NEW ZEALAND
INFRASTRUCTURE
COMMISSION
Te Waihanga

He Tūāpapa ki te Ora
Infrastructure for a Better Future

Aotearoa New Zealand Infrastructure Strategy Consultation Document
May 2021

Whitiwhitia te ora, whitiwhitia te ora
Tēnā rā koutou katoa.
E rere taku manu ki ngā maunga whakahī, ki ngā awa whakatere taniwha, ki reira mihi atu ai ki ngā kāwai nui, ki ngā kāwai roa e!
Nei te reo mihi, nei te reo rāhiri o Te Waihanga.
E whātoro ake nei ki a koutou katoa tūhono mai, kōrero mai kia anga whakamua ai ngā mahi waihanga i Aotearoa.
Tihei mauri ora!

This mihi acknowledges the mountains and the rivers of Aotearoa and the people/iwi who are associated with them (not just Māori but all people who live in the particular areas). This mihi also invites people to join this journey discussing the future of infrastructure for New Zealand.

He Tūāpapa ki te ora *can translate to mean 'a foundation to/ towards wellbeing. The word 'tūāpapa' is commonly interpreted as 'foundation'. It encapsulates the idea that the infrastructure system is the foundation for our way of living. 'Ora' is widely recognised as meaning 'life' or 'wellbeing'.*

About this document
E pā ana ki tēnei tuhinga

The New Zealand Infrastructure Commission, Te Waihanga is developing an Infrastructure Strategy for Aotearoa New Zealand. This consultation document sets out a proposed direction for the Strategy for your feedback, ideas and views. Following consultation, this information will be used to finalise the draft Infrastructure Strategy that will be provided to the Minister for Infrastructure in September 2021.

Submissions will be open from 12 May to 2 July 2021 and you can provide your feedback at www.infrastructure.govt.nz/have-your-say.

Mā Te Waihanga e whakawhanake tētahi Rautaki o te Hanganga o Aotearoa mō ngā tau 30. Mā tēnei tuhinga ka whakatakoto ngā aronga marohi o Te Waihanga hei whakahoki kōrero, whakaaro, tirohanga māu. Whai muri i te whakawhiti, ka hangaia te Rautaki Hanganga Hukihuki e mātou, ka tukuna ki te Minita o Hanganga hei te marama o Mahuru, 2021.

Ka tuwhera ngā tāpaetanga i te 12 o Haratua tae atu ki te 2 o Hōngongoi 2021, ā, ka taea tō whakahoki kōrero te tāpae mā www.infrastructure.govt.nz/have-your-say.

"Infrastructure is more than just concrete and steel. It's the services that shape our lives. We use roads to take the kids to school, power to heat and light our homes, and mobile networks to connect us to friends and family. So, everyone deserves a chance to have their say."

— **Ross Copland, Chief Executive at Te Waihanga**

"Kaua ko te raima, ko te tīra noa iho rānei tēnei mea te hanganga. Ko ngā ratonga kē ia e whakaaweawe ana i tō tātou ao. Ka whakamahi tātou i ngā huarahi ki te kawe tamariki ki ngā kura, pūngao ki te whakamahana me te tūrama i ō tātou kāinga, me ngā whatunga kawereo ki te tūhonohono i a tātou ki ō tātou hoa ki ō tātou hoa tae atu hoki ki te whānau. Nō reira, e tika ana kia whakahoki kōrero ngā tāngata katoa."

— **Ross Copland, Tumu Whakarae o Te Waihanga**

Overview
Tirohanga whānui

Our population has grown quickly, especially in cities, and we lag behind other countries in the infrastructure we need.

We're facing serious problems like climate change, unaffordable homes, congested cities and leaking pipes. Although we're building more infrastructure, there are limits to how much we can spend. It is expensive and it requires skills that are in demand. There are rules and regulations that also affect what can be done.

The Infrastructure Strategy will help to create an infrastructure system that gets the best results for all New Zealanders both now and well into the future. But to get it right we need your help.

In the past year Te Waihanga has engaged with representatives from central and local government, private infrastructure providers and the general public. We have also held workshops with stakeholders from around the country to listen to their concerns and learn about their priorities for infrastructure. We thank all those involved to date, as these discussions have helped shape the direction of and ideas in this document.

This consultation document shares a proposed vision for infrastructure, guiding principles, and areas where we have identified change is needed. They form a starting point for this conversation with you, the people of Aotearoa New Zealand, as we work toward the Infrastructure Strategy. We are looking to a future where our infrastructure keeps pace with population and economic growth and gives New Zealanders the services they expect.

What we've heard so far

Through 'Our Aotearoa 2050' survey we asked New Zealanders for their views on infrastructure issues. They told us:

- The time it takes to build new transport options is an important transport issue. Lack of access to public transport and the time it takes to get around cities are close behind. Improving public transport is the preferred solution.
- Affordable housing and our ageing schools and hospitals are the main issues holding us back as a country. More investment in our water networks is needed and we could be using technology to save water.
- We create too much waste and our cities can't keep up with its growth. Producing less waste is important in preparing for the impacts of climate change.
- Our environment is the top priority when it comes to making infrastructure decisions.

Proposed vision for infrastructure 2050
Te tirohanga marohi mō te hanganga 2050

Infrastructure lays the foundation for the people, places and businesses of Aotearoa New Zealand to thrive for generations.

E whakatakoto ana te hanganga i te tūāpapa o te ora o te tangata, o ngā wāhi, me ngā pakihi o Aotearoa kia ora rawa atu mō ngā whakatupuranga.

Proposed outcomes and principles
Ngā hua me ngā mātāpono e marohitia nei

All decision-making about infrastructure must be guided by Te Tiriti o Waitangi (the Treaty of Waitangi) and its principles, but specifically the obligation to partner with Māori. As well as this, we propose a fundamental principle that infrastructure should support oranga tangata or the wellbeing of people.

To achieve this, we propose that infrastructure investment decisions be guided by the following outcomes.

- **Efficient:** Infrastructure decisions provide value for money, meaning that the benefits of infrastructure for economic, social, environmental and cultural wellbeing are larger than the costs to provide it.
- **Equitable:** Infrastructure decisions, including those that relate to funding, are fair and inclusive of all New Zealanders and recognise the needs of those who are disadvantaged or vulnerable in our society.
- **Affordable:** Infrastructure is affordable for providers and users, which means that we carefully prioritise new investment, while making the most of the infrastructure we already have.

We propose that these outcomes be supported by the following decision-making principles.

- **Future-focused:** We think about the future while learning from the past, and ensure that our infrastructure is adaptable and responsive to changing circumstances, including climate change.
- **Transparent:** We are open, honest and transparent about how infrastructure decisions are made and the trade-offs we are making between different outcomes.
- **Focused on options:** We consider all relevant options to deliver outcomes, including non-built alternatives to physical infrastructure.
- **Integrated:** We think across infrastructure networks and avoid siloed thinking and decision-making.
- **Evidence-based:** Infrastructure decisions are based on robust and accurate information about costs, benefits, risks, and wider positive and negative impacts, including the quantifications of costs, benefits and risks wherever possible.

Me ārahi ngā whakataunga katoa e pā ana ki te hanganga e Te Tiriti o Waitangi me ngā mātāpono, inā hoki te takohanga ki te mahi tahi ki a Ngāi Māori. Waihoki, e marohi nei mātou ko tētahi tino mātāpono me tautoko te hanganga i te orange tangata.

E tutuki ai tēnei, e marohi nei mātou me ārahi ngā whakataunga e pā ana ki te whakangao pūtea e ngā hua e whai ake nei.

- **Whāomo:** Me tino pai te wāriu o te whakapau pūtea, arā, inā noa atu te nui o ngā painga o ngā hanganga mō te orange ōhanga, pāpori, taiao, ahurea anō hoki i te nui o te utu ki te whakarato.
- **Tōkeke:** E whārite ana, e peke katoa ana anō hoki ki ngā tāngata katoa o Aotearoa ngā whakataunga hanganga, waihoki, e tautohungia ana anō hoki ngā hiahia o te hunga whakatiki, whakaraerae hoki i tō tātou pāpori.
- **Iti te utu:** He iti te utu o te hanganga mō ngā kaiwhakarato me ngā kaiwhakamahi, arā, e āhei ana te āta whakamatamua i te whakangao pūtea i te hanganga kua oti kē te whakatū.

E marohi nei mātou kia tautokongia ēnei hua e ngā mātāpono whakatau e whai ake nei.

- **Anamata:** E whai whakaaro ana mātou ki te anamata, me te ako anō hoki i te hītoria, me te whakarite i ō tātou hanganga kia urutau, kia rata anō hoki ki ngā āhuatanga o te wā, pēnei i te hurihanga o te āhuarangi.
- **Pūata:** He tuwhera, he pono, he pūata anō hoki mātou mō ā mātou whakataunga hanganga me ngā tikanga whaipānga, me ngā whakawhāritenga o ngā hua rerekē.
- **Aro ana ki ngā kōwhiringa:** E whai whakaaro ana mātou ki ngā kōwhiringa e whai pānga ana ki te whakaputa hua, tae atu hoki ki ngā whiringa ehara i te ōkiko.
- **Kōmitimiti:** E whai whakaaro ana mātou ki ngā whatunga hanganga rerekē, kia kaua mātou tā mātou whakaaro e whāiti.
- **Taunakitanga:** E tautokongia ana ngā whakataunga hanganga i runga i ngā pārongo tōtika, pakari hoki, mō ngā utu me ngā painga me ngā pānga pai, kino hoki, tae atu hoki ki te inenga o ngā utu, me ngā painga, me ngā tūraru, ki te taea.

New Zealand's infrastructure challenge is large and growing

E tupu tonu ana ngā raruraru hanganga o Aotearoa

We are facing significant infrastructure challenges that will require bold action to address.

Years of under-investment mean there is a substantial backlog of infrastructure that needs to be built. Added to this are the challenges of a growing and ageing population. This requires not only new infrastructure to cope with the demands of growth, but also maintained and improved levels of service from existing infrastructure. Adapting to and mitigating the impacts of climate change will add cost and complexity to New Zealand's infrastructure system. All these issues must be addressed in an environment where the costs of building infrastructure are high and growing.

Figure 1: Future infrastructure cost pressures

There is a significant gap between the infrastructure we need and what we can afford. It's not just a case of building more. We must also do better with the infrastructure we already have if we are to meet the proposed vision for 2050.

Proposed Action Areas
Ngā wāhanga mahi e marohitia nei hei whakatutuki

To meet the proposed vision and the challenges New Zealand faces, we have identified a number of areas where change is needed. We call these areas Needs.

We have categorised these Needs under three Action Areas:

1. **Building a Better Future:** Delivering infrastructure that is resilient to stresses and shocks and ready for change.
2. **Enabling Competitive Cities and Regions:** Ensuring that our infrastructure systems support the needs of people living in cities and regions and improve our connections both within New Zealand and with our markets overseas.
3. **Creating a Better System:** A step change in how we plan, design, fund and deliver infrastructure.

1

Building a Better Future

Delivering infrastructure that is resilient to stresses and shocks and ready for change.

Needs

1. Prepare infrastructure for climate change
2. Transition energy infrastructure for a zero-carbon 2050
3. Adapt to technological and digital change
4. Respond to demographic change
5. Partner with Māori: Mahi Ngātahi
6. Ensure security and resilience of critical infrastructure

2

Enabling Competitive Cities and Regions

Ensuring that our infrastructure systems support the needs of people living in cities and regions and improve our connections both within New Zealand and with our markets overseas.

Needs

1. Enable a responsive planning system
2. Coordinate delivery of housing and infrastructure
3. Improve access to employment
4. Plan for lead infrastructure
5. Improve regional and international connections

3

Creating a Better System

A step change in how we plan, design, fund and deliver infrastructure.

Needs

1. Integrate infrastructure institutions
2. Ensure equitable funding and financing
3. Make better use of existing infrastructure
4. Require informed and transparent decision-making
5. Develop and prioritise a pipeline of work
6. Improve project procurement and delivery
7. Reduce costs and improve consenting
8. Activate infrastructure for economic stimulus

Proposed priorities
Ngā whakaarotau e marohitia nei

We have identified several areas that have the potential to make the biggest difference to our infrastructure system. These proposed priorities fall into five categories.

1. Institutional and governance reform

New Zealand has many organisations involved in infrastructure planning, funding and delivery. Decision-making across the infrastructure system is currently fragmented and lacks coordination. Better integration and coordination between local and central government infrastructure functions could significantly improve New Zealand's infrastructure system. Extensive reviews and reform are already underway, including the Review into the Future for Local Government, reform of our health and disability system and the Three Waters (drinking water, stormwater and wastewater) Reform Programme. Further options to improve New Zealand's governance of infrastructure need to be explored.

2. Getting the price right

There is a growing gap between the demand for infrastructure and the funding available or the willingness to pay for it. As well as building new infrastructure, we need to find better ways to use the infrastructure we already have. This means focusing on ways to better manage demand at peak periods (such as congestion on motorways during rush hour). Pricing strategies can enable demand to be better managed. Examples include:

- Congestion pricing or road tolling to reduce congestion in our cities and make them easier to access.
- Increasing coverage of on-street parking charges to make the best use of our urban spaces.
- Water metering to ensure better use of water infrastructure.
- Waste-disposal charges that reflect the true cost of disposal to landfill.
- Including the full cost of carbon in infrastructure business case appraisals and decision-making.

Any pricing strategy would need to consider mitigation approaches for low-income New Zealanders, so they are not disadvantaged.

3. Supporting housing supply

Housing in New Zealand is highly unaffordable, especially in fast-growing cities, and there are also broader issues with housing supply and quality. More development options are needed to increase housing supply and affordability. This will require changes to the planning environment and a consideration of options to plan, fund and deliver the necessary associated infrastructure. Options could include:

- Developing consistent national planning rules to standardise the current fragmented approach to designing district plan rules.
- Implementing regional spatial planning, where all the infrastructure elements needed for our regions and cities are planned for together, and requiring these plans to be funded.
- Merging regional and district plans into combined plans with specific measures to address the time and cost of plan making under the current system.
- Identifying the locations where planning restrictions are having a large impact on housing supply, and identifying steps to optimise these regulations to benefit all New Zealanders.
- Creating targets for new housing development opportunities in cities and setting housing requirements through national direction.

4. Supporting a zero-carbon economy and preparing for climate change

Climate change may very well be the defining challenge of this century. It will have dramatic effects on how, where and when infrastructure is built, as well as the way it is used. The 2050 net-zero carbon emissions target will require new approaches to the design and construction of infrastructure and the waste it produces. To achieve the target there is growing consensus that:

- Electrification of transport and greater use of public transport and active travel (walking, cycling and micro-mobility) will be essential in cities.
- Cost-effective solutions must be found to decarbonise heating used in industrial processes (such as drying milk powder and smelting steel) and significant investment is needed in the energy sector to meet the growing demand for electricity.
- The planning system must be enabling of the infrastructure necessary for climate-change mitigation and adaptation.

5. A digital future

Technology will dramatically alter how we design, build and use infrastructure in the future. It's not possible to predict with any degree of certainty the extent of the technological advancement-that will occur in the next 30 years. However, there are actions that can be taken now to prepare for the changes that are likely to come. Updating the national digital strategy could be a first step. A move towards better data collection and transparency, along with open data for infrastructure sectors requires greater thought to enable a greater understanding of New Zealand's existing infrastructure performance, costs and impacts, as well as our future infrastructure requirements.

Next steps
Te ara ki mua

We are keen to hear your views on the areas we have identified as needing to change.

We have put forward some options and are keen to get your feedback on those. We also want to hear your great ideas about other things New Zealand can do to improve its infrastructure system. Please have your say at www.infrastructure.govt.nz/have-your-say.

The ideas you contribute during this consultation period will help us to develop the draft Infrastructure Strategy. It will be a strategy for New Zealand, developed with input from all New Zealanders.

We will provide the draft Infrastructure Strategy to the Minister for Infrastructure in September 2021. The draft Infrastructure Strategy will include a set of recommendations for the Minister to consider and respond to. The final Infrastructure Strategy will then be tabled by the Minister for Infrastructure in Parliament before the end of March 2022.

How to read this document
Me pēhea te pānui i tēnei tuhinga

This document sets out the approach we propose to take in developing the Infrastructure Strategy. We welcome your feedback on all parts of this so we can make sure we get it right. Here's what you'll find in each of the main sections.

Introduction

The importance of infrastructure to our lives and why we need a strategy for the future.

A 2050 vision for infrastructure

Our thinking behind a proposed vision for the future and principles for getting there.

The challenges for New Zealand's infrastructure

The issues that we think need to be addressed in the Infrastructure Strategy. These include major long-term issues like climate change and population change, and specific challenges we've found in infrastructure sectors like energy and transport.

What you have told us

Steps we've taken to get feedback so far and what we've heard.

Areas where action is needed to achieve the 2050 vision

Three **Action Areas** where we believe change will be needed based on the challenges we've identified.

Beneath these are a series of **Needs**, as required by our legislation, and **Options** for change or action, with timeframes for when we think we need to address them.

We are keen to hear whether you agree or disagree with the Options or if you think there are other things we should be looking to do. You'll find some questions on each of these to help prompt your thinking.

For each option we reference the relevant evidence base that has informed our thinking using a three-letter acronym. This is a reference for the full citation under the section 'Want to know more?'. These documents give additional information on the problems identified, the case for action or how the recommendation might work in practice.

The remaining sections share next steps, the complete list of questions and options and references.

Contents
Ngā ihirangi

Introduction
Kupu whakataki

Infrastructure supports our way of life

Our infrastructure is the tūāpapa, the foundation, and the base for our way of life. It's the roads, the pipes, the powerlines, the schools, the hospitals and the train stations. Infrastructure is a connected system that delivers and supports essential services like power, water, transport, healthcare and education. This is the infrastructure we depend on.

We often don't think about our infrastructure unless something goes wrong. But as we grow, we need our infrastructure to grow too. The way we and future generations of New Zealanders live will depend on the decisions we make now. We need to think about how we'll want to live. We need to think about issues like our changing climate, new technology and challenges like earthquakes and pandemics.

This means some difficult questions will need to be asked and big decisions will need to be made. Our infrastructure is the result of a lot of hard work, money and skills, and it can shape our natural and built environments. It's the result of the systems we put in place to plan, the rules we make to protect us and our environment, and the organisations we form to make decisions and care for the infrastructure investments we have made.

Why do we need an infrastructure strategy?

New Zealand already has a lot of organisations that plan, build and operate infrastructure: Waka Kotahi is responsible for our highways, councils look after local roads, water, public transport, and more, and our ports and airports are managed by a combination of publicly listed and council-owned entities, with some Crown involvement. But for all the people and organisations involved, there hasn't been one institution looking across them all.

That's where the New Zealand Infrastructure Commission, Te Waihanga comes in. Our job is to take a 'helicopter view' of how New Zealand plans, builds, operates and pays for our infrastructure. This needs to happens in a way that improves quality of life for all New Zealanders.

The Infrastructure Strategy will need to:

Look at the infrastructure we have

To plan for the future we need to understand where we are now. The Infrastructure Strategy will look closely at our infrastructure and the organisations and systems that build and support it. It will identify ways we can better use what we have.

Look to 2050

We will be setting a direction for 2050 and planning how we'll get there in each decade. There are some big changes we need to plan for. Our climate is changing and we need to be prepared. Our infrastructure is ageing while at the same time digital technology is rapidly changing our way of life and altering what's possible. Our population is not only growing but becoming older and more diverse. All of these factors affect our infrastructure.

Work for everyone

Our infrastructure must support everyone regardless of income, gender or ethnicity. All New Zealanders, including those who are disabled or disadvantaged, should have the same opportunities. This is important because we know that poor infrastructure doesn't affect everyone equally.

