were developed in cooperation with the authors of the NFDS.

Nine commodity groups (liquid milk, manufactured dairy products, meat, livestock, horticultural products, wool, other agricultural products, fish, and coal) are mostly exported or processed for export, and their production was projected by the authors of the NFDS based on an analysis of expected supply, taking into account constraints on available resources. These projections did not vary by scenario. For the remaining commodity groups, the authors identified drivers of the growth in supply and demand for each commodity by region, such as GDP and population by region, and world GDP growth (which influences demand for exports). Our model uses projections of these drivers under each scenario to grow the base year (2012) freight flows. The GDP and population assumptions used for the Base Case and alternative scenarios are the same as those for other projections in this document.

Another significant extension of the NFDS work in our model is a break-out that separates import and export movements from domestic movements. There were also some minor updates to the base year freight flow data to reflect known changes since 2012. These 'model basis' 2012 freight flows are the ones grown to create the future projections. However, the model results for 2012 have not been updated as they are historically correct.

Tonne km by region

The tonne km by region model projects the number of tonne km of freight on the roads in each region. Projections are based on region-to-region and intra-regional road freight tonnages from the freight model, as well as assumptions about how road freight would be routed between regions.

Health benefits of walking and cycling

The health model projects household transport-related health outcomes, including changes in the number of deaths, years of life lost (YLLs), years living with disability (YLD), and disability-adjusted life-years (DALYs) due to diseases of inactivity, as well as collisions of pedestrians and cyclists with vehicles.

The model was adapted for the Ministry by the University of Otago School of Public Health. It is based on the Integrated Transport and Health Impact Modelling Tool (ITHIM) produced by James Woodcock et al at the Centre for Diet and Activity Research at the University of Cambridge, United Kingdom. The latter model has previously been adapted to a number of countries and regions worldwide.⁵³



Household travel

The household travel model projects household travel by region and mode based on travel patterns in the New Zealand Household Travel Survey.

The initial model projection of household travel is obtained by breaking down the population into cells, each representing a combination of region, income class, household type, age class, and household vehicle ownership (0, 1, 2 or 3 vehicles). Per capita travel in each cell is assumed to remain the same as it is today. The travel demand in each cell is then grown according to future population projections. The results are re-aggregated to give a projection of future travel demand by mode in each region.

⁵³ Michael Keall, Ed Randal, Jagadish Guria, Alistair Woodward, "Health outcomes projected from Transportation Modelling for the New Zealand Transport Outlook", August 2016

The following assumptions and adjustments to the initial model projections are used in our final projections

	Base Case	Staying Close to the Action	Metro-Connected	Golden Triangle	@Home in Town and Country
Demographics					
Population by household type and age	Stats NZ medium B projection	Stats NZ medium B projection	Stats NZ medium B projection	Stats NZ high B projection	Stats NZ high B projection
Regional population growth	Stats NZ medium projection as updated February 2017	Stats NZ medium B projection as updated February 2017	Stats NZ medium B projection as updated February 2017 Growth is set to the same percentage rate in 11 territorial authorities with populations > 75,000 in 2013: Auckland, Christchurch, Wellington, Hamilton, Dunedin, Tauranga, Lower Hutt, Whangarei, Palmerston North, New Plymouth, and Hastings. This percentage rate is equal to the percentage rate of the 11 territorial authorities combined in the original Stats NZ medium B projection. In other territorial authorities, growth rates are the same as in the Base Case.	Stats NZ high projection as updated February 2017	Stats NZ high projection as updated February 2017 Growth is set to the same percentage rate in all regions
Economy					
GDP	2016/17 – 2030/31 Treasury 2016 Half-Year Economic and Fiscal Update 2031/32 – 2042/43 Treasury Superannuation Fund Contribution Rate Model	Same as Base Case	Same as Base Case	Real per capita GDP grows at 1% per year faster than Base Case due to rapid technological advancement	Real per capita GDP grows at 1% per year faster than Base Case due to rapid technological advancement
Urban planning					
Change in average trip length	Initial model projection [reflects only economic and demographic changes]	Down 10% in Auckland and 5% in Wellington compared with initial model projection by 2042/43	Initial model projection [reflects only economic and demographic changes]	Up 10% compared with initial model projection by 2042/43	Initial model projection [reflects only economic and demographic changes]
Uptake of pedestrian travel	Initial model projection [reflects only economic and demographic changes]	Up 30% compared with initial model projection by 2042/43	Up 20% compared with initial model projection by 2042/43	Up 10% compared with initial model projection by 2042/43	Up 10% compared with initial model projection by 2042/43
Uptake of cycling	Initial model projection [reflects only economic and demographic changes]	Up 200% compared with initial model projection by 2042/43	Up 100% compared with initial model projection by 2042/43	Up 50% compared with initial model projection by 2042/43	Up 50% compared with initial model projection by 2042/43
Technology					
Auckland demand management road pricing	No	In 2022/23 holds VKT by all vehicle types 17% below Base Case levels; VKT then grows by 1% per year thereafter	No	No	No
Wellington demand management road pricing	No	In 2022/23 holds VKT by all vehicle types 15% below Base Case levels; VKT then grows by 0.5% per year thereafter	No	No	No
Per capita work trips	Initial model projection [reflects only economic and demographic changes]	Down 10% compared with initial model projection by 2042/43	Down 10% compared with initial model projection by 2042/43	Down 20% compared with initial model projection by 2042/43	Down 30% compared with initial model projection by 2042/43
Per capita non-work trips	Initial model projection [reflects only economic and demographic changes]	Down 5% compared with initial model projection by 2042/43	Down 5% compared with initial model projection by 2042/43	Down 10% compared with initial model projection by 2042/43	Down 15% compared with initial model projection by 2042/43
Shift from private vehicles to vehicle or ride share	20% shift by 2042/43	40% shift by 2042/43	40% shift by 2042/43	60% shift by 2042/43	80% shift by 2042/43