Work in partnership

The Infrastructure Strategy will need to have a life beyond the page if it's going to make a real difference. A partnership is needed with infrastructure providers, the people who use infrastructure and – recognising the principles of Te Tiriti o Waitangi (the Treaty of Waitangi) – tangata whenua. Achieving effective partnerships will require the Infrastructure Strategy to outline a way forward that is affordable and implementable, and that will deliver benefits to current and future New Zealanders.

This consultation document is designed to get you thinking

We need your feedback to develop an Infrastructure Strategy for you, the people of New Zealand, that addresses the issues facing our infrastructure and the diverse needs of all New Zealanders.

A 2050 vision for infrastructure
Tētahi tirohanga 2050 mō te hanganga

A pathway to wellbeing for current and future generations: He Tūāpapa ki te ora
He huarahi ki te oranga o ngā reanga onāianei, o te anamata hoki: He Tūāpapa ki te ora

He Tūāpapa ki te ora: a foundation for wellbeing or toward wellbeing

Tūāpapa: foundation **Ora:** life or wellbeing **Ki:** movement toward

Infrastructure is the tūāpapa or foundation for everything we do. We need it to get around, get ready for the future, and to get ahead. It is vital for our oranga (wellbeing) and therefore improving the living standards of all New Zealanders. It is also fundamental to delivering a stronger, more diverse and more productive economy.

Our legislation is grounded in the concept of wellbeing and we recognise the cultural and constitutional foundation of Aotearoa, based in Te Tiriti o Waitangi (the Treaty of Waitangi).

Te ao Māori (the Māori worldview) views infrastructure holistically and in connection with everything: the land, environment, communities and people. Two whakataukī (proverbs) speak to the complexity of infrastructure decision-making and the need for a broader perspective of current and future wellbeing.

The first whakataukī speaks to the importance of placing the wellbeing of the people at the heart of infrastructure decision-making:

> *He aha te mea nui o te ao? He tangata, he tangata, he tangata.*
>
> *What is the most important thing in the world? It is the people, it is the people, it is the people.*

The second whakataukī highlights the permanence of land and the responsibility of each generation to protect the built and natural environment we live in for future generations.

> *Toitū te whenua, whatungarongaro te tangata.*
>
> *Land remains while people disappear.*

This speaks to the long life of infrastructure assets. Good infrastructure decision-making should support the wellbeing of current and future generations, while sustaining the life-supporting capacity of the land, air and water.

Te ao Māori encourages us to think about infrastructure from the broad perspectives of wellbeing (oranga), kaitiaki (guardianship and stewardship), integration, longevity and connection to place.

This shapes the vision for infrastructure as we look out to 2050.

Proposed vision for 2050
Te tirohanga marohi mō te tau 2050

Looking to 2050, we aim for infrastructure that supports:

- A productive, sustainable and carbon-neutral economy.
- Affordable, accessible and healthy housing.
- Reliable, affordable and accessible travel options powered by renewable energy.
- Clean natural environments and heathy ecosystems.
- Access to education, employment, knowledge and recreation.
- Safe and healthy communities, iwi, hapū and whānau.
- A globally integrated economy.
- Resilience to the stresses and shocks the future will inevitably bring.

To meet these aims, we are interested in your feedback on the following proposed collective vision.

Infrastructure Vision 2050

Infrastructure lays the foundation for the people, places and businesses of Aotearoa New Zealand to thrive for generations

We are looking to a future where our infrastructure keeps pace with population and economic growth and gives New Zealanders the services they expect. Infrastructure isn't the only contributor to a better future, but it's a cornerstone that underpins our collective wellbeing.

Discussion question

Q1. What are your views on the proposed 2050 infrastructure vision for New Zealand?

Outcomes and principles to guide good infrastructure decision-making

Ngā hua me ngā mātāpono e eke ai ngā whakatau mō te whakatū hanganga

Good decision-making doesn't just happen. It is a conscious and principled process.

All decision-making about infrastructure must be guided by **Te Tiriti o Waitangi** (the Treaty of Waitangi) and its principles, but specifically the obligation to partner with Māori.

As well as this, our legislation directs us to consider the fundamental principle that infrastructure should support **oranga tangata** or the wellbeing of people.

To achieve this, we propose that infrastructure investment decisions be guided by the following outcomes.

Efficient: Infrastructure decisions provide value for money, meaning that the benefits of infrastructure for economic, social, environmental and cultural wellbeing are larger than the costs to provide it.

Equitable: Infrastructure decisions, including those that relate to funding, are fair and inclusive of all New Zealanders and recognise the needs of those who are disadvantaged or vulnerable in our society.

Affordable: Infrastructure is affordable for providers and users, which means that we carefully prioritise new investment, while making the most of the infrastructure we already have.

We propose that these outcomes be supported by the following decision-making principles:

Future-focused: We think about the future while learning from the past and ensure that our infrastructure is adaptable and responsive to changing circumstances, including climate change.

Transparent: We are open, honest and transparent about how infrastructure decisions are made and the trade-offs we are making between different outcomes.

Focused on options: We consider all relevant options to deliver outcomes, including non-built alternatives to physical infrastructure.

Integrated: We think across infrastructure networks and avoid siloed thinking and decision-making.

Evidence-based: Infrastructure decisions are based on robust and accurate information about costs, benefits, risks and wider positive and negative impacts, including the quantification of costs, benefits and risks wherever possible.

Discussion question

Q2. What are your views on the decision-making outcomes and principles we've chosen? Are there others that should be included?

The challenges for New Zealand's infrastructure
Ngā raruraru e pā ana ki ngā hanganga o Aotearoa

3

Infrastructure affects our wellbeing
E pāngia ana tō tātou oranga e te hanganga

"Wellbeing is when people are able to lead fulfilling lives with purpose, balance and meaning to them."

— **Wellbeing Budget 2019.**[1]

Well-functioning infrastructure contributes to wellbeing in many ways. Health and education infrastructure support our ability to live healthy and productive lives. Transport infrastructure enables us to access opportunities, interact with friends and family, and trade with each other. Telecommunications infrastructure allows us to connect with each other and share information. Energy infrastructure powers it all: our homes, hospitals, cars, trains, factories and businesses. Water infrastructure protects our health and the quality of our environment. High-performing infrastructure is often invisible. It is only when it is unavailable that its importance for wellbeing becomes apparent to many.

Compared to people in many countries, New Zealanders have a high standard of living. New Zealand is ranked 12th in the OECD (Organisation for Economic Co-operation and Development) across all indicators in its Better Life Index.[2] From an economic perspective, the World Economic Forum found in 2019 that New Zealand ranked first out of 141 economies for macroeconomic stability, third for the quality of our institutions and fifth for our labour market.[3]

However, our infrastructure is holding us back. New Zealand ranks 46th out of 141 economies for the state of our infrastructure.[4] Similarly, the G20 rates New Zealand's overall infrastructure performance as below average for a high-income country, and behind comparable countries including Singapore, Denmark, Australia and Ireland.[5] We are not making the most of the infrastructure we have and there is research showing that we lack a lot of the infrastructure we need. At the same time, the costs of building infrastructure are rising quickly.[6]

Figure 2: Global Competitiveness Report 2019: New Zealand, World Economic Forum[7]

New Zealand's infrastructure challenge is growing
E tupu tonu ana ngā raruraru hanganga o Aotearoa

New Zealand is facing some major challenges that can be linked to infrastructure. If we don't act, these will harm our economic future and damage our society and environment.

These challenges include:

- Improving New Zealanders' access to safe drinking water.
- Managing our three waters infrastructure (drinking water, stormwater and wastewater) to reduce pressure on the environment.
- Ensuring that New Zealanders have access to housing that is safe, warm and affordable.
- Building homes quickly enough to meet demand, without creating low-quality short-lifespan housing and putting pressure on infrastructure networks (like electricity) due to poor design.
- Avoiding unnecessary congestion in urban areas.
- Adapting to and mitigating the effects of climate change.
- Adapting to rapid changes in technology and protecting against risks from cyber security.
- Making the best use of what we already have through improved efficiency and performance of networked infrastructure.

New Zealand's infrastructure challenges are increasing. There are several reasons for this, as shown in the following indicative chart:

- New Zealand has a backlog of infrastructure that needs to be built due to past under-investment (current infrastructure deficit).
- The population of our country is changing. We're growing, urbanising and aging. We need new and improved infrastructure to cope with these changes.

- Adapting to climate change is difficult and expensive due to the need to defend or relocate infrastructure that is threatened by sea-level rise. In addition, new infrastructure is likely to be required to mitigate the impacts of climate change by enabling a low-emission economy.
- Construction cost pressures are increasing, reflecting issues like rising input costs, boom-bust cycles and the increasing complexity of the projects we are undertaking, many of which are occurring in existing urban areas. These issues, combined with our planning system, are eroding productivity.
- There are also ongoing costs associated with depreciation and the renewal of our infrastructure to maintain existing levels of service.

Figure 3: Future infrastructure cost pressures

New Zealanders clearly derive significant wellbeing from infrastructure and understand how further investment can benefit their lives, businesses, communities and the environment. However, our infrastructure aspirations appear to greatly exceed what is currently planned and able to be funded. This highlights the need for a long-term infrastructure strategy that builds a public acceptance of closing the infrastructure gap, using a combination of:

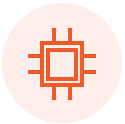
- **Demand management** to make better use of existing infrastructure and extend its life.
- **New funding and financing** to provide access to more capital for new infrastructure projects.
- **Productivity improvements** in infrastructure planning, construction and management that reduce the cost of renewing of building new infrastructure.

Long-term trends on the infrastructure horizon
Ngā ia pae tawhiti i te huapae hanganga

Planning for a 30-year infrastructure horizon requires an understanding of major long-term trends.

Climate change: Our climate is warming, rainfall patterns are changing, weather events are getting more extreme and our sea levels are rising. Climate change will affect every aspect of New Zealand's infrastructure. This includes, for example, where and how we build, the materials that are used and the cost of sourcing them, as well as the resources and energy used to construct, maintain and operate assets.

Population change: Our population is growing, becoming more urbanised and ageing. The populations of cities are likely to increase, particularly Auckland's, which will place pressure on existing infrastructure and demand greater investment. At the same time, some parts of New Zealand are expected to stagnate or experience population decline. Strategies for managing smart decline may become more important for these areas. They may need to find ways to reduce or even decommission infrastructure to manage the financial burden of maintaining underutilised assets. New Zealand's population is also generally ageing, which will change infrastructure demand and raise access and affordability issues.



Technology change: A wide-ranging technological transformation is underway globally, affecting all sectors of the economy. It is characterised by almost universal connectivity and immense computing power, and draws on the generation and use of vast amounts of data. The list of potentially transformative technologies is long. We're seeing the long-run marginal cost of new renewable-energy technology fall so rapidly it is cheaper than thermal generation, tunnelling technology is transforming urban mass transit systems, low-orbit satellite technology is revolutionising telecommunications and battery technology is providing a credible pathway for decarbonising light-transport vehicles. Micro-mobility and ride-share apps are disrupting transport systems, while artificial intelligence, the Internet of Things and digital twins are transforming infrastructure design, planning and asset management.[8] Technological change has the potential to create major changes in how assets are managed and priced (and therefore funded), enabling asset owners to make better use of existing infrastructure. There is also an increasing need to identify and respond to cybersecurity risks facing infrastructure providers and users, as critical systems are increasingly being controlled by remote, non-human automation systems that are vulnerable to new threats.

Infrastructure for all New Zealanders: When infrastructure fails or performs poorly, often it is the disadvantaged, who have fewer options, who feel it most acutely. Those with resources readily find alternatives. When energy networks are disrupted or water quality is compromised, they can afford off-grid alternatives (like solar power and rain-water-collection systems). When congestion worsens, living in inner-city locations can be an easier but expensive substitute. These options are not available to the disadvantaged who don't have the resources available to pay for alternatives. As well, some people cannot access technology for financial or physical reasons, and affordable and viable options are not always readily available to them.

Meeting the infrastructure challenge front-on is not only about productivity and sustainability. It is also fundamental to achieving an equitable society in which all New Zealanders have the chance to participate and flourish. This requires the social impacts created by infrastructure decisions to be considered, so that any hardship or disadvantage can be appropriately mitigated. This is particularly important when considering pricing strategies and affordability issues.

Diversity and inclusion: These are also issues for infrastructure. For example, Māori, Pasifika and women are under-represented, particularly in professional and decision-making roles. In 2018, less than 13 percent of Engineering New Zealand's membership were women, with Māori making up 5.5 percent and Pasifika 2.4 percent.[9] As well, only 13.5 percent of the construction-sector workforce are women.[10] There is a large potential workforce that could increase our capacity and capability to deliver infrastructure, as well as add diversity of knowledge, experience and worldview to the sector.

A digital twin is a realistic digital representation of assets, processes or systems in the built environment.

The unique features of infrastructure
Ngā āhuatanga motuhake o te hanganga

Infrastructure has unique features that make it different from other goods and services[11]

These relate to how infrastructure is made and how it is used. These features affect how infrastructure is funded and how the organisations that provide it are structured and operate. All infrastructure sectors share these features to some degree.

- Infrastructure is **long-lived**. With good maintenance, infrastructure assets may last for over a century. This means they have ongoing impacts on communities. The way they are funded may need to take the long-lived nature of the infrastructure into account.
- Infrastructure is **lumpy**. Developing infrastructure involves large up-front costs. Many infrastructure sectors are natural monopolies. They do not always have competitors because it is not efficient to have several providers. To make sure infrastructure is provided cost effectively and fairly, we need rules and regulations in place.
- Infrastructure can be **interconnected**. Some infrastructure, like roads, water, and electricity, only work well if it operates as a network. For instance, a new water pipe can only supply a home with drinking water if it connects to other water pipes that link it to a water source. This can make it hard to work out who should pay for the new infrastructure components, and how much they should pay, as the pipe is connected to a network of infrastructure that is shared by many people.
- Infrastructure often provides **shared services** to a large number of people. When a residential power line fails, every home served by that line loses power. There need to be rules and standards in place about infrastructure quality to make sure the decisions an infrastructure provider makes are consistent with community preferences.
- Infrastructure generates **spill-over** effects. For example, a new road or a passenger transport service can make an existing road quieter or busier. It may also make it quicker to get to a hospital or to work. These wider impacts may have important implications for who benefits from infrastructure, and consequently choices about who should pay.

These unique features of infrastructure also influence the issues and challenges that each infrastructure sector has and the way in which they may be managed best.

Issues and challenges facing networked infrastructure

Ngā take me ngā wero o te hanganga whatunga

We have developed State of Play documents on the energy, telecommunications, water and transport sectors. These identified the following key issues.

Issues	
Energy	• About 60 percent of New Zealand's energy is produced from non-renewable sources. • The net-zero carbon emissions target doubles the electricity generation capacity required by 2050. • Maintaining affordability and energy security while we transition to renewable energy sources.
Telecommunications	• Ensuring people who live remotely can access services. • Cyber security and the risks from technology changes. • Barriers to access for the disadvantaged. • Increasing reliance on communications makes telecommunications infrastructure more critical.
Water	• Ensuring drinking water meets health standards. • Managing the impact of taking and discharging water, including water used for irrigation. • Large existing infrastructure deficit and rising expectations about water quality. • Climate change will affect water infrastructure and use.
Transport	• Population growth is putting pressure on transport infrastructure. • Managing peak-period congestion is an ongoing issue in cities. • Use of transport infrastructure produces a significant proportion of our total carbon emissions. • Cost of new infrastructure is growing fast.

What's on the horizon	
Energy	• The transition to net-zero carbon emissions will create challenges for price, reliability and management of supply during dry years. • New and improving energy technologies are expected to greatly reduce the cost of the transition over time.
Telecommunications	• Greater digital connectivity and increased demand for both speed and volume of data. • New technologies could improve access (such as satellite broadband). • Better international connectivity through undersea cable investment by the private sector.
Water	• Governance and regulatory reforms proposed to provide greater efficiency and safety.
Transport	• Electrification of the light-vehicle fleet and use of alternative fuels to reduce carbon emissions. • Use of technology such as driverless cars and artificial intelligence to manage demand and improve road safety. • Congestion pricing measures in cities to reduce peak traffic demand.

For more detailed information on the issues and challenges facing these and other infrastructure networks (including health, education, and waste), see our State of Play reports.
https://infracom.govt.nz/strategy/state-of-plays

Infrastructure is undergoing significant change

E panoni whakaumutia ana te hanganga

The Government is undertaking several policy reviews and reforms that will have significant implications for these and other infrastructure sectors.

They include:

- Resource management reform.
- Responding to climate change adaptation and mitigation.
- Three waters reform.
- Health and disability sector reform.
- Review into the Future for Local Government.
- Emergency management reform.
- Waste legislation review and waste strategy development.

These reviews and reforms are likely to have long-term impacts on how infrastructure is consented, delivered, owned and governed. The impacts of these reforms on infrastructure are still evolving, but a key challenge will be ensuring they are consistent and coordinated from an infrastructure perspective. As the Government's lead infrastructure advisor, Te Waihanga is actively involved in providing advice to the Minister for Infrastructure on many of these reforms. They will also be considered in the Infrastructure Strategy if they have been sufficiently advanced by that stage.

Infrastructure is periodically required to respond to shocks and the most recent of those is the Covid-19 pandemic.

It has forced us to rethink how we live our lives and how we use infrastructure to connect and get around. Covid-19 has had a significant impact on the infrastructure sector, amplifying the following challenges:[12]

- Uncertainty over the infrastructure pipeline, with projects cancelled or delayed because of Covid-19.
- Local government funding and financing constraints. Local government has experienced a fall in non-rates revenue because of Covid-19 and this has driven reductions and deferrals in infrastructure expenditure.
- A workforce shortage. With the overseas workforce drying up due to Covid-19, organisations are struggling to source skilled workers. This is a barrier to recovery and has put further pressure on an infrastructure labour market that is operating close to full capacity. This situation may be made worse if construction workers take up opportunities in Australia made possible by the trans-Tasman bubble and an infrastructure boom fuelled by fiscal stimulus at Federal and State level.
- Supply chain disruption for essential materials and associated impacts on our export- and import-related infrastructure. This is adding to the cost of freight, increasing lead times and lowering inventory levels.

The Covid-19 pandemic is a reminder of the importance of a resilient, flexible and agile infrastructure system, as demonstrated, for instance, in the move to working from home, where telecommunications infrastructure has become a substitute for physical transport infrastructure.

What you have told us
Tāu kōrero ki a mātou

4

In the past year we have been laying the groundwork for the Infrastructure Strategy. We have developed and published in-depth reports on New Zealand's infrastructure sectors, in consultation with sector stakeholders. We have also undertaken the following specific engagement.

Asset owners survey

A survey was conducted during 2020 of asset owners from the local government, central government, health, transport, energy and telecommunications sectors. Key themes identified from this survey are set out below:

Funding and financing: Affordability and the availability of funding were raised as major short to medium- and longer-term challenges across the sectors. Many organisations identified an infrastructure deficit and a maintenance and renewal backlog as both short- and longer-term issues. This is compounded by the infrastructure impacts associated with climate change. Actions recommended by asset owners included:

- Access to new sources of funding and finance.
- The development of a national funding plan.

Asset management: The adequacy of current infrastructure was a challenge raised across the sectors. This was combined with internal capability and capacity problems, including access to skilled asset-management staff. It can be difficult to attract people with the right asset-management and decision-making skills and experience. Areas for suggested change included:

- More effective long-term planning for organisations.
- Better supply chain planning.
- A focus on education, training, and skills.

Natural hazards and climate change: Climate change was raised as a significant medium to longer-term challenge across the sectors. It was identified as likely to increase the incidence of natural hazards and to have significant impacts on the physical condition of infrastructure, service continuity, insurance accessibility and available funds. As well as an increase in the cost of asset protection, there will be an increased risk of asset failure and organisations will need to re-route infrastructure. Areas for suggested change included:

- A national response to climate change, natural hazards and other environmental issues including funding, national standards and more guidance and clarity on the roles of local and central government.
- Options for a national infrastructure insurance scheme.
- Centralised funding to support climate change impacts, particularly in high-risk areas.
- Exploring how price signals could be included in the infrastructure system (such as the transport system) to account for greenhouse gas emissions.
- Early government decisions on the location of strategic assets affected by sea-level rise predictions and support for risk reduction through defences and moving businesses to less affected areas.
- Investigating how a transition to a low-emissions economy may occur, in what sectors and over what timescale, and with consideration of the impacts on the entire supply chain.