Air travel and aviation emissions

The **regional air travel** model projects origin-to-destination domestic passenger travel. It is an econometric model developed for the Ministry by Professor Tim Hazledine of the University of Auckland.

The **international air travel** model projects international departures by the true origins of air travel. These are the sum of two components: departures by overseas visitors and departures by New Zealand residents. Departures by overseas visitors to 2022 are taken from MBIE's projections of international tourist arrivals, assuming that all overseas visitors depart New Zealand shortly after their arrival. We extrapolated these projections to 2043. Departures by New Zealand residents are based on an econometric projection of New Zealand-wide resident departures that are then pro-rated to origins based on projected population trends.

The **leg-based departures** model projects total airport departures by region. These include passengers who originate their trip at the airport, as estimated by the two models above, as well as connecting passengers. Numbers of connecting passengers are assumed to grow with the growth of domestic air travel.

The **aircraft km travelled/emissions** model uses the results of the regional air travel model, as well as assumptions about changes in aircraft fleet composition and aircraft load factors to project aircraft km travelled by aircraft type. Additional assumptions about fuel use by aircraft type per take-off and landing and per km of cruise are used to project fuel use and greenhouse gas emissions by aircraft type.

The following assumptions are used in our projections					
	Base Case	Staying Close to the Action	Metro-Connected	Golden Triangle	@Home in Town and Country
Demographics and economy – refer table on the previous page					
Domestic travel					
Frequency of domestic air travel	Initial model projection [reflects only economic and demographic changes]	Initial model projection [reflects only economic and demographic changes]	Up 5% compared with initial model projection [due mainly to people who work remotely from their colleagues]	Initial model projection [reflects only economic and demographic changes]	Up 10% compared with initial model projection [due mainly to people who work remotely from their colleagues]
International tourism					
Tourist arrivals	2016 – 2023 MBIE 2017 projection 2024 – 2025 3.5% per year [Ministry of Transport projection] 2026 – 2043 3% per year [Ministry of Transport projection]	Same as Base Case projection	Same as Base Case projection	2016 – 2023 MBIE 2017 projection 2024 – 2025 4% per year [Ministry of Transport projection] 2026 – 2043 4% per year [Ministry of Transport projection]	2016 – 2023 MBIE 2017 projection 2024 – 2025 4% per year [Ministry of Transport projection] 2026 – 2043 4% per year [Ministry of Transport projection]
Tourist visitor days	2016 – 2023 MBIE 2017 projection 2024 – 2025 3.5% per year [Ministry of Transport projection] 2026 – 2043 3% per year [Ministry of Transport projection]	Same as Base Case projection	Same as Base Case projection	2016 – 2023 MBIE 2017 projection 2024 – 2025 4% per year [Ministry of Transport projection] 2026 – 2043 4% per year [Ministry of Transport projection]	2016 – 2023 MBIE 2017 projection 2024 – 2025 4% per year [Ministry of Transport projection] 2026 – 2043 4% per year [Ministry of Transport projection]

Road fleet/fuel/emissions

The vehicle fleet emissions model projects change in the vehicle fleet by characteristics including vehicle type, fuel type, age, engine size (for light vehicles), gross vehicle mass (for heavy vehicles), and vehicles that are imported new vs used. This data is combined with assumed fuel consumption factors for different vehicles to estimate fuel use and greenhouse gas emissions.

The model simulates vehicle fleet additions and retirements over time, with the overall growth of the fleet and vehicle km travelled drawn from the VKT/vehicle numbers model. Historical fleet and VKT data is drawn from the Motor Vehicle Register.

VKT/vehicle numbers

The VKT/vehicle numbers model projects vehicle kilometres travelled (VKTs) by road vehicles by type of vehicle (cars/SUVs, vans/utes, heavy trucks, heavy buses, and motorcycles) and region, as well as the number of vehicles in the fleet by type of vehicle and region. Projections for cars/SUVs and vans/utes are further broken out into private light vehicles, commercial light vehicles, and vehicle share/taxi vehicles. Projections are based on results from the household travel model and tonne km by region model, as well as historical data on VKT and vehicle fleet composition from the Motor Vehicle Register from 2001 to 2015.