Regional engagement

During 2020 Te Waihanga consulted local authorities to better understand the key challenges of infrastructure, encourage contribution to the infrastructure pipeline and raise awareness of the Infrastructure Commission. The result of this consultation is the Regional Consultation Report. Key areas for further consideration arising from this work include:

- Studying the benefits of a central agency to part-fund non-land transport public infrastructure in partnership with local government. It could create financial levers to encourage common asset-management systems.
- Aligning regions and regional boundaries to ensure a consistent approach for all local, regional and central government agencies.
- Taking a consistent approach to asset management, asset renewals and resourcing.

This work also raised several funding and financing challenges, including:

- Using development contributions to fund growth.
- Debt constraints as councils need to keep some headroom to deal with natural disasters. Also, they may have self-imposed thresholds due to debt-servicing issues.
- Unfunded responsibilities being passed down to councils by central government. This takes resources away from infrastructure investment and core service delivery.
- Lack of funding from government for infrastructure supporting state-owned assets, with ratepayers effectively subsidising these assets.
- The high cost that water reforms are placing on councils, particularly smaller provincial and rural councils with fewer ratepayers than others.

Digital engagement

We have started a conversation with the wider public on expectations for New Zealand's infrastructure. Our Aotearoa 2050 survey asked people for their views on infrastructure issues, potential solutions and their priorities for the future. More than 23,000 people responded and some key trends included:

- The time it takes to build new transport infrastructure was an important transport issue for New Zealanders. A lack of access to public transport and the time it takes to get around cities are close behind.
- People are showing a clear preference for improving public transport as a potential solution.
- Our aging schools and hospitals, and safe drinking water are key concerns when it comes to issues that are holding us back as a country. Respondents feel that more investment in our water networks is needed and we could be using technology to save water.
- In terms of getting ready for the future, people's top concerns are that we create too much waste and that our cities can't keep up with its growth. Most feel that producing less waste is an important action in preparing for the impacts of climate change.
- Across all areas, New Zealanders see the environment as the top priority when it

comes to making decisions.

Discussion question

Q3. Are there any other infrastructure issues, challenges or opportunities that we should consider?

What we've heard – some of the results from our Aotearoa 2050 survey.

8500+
comments made

23,500+
responses
to Aotearoa 2050

The environment was rated as the highest priority when making infrastructure decisions

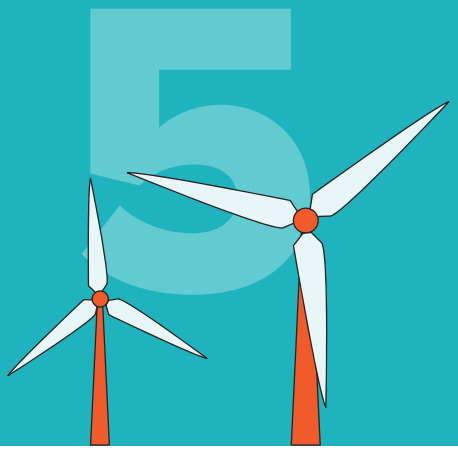
To 'get ready' for climate change, **85%** of respondents said we should **definitely produce less waste**

The most important infrastructure issue was: **we do not always have safe drinking water 70%** of respondents said it was **very important**

88% of respondents said that the issue of it taking too long to build new transport options was very important or important.

Areas where action is needed to achieve the 2050 vision

Ngā wāhanga hei whakatutuki i te tirohanga 2050



Our three proposed Action Areas

Ngā wāhanga mahi e toru e marohitia nei hei whakatutuki

We have looked closely at New Zealand's infrastructure sectors for common problems and opportunities. We have used this information and the views obtained from our engagement to date to undertake an infrastructure needs assessment, as required by the New Zealand Infrastructure Commission/Te Waihanga Act 2019. This has helped us to identify areas where we think change will be needed to improve New Zealand's infrastructure system.

We've identified 19 Needs (areas where change will be needed). These have been categorised into three Action Areas. These Action Areas and Needs are set out in the table below.

Action Area	Needs (Areas where change will be needed)
Building a Better Future Delivering infrastructure that is resilient to stresses and shocks and ready for change.	F1. Prepare infrastructure for climate change F2. Transition energy infrastructure for a zero-carbon 2050 F3. Adapt to technological and digital change F4. Respond to demographic change F5. Partner with Māori: Mahi Ngātahi F6. Ensure security and resilience of critical infrastructure
Enabling Competitive Cities and Regions Ensuring that our infrastructure systems support the needs of people living in cities and regions and improve our connections both within New Zealand and with our markets overseas.	C1. Enable a responsive planning system C2. Coordinate delivery of housing and infrastructure C3. Improve access to employment C4. Plan for lead infrastructure C5. Improve regional and international connections
Creating a Better System A step change in how we plan, design, fund and deliver infrastructure.	S1. Integrate infrastructure institutions S2. Ensure equitable funding and financing S3. Make better use of existing infrastructure S4. Require informed and transparent decision-making S5. Develop and prioritise a pipeline of work S6. Improve project procurement and delivery S7. Reduce costs and improve consenting S8. Activate infrastructure for economic stimulus

Building a Better Future
Te whakarite i tētahi anamata pai ake

Delivering infrastructure that is resilient to stresses and shocks, and ready for change

Most infrastructure has a long lifespan. The hydro dams, bridges, pipes, wires and buildings around us may last for 100 years. Some will last longer. This means that today's decisions about what to build, and where, will stay with us and inevitably shape the way we live into the future. So we need to be thinking carefully about the future we want when planning for new infrastructure and design with flexibility of use in mind, adopting a 'long life, loose fit approach.'[13]

What we've heard – some of the results from our Aotearoa 2050 survey.

"We need to link every infrastructural development to environmental outcomes - i.e. transport & carbon-output - we need to build a carbon zero infrastructure."
– Dorien, Marlborough

The environment was rated as the highest priority when making infrastructure decisions

To 'get ready' for climate change, **85%** said we should **definitely produce less waste**

Our key infrastructure is vulnerable to natural disasters. **52%** said this was **very important**

"We need to invest in the right energy solutions for our environment"
– Anonymous, Auckland

75% said we should **definitely improve public transport**

There are some big challenges heading our way.

- The world's climate is changing, and this will have dramatic effects on how and where we live, work and play.
- Our population is growing (especially in the Auckland – Hamilton – Tauranga triangle), it is ageing and it is becoming more ethnically diverse. Infrastructure will need to keep up with this growth, and also need to function in different ways to suit the needs of a changing population.
- Technology is changing rapidly. This provides real opportunities to revolutionise our infrastructure sectors, but technology may also disrupt traditional business models and have unintended negative consequences.

Taken collectively, this degree of change will require our infrastructure to be flexible, able to withstand future stresses and shocks and adaptable to changing needs.

Needs

The areas in which we believe change will be needed for Building a Better Future are as follows:

- Prepare infrastructure for climate change.
- Transition energy infrastructure for a zero-carbon 2050.
- Adapt to technological and digital change.
- Respond to demographic change.
- Partner with Māori: Mahi Ngātahi.
- Ensure the security and resilience of critical infrastructure.

Discussion question

Q4. For the 'Building a Better Future' Action Area and Needs:

- What do you agree with?
- What do you disagree with?
- Are there any gaps?

F1. Prepare infrastructure for climate change

Te whakarite i ngā hanganga mō te hurihanga o te āhuarangi

Climate change is the defining challenge of this century and demands a new approach to infrastructure.

The significance and severity of the impacts of climate change will become more evident over time. Our climate is getting warmer, rainfall patterns are changing, weather events are getting more extreme, and sea levels are rising.[14]

Figure 4: Impacts of climate change for New Zealand

▲ 1°C

Temperatures are about 1°C warmer than they were a century ago, with three of the hottest years on record occurring since 2014.

Our country is experiencing fewer frost days and more warm days. Some locations are also experiencing drier soils and altered precipitation patterns.

▲ 14-22cm

Sea levels have risen 14-22cm since the early 1900s.

More intense weather events (droughts and storms) have occurred in many parts of the country in the past few years, and at unexpected times of the year.

▼ 25%

Our glaciers have lost 25% of their ice in the past 40 years.

The Government has set a net-zero carbon emissions target by 2050. The target is ambitious and will require significant change for infrastructure.

He Pou a Rangi, the Climate Change Commission, has recently released draft advice that proposes a pathway for New Zealand to reach net-zero carbon emissions and contribute to the global challenge of reducing emissions. It found that:

> *"...the Government must pick up the pace. Aotearoa will not meet its targets without strong and decisive action now to drive low emissions technologies and behaviour change across all sectors. 2050 is not far away – particularly if you consider the life span of infrastructure, vehicles, buildings – and people."* [15]

Infrastructure contributes to climate change by generating greenhouse gas emissions from its direct operations, the materials used in its construction and the activities it enables.

The construction and maintenance of infrastructure often generates substantial amounts of embodied carbon through the use of materials such as concrete and steel. Many construction activities, such as earthmoving and tunnelling, also require significant carbon-intensive fuel use. Dematerialisation through design, innovation in low-carbon materials, and the uptake of low-carbon construction methodologies all have an important role to play in reducing the carbon impacts of construction and maintenance.

Embodied carbon means all the greenhouse gas emissions emitted in producing materials. It includes the carbon used to extract and transport raw materials, as well as emissions from construction and manufacturing processes.

The impacts of climate change on infrastructure are wide-reaching.

Climate change will affect most of our infrastructure decisions from where we put new roads and hospitals to the materials and methods used to construct, maintain and operate infrastructure. Mitigating the effects of climate change will affect what, and particularly, how we build. Adapting to climate change will affect where we build.

The long-lived nature of infrastructure means today's decisions lock in ways of living for generations.

The infrastructure we build today can lock in future emissions, so a long-term view is needed. This includes a consideration of the following issues:

- Decisions on where to build new infrastructure will be affected and a different regulatory approach to prevent development in certain places may be required, based on exposure to natural hazards.
- Decisions need to open up a wide range of future options and, where appropriate, keep options open for as long as possible.
- Asset renewal programmes may provide opportunities to improve the capacity of assets to adapt to climate change, as well as plan for how services will be provided into the future.
- The design of infrastructure may need to change in certain circumstances. For example, the inclusion of engineered wetlands to treat stormwater (water-sensitive urban design) can provide a buffer between the land and the sea, and therefore, protect communities from storm surge.
- Infrastructure investment and decision-making will need to evaluate, and include the costs of mitigating of the carbon generated by infrastructure over its whole life. This includes construction, use, maintenance and decommissioning. It should start immediately and business-case guidelines will need to be adapted to ensure full consideration of mitigation and adaptation requirements.
- Proposals for new major capital works may need to undergo a bright-line (pass/fail) infrastructure resilience test to ensure the works can withstand a range of major stresses and shocks, including the future impacts of climate change.
- The planning system will need to adequately enable the infrastructure requirements necessary for climate change mitigation and adaptation.
- Information and assessments from insurance markets on the risks associated with climate change may be important sources of information for adaptation policies and planning rules.

Infrastructure can unlock a low-carbon economy.

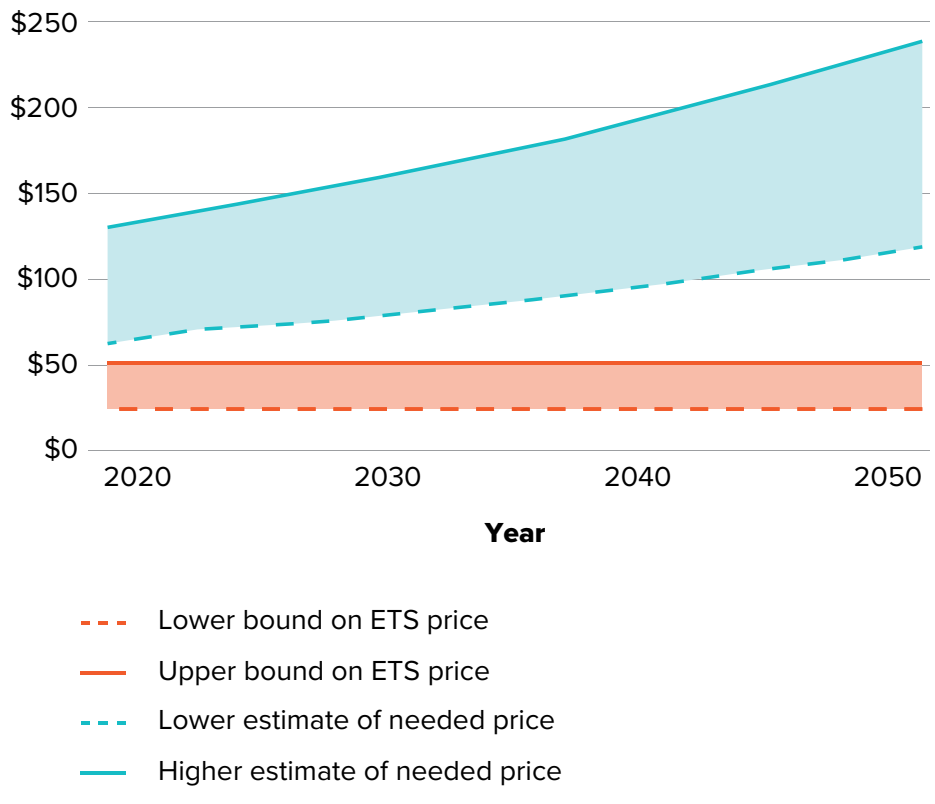
Much of our carbon emissions come from activities that are moving resources around the country and from the heating requirements of large industrial processing activities (called process heating). There are opportunities to decarbonise these activities. For instance, developing more renewable energy capacity in our electricity transmission and distribution networks can support the electrification of vehicles and large-scale process heating. But it is not all about new infrastructure. Non-built solutions, using pricing mechanisms, demand management, or standards and rating tools can help us to better use the infrastructure assets we have in a more sustainable way.

The true cost of carbon could be more regularly included in infrastructure planning to ensure good project selection. But the existing price is probably too low.

At present, market prices in New Zealand's Emissions Trading Scheme likely fall short of what is needed to reduce carbon emissions sufficiently and meet government targets. Under New Zealand's Emissions Trading Scheme, carbon emissions are currently priced at just under $40/tonne. Recent reforms have established a price floor of $20/tonne and a cost containment reserve that will be auctioned to cap prices at $50/tonne.[16] According to recent Treasury estimates, a significantly higher price, as high as $232/tonne by 2050, would be needed to hold global warming at less than 2 degrees Celsius.[17] Some international research indicates that the true cost of carbon emissions could be nearer $400/tonne.[18]

Getting the price right is fundamental to driving infrastructure decisions that support a low-carbon economy.

Figure 5: Emissions Trading Scheme price compared with price needed to meet carbon emission goals[19]



The challenge for the transport sector is significant.

Transport makes up 36 percent of New Zealand's long-lived emissions,[20] with most emissions arising from fossil fuels used to power vehicles.[21] Emissions from domestic transport have continued to rise in recent times. Electrifying the transport system will play an important role in decarbonising the transport sector, alongside increased levels of active and mass transport, and mode-shift to reduce the carbon impacts of the domestic freight network. There are a number of non-built solutions that need to be considered in the transport sector. Pricing options can ease demand for infrastructure by smoothing peaks (through congestion charging, for instance) or incentivising alternatives (through efficient public transport and parking prices).

Local government could also prioritise options to increase the use of public transport by making better use of existing urban space, or implement density targets that significantly up-zone areas that are in close proximity to employment and other amenities in some cases. This could reduce demand for transport infrastructure altogether.

Discussion question

Q5. How could we encourage low-carbon transport journeys, such as public transport, walking, cycling, and the use of electric vehicles including electric bikes and micro-mobility devices?

Infrastructure can help reduce carbon emissions through better waste management.

New Zealanders dispose of about 15 million tonnes of waste every year,[22] which produces 4.6 percent of New Zealand's gross greenhouse gas emissions.[23] Infrastructure contributes to waste through the materials and construction methods used in construction (construction and demolition waste is one of the largest waste streams by mass in New Zealand).

While infrastructure supports activities that create waste, it can also be used to manage these effects. This could be through more efficient transport and waste disposal infrastructure or through other innovations. For example, the organic portion of waste produces methane gas during decomposition (a greenhouse gas many times more harmful than carbon dioxide), but with the right infrastructure in place, this gas can be captured and used to produce electricity reducing carbon emissions.

One infrastructure-specific initiative that might contribute to better waste management is greater centralisation of waste facilities. Waste recovery infrastructure typically requires scale to justify the investment in the specialist plant and equipment needed to produce high-quality separated resource streams suitable for reuse, remanufacture into new products, energy recovery or disposal. Achieving greater centralisation comes with challenges. The commercial success of centralising waste streams depends critically on the cost of transporting waste to central locations, the cost of operating the facility and the value of the resources that are recovered.

Barriers to centralisation are also common and can include local interests or preference for the status quo.

There are several areas in which infrastructure offers opportunities to improve the way we deal with waste. These include:

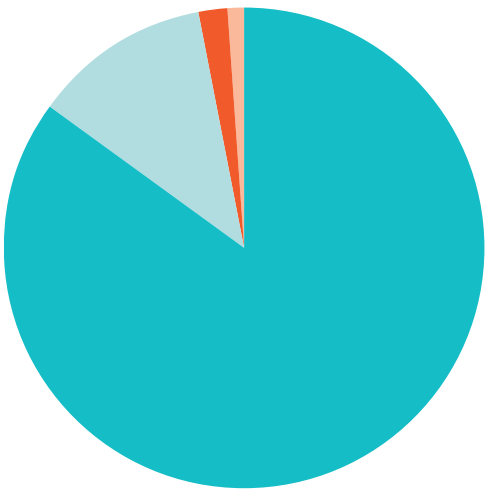
- Reducing the amount of waste generated in construction and demolition though materials selection, procurement and prefabrication.
- Incentivising reuse and recycling through waste management planning on construction sites, procurement and adoption of rating tools.
- Managing demand through the waste levy to further encourage diversion of waste from landfill.[24]
- Increasing the availability of infrastructure specifically for recycling construction waste (materials recovery facilities) in regions where construction activity is predicted to remain high, to support waste diversion from landfill.
- Investing in transport infrastructure that enables centralisation of specific waste streams at scale.
- Using energy-dense waste products as fuel for existing processes, for example by burning tyres to generate the heat to make cement.

Discussion question

Q6. How else can we use infrastructure to reduce waste to landfill?

What we've heard – some of the results from our Aotearoa 2050 survey.

Produce less waste



- Definitetly **85%**
- Maybe **12%**
- No **2%**
- I'm not sure **1%**

"We should be building resilient communities where people are self sufficient for as much as possible ie power, water, waste reduction etc."
– Anonymous, Tasman

"I would like to see much more emphasis on product stewardship to reduce waste, possibly with government supporting/education of businesses to facilitate them making the necessary changes."
– Anonymous, Auckland

F1.1	Adapt business case guidelines to ensure full consideration of mitigation and adaptation
2022-2026 CCC, SRC	Require all infrastructure projects to directly assess climate change impacts (mitigation and adaptation). Ensure all infrastructure projects evidence they are compatible with a net-zero carbon emission future to prevent infrastructure with a long asset life locking-in a high-emissions future. Require all infrastructure projects to apply a consistent cost of carbon that is commensurate with New Zealand's international commitments in cost-benefit analysis and sensitivity analysis.

F1.2	Recognise climate uncertainty in decision-making processes
2022-2026 CHZ, PSR	Ensure that, whenever possible, decisions open up a wide range of future options and, when it is optimal to do so, keep options open for as long as possible.