Uptake of electric vehicles

The uptake of electric vehicles (EVs) was based on research commissioned by the Ministry on the future cost of EVs and batteries.⁵⁴ The model compares the cost of ownership (capital cost, running costs, maintenance costs) of light EVs and conventional vehicles. Historically around half of New Zealand's light vehicles are imported used, mainly from Japan.⁵⁵ Hence, the future rate of growth of new EV sales in Japan is likely to have a significant impact on the later availability of used EVs in New Zealand. Current sales of EVs in Japan are quite low. This may change as Japanese carmakers continue to introduce new EV models, such as the recently updated Nissan Leaf and the recently released Toyota Prius plug-in hybrid.

The model projects uptake to 2030, based on when battery electric and plug-in hybrid vehicles will achieve total ownership cost parity with conventional vehicles. The projection of light EV uptake from the end of the modelled period to 2040, as well as electric motorcycles, mopeds, trucks, and buses from 2016 onwards came from consultation with the New Zealand Transport Agency, Ministry of Business, Innovation and Employment, Ministry for the Environment, and the Energy Efficiency and Conservation Authority.



⁵⁴ www.transport.govt.nz/ourwork/climatechange/electric-vehicles/development-of-the-electric-vehicles-programme

⁵⁵ www.transport.govt.nz/assets/Uploads/Research/Documents/Fleet-reports/The-NZ-Vehicle-Fleet-2016-web.pdf [Figures 2.1 and 2.2] and www.transport.govt.nz/assets/Uploads/Research/Documents/Fleet-reports/NZ-Vehicle-Fleet-Graphs-2016-web2.xlsx [Table 1.8]

Further information

Your 'GoTO'

The Ministry's website contains further information on many of the issues discussed in this report.



[TRANSPORT.GOVT.NZ/TRANSPORTOUTLOOK](https://transport.govt.nz/transportoutlook)

Related documents

NZTA Long Term Strategic View

The NZ Transport Agency [NZTA] has developed a first version of a Long Term Strategic View [LTSV] of the land transport system. The LTSV was developed to address the need for a consolidated, national-level view of issues and opportunities in the New Zealand transport system. It provides insight on the future influences on the transport system; the challenges and opportunities they will create; their scale; and when, where and why they will emerge. The first version of the LTSV provides a starting point for further collaboration with the sector, to develop a forward-looking view of the transport system and the contribution it makes to wider social and economic outcomes across New Zealand.



nzta.govt.nz/planning-and-investment/long-term-strategic-view/



Further information on many of the issues covered in this report can be found on the following sites.

Autonomous vehicles	www.transport.govt.nz/ourwork/technology/specific-transport-technologies/road-vehicle/autonomous-vehicles/	An overview of autonomous [self-driving] vehicles including testing and issues relating to their use
Aviation emissions	www.transport.govt.nz/assets/Uploads/Air/Documents/Aviation-Emissions-Reduction-Plan.pdf	New Zealand's aviation emissions action plan outlines policies and actions to reduce international aviation CO ₂ emissions [September 2016]
Drones	www.transport.govt.nz/ourwork/technology/specific-transport-technologies/remotely-piloted-aircraft/	An overview of the use of drones [unmanned aerial vehicles] and their implications
Economic Development and Transport	www.transport.govt.nz/assets/Uploads/Our-Work/Documents/edt-summary-report.pdf	Effect of investment in transport driving economic growth [November 2014]
Electric vehicles	www.transport.govt.nz/ourwork/technology/specific-transport-technologies/road-vehicle/engine-technologies/ www.transport.govt.nz/ourwork/climatechange/electric-vehicles/	Information on electric and hydrogen vehicles and their uptake
Future Demand	www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/future-demand/	A range of plausible futures that may impact on demand for personal travel [November 2014]
Future Freight Scenarios Study	www.transport.govt.nz/assets/Uploads/Research/Documents/Future-Freight-Scenarios-Study.pdf	A study by Deloitte on the impact of larger container vessels [November 2014]
Future Funding	www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/future-funding/	Land transport revenue and funding [November 2014]
Intelligent Transport Systems [ITS] Technology Action Plan	www.transport.govt.nz/ourwork/technology/intelligenttransportsystems/itsystems-technology-action-plan/	Action plan outlining the Government's approach to encouraging and enabling ITS technologies [May 2014]
Public Transport 2045	www.transport.govt.nz/ourwork/keystrategiesandplans/strategic-policy-programme/	Information about the Ministry's study on the long-term future for public transport, including emerging ideas, opportunities, and challenges
Technology and Transport	www.transport.govt.nz/ourwork/technology/	Summary of technological developments in transport

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Transport Outlook: Future State