F1.3	Require a bright-line (pass/fail) infrastructure resilience test
2022-2026 IVA	Require that, where appropriate, proposals for new major capital works are subject to modelling that indicates, through siting, design, specifications and construction, that the infrastructure will be able to withstand a range of major stresses and shocks, including the future impacts of climate change.

F1.4	Ensure non-built transport solutions are considered first
2022-2026 INH, NOF	To decarbonise existing transport networks, require non-built solutions to be considered first. In the case of existing roading networks, alongside transitioning to electric vehicles, non-built solutions could take the form of: • Charging to reduce demand. • Lowering the cost of public transport at non-peak times. • Real-time parking pricing. • Making better use of existing space to speed up public transport. • Density targets and supply requirements through zoning policy.

F1.5	Enable active modes of travel
2022-2026 ECB	Improve the uptake of low-carbon transport options by increasing the density of housing (up-zone) areas within a cycling catchment of all major employment areas

F1.6	Require local government to consider information from insurance markets to inform climate-risk-related planning policy
2022-2026 RIP	Insurance markets are constantly assessing spatial risks associated with climate change. This pricing information should be an input to planning processes to inform adaptation policies in district plans.

F1.7	Drive a culture of waste minimisation
2022-2026 RWL	Update procurement guidance to require the avoidance of waste creation as a design/procurement objective: • Require the design of public-sector projects to evaluate the use of recycled products where feasible. • Require that all projects of a certain size develop waste minimisation plans as tender deliverables that are considered as part of procurement evaluations.

F1.8	Efficient pricing of waste
2022-2026 FOT	Review waste-disposal charges to landfill and investigate different pricing mechanisms with a view to better reflecting the true cost of waste disposal to landfill. Include research and community engagement on the roles of different pricing mechanisms, including household and construction waste-disposal fees.

F2. Transition energy infrastructure for a zero-carbon 2050

Te whakawhiti i te hanganga ngao kia kore ai te whakapaunga o te waro, ki te whakatutuki i te whāinga warokore 2050

Energy production from renewable sources will need to increase substantially to meet a growing demand for electricity and clean energy.

The need for investment in the energy sector is driven by three key factors:

- Electrification of transport and heating used in industrial processes, which requires greater electricity generation.
- Reductions in the use of energy sources that generate significant carbon emissions, such as petroleum products (primarily transport fuels), coal and gas.
- The increasing demand for energy due to factors that are unrelated to climate change policies, such as population and industry growth.

He Pou a Rangi, the Climate Change Commission, notes that wind, solar, and biomass would need to expand at a faster rate than expected under current policies to meet the country's energy needs and replace coal and natural gas.[25]

A successful transition to renewable energy could deliver wide benefits.

If done well, the transition to renewable energy could improve energy equity (through lower electricity costs). Energy exports could grow further, as well as increase the investment attractiveness of New Zealand. Other benefits include an increased alignment with te ao Māori values of kaitiakitanga (stewardship over the environment) and manaakitanga (respect and care for others).

Targets should be consistent, stable and achievable.

The Government has brought forward the 100 percent renewable electricity target by five years to 2030. Regardless of views on the target itself, it is not currently considered achievable due to a range of constraints (consenting barriers and delays being among the most significant).

> *"If we are to achieve our climate change targets and meet the environmental challenge of our generation, the future needs to be very different from the past. ...[this is] unlikely to happen fast enough with current policy settings. 3-7 years to consent and enable property access for a major project is simply too long if we are to meet electricity targets."*
> **— Transpower, submission on MBIE Accelerating Electrification consultation.[26]**

In particular, due to our reliance on hydro electricity generation, achieving the "100 percent by 2030" target requires backup generation to adequately cover the risks from a dry year. The Climate Change Commission referred to the target as aspirational. For the purposes of its modelling, it assumed backup generation would be provided by the proposed Lake Onslow pumped hydro storage scheme, which they assumed would not be operational until 2037 (well after the 2030 target).[27]

Inadequate backup generation could undermine investment in our industries, potentially drive out key industrial energy users, and increase imports from higher-emission producers overseas. It also has the potential to increase electricity costs or keep them higher than they need to be,

harming efforts to electrify industry and heavy transport that would offer considerable carbon reductions. The Interim Climate Change Committee – the predecessor to the Climate Change Commission – reported in 2019 that achieving 100 percent renewable electricity by 2035 (which was the target date at that stage) would result in higher carbon emissions overall.[28]

The renewable electricity target has changed frequently in recent times. It has been through several recent iterations through to the current government target of "90% renewable by 2025." It is also unique to electricity. No targets have been expressed for other parts of the energy sector that are vastly more carbon intensive and may offer relatively low marginal abatement costs.

From an infrastructure perspective, some significant challenges will need to be addressed if the transition to renewable energy is to be successful.

The Ministry of Business, Innovation and Employment consulted in late 2019 on options to accelerate renewable electricity generation and infrastructure.[29] The focus below is on infrastructure aspects.

Greater certainty is needed on issues such as the Government's approach to covering 'dry-year' risks and potential closure of the Tiwai Aluminium Smelter at the end of 2024. The Climate Change Commission assumed the smelter would close in 2021 (as had been announced a year earlier) and suggested the Government, under the framework of a national energy strategy, decide how to progress solutions to dry-year risks.[30]

Preparing electricity distribution networks to cope with the future installation of tens of thousands of local generation, storage and demand-management facilities presents another challenge.[31] These facilities are often called distributed energy resources (DERs) because they are connected to local distribution networks. Connecting tens of thousands of DERs to a network may fundamentally alter the way the network has to operate and may greatly increase investment requirements. It is important that preparatory work starts soon so that networks are well prepared for the potential influx of DERs.

Electrification of transport and industry will require more transmission capacity to be built to cater for larger power flows over the national grid. Usually the full cost of transmission upgrades is charged to existing grid users. However, in the current situation, where fast action is needed to meet New Zealand's climate goals and interest rates are very low, it may be more efficient to build spare transmission capacity early to cater for, and encourage, the growth of future renewable generation. It may be necessary to defer charging grid users for the costs of the spare capacity until the anticipated new grid connections have been made. Otherwise the first users to connect will be over-charged and may choose to delay their installation. This is commonly referred to as 'first mover disadvantage'.[32]

Obtaining resource consents for electricity network investments takes a very long time, particularly for large transmission and renewable generation investments. Alongside proposed reviews of various national policy statements and standards, there may be merit in developing renewable energy zones in New Zealand to reduce the cost of achieving the 2050 net-zero carbon emissions target. A renewable energy zone is a specific area with favourable renewable energy resources, a permissive/enabling consenting environment and transmission capacity readily available to connect low-cost, renewable electricity generation to the grid.[33]

Although we have plentiful onshore wind resources, there may come a time in the next few decades when offshore wind, sub-sea turbines or wave energy becomes commercially competitive with other forms of renewable generation. It may be prudent to investigate whether an offshore renewable-energy regulatory framework is needed to enable an environmentally responsible exploration, construction and operation of offshore wind and other clean energy technologies.[34]

The transition to net-zero carbon by 2050 is expected to reduce natural gas usage for household heating and cooking, industrial heat processes and electricity generation. Maintaining a viable gas industry during the transition will be challenging due to the high costs of maintaining gas deliverability and because of the fixed costs of gas transmission and distribution. A recent study by an owner of our major gas pipelines found that its pipelines might be able to be repurposed to transport hydrogen and/or biofuels at a far lower cost than building new pipelines.[35] According to the gas industry regulator, it will be important to adopt arrangements that encourage a managed and orderly transition of the gas sector's infrastructure and workforce.[36]

Discussion questions

Q7. What infrastructure issues could be included in the scope of a national energy strategy?

Q8. Is there a role for renewable energy zones in achieving New Zealand's 2050 net-zero carbon emissions target?

Q9. Of the recommendations and suggestions identified in the Ministry of Business, Innovation and Employment's "accelerating electrification" document, which do you favour for inclusion in the Infrastructure Strategy and why?

What we've heard – some of the results from our Aotearoa 2050 survey.

37% of respondents said the **people** were a very high priority

55% of respondents said the **environment** was a very high priority

30% of respondents said **jobs** were a very high priority

"Nothing is more important than keeping our planet viable."
– Anonymous, Otago

"If we don't protect the planet, people and jobs will be things of the past."
– Anonymous, Canterbury

F2.1	**Enable electricity distribution networks to minimise barriers to the connection and use of large numbers of local generation, storage and demand response facilities (distributed energy resources or DERs)**
2022-2026 EAN, ARE	Require (and possibly fund) electricity distributors to work with DER providers to develop and implement (by 1 July 2023) standard arrangements for procuring support services from DERs and any other associated requirements.

F2.2	**Reduce barriers to building spare transmission capacity where that would reduce inefficient barriers to large-scale renewable generation and the electrification of large process heating units**
2022-2026 TPM, LEE, ARE, GTG	Subject to appropriate regulatory oversight, enable and encourage Transpower to temporarily defer charging customers for the costs of spare transmission capacity built specifically to cater for future renewable generation connections (the deferral would end when sufficient new connections have occurred). By making it easier for Transpower to build spare capacity ahead of provable need, generators would find it easier and faster to commit to renewable investments if electricity demand increased at a higher rate than they anticipated. Similar issues arise with respect to building spare grid capacity to cater for future connections (or augmentations of existing connections) for industrial consumers.

F2.3	**Investigate the need for a specific regulatory framework for offshore energy generation**
2027-2032 ARE, OCE	Investigate the future need for an offshore renewable-energy regulatory framework to facilitate an environmentally responsible exploration, construction, operation and decommissioning of offshore wind and other clean-energy technologies and associated infrastructure in our territorial waters.[37]

F3. Adapt to technological and digital change
Te urutau ki te panoni hangarau, me te panoni tahiko

A wide-ranging technological transformation is underway worldwide, affecting all infrastructure sectors.

We see it in the move to electric vehicles and the potential for driverless cars, the use of drones to distribute freight, and innovative construction materials and methods. The technological transformation is characterised by almost universal connectivity and computing. It also generates and uses vast amounts of data.

The impacts of technology on and within infrastructure sectors will vary greatly.

Technology change is an important driver of innovation, job creation and export growth, and it has a widespread application to infrastructure. It can both change the way we manage existing infrastructure assets (through real-time pricing or digital twins for instance) and change what it is that we want from our infrastructure (by adapting to changing transport technologies, like e-bikes).

Technology can make existing infrastructure more productive and, as a result, reduce the need for new infrastructure in some situations. In other cases, technological change can drive demand for completely new infrastructure.

While many technological advancements result in gradual improvements to products, some innovations reorganise existing markets and create entirely new markets. For example, in the future, inexpensive batteries could make self-sufficient electricity generation cost effective for many people, particularly in remote areas of the country. This could have significant impacts for the energy sector. Similarly, new satellite broadband technologies could provide a long-term solution to the provision of enhanced mobile services to remote rural communities.[38] The technological revolution may play an important part in achieving our clean and knowledge-intensive growth in the decades ahead.

The use of technology across New Zealand's infrastructure sector varies.

There are significant differences between New Zealand's infrastructure sectors in the current use and sophistication of technological advancements. Technological change, maturity and innovation thrive in telecommunications and in some parts of the energy market. These are generally highly competitive sectors, with profit incentives. This drives technological innovation, agility and productivity. In comparison, technological advancements in water, waste and many parts of the transport and the education sectors can lag behind.

There may be a need to create market-based dynamics, facilitated by technologies and greater transparency to drive improvements across the system. Where these market forces do not exist, we can consider imposing system-level targets (for efficiency, innovation, digitisation and human-centric benefits) and accountability frameworks around them. This involves seeing data as a valuable asset for creating incentives and transparency of performance.

Transparent, open data is an essential element of technological advancement for the infrastructure sector.

Open data can transform infrastructure provision. For example:

- Effective, real-time data can provide people with greater choice, allowing them to play larger roles in deciding on the services they want and how much they are prepared to pay for them. This has implications for the way infrastructure providers define levels of service.
- Better real-time data will allow infrastructure providers to better understand their networks, from traffic flows to parking and water use, as well as how those networks interact with other infrastructure networks.

Infrastructure delivered in the next 30 years will need to be flexible and agile to adapt to changing requirements. Getting the most from our infrastructure investment requires good information about the design, construction and operation of the infrastructure. Among other things, this requires consistent building information to be maintained digitally and accessibly throughout the lifecycle of an infrastructure asset.

A move to open data requires the development of common national infrastructure metadata standards. It also requires the clear identification of the ownership of the data, independence for those institutions that have kaitiakitanga over it, and capabilities to generate value from its management. There is a need to get the balance right between obtaining and getting the most from data and protecting the privacy concerns of New Zealanders.

The list of technologies that could transform the infrastructure sector is long.

Accompanying a move to open data, two technologies have the potential to drive significant change.

- Digital twins for public-sector assets to better manage and improve infrastructure systems. Sensors are used to gather data for better infrastructure management. Digital twins are only as good as the data they use, and data acquisition is key.
- Machine-assisted learning/artificial intelligence for infrastructure processes. These include resource consenting, transport demand management, the identification of health patterns leading up to harm incidents and detecting them before harm occurs, and road-crash avoidance technologies focused on reducing pedestrian and cycling injuries.

Several challenges affect the adoption and therefore the speed of technological change in the infrastructure sector.

These include the lack of a clear, overarching national strategic direction, no long-term spatial planning strategy, and an existing digital policy that needs to be updated. As well, procurement systems need to be reshaped to promote strong demand for technological change and innovation, while capability in the sector and certainty of funding for data asset development and maintenance are also significant challenges.

Rapid technological change presents a challenge to legislative cycles. New Zealand has a regulatory framework that, like those in many other countries, is often slow to adapt to new ways of doing business digitally and the use of new technology. Given the speed of recent technological change, identifying legislative improvements to better enable adoption of new technologies may be warranted.

As technology constraints are removed, however cyber-security risks increase. This will likely pose a risk to our infrastructure with the increased coupling across sectors and reliance on technology. The development of a strategy to manage these man-made risks is an important protection feature for our critical infrastructure.

While we are approaching universal connectivity, technological barriers exist for some in New Zealand.

This is particularly relevant to:

- People on low incomes and some with disabilities, including many participants in the infrastructure workforce, who are unable to afford the tools or lack the skills or capability needed to participate fully as digital citizens.
- The digital divide between those who live in towns and cities who are well-connected, and rural consumers on the fringes of New Zealand's infrastructure who must pay high costs to participate in the digital economy.

Discussion questions

Q10. What steps could be taken to improve the collection and availability of data on existing infrastructure assets and improve data transparency in the infrastructure sector?

Q11. What are the most important regulatory or legislative barriers to technology adoption for infrastructure providers that need to be addressed?

Q12. How can we achieve greater adoption of building information modelling (BIM) by the building industry?

F3.1	Move towards open data for the infrastructure sector
2022-2026 PTC	Identify clear legislative steps required to move toward full open data for public infrastructure across central and local government.

F3.2	Accelerate common infrastructure metadata standards
2022-2026 PTC	Develop and mandate national infrastructure metadata standards.

F3.3	Accelerate investigations on the use of digital twins and prepare for a nation-wide digital twin
2022-2026 PTC	Develop early use cases of digital twins in public-sector infrastructure.

F3.4	Design and launch artificial intelligence use-cases
2022-2026 PTC	Investigate the opportunities to use artificial intelligence and machine learning across infrastructure sectors. Examples could include: • In planning, digitising elements of the consenting process. • In transport, reducing deaths and serious injuries through active collision-avoidance technologies. • In health, identifying patterns that lead to harm incidents. • Across sectors, managing real-time infrastructure pricing strategies (such as congestion charging and parking).

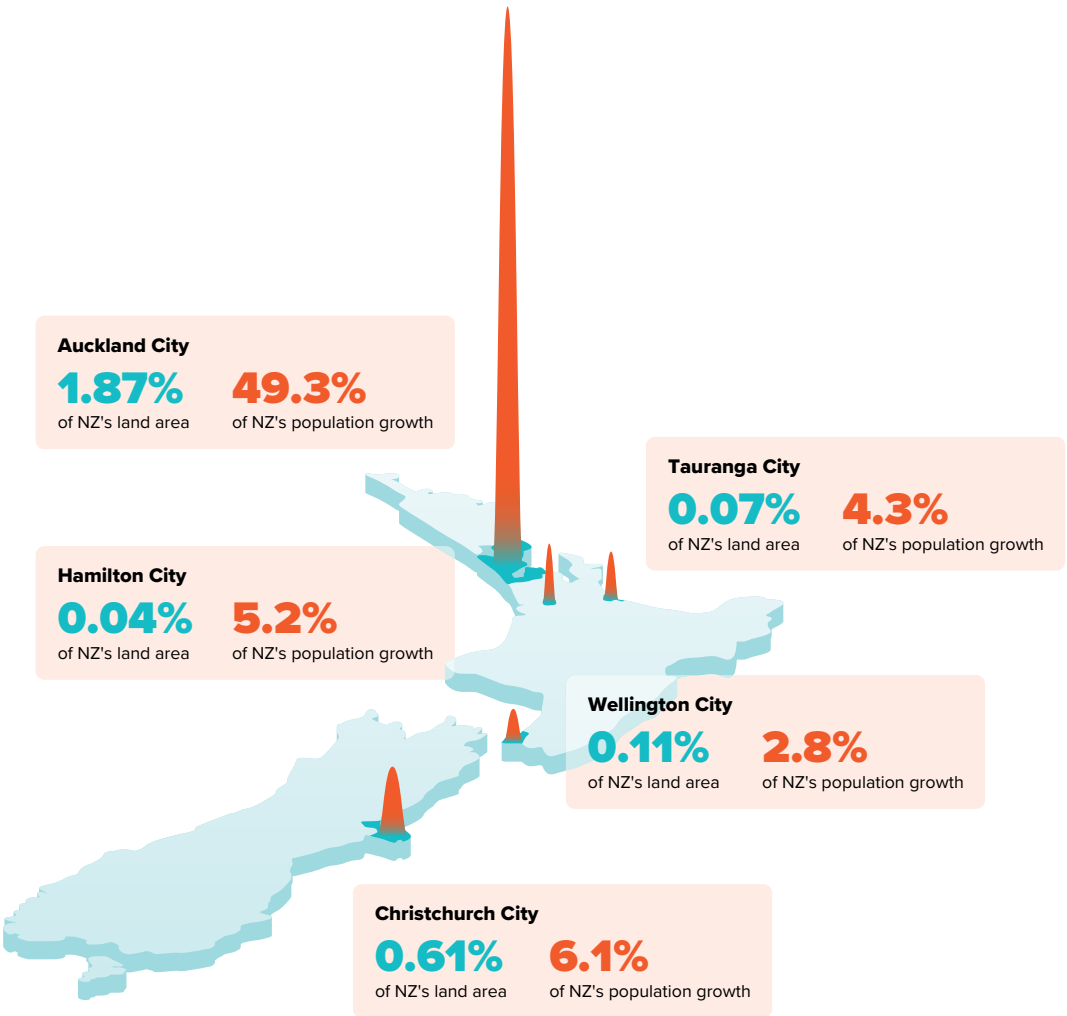
F3.5	Deliver and retain digital information
2022-2026 PTC, PII	Facilitate the consistent use of building information modeling (BIM) by public-sector procurers and central government by developing a common set of standards and protocols in close consultation with industry, including private-sector bodies that undertake similar types of procurement. Support the uptake of these standards by developing detailed implementation advice for agencies on the efficient use of BIM.

F4. Respond to demographic change
Te urupare ki te rerekē haere o te hangapori

Our population is growing, becoming more urbanised, and ageing.

Understanding how New Zealand's population will change over time and where people will live drives infrastructure planning. New Zealand is expected to continue to grow rapidly in coming decades, primarily through migration. Most of New Zealand's population lives in urban areas, but growth is expected to be highly concentrated. Some two-thirds of all population growth is expected to occur in five local-government areas that account for less than 3 percent of all New Zealand's land area.[39]

Figure 6: Five biggest cities' projected population growth compared to land area (2020–2048)[40]



Populations of cities are likely to increase.

Consistent with trends in the past century, the upper North Island, especially the Auckland – Hamilton – Tauranga triangle, is expected to grow the most rapidly.[41] Growth places pressure on existing infrastructure and raises demand for new infrastructure. This raises funding and affordability issues for local and central government, as well as the importance of integration between infrastructure and land-use planning.

While population growth may place further strains on infrastructure, if managed properly it could make services such as public transport, water services and wastewater treatment plants more affordable as the costs are spread across more users. Productivity and wages can increase if growth is well managed in our cities. However, if our cities fail to meet the challenges of growth, people will look to the regions as alternatives. This could result in a ripple effect, with the problems of growth simply being transferred to regional New Zealand.

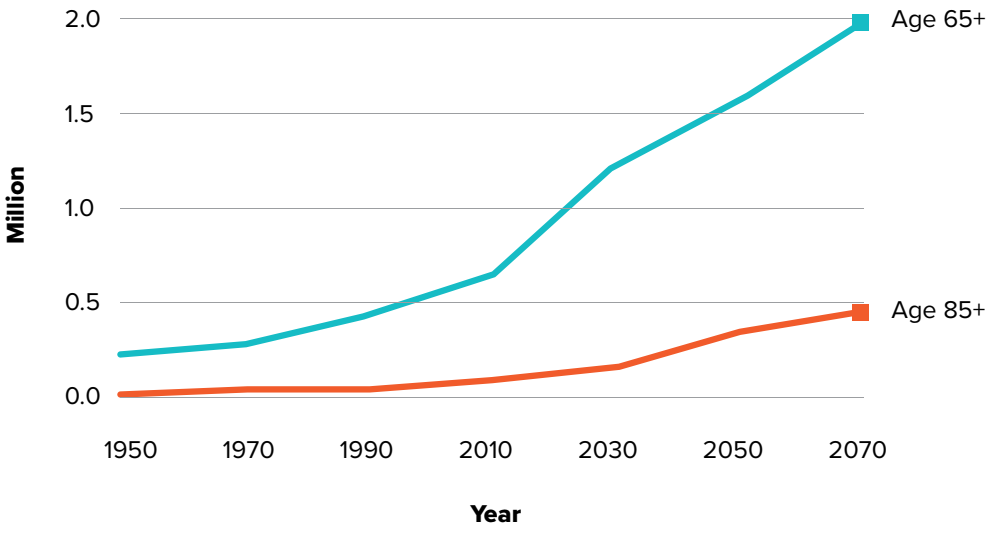
It's not all about population growth.

Six territorial authorities that account for almost 50 percent of New Zealand's land area are likely to experience population decline in the next three decades. The West Coast region is projected to experience a 6 percent decline in this period. Strategies for managing smart decline are likely to become important for these areas. Territorial authorities may need to find ways to reduce or even decommission infrastructure to manage the financial burden of maintaining underutilised assets.

Demographic changes will affect future demand for infrastructure.

New Zealand's population is getting older. Those over 65 years of age are the fastest growing age group. The size of this group is forecast to double to 1.49 million in 2051, from 792,500 in 2020.[42] This will increase demand for universally accessible infrastructure, such as better or wider footpaths for people using mobility devices. Additionally, territorial authorities with higher-aged populations could experience funding issues, as those over 65 are more likely to be on fixed incomes (superannuation) and as a result, may not be able to afford higher infrastructure charges. There is also a shift in living arrangements for the over 65s, from own homes to retirement villages and care facilities. This may shift patterns of growth and the locations of infrastructure needed to support that growth.

Figure 7: Actual and projected persons 65+ and 85+ (1950-2070)[43]



Population projections are volatile, and this affects infrastructure decisions.

Relative to most other OECD countries, New Zealand has significant volatility in population growth.[44] In the 2000 to 2018 period the average annual population growth rate was 1.3 percent, with a standard deviation of 0.6 percent. Iceland and Ireland were the only countries with faster growth and higher volatility, and both suffered major financial booms and crises in this period.

Population projections by their nature are uncertain. Only 23 territorial authority areas are currently forecast by Stats NZ to be certain to grow in the next 30 years.[45]

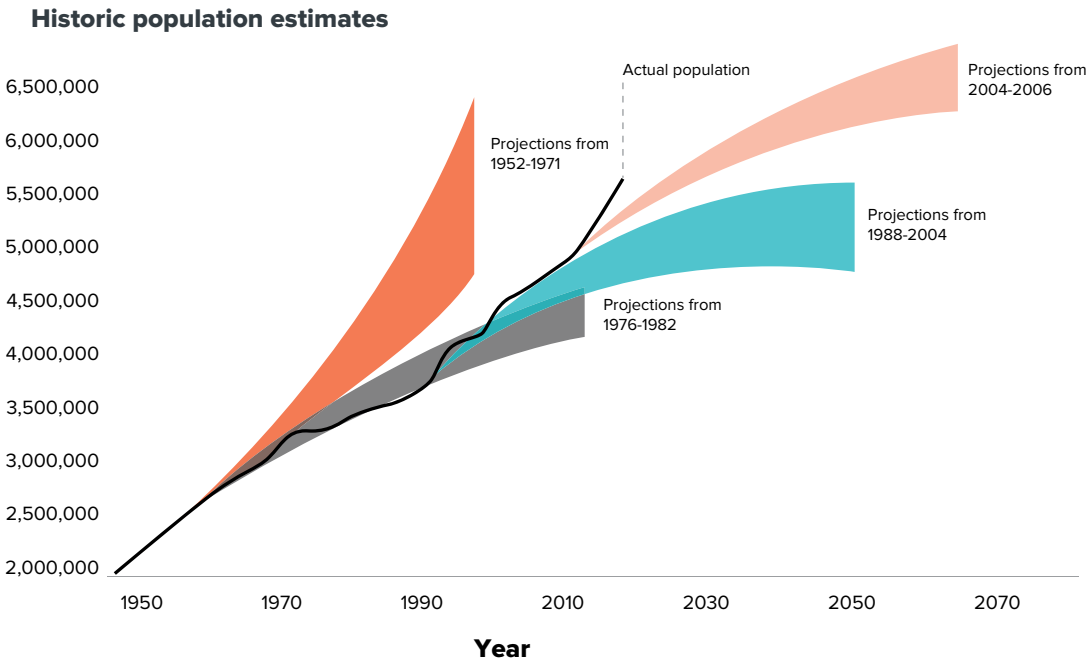
	Number of territorial authorities	2018 population	2048 population projections		
			Low projection	Medium projection	High projection
Certain to grow	23	3,523,000	4,071,000	4,708,000	5,368,000
Likely to grow but could decline	38	1,310,000	1,230,000	1,444,000	1,667,000
Likely to decline but could grow	6	68,000	53,000	64,000	76,000

For infrastructure owners, uncertainty in population forecasts flows into planning and decision-making for future infrastructure. This uncertainty is particularly affected by the long-run nature of constructing infrastructure, and the risk that demand will be greater or lesser than projected by the time any new infrastructure has been designed, consented, constructed and operational.

It can be helpful to consider two types of forecasting risk: uncertainty about the magnitude of growth and uncertainty about the direction of growth. While the former may result in building infrastructure too early or too late, the latter may result in overbuilding or underbuilding the total amount of infrastructure in a particular area.

Population projections have both over-shot and under-shot growth in past decades, as shown in Figure 8.[46] Planners and decision-makers need to be familiar with the risks of projection uncertainty when planning for new infrastructure and have the requisite tools to manage uncertainty adequately (for instance, by phasing investment or future proofing corridors). ‘High’ and ‘low’ growth scenarios should be used to test district and long-term plans, as well as the growth scenario that is ‘most likely’. One additional option for managing these problems is a national population strategy, with enabling policies, that sets out a preferred long-run population path.[47]

Figure 8: Historical population growth compared with historical population projections[48]
Source: New Zealand Infrastructure Commission, adapted from Stats NZ



Discussion questions

Q13. How should communities facing population decline change the way they provide and manage infrastructure services?

Q14. Does New Zealand need a Population Strategy that sets out a preferred population growth path, to reduce demand uncertainty and improve infrastructure planning?

F4.1	Improve analysis of upside and downside risks in infrastructure provision
2022-2026 CBD	Require territorial authorities to test district plans and long-term plans against a 'high' and 'low' growth scenario in addition to the 'most likely' growth scenario to address uncertainty in demand projections. Document and communicate identified risks to decision-makers and the public.

F5. Partner with Māori: Mahi Ngātahi

Te mahi ngātahi ki te iwi Māori: Mahi Ngātahi

Mahi Ngātahi/collaboration with Māori focuses on supporting a better future for New Zealand through better relationships with Māori. This leads to better infrastructure outcomes for all.

Māori communities are overrepresented in poor infrastructure statistics, specifically those that speak to access issues. Māori statistically are the greatest users of much of our social infrastructure, including social housing, hospitals and healthcare. Specific infrastructure issues for Māori are as follows:

- **Housing:** Māori are over-represented in many housing statistics, such as homelessness, home ownership, poor-quality housing, crowded housing and shared/commercial accommodation. Infrastructure issues of this nature are at the core of poor wellbeing and socio-economic statistics.[49]
- **Health:** Many Māori living in rural Māori communities view access to health facilities located in urban centres as a barrier to accessing those health services.[50]
- **Transport and telecommunications:** Māori rural communities have poor access to transport and telecommunications infrastructure. This often compounds the other difficulties they face and the corresponding social impacts.[51]
- **Water:** Issues include the need for a stronger partnership in water-management systems and to embed Te Tiriti o Waitangi (the Treaty of Waitangi) to allow Māori to have decision-making powers. As well, water infrastructure and management systems do not always protect te mauri o te wai (water has a vitality or essence that supports life) and cultural values associated with fresh water.

There are also issues between iwi and the infrastructure sector:

- There appears to be a lack of meaningful relationships between iwi/Māori and many key infrastructure players (Crown and private).
- Mātauranga Māori (Māori knowledge) and mātauranga ā-iwi (iwi knowledge) have potential to add significant value and innovative solutions to current infrastructure issues.
- The current understanding of te ao Māori in the infrastructure sector is low and superficially drawn on in the infrastructure sector. There is also frustration in the industry with the uncertainty, time that has to be spent and lack of guidance on how best to engage with iwi/Māori.
- The current resource management approach is not working for Māori due to a lack of meaningful involvement, as well as consultation fatigue on both sides.
- There are differing resource levels available to support engagement.

The growing strength of the Māori economy and iwi asset base means that Māori will play an increasingly significant role in the infrastructure sector.

However, Māori are currently under-represented in professional and decision-making roles in infrastructure. For example, in 2018, only 5.5 percent of Engineering New Zealand's membership was Māori.[52] Greater representation and participation will improve knowledge in the infrastructure sector, build the economic capability of iwi businesses, and support more collaborative relationships.

Discussion questions

Q15. What steps can be taken to increase collaboration with Māori through the process of planning, designing and delivering infrastructure?

Q16. What steps could be taken to unlock greater infrastructure investment by Māori?

Q17. What actions should be taken to increase the participation and leadership of Māori across the infrastructure system?

F6. Ensure security and resilience of critical infrastructure

Te whakatūturu i te haumarutanga, me te kaha o ngā hanganga whaitake

Critical infrastructure generally means any physical facilities, assets, systems and networks that, if they were unavailable for an extended period, would affect significantly the functioning of society and the economy.

This would result in negative impacts on national wellbeing (including the economic wellbeing of New Zealand) and the maintenance of national security.

New Zealand's critical infrastructure is vulnerable to a range of threats.

Most of these threats are natural (such as flooding and seismic risk) and in many cases will be made worse by the impacts of climate change. Manmade threats, such as cyber-security risks, are also becoming more prevalent for infrastructure. There is neither a nationally shared definition of critical infrastructure nor an agreed framework to plan and manage it that spans all infrastructure sectors. Consequently, decision-making is potentially reactive and fragmented in response to crises that occur, rather than proactively planned. Work to address some of these challenges in the emergency management sector is currently being undertaken by the National Emergency Management Agency through a review of the Civil Defence and Emergency Management Act 2002, which sets out the current requirements for lifeline utilities.

New Zealand has limited resources to respond to threats and shocks that may affect critical infrastructure.

We need a common definition of critical infrastructure that is well understood by the sector, and an identification of the assets that fall within the definition. This will provide a framework to prioritise the infrastructure to focus on and against which to set minimum service-level criteria. A well understood governance structure, with clear roles and responsibilities, will help ensure the security and resilience of critical national infrastructure.

F6.1	Define critical national infrastructure
2022-2026 HGI, DIV	Develop a common definition of critical national infrastructure. This needs to be well understood across the sector and enable parties to identify clearly their roles and responsibilities in relation to critical national infrastructure.

F6.2	Identify critical national infrastructure
2022-2026 HGI, DIV	Identify infrastructure assets that meet the definition of critical national infrastructure. The identification process would cover the resilience of infrastructure networks to shocks, as well as individual assets.

Enabling Competitive Cities and Regions
Te Whakaahei i ngā Tāone me ngā Tuawhenua Tātāwhāinga

Ensuring that our infrastructure systems support the needs of people living in cities and regions and improve our connections both within New Zealand and with our markets overseas.

Infrastructure, when planned, delivered and managed well, can improve the lives of all New Zealanders by raising incomes and productivity, increasing the supply and affordability of housing, improving physical and social connection and lifting quality of life.

Infrastructure can contribute to the success of New Zealand's cities and regions by enabling:

- More affordable and abundant housing that improves social, economic and health outcomes.
- Higher levels of economic productivity and improved inter-regional and international connectivity to enable higher incomes and living standards.
- Better quality of life due to better performing infrastructure.
- Urban environments that provide greater connectivity with employment, social services and recreation opportunities.

Success in these areas can create a virtuous cycle, attracting more residents and businesses that contribute to the ongoing prosperity and liveability of cities and regions.[53]

Connectivity is a measure of how easily goods, people, ideas, data and capital can flow around an economy and to and from the economy's global trading partners.

What is the problem?

Our cities currently face several problems that constrain their ability to deliver high living standards and compete for global talent. These include:

- Extremely unaffordable housing, especially in fast-growing cities, and broader issues with housing quality, including standards of heating, ventilation and dampness.
- Comparatively high levels of traffic congestion, poor availability of public transport and walking and cycling options, and urban design that leads to poor quality-of-life outcomes.
- Limited urban wage premiums. Higher incomes in Auckland and Wellington are largely offset by higher housing costs, pushing people to live in other places that offer lower wages.[54] Conversely, those on nationally set incomes (such as nurses, teachers and police) face higher housing costs than their peers elsewhere.

For regional New Zealand, more dispersed populations often drive down infrastructure economies of scale, affecting incomes and the cost of living. In some communities that might experience population decline, the infrastructure challenge is to keep operational costs in check while maintaining levels of service. This sometimes requires asset replacement or substantial upgrades to meet new national standards (such as those for water quality).

What we've heard – some of the results from our Aotearoa 2050 survey.

"Our roads are getting busier and putting a greater strain on the communities through which they pass - increased traffic means increased pollution, decreased pedestrian and cyclist safety, and reduced ability to traverse neighborhoods."
– Teresa, Canterbury

"Housing development is going into areas like Huapai before the transport infrastructure is put in place causing huge transport issues (traffic jams, delays, loss of productivity, etc)."
– Anonymous, Auckland

87% ranked housing unaffordability as **very important or important**

92% of respondents to Aotearoa 2050 ranked **unreliable access to safe drinking water** as a **very important or important** issue.

To solve transport issues:

48% thought we should definitely **enable people to live closer to their work**

To ensure we have water that's safe to drink:

80% thought we should definitely **invest in our water networks**

76% thought we should definitely **use technology to save water**

Needs:

The areas where we believe change will be needed to enable Competitive Cities and Regions are as follows:

- Enable a responsive planning system.
- Coordinate the delivery of housing and infrastructure.
- Improve access to employment.
- Plan for lead infrastructure.
- Improve regional and international connections.

Discussion question

Q18. For the 'Enabling Competitive Cities and Regions' Action Area and the Needs:

- What do you agree with?
- What do you disagree with?
- Are there any gaps?

What we've heard – some of the results from our Aotearoa 2050 survey.

"We are not building high speed rail networks to connect cities and to help decentralise the population from cities to rural areas. We are not building new cities or new airports."
– James, Canterbury

"Travel between cities, their satellites, and regional centers are too expensive because your only option is to drive or fly."
– Hannes, Auckland

200+
comments mentioned improving connectivity around and within regions and cities

"We need to build the best public transport and passenger rail, in the regions too, to shift away from our focus of private vehicles and roading; the rail infrastructure is there and underutilised."
– Anonymous, Hawke's Bay

C1. Enable a responsive planning system
Te whakaahei i tētahi pūnaha whakamahere rata

New Zealand's urban housing and land prices are high by international standards.

In 2020 Auckland was one of the world's most severely unaffordable cities, with a median house price that was 10 times the median household income.[55] Similarly-sized Australian cities (Brisbane, Perth, Adelaide) have much lower house prices relative to incomes. All large and mid-sized New Zealand cities have median house prices in excess of five times the median household income.

Since 2000 average house prices have quadrupled in Auckland and tripled in other large, fast-growing cities, including Christchurch, Wellington, Hamilton and Tauranga. Average rents have more than doubled in these cities.[56] Wages have not kept up, meaning that New Zealanders, especially those on low incomes, must spend a growing share of their incomes on housing.[57]

There is a limited supply of opportunities to build new homes, either 'upwards' or 'outwards'. This is an underlying cause of high housing prices in New Zealand cities.

Past research has identified a number of constraints to building new housing.[58] Constraints related to planning and infrastructure policy include:

- District plan policies under the Resource Management Act 1991, which limit the location and density of development. They often create barriers to transitioning between different land uses, such as redeveloping a declining industrial area into housing, as well as barriers to new subdivision.
- A lack of appropriate water and transport infrastructure to service housing growth, reflecting shortcomings in existing funding and financing arrangements.
- Planning policies and practices that often make it difficult to consent new housing, even where it is enabled by plans.

Other constraints include the availability of development finance and capacity constraints in the residential construction sector.

Housing supply constraints are an underlying cause of high urban housing prices.

Housing prices are also influenced by demand-side factors, such as population growth, the availability of mortgage credit, and tax policies that incentivise property investment.[59] However, empirical research has demonstrated that local supply constraints have large impacts on prices.[60] The Ministry of Business, Innovation and Employment has estimated the combined effect of land-use regulations and infrastructure supply constraints. These constraints, which limit both intensification and new subdivision, are estimated to raise city fringe land prices by over $200,000 per section in Auckland and Queenstown, and between $90,000 and $140,000 in Wellington, Tauranga, Hamilton and Christchurch.[61] Higher impacts are observed in inner-city areas where development is restricted.[62]

Options to improve housing supply and affordability do not always require new infrastructure.

We can improve housing supply and affordability by using infrastructure and non-infrastructure policies to increase the competitiveness of urban land markets.[63] A competitive urban land market is not a 'laissez-faire' market, but one where policy enables more options about where and when to develop and redevelop urban land, while efficiently managing the positive and negative impacts of development.

Potential options that do not require new infrastructure include:

- A commitment to ongoing reviews of the urban planning system and to reforming policies and practices that affect housing affordability.
- Standardising planning rules. This could be achieved through a nationally standardised planning rulebook that councils are required to follow with limited variations. A standardised approach could reduce the costs that councils incur in developing district plans and reduce the costs and complexity faced by developers and residents, while continuing to provide flexibility on where to apply urban and rural zones.
- Consolidating district and regional plans to create certainty, improve efficiency, reduce risk and reduce consenting timeframes and costs.
- Setting targets for housing development capacity and triggers for the release of additional development capacity to provide for future housing growth.
- Reviewing land held by the Crown to identify opportunities to release land for housing.

What we've heard – some of the results from our Aotearoa 2050 survey.

"Housing has to be the first priority."
– Anonymous, Auckland

800+
comments mentioned housing

"We need to put more emphasis on improving the quality of our housing in turn helping to improve the health and wellbeing of our communities."
– Haily, Canterbury

87% ranked housing unaffordability as **very important or important**

Our cities can't keep up with growth. **60%** said this was a **very important** issue

Infrastructure-related options are discussed under the next Need.

C1.1	Continue to review and reform urban planning
2022-2026 BUP, RAN	Accelerate reforms of urban planning policies and practices that are not delivering, including those that have adverse impacts on housing affordability. Suggested actions include: • Accelerating the implementation of the National Policy Statement on Urban Development (NPS-UD) requirements to upzone around rapid-transit and centre zones. • Monitoring and enforcing council compliance with NPS-UD requirements. • Adopting independent hearings panels to review impending district plan changes. • Requiring that current resource management reforms be appropriately enabling of urban development. • Clarifying definitions of 'environment' and 'amenity' to ensure that environmental protections are not applied to subjective amenity issues.

C1.2	Standardise planning rulebooks to increase capacity and reduce cost and uncertainty
2022-2026 BUP, RAN, JUL	Merge regional and district plans into a combined plan, resulting in 14 combined plans rather than roughly 100 council plans. Prior to developing combined plans, develop the National Planning Standards into a nationally standardised planning rulebook that local authorities are required to adopt with limited variations.

C1.3	Set targets for housing development capacity and triggers for release of additional development capacity
2022-2026 BUP, RAN, CBU, PIR	If the National and Built Environments Act is signed into law, develop a national direction, in the form of the new National Planning Framework, that: • Sets targets that local authorities must achieve for housing and business development capacity to accommodate future growth, and that take precedence over subjective amenity barriers. • Directs local authorities to use information on land prices to guide the planning and release of development capacity in high-demand areas. • Carries over existing NPS-UD direction on enabling intensification and disallowing the use of minimum parking requirements in district plans. • Incorporates additional direction on enabling intensification and private plan changes in addition to what is already in the NPS-UD.

C1.4	Review and realign Crown landholdings
2027-2032 ULH	Review major public landholdings to identify opportunities for land swaps, releases of land for development and relocations of major public facilities to more optimal locations. This includes reviewing the locations of major legacy facilities, particularly when they occupy large sites in growing urban areas with high land prices.

C2. Coordinate delivery of housing and infrastructure

Te whakahaere i ngā mahi whakatū whare, whakatū hanganga

Integrated planning and the delivery of infrastructure and development can reduce the pressure that growth places on infrastructure networks, particularly transport and water infrastructure. It can also identify cost-effective ways to develop new housing.

This in turn helps to address issues with housing supply and affordability, and reduces the environmental impacts of growth, such as carbon emissions from vehicle use and water runoff issues.

An integrated approach requires infrastructure providers, land-use planners and private-sector developers to work together with a shared understanding of common objectives and a willingness to work across organisational and professional 'silos' to achieve those objectives. Regional spatial plans (as proposed by the resource management reforms) will provide opportunities to improve coordination and identify common objectives across the sector.

Infrastructure is needed to enable housing development, but the costs to develop infrastructure can be high.

Case studies highlight that it can be costly to build new infrastructure to service growth.

- In Auckland, a 2015 study found that the average infrastructure cost for new subdivisions could range between $153,400 and $193,000 per dwelling. However, the development contributions paid by developers were no more than $50,000 per dwelling.[64]
- In Wellington city, a recent analysis found that almost every suburb in the city is currently facing water-storage or pipe-capacity constraints, or will be facing constraints in the near future.[65] A subsequent pre-feasibility analysis estimated that the total cost of water upgrades to service growth may be as high as $5 billion, with per-household costs that range from $50,000 per added household in the central city to more than $300,000 per household in some nearby suburbs.[66]

Pressures on infrastructure funding could be reduced by increasing housing development opportunities in areas where there is capacity in existing networks or where there are low-cost opportunities to upgrade networks.

Unfortunately, there are no simple rules on where and how to build housing to minimise infrastructure costs. Infrastructure costs per household tend to fall as population density increases, because the fixed costs of infrastructure provision can be shared by more people.[67] Water network operating costs fall significantly with population density.[68] However, adding housing to existing suburbs sometimes requires complex and costly upgrades to water and transport infrastructure.

Options for improving our ability to provide infrastructure for growth include:

- Acquiring better information about the condition and capacity of existing infrastructure and the cost to upgrade infrastructure to accommodate additional residents. This improves the ability to plan for growth.
- Incentivising local governments to make greater use of targeted rates or value-capture mechanisms to fund growth infrastructure, rather than relying on general ratepayer funds.

Transit-oriented development can reduce the traffic impacts of growth.

There is limited space to expand transport corridors in existing urban areas. A move towards higher-occupancy vehicles, public transport, walking and cycling is needed to manage significantly increased transport demand. Integrating land use, transport and transit-oriented developments (TODs) is an important way to achieve this.[69] The benefits for the efficiency of the transport network can be large, but achieving them requires attention to detail.[70]

Simply increasing overall urban population density is unlikely to work.[71] Large reductions in vehicle travel, and corresponding increases in the use of public transport, walking and cycling, can be achieved by developing in areas that are close to jobs and designing developments and transport networks that make it easy to walk and use public transport. Reducing the quantity of residential and on-street parking has been shown to reduce vehicle ownership and, as a result, the traffic impacts of new development.[72]

There are many low-level barriers to achieving an effective TOD. These include poor street connectivity that hampers walking trips and access to public transport, and historical street design standards that result in unsafe or uncomfortable walking environments.[73] Post-implementation reviews are needed to understand whether New Zealand has implemented TOD policies successfully, and to identify any changes that may be needed to ensure better outcomes from future developments.

Water infrastructure is a challenge for growing cities.

Water reform offers an opportunity to improve how we provide water infrastructure for new housing. The reform programme can proactively enable urban development through measures such as:

- Economic regulation of the sector that supports the efficient provision of new infrastructure.
- Enabling new water entities to use their balance sheet capacity to finance infrastructure for growth.
- Ensuring that there are appropriate incentives in place for housing developers to finance new water infrastructure where it is appropriate.

Another option is to enable publicly owned water providers to charge water users directly for services and to enable volumetric wastewater charges for large wastewater sources. This would benefit the sector by providing clear revenue streams to fund infrastructure and encourage users to conserve water.

New housing development should mitigate impacts on water networks.

Most areas of New Zealand receive around 600 to 1600 millimetres of annual rainfall.[74] In undeveloped areas, roughly 40 percent of this water evaporates into the air, 30 percent is absorbed into soil to recharge aquifers, and the remainder runs off as stormwater. Urban development increases impervious surfaces and doubles the share of rainfall that runs off sites, and must be captured and channelled through stormwater infrastructure.[75] In addition, potable water supply must be piped in to houses and businesses and wastewater must be piped out.

However, developments can be designed to increase the share of water that is captured and used on site and reduce peak flows of water to and from urban sites.[76] This can reduce the cost of new water infrastructure and allow more housing to be developed in areas serviced by existing infrastructure.

Some places in New Zealand have adopted urban planning rules and other policies to incentivise integrated stormwater management, which uses methods like stormwater retention ponds and rainwater collection tanks to mitigate peak flows into stormwater systems.[77] Internationally, there is a trend towards integrated water-cycle management, which includes the on-site use of captured rainwater and wastewater to reduce demands on water and wastewater networks.[78]

There is a need to consider how combined district and regional plans can incentivise the use of these measures and to identify and address other barriers to adoption.

C2.1	Ensure the provision of three waters infrastructure to enable growth
2022-2026 WSA, LFF, MHT	Ensure the current three waters reform programme proactively enables urban development by: • Establishing an economic regulator for the sector with a mandate to ensure the availability of infrastructure for growth, funded by appropriate infrastructure growth charges or other 'user pays' funding tools. • Enabling regulators to allow new water entities to use their balance sheet capacity to finance infrastructure for growth, as well as funding asset renewals and improvements to water quality. • Clarifying the interface between new water entities and developer-financed water infrastructure provided under the Infrastructure Funding and Financing Act 2020. • Ensuring that developers can benefit appropriately from the provision of infrastructure that has spare capacity.

C2.2	Volumetric charging to fund proportion of water infrastructure
2022-2026 LFF	Enable publicly owned water providers to charge water users directly for their services and enable volumetric wastewater charges for large wastewater sources.

C2.3	Improve information on infrastructure capacity and costs to service growth
2022-2026 CBD, WCB	Improve information for land-use planners, infrastructure planners and the development sector so that they can understand the locations and timing of growth opportunities and the cost of growth in different places. Includes two key pieces of information: • Water entities to publish geo-spatial information on water asset condition, capacity for growth in existing water networks, and increases in capacity for growth due to planned network upgrades. As part of this, a common approach to measuring the condition and capacity of water infrastructure assets should be developed. • Develop, validate and publish a spatial model of long-run average infrastructure costs to service growth in different locations, to inform issues like regional spatial planning, local-government development contributions policy, and the alignment of development capacity increases with infrastructure capacity and low-cost opportunities for development.

C2.4	Conduct post-implementation reviews of transit-oriented development opportunities
2022-2026 TSS	Many existing urban strategies highlight the importance of transit-oriented development (TOD). To understand whether strategies are translating into on-the-ground implementation, undertake a post-implementation review of recent TOD opportunities in New Zealand cities. This review would cover the performance of developments against international best practice, the scale and pace of housing and commercial developments relative to planning projections, transport outcomes for people living or working in the areas, broader wellbeing outcomes and barriers to achieving better outcomes, and provide recommendations for policy and delivery changes to improve outcomes for future TODs.

C2.5	Implement regional spatial planning
2022-2026 BUP, RAN	Develop a new Strategic Planning Act that provides a framework for regional spatial plans and directs local authorities and infrastructure providers to develop them. Require that combined plans and regional and local funding plans should not be inconsistent with regional spatial plans. Consider central government funding and resourcing to support regional spatial plan development.

C2.6	Increase the use of water-sensitive urban design measures to reduce pressure on water networks
2022-2026 GIW	Develop combined district and regional plans to enable and incentivise water-sensitive urban design to reduce the pressure that growth places on stormwater and other networks. Review other barriers to water-sensitive urban design practices, such as poor coordination between water infrastructure providers, land-use planners, and developers.

C3. Improve access to employment
Te whakapakari ake i ngā āheinga mahi

Traffic congestion and a lack of housing limit access to higher-wage jobs.

Employment that offers high wages tends to be clustered in large, dense employment centres. This applies equally to those working in the finance sector and those in the service sector. It is driven by the economic benefits that firms and workers realise from locating close to each other.[79]

New Zealand cities are small by international standards, and city centres tend to be the only places that offer large, reliable wage premiums. For instance, Census data shows that, after adjusting for industry mix, wages in the Auckland and Wellington city centres are almost 30 percent higher than the national average. Other locations in Auckland and Wellington offer wages that are similar to the national average.[80]

However, access to opportunities for high-wage employment is limited by three factors:

- The availability and price of housing near city centres. Many people cannot afford to live near a city centre or must sacrifice living space to do so.
- Traffic congestion and the limited supply of alternatives such as rapid transit and safe cycling infrastructure, which makes commuting to a central work location slow and unreliable, particularly for those people who can't afford to live close to a city centre.
- The capacity of the transport network and parking in the city centre to cope with an increased number of commuters.

Congestion pricing is the best way to ease traffic congestion.

Historically, transport agencies have attempted to relieve peak-period traffic congestion by building more road capacity. This strategy has not been successful because increasing road capacity encourages people to drive more.

International research shows that there is a one-to-one relationship between road capacity increases and increases in traffic volumes – the 'fundamental law of road congestion'.[81] Locally, this effect can be observed in the slow and unreliable peak travel times on urban motorways that have recently been widened.

However, congestion pricing and road tolling are effective in relieving congestion. For instance, an analysis undertaken for The Congestion Question (a recent study of congestion pricing options in Auckland by Auckland Council and the Government) found that comprehensive congestion pricing would reduce peak-time traffic volumes by 8 to 12 percent and significantly improve average travel times.[82]

There are opportunities to improve access by:

- Progressing the implementation of congestion pricing in Auckland and progressing investigations for Wellington.
- Outlining a plan for expanding congestion pricing or road tolling to other fast-growing cities that might otherwise experience worsening traffic congestion.

In addition, other transport pricing measures could be considered, such as reforms to enable a more efficient pricing of on-street parking to mitigate localised congestion impacts.

Discussion questions

Q19. What cities or other areas might be appropriate for some form of congestion pricing and/or road tolling?

Q20. What is the best way to address potential equity impacts arising from congestion pricing?

New transport infrastructure will still be needed to increase mobility.

If congestion pricing is implemented, it will need to be progressed alongside improvements to public transport networks and walking and cycling facilities.

- Congestion pricing will increase demand for non-car transport modes. Improving public transport networks and walking and cycling facilities will make it easier for people to change their travel behaviour.
- Improvements to non-car alternatives can lower tolls for remaining drivers[83] and increase the public acceptability of pricing.[84]
- By optimising the use of existing transport networks, congestion pricing may allow some costly infrastructure projects to be deferred. However, in the long-term investment will still be needed to provide for rising demands for mobility.
- If congestion pricing is implemented, signals from congestion pricing should be used to help optimise the timing and delivery of new multi-modal transport infrastructure.
- Different solutions may be needed to increase transport capacity in different places. For instance, dense employment areas may be most efficiently served by rapid transit infrastructure that can move many people in a space-efficient way, while lower-density areas might be most efficiently served by road infrastructure.

Remote working may play a larger role in the future.

Improvements to telecommunications and digital technology mean that digital accessibility is an increasingly viable substitute for physical accessibility to urban labour markets. However, the share of people working from home did not change significantly between the 2001 and 2018 Censuses.[85]

Covid-19 lockdowns may increase the adoption of remote working and telecommuting. During New Zealand's Alert Level 3/4 lockdowns in 2020, 42 percent of employed people worked from home at least part of the time and many organisations adopted remote-working tools and developed flexible working policies.[86] It will be important to monitor this trend to understand how remote working can contribute to urban accessibility.

C3.1	Implement congestion pricing and/or road tolling to improve urban accessibility
2022-2026 TCQ, LGW, LFF	Use congestion pricing and road tolling to improve urban transport outcomes and the performance of the transport network. Specific measures include: Progressing the implementation of The Congestion Question's recommended congestion pricing scheme for Auckland. If the availability of transport alternatives is a concern, stage the implementation to focus initially on areas with the best supply of public transport and walking and cycling options (e.g. Auckland city centre), and confirm a timeframe for full implementation following the delivery of further public transport and cycling improvements. Immediately remove legislative barriers to implementing congestion pricing and/or highway tolling. Progress the implementation of a congestion pricing scheme for Wellington following the Let's Get Wellington Moving programme business case.

C3.2	Use congestion pricing to plan for new transport infrastructure
2027-2032 TCQ, LGW, LFF	To make it easier for people to respond to signals from congestion pricing: Improve the quality, speed and reliability of public transport to major employment centres. Improve active transport infrastructure, starting with low-cost solutions such as improving pedestrian crossings and reallocating existing road space to provide safe cycling facilities. Use signals from congestion pricing to help optimise the timing and delivery of new multi-modal transport infrastructure.

C3.3	Plan for congestion pricing schemes in other New Zealand cities
2022-2026 TCQ, LGW, LFF	Identify and prioritise other urban areas where congestion pricing may be beneficial at some point on a 30-year horizon, and develop a work programme for developing appropriate schemes for those areas.

C4. Plan for lead infrastructure

Te whakamahere i ngā hanganga tino pai o āpōpō

Planning for new infrastructure ahead of a new housing development can provide many benefits.

This is known as 'lead infrastructure' and it can shape a new growing area, make it easier to provide enough infrastructure capacity, and give certainty to developers. Arterial road networks and rapid transit networks are key examples of lead infrastructure.[87,88] If these networks are not protected or provided for in advance of housing development, it can be difficult if not impossible to provide them later. This increases the likelihood of future problems such as traffic congestion, a lack of good public transport and a lack of walking and cycling options.

Lead infrastructure planning provides for all transport modes and enables future choices.

Planning for lead infrastructure should be comprehensive rather than focused on a single type of infrastructure or a single mode of transport. There is a need to consider:

- The provision of rapid transit networks in existing and future urban areas, noting that the full delivery of these networks may not be needed in the near future.
- The reservation of corridors that can adapt to uncertainty in future needs. For instance, a long-term rapid transit corridor should be viable to deliver as a busway or rail line, or convert to other uses.
- The design of street networks to provide for current and future needs. For instance, street grids that distribute traffic across many routes lead to better long-term outcomes than street layouts that feed all traffic into a small number of major roads.[89]

There are situations where it makes sense to invest in new infrastructure ahead of housing and commercial development in growing areas. However, this can be costly and financially risky for providers.

One option is to identify, protect and acquire corridors of land and sites for future lead infrastructure. Corridor protection ensures that land is available to provide lead infrastructure in the future, while also enabling a degree of flexibility in how and when to develop that infrastructure.

There are several constraints to protecting land for future infrastructure.

- The Resource Management Act requires a high level of project detail before an infrastructure corridor or piece of land can be protected. This undermines the need for future flexibility.
- The Resource Management Act typically only provides protection for five years at a time. Land will often need to be protected for much longer periods of time.
- Under the Public Works Act 1991, infrastructure providers are required to buy land if the owner requires this. The alternative is to lift the designation. In the absence of dedicated funding for the property purchases needed to protect lead infrastructure corridors, few corridors are protected in advance for future infrastructure.

Legislation and policy reforms are needed to enable corridor protection for lead infrastructure.

There are opportunities to achieve better outcomes by:

- Developing a lead infrastructure policy that sets out when, where and how to protect corridors in advance of development.
- Amending resource management legislation to better enable the protection of infrastructure corridors in advance of growth.
- Funding early corridor-protection activities, including purchasing key sites or sites where required by landowners.
- Using regional spatial planning to identify corridors for future rapid transit networks within cities and arterial road networks in growth areas.

Discussion questions

Q21. Is a 10-year lapse period for infrastructure corridor designations long enough? Is there a case for extending it to 30 years consistent with spatial planning?

Q22. Should a multi-modal corridor protection fund be established? If so, what should the fund cover?

C4.1	**Develop a lead infrastructure policy, supporting implementation guidance, and a corridor protection evaluation methodology**
2022-2026 BUP, CPR, ATA	Develop a lead infrastructure policy that provides a clear definition of lead infrastructure and uses the definition to identify what is and is not lead infrastructure. Support this policy by implementating guidance for infrastructure providers. To support corridor-protection decisions, develop evaluation guidance on the use of real option valuation techniques to make decisions about corridor protection in light of the uncertainty of future demands.[90] Use this guidance as a key input to an economic analysis of concept plans for corridor designations and investment through a new corridor reservation fund.
C4.2	**Enable lead infrastructure corridor protection through resource management reform**
2022-2026 RAN, ITA	Extend the duration of designations to 10 years and allow designations to be granted based on concept plans. Base statutory tests for infrastructure corridor designation on a corridor protection evaluation methodology.
C4.3	**Establish a corridor reservation fund to protect lead infrastructure corridors**
2027-2032 BUP	Establish a corridor reservation fund with a secure funding source that can be used for early corridor-protection activities, such as purchasing key sites for future projects

C5. Improve regional and international connections
Te whakakaha i ngā hononga ā-rohe, ā-tāwāhi hoki

International trade plays a crucial role in the New Zealand economy, in terms of both exporting and importing goods.

Exports made up 28 percent of GDP in 2018, with most being from primary industries. Imports also made up 28 percent of GDP in 2018[91] and are distributed throughout the country. In the year ended August 2020, and at its peak, New Zealand's goods exports reached $61 billion.

Our country's economic viability also relies heavily on the movement of people. This includes encouraging people with specialist skills into the country, connecting New Zealand business people to offshore markets and investments, facilitating the movements of New Zealand's people and enabling tourism. Prior to Covid-19, in the year ended March 2020, tourism delivered $42 billion to the country and generated a direct contribution of 5.5 percent of GDP.[92,93.]

- A significant portion of our future economic growth will depend on enhanced international connectivity to improve productivity, access people with specialist skills and capital, and increase export volumes and values.[94] Infrastructure is important for supporting this connectivity.
- Ports and international airports, internet infrastructure and data and mobile networks underpin New Zealand's international connectivity.
- Ports and international airports are gateways for exporting and importing goods.
- Airports and cruise-ship terminals are gateways for people, supporting a wide range of business and tourism opportunities.
- The internet, data and mobile networks enable businesses and people to connect and interact, driving opportunities in virtually every sector of the economy.[95]

Shipping accounts for most of the volume of exports and imports. However, those transported by air tend to be significantly higher in value. Air transportation presents opportunities for economic growth by providing a route to offshore markets for high-value and/or time-critical goods.[96] Airports also enable New Zealand to attract business investment and skilled people, as well as spur tourism.[97] Meanwhile, internet, data and mobile networks continue to "transform ways in which businesses operate and people interact, as they drive productivity and efficiency improvements in almost every sector of the economy".[98]

A comparison of New Zealand's ports and airports with their global peers indicates that they are currently ranked reasonably, but not outstandingly across key metrics.

According to the World Economic Forum's Global Competitive Index 2019,[99] out of 141 countries New Zealand ranked:

- 43rd on airport connectivity to global air transport networks.
- 30th on efficiency of air transport services.
- 66th for shipping connectivity to global shipping networks.
- 32nd for efficiency of seaport services.

Encouragingly, New Zealand's telecommunications infrastructure is largely performing well by international standards.

New Zealand's average broadband speeds are roughly the same as those in the United States. In addition, once the national fibre rollout is completed in 2022, New Zealand will be a leading OECD country in terms of fibre access. New Zealand's digital network and international connectivity currently appear to be robust.

Freight supply chains operate best when the customer experience is seamless.

From an infrastructure perspective, this means that transitions between transport modes happen efficiently and airports, ports, road, rail, coastal shipping and any other related infrastructure operate as one integrated system, rather than within their individual silos. At present, the infrastructure components of our critical supply chains have planning, ownership, governance and funding structures that vary significantly. For example, a typical multi-modal New Zealand supply chain, usually supported by freight forwarders and other intermediaries, could involve a combination of:

- State highways run by a government agency (Waka Kotahi).
- Railways operated by a state-owned enterprised (KiwiRail).
- Council-owned ports, airports and local roads.
- Privately owned airport, air-freight, sea-freight and road-freight operators.[100]
- Mixed-ownership-model ports and airports (private/local government and central government).

Investment decisions for individual facilities are primarily made by asset owners taking into account their individual mandates and/or shareholder benefits. This can result in decisions made in isolation from each other, potentially limiting the ability to have a considered, coordinated approach to the freight supply chain network.[101]

To improve international connectivity and understand our freight supply chain better, we need to better understand national and international trends and targets.

This information could then be developed into an evidence-based long-term national freight supply chain strategy covering airports, ports, road, rail and coastal shipping. The strategy could address issues through:

- Processes for investment prioritisation and system-level planning.
- Unlocking the comparative advantages of different elements of the network.
- Reviewing the effectiveness of the legislative environment.
- Assessing resilience risks.
- Fostering engagement and collaboration across supply chains.
- Optimising the use of new technologies.

A freight supply chain strategy would potentially support a more efficient and integrated multi-modal freight supply chain.

Regions are the country's economic backbone from which the bulk of our primary exports are sourced.

For example, prior to COVID-19 disruptions, primary-sector exports represented nearly 80 percent of New Zealand's total merchandise exports by value, and more than half of total exports when including services.[102] High levels of regional connectivity are required for economic success and community wellbeing. Regional connectivity provides New Zealanders with access to employment, health, education, and other services within and between cities, towns and rural areas. It enhances the movement of people, information and goods, enabling social cohesion and wellbeing. Road, rail, air and coastal shipping are critical to regional connectivity.

Strengthening regional connectivity is challenging for several reasons. New Zealand has geographically isolated areas, with infrastructure networks that are expensive to build and maintain due to climate, geology and seismic factors. Low population density also means that many areas do not have multiple competing infrastructure networks. One of the challenges for regional infrastructure is to help address regional disadvantage by improving access to employment and social infrastructure and reduce living costs for those in more isolated locations.

Infrastructure plays a critical role in enabling the regions to play to their strengths in areas such as tourism, high-value exports and improving productivity and access to markets.

Better spatial planning can increase focus on the connectivity needs of the regions and the infrastructure required to support this connectivity. There is also strong evidence that digital access will assist with job accessibility and bridge social isolation in the regions.[103,104] An accelerated investment in 5G, rural broadband and the Mobile Black Spots programme is needed to achieve equity of access to digital services.

A national digital strategy focusing on both the private and public sectors could help to ensure New Zealand retains its current digital connectivity advantages and keeps its regions connected.

The digital strategy could set an overarching framework to guide both tactical implementation step changes in the short to medium term, and strategic visions in the longer horizon. Examples of areas that could be covered in a digital strategy are:

- Identifying digital opportunities for New Zealand.
- Estimating future processing power and bandwidth requirements and identifying infrastructure requirements to maintain and future-proof global digital connectivity including, for example, infrastructure capacity and the security of future deep-sea cables out to 2050.
- A full consideration of the role of government in digital infrastructure requirements.
- A consideration of digital security issues, including cyber security, privacy, data ownership and safety online, within and across the infrastructure sector.
- Identifying barriers to equitable access to digital services, including in rural areas that currently have limited telecommunication services, and actions that could be taken to promote equitable access.

Discussion question

Q23. What infrastructure actions are required to achieve universal access to digital services?

C5.1	Develop a long-term national supply chain strategy
2022-2026 IFT, NSC, FSE	Develop an evidence-based, long-term national freight supply chain strategy covering airports, ports, road, rail and coastal shipping to support the creation of a fully integrated, multi-modal freight supply chain system. The strategy could look at competition between modes, ownership structures, regulatory regimes and the infrastructure investment required to improve the efficiency and sustainability of New Zealand's supply chains.

C5.2	Update the 2006 digital strategy
2022-2026 PTC	The 2006 digital strategy should be updated to prepare New Zealand for realising the full benefits of a connected digital society.

Creating a better system
Te hanga i tētahi pūnaha pai ake

A step change in how we plan, design, fund and deliver infrastructure.

New Zealand's current systems and processes for planning, determining, delivering and operating infrastructure are being challenged. As New Zealand ramps up its infrastructure investment, we need to ensure these systems are sufficiently flexible and adaptable to respond to current and future pressures, changes, stresses and shocks (both those we can foresee and those we cannot). Our infrastructure needs to be not only fit for purpose but also fit for the future.

The elements of a good infrastructure system.

There are many elements that make up a good infrastructure system. It can be helpful to think of them using the following four categories.

What we've heard – some of the results from our Aotearoa 2050 survey.

"We need to understand the relative costs and benefits of policy options."
– Anonymous, Auckland

To help solve our transport problems:

43% said we should definitely **make better use of the roads we have**

To improve the quality of our drinking water:

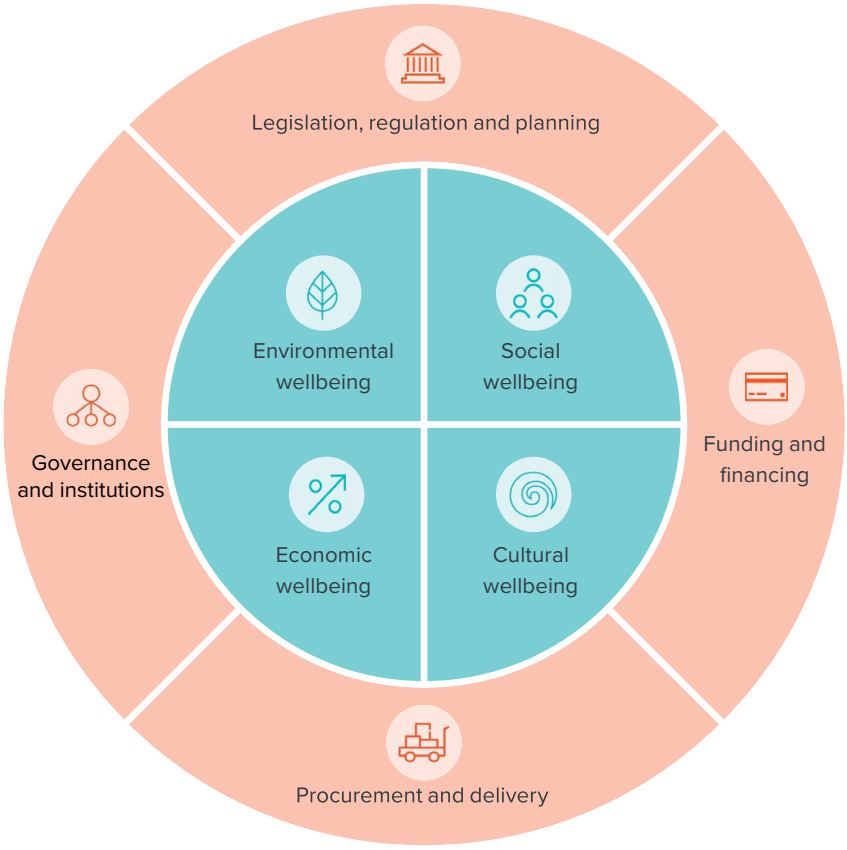
47% said we should definitely **make better use of the water networks we have**

70% said we should definitely **use technology to save water**

"We face a local & global skills shortage. We have experts in every sector but lack a strategic approach to capability, skills, education and training."
– Clare, Auckland

Governance and institutions
There are clear, transparent governance structures and institutions that promote integrated planning and decision-making.
Legislation, regulation and planning
There is a legislative, regulatory and planning environment that focuses on long-term outcomes and is flexible to a changing environment.
Funding and financing
Funding, financing and decision-making accountabilities are clear and aligned with strategic plans. There is an ability to access finance and borrow prudently in a way that recognises intergenerational equity.
Procurement and delivery
There is a culture of robust and transparent decision-making and delivery. This goes beyond building new infrastructure to include the operation, maintenance, replacement and sometimes even decommissioning of assets.

Figure 9: Integrated infrastructure management framework[105]



What is the problem?

There are several challenges in the current infrastructure system. They include:

- Fragmented planning and decision-making across the infrastructure system.
- Difficulties in funding infrastructure, especially in growing cities and responding to the infrastructure costs of a zero-carbon 2050.
- An inconsistent and bespoke application of investment planning and business case application.
- A lack of transparency in investment decisions and experience at some organisational levels in delivering infrastructure projects.
- The cost of building infrastructure in New Zealand, which appears to be high by international standards and is rising rapidly.

New infrastructure is expensive and we cannot afford to build everything. Trade-offs and prioritisation are necessary. To create a better infrastructure system, we also must analyse and consider current system deficiencies, global best practice and future needs.

Needs:

The areas where we believe change will be needed for Creating a Better System are:

- Integrate infrastructure institutions.
- Ensure equitable funding and financing.
- Make better use of existing infrastructure.
- Require informed and transparent decision-making.
- Develop and prioritise a pipeline of work.
- Improve project procurement and delivery.
- Reduce costs and improve consenting.
- Activate infrastructure for economic stimulus.

Discussion question

Q24. For the 'Creating a Better System' Action Area and the Needs:

- What do you agree with?
- What do you disagree with?
- Are there any gaps?

S1. Integrate infrastructure institutions
Te kōmitimiti whakanōhanga

New Zealand has many infrastructure providers, regulators and policy-makers involved in infrastructure planning, funding and delivery.

For example, there are:

- Multiple central government departments, Crown agencies, special-purpose vehicles, Crown companies, state-owned enterprises, and mixed-ownership-model companies.
- 78 local authorities, which comprise 11 regional councils, 61 territorial authorities, six unitary councils (territorial authorities with regional council responsibilities), 116 community boards and 21 local boards (in Auckland). There are also a number of council-controlled organisations.
- Privately owned organisations, as well as organisations with a mix of public and private ownership.

The table below sets out the predominant asset ownership structure in each infrastructure sector in New Zealand.

This provides a complex mix of organisations, sometimes with competing objectives, and differing levels of skill, funding and resourcing.

● Sector/ Provider	Private	Local Authority	Central Government (including State Owned Enterprise)
Transport			
Cycleways		●	●
Local roads		● [1, 2]	
State highways			●
Public transport		● [1]	
Freight/ Long distance rail			●
Ports & airports	●	●	●
Water & Waste			
Drinking water networks		● [2]	
Wastewater networks		● [2]	
Stormwater networks		● [2]	
Irrigation	●		

Sector/ Provider	Private	Local Authority	Central Government (including State Owned Enterprise)
Flood protection	●	●	
Waste	●	●	
Telecommunications			
Mobile networks	●		
Copper network	●		
Fibre network	●		
Energy			
Oil & gas distribution	●		
Electricity distribution	● [3]	●	
Electricity transmission			●
Social			
Health facilities	●		●
Education facilities	●		●
Courts & justice facilities			●
Corrections facilities			●
Defence bases & facilities			●
Civic infrastructure[4]	●	●	●

Notes:

1 Co-funded through National Land Transport Fund
2 Sometimes privately developed then vested in local authorities
3 Including consumer trusts
4 For example museums, stadia, libraries, community centres, swimming pools, parks and sports fields - predominately provided by local authorities

Industry structure, governance and regulation vary significantly between different infrastructure sectors.

For instance:

- **The electricity sector** includes several electricity generators that compete to supply the wholesale electricity market, and electricity retailers that purchase power from the wholesale market and compete to provide a wide range of services to customers. There are 29 distribution entities and one transmission company that operate as regulated monopolies. There are also economic regulators that set rules for the competitive market and administer price control of the regulated monopolies.
- **Land transport infrastructure** (roads, rail and public transport) is provided by both a Crown entity (Waka Kotahi) that is funded from user charges and taxes, and local authorities that are funded by a combination of local-government rates, development contributions and central-government user charges and taxes. A state-owned enterprise (KiwiRail) is responsible for maintaining the rail network and is funded from a combination of user charges and central government payments.
- **Water infrastructure** is mostly provided by local authorities (or council-controlled organisations) and funded from either rates or user charges. The private provision of water infrastructure also plays a role.

Differences between infrastructure sectors are sometimes due to differences in the nature of the infrastructure, and sometimes due simply to history.

There are benefits of different organisational arrangements.

There can be benefits in having several infrastructure providers within a sector. Competition between providers can provide users with greater choice and lower costs. It can also encourage innovation and productivity improvements. An example is the telecommunications sector, where there are several providers of phone and data services that have introduced new services and competitive pricing.

There can also be benefits in centralisation or consolidation. It can:

- Enable infrastructure planning, funding and delivery to be better integrated.
- Bring economies of scale that, in some sectors, can reduce costs for taxpayers, ratepayers and users.

Centralised organisations can also be better equipped to manage infrastructure that crosses over existing boundaries. For instance, it has been more than 30 years since New Zealand established the geographical boundaries of local and regional councils. During that time cities have grown substantially, increasing the need for infrastructure that crosses institutional borders, and integrated planning. Centralised organisations can provide integration but do not necessarily have the same drivers to promote innovation, cost savings and improved services to users. In situations where natural monopolies emerge, economic regulators can serve to support these outcomes.

Reform processes will significantly change some infrastructure organisations.

The Review into the Future for Local Government and other reforms underway for resource management and the provision of three waters (water, wastewater, and stormwater) could fundamentally change the structure of parts of the local government infrastructure sector. Water reform is intended to improve the quality, capacity, and reliability of the water sector, but the details are still evolving. As part of the scope of the Review into the Future for Local Government, it may be appropriate to review local government functions related to infrastructure and the relationship with central government funding, planning and delivery functions.

Regardless of the outcome of the reforms, many infrastructure projects will continue to involve multiple agencies, with each having its own decision-making processes, governance arrangements, infrastructure priorities, and funding streams.

There is an ongoing need to ensure that infrastructure agencies work collaboratively to progress infrastructure planning and delivery.

These include central and local government agencies and organisations. An integrated approach involves policy-makers, regulators and infrastructure providers coordinating work across geographic boundaries and portfolios to deliver better outcomes for communities. There may be benefit in a common set of principles to guide how infrastructure providers are structured, governed and regulated, which takes into account underlying sector and geographic differences.

Regional spatial planning can improve coordination.

The resource management reforms will introduce a new process for regional spatial planning. This will require local and central governments and infrastructure providers to work together to outline how and where regions will grow and what infrastructure is required to support and shape growth. Regional spatial planning is an opportunity to improve coordination across the infrastructure sector. There is a need to ensure that these plans will meet our infrastructure needs and that they can be implemented. Clarity on how the design and implementation of spatial plans will be funded is also required.

Discussion questions

Q25. Does New Zealand have the right institutional settings for the provision of infrastructure?

Q26. How can local and central government better coordinate themselves to manage, plan and implement infrastructure?

Q27. What principles could be used to guide how infrastructure providers are structured, governed and regulated?

S1.1	Clarify funding of spatial plans
2022-2026 DSA	Regions will be required to produce regional spatial plans that outline how and where they will grow. It is currently unclear how the development and implementation of these plans will be funded. Funding arrangements to both design and implement regional spatial plans should be clarified as part of the Resource Management Act reform process.

S1.2	Review roles and functions of local government and other related infrastructure providers
2027-2042 RAN, LFF, ROY	As part of the Review into the Future for Local Government, review local-government functions related to infrastructure and the relationship with central government, including funding, planning and delivery. The review of local-government infrastructure functions should address: • The role and function of local government following the three waters reform and reform of the Resource Management Act. • Institutional settings and structures for other related infrastructure providers, e.g. in land transport. • The appropriateness of existing local-government boundaries given expanding labour markets, particularly in growing cities. • The ability of local government to provide, fund, maintain and operate both social and economic infrastructure.

S2. Ensure equitable funding and financing

Te whakatūturu i te tahua pūtea, ahumoni hoki e tōkeke ana

Infrastructure can make our lives easier, but it is not free. Someone must pay for it.

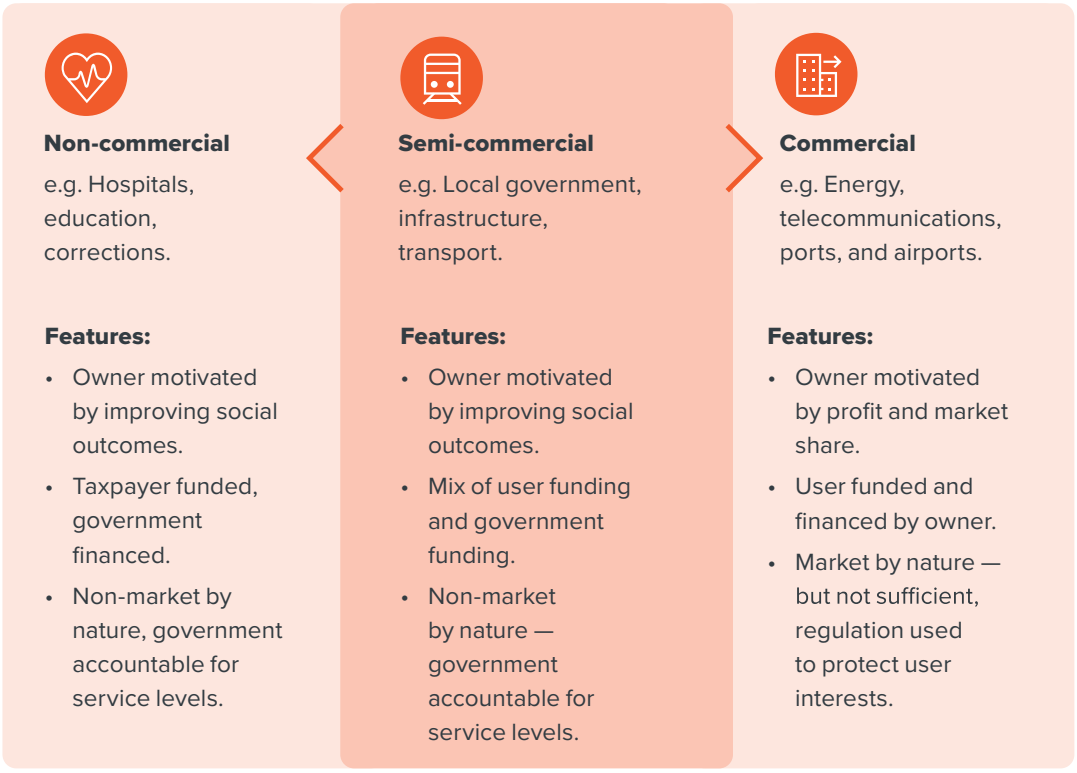
The way we fund and finance infrastructure can have significant impacts on what projects are implemented, which community needs are met, who can access infrastructure, and how we use it.[106] It also has a large bearing on when we pay for it, which has implications for intergenerational equity. These challenges are not unique to New Zealand. The growing gap between the demand for infrastructure and available funding is a major trend internationally.

Financing is distinct from funding. Funding represents all the revenue needed to pay for infrastructure. It ultimately comes from the community through end users, taxpayers or ratepayers. In contrast, financing affects when we pay for our infrastructure. It could mean using cash surpluses now or borrowing from sources we need to service and repay later.

The unique characteristics of infrastructure make funding and financing decisions (page 32) more challenging. Infrastructure is long-lived, new investment is often lumpy, networks are interconnected, services are shared, and spillovers (where use by one individual can affect someone else) are common.

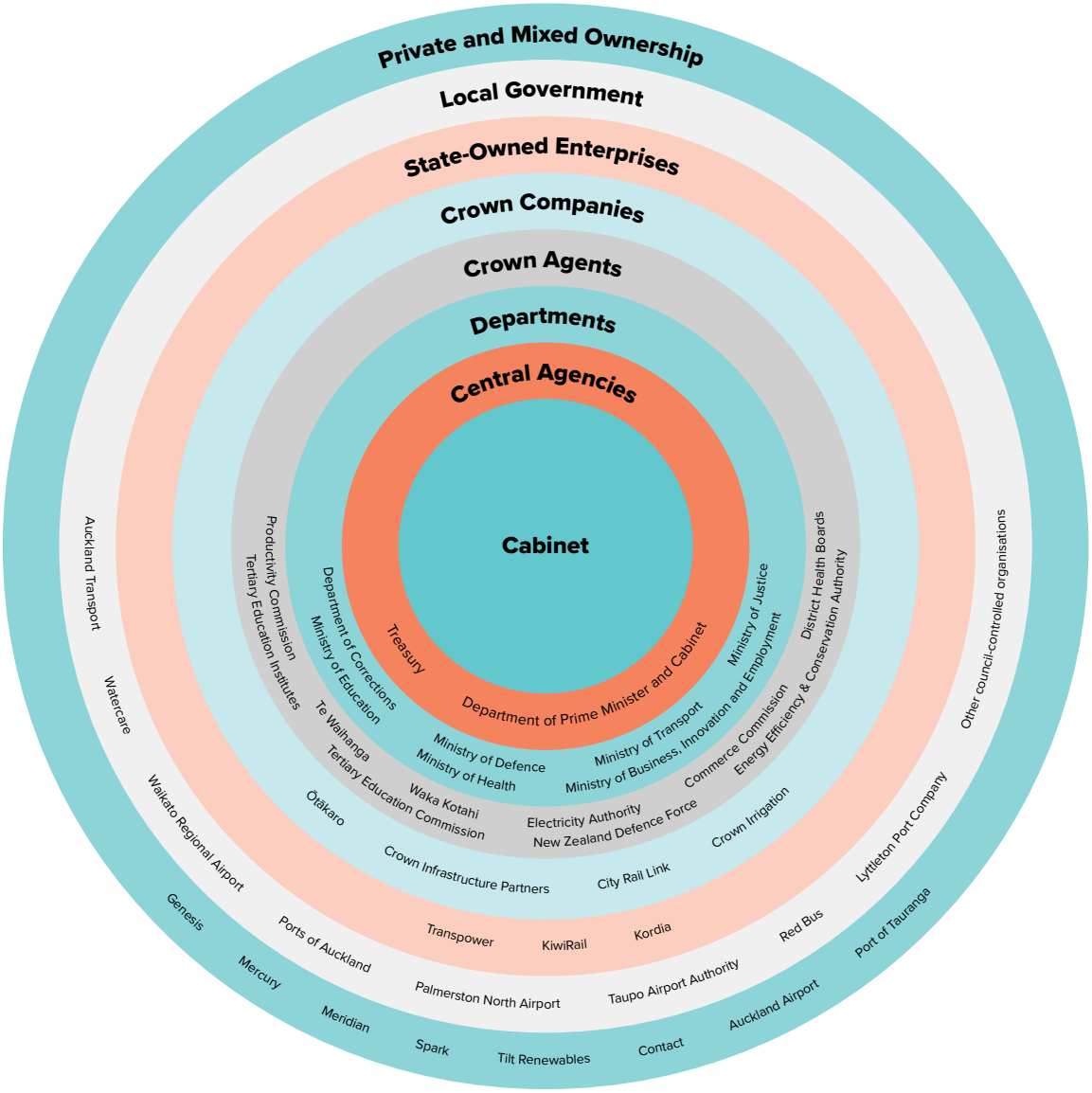
There are large differences in how the various infrastructure sectors fund and finance infrastructure. Infrastructure funding can be thought of as a continuum, ranging from commercial funding that is primarily based on revenue from end users, to semi-commercial and non-commercial funding, which is primarily based on funds from taxpayers and ratepayers.

Figure 10: Equitable funding and financing



Different infrastructure sectors rely on different funding types, depending on their underlying characteristics and current policies. Figure 10 above is an illustrative view of how different sectors might currently sit on this continuum.

Figure 11: Just some of the players in our infrastructure system



New Zealand is facing some significant challenges that affect how we fund infrastructure.[107]

> *"The scale of some of these [funding] pressures on local government is unprecedented. They are also highly uneven across councils."*
> **— New Zealand Productivity Commission**

Our cities are growing with speed. Two-thirds of all population growth in the next 30 years is expected to occur in five territorial authorities. The infrastructure funding challenge in these areas is likely to intensify, particularly to support housing and employment needs.

A wider use of funding and financing tools may help. A greater use of value-capture mechanisms can improve equity by ensuring the people who benefit from infrastructure pay a greater share. These mechanisms include targeted rates, the Infrastructure Funding and Financing Act and development contributions. Some changes may be required to these mechanisms. It may be appropriate for example, to enable local authorities to use land-value change as a basis for targeted rates. This would require a legislative change. In terms of financing tools, a greater use of debt can help spread costs across generations, but the simple availability of these tools may not be sufficient.

The political environment of local government is not always conducive for funding growth. This can be because:

- The costs and benefits of growth accrue to different institutions.
- It takes time for growth to pay for itself, creating a misalignment between the interests of existing voters and those of future residents.
- The costs of growth (through, say, rising congestion and crowding) loom larger than the benefits of growth for existing residents.

In each case, funding for growth can be challenging and infrastructure may be less responsive to population change as a result. In other sectors where the operating environment are more commercial (such as telecommunications and energy), infrastructure providers benefit more directly from population growth, and infrastructure responsiveness is less problematic.

A new funding and financing approach may be needed for large-scale projects with potentially transformational regional and national impacts. Current funding and financing arrangements are suitable for ongoing and 'business-as-usual' infrastructure. However, they may be less suitable for large-scale projects such as Auckland's City Rail Link, which used a Special Purpose Vehicle co-funded and financed by the Crown and Auckland Council. There is no standard approach to how central government contributes to these projects.

Commitments to zero-carbon 2050 have funding impacts. The costs associated with mitigating climate change will be felt most significantly in the transport and energy sectors as New Zealand electrifies the movement of people and freight. In contrast, the costs of adapting to climate change may be felt more broadly across sectors, as population settlement patterns change. For instance, around $5.1 billion worth of local-government infrastructure will be at risk from sea-level rise of one metre.[108] As well, embedded carbon is likely to have cost and funding impacts.

Climate change may also accelerate the need to change the land transport funding system. Land transport revenue may not be sustainable in the medium term with the likely rapid rise in electric vehicles. These vehicles are currently exempt from paying road-user charges and do not pay a fuel tax. An eventual shift to some form of road-user charge is needed. There is also a need to consider whether the current funding system of 'pay as you go' is fit for purpose, how road pricing might be included in any future transport funding system and how this can support preparations for achieving net-zero carbon by 2050. In the shorter term, a transition plan for transport funding needs to be considered.

There is a tourism funding gap. There is a funding gap for a small number of tourism-reliant territorial authorities, caused by the need to provide infrastructure for international visitors. While this may not currently be an issue in a Covid-19 environment, it is expected to rise once again in the medium term. These challenges increase where the rating base of an area is stagnant or declining. Options to enable the International Visitor Conservation and Tourism Levy to be used for tourism infrastructure could be explored.

Some areas face stagnant or declining funding bases. It may become challenging for some territorial authorities to fund existing operational costs and maintain levels of service if their rating bases fall as forecast, due to a declining population and/or business closures. In these areas, a wider approach may be necessary, including identifying non-built or technological solutions, instead of building new infrastructure. In some situations assets may need to be decommissioned.

The short-term effects of Covid-19 have also made many of these funding problems worse by reducing existing revenue streams. Local government has been particularly affected, as has the tourism sector.[109]

> *"For most of the last hundred years, as a country, we have built for growth. Now, up to nine regions face declining forecasts. For places in these regions, managing networked infrastructure services in conditions of economic and population decline, while standard and service-level expectations increase, might be more challenging."*
> **— Auditor-General [110]**

There are other funding issues to consider.

- **Crown land is mostly exempt from paying general rates.** This includes Crown land occupied by institutions such as education providers and hospitals. The users of these services create infrastructure costs and benefit from the infrastructure of the areas, which must be managed and maintained by local authorities. It may be appropriate for the Crown to pay rates on land that generates a demand for infrastructure.
- **Requirements for local authorities to cash fund depreciation.** The Local Government Act 2002 requires local authorities to account for the depreciation of existing assets together with debt-servicing costs in the overall operating budgets as forecast in their Annual and Long-Term Plans. This places a large burden on the amount needed from ratepayers to fund operating expenses. This is in addition to the demands of funding the consequences of population growth together with changing community needs.
- **Capital charge and depreciation funding for Crown investments.** Rules around capital charge and depreciation funding are designed to encourage efficient and sustainable use of capital by government departments. These rules can, at times, create fiscal challenges for departments, especially if there has been a history of underinvestment in capital assets. Consideration as to whether the current approach to pricing capital is driving the right incentives is needed. This might include how the capital charge and depreciation funding regime could be refined to ensure that a significant rebuild or new development is properly accounted for in the system and does not starve the agencies of capital for business-as-usual capital replacement.

Funding and financing challenges do not always require new revenue streams.

Funding pressures can be reduced by applying basic disciplines of good infrastructure provision and management. This helps to minimise risk, cost and build requirements. Good infrastructure provision can include managing the demand for existing infrastructure. When new infrastructure is required, good planning and business case processes give projects the best chance of being completed on time, on budget and to specification. This enables them to operate efficiently and as projected. Having a first-rate investment-management system and a robust approach to procurement can bring cost efficiencies and make it easier to fund and finance high-quality projects.

New Zealand has a history of creating new financing sources.

New Zealand has taken a range of steps to improve alternative sources of finance over a period of time. Examples include:

- The development of the mixed-ownership model between 2011 and 2014, with Meridian Energy, Genesis Energy and Mercury Energy, allowing private capital investments in these utility companies while protecting Crown control.
- In local government, the establishment of the New Zealand Local Government Funding Agency in 2002, pooling some $13 billion of local-government funding to lower financing costs for local authorities and council-controlled organisations by accessing domestic and international markets.
- Eight public-private partnerships in the transport, education and justice sectors. Each partnership involves a licence being granted to a commercial partner for the delivery and operation of an asset that is owned publicly.
- Auckland Council, following one of the largest local government amalgamations in New Zealand's history in 2010, establishing a track record of issuing multi-currency bonds to domestic and international investors, including the issuance of green bonds for environmentally sustainable projects (including its new electric train fleet and the Central Interceptor wastewater scheme).
- The creation of several special-purpose vehicles, including the Housing Infrastructure Fund, the repurposing of Crown Fibre Holdings to Crown Infrastructure Partners, and the City Rail Link.
- The recent Infrastructure Funding and Financing Act, which provides for the creation of special-purpose vehicles for off-balance-sheet financing of growth infrastructure.

Further developments are under way in the water sector, with reforms likely to lead to increased options for how water assets are financed.

However, even with the changes described above, there may still be scope to consider alternative mechanisms for financing infrastructure.

Discussion questions

Q28. What steps could local and central government take to make better use of existing funding and financing tools to enable the delivery of infrastructure?

Q29. Are existing infrastructure funding and financing arrangements suitable for responding to infrastructure provision challenges? If not, what options could be considered?

Q30. Should local authorities be required to fund depreciation as part of maintaining balanced budgets on a forecast basis?

What we've heard - some of the results from our Aotearoa 2050 survey

"Infra-structure funding is too variable because of the three year political cycle. It is also subject to considerable variation in central government policy."
– Anonymous, Auckland

"The front end costs of infrastructure development is too expensive and does not represent value for money."
– Anonymous, Auckland

"Local infrastructure needs to be paid for centrally ie through increased taxes rather than local rates."
– Charly, Wellington

"National Co-ordination of infrastructure projects. This is required to avoid duplication/petty politics/ and projects failing to be completed by appropriately allocating resources and priorities...."
– Anonymous, Wellington

"We need to balance infrastructure costs between current and future generations, between people with different abilities to pay, and different uses."
– Anonymous, Bay of Plenty

450+
comments mentioning the cost of infrastructure

200+
comments mentioning expensive infrastructure

S2.1	Fund tourism infrastructure
2022-2026 LFF	Enable the International Visitor Conservation and Tourism Levy to be used for tourism infrastructure, especially networked infrastructure. The levy was established in 2019. It was forecast to provide $450 million in the first five years of operation. The levy could be made available to certain local authorities (for instance, those with high international visitor to resident ratios), if they can demonstrate they have explored all other means to finance infrastructure pressures caused by tourism.

S2.2	Rating Crown land
2027-2032 ULH	Require the Crown to pay rates to local authorities for land that it owns that is currently exempt, where it generates a demand for infrastructure. This includes Defence Force land, schools and hospitals. Currently, Crown land is mostly exempt from general rates. This is a potentially significant source of 'lost' income for local authorities with significant proportions of Crown land in their areas.

S2.3	Develop a transition plan for transport funding
2022-2026 KCM	Develop a pathway and transition plan for shifting all vehicles onto time, distance, and level-of-service-based pricing, improving transport pricing and the required governance arrangements needed to support this. Include a consideration of the merit of differential pricing for commercial and non-commercial traffic. This recommendation would need to be considered alongside recommendation C3.1, which relates to congestion pricing for urban areas.

S2.4	Use value-capture mechanisms to fund infrastructure for growth
2022-2026 BUP, LFF, MHT	Incentivise local authorities to make greater use of targeted rates or value-capture mechanisms to fund growth infrastructure.

S2.5	Enable land-value change as a basis for a targeted rate
2022-2026 BUP, LFF, MHT	Implement a legislative change to allow local authorities to be given the option of using land-value change as a basis for a targeted rate.

S3. Make better use of existing infrastructure

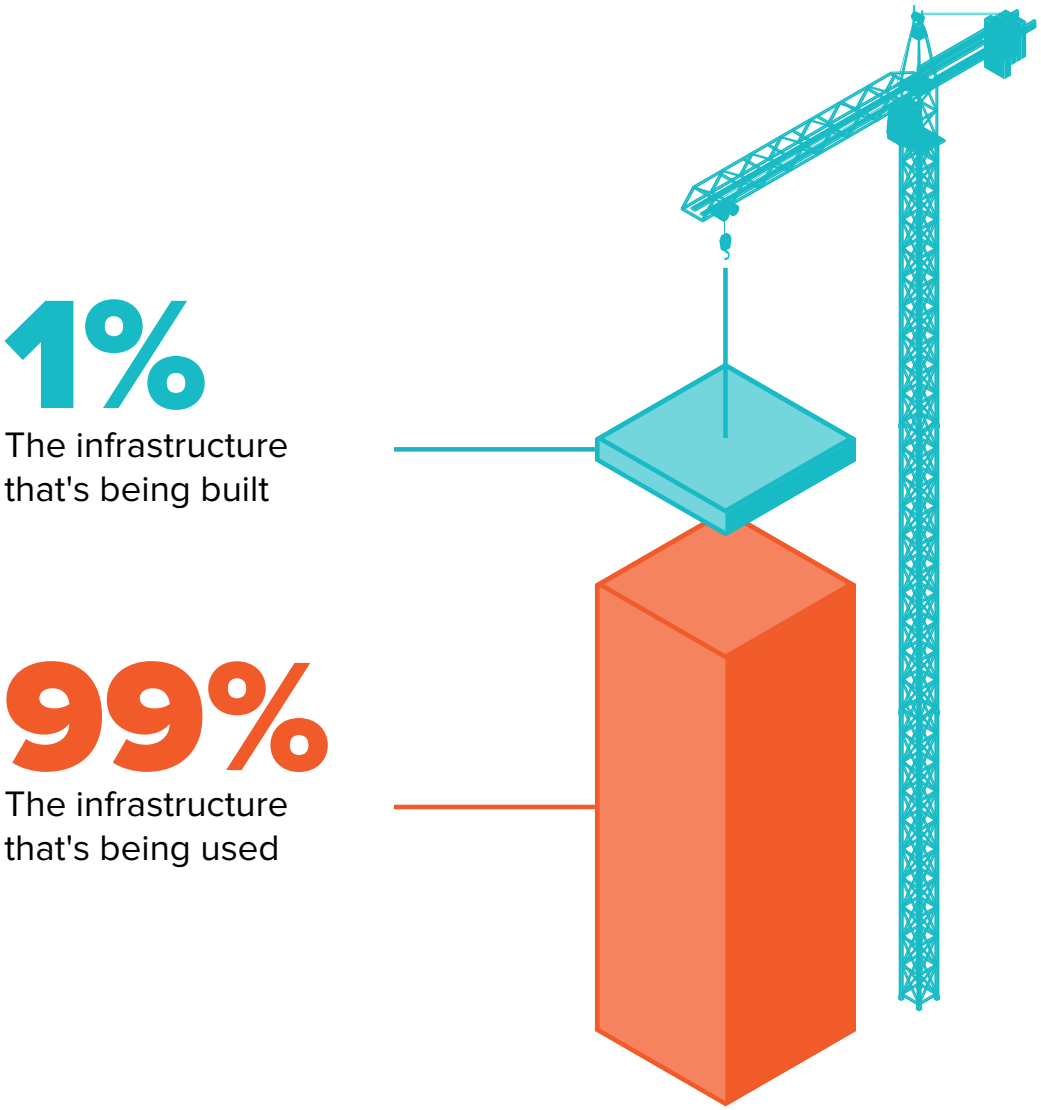
Te whakapai ake i te hanganga e tū ana i tēnei wā

It's not just about building more infrastructure.

New Zealand's infrastructure demands are growing faster than our willingness to pay for new or improved infrastructure. This means we will need to look for ways to get more out of the infrastructure we already have. Most of the infrastructure that New Zealanders will use in the future already exists.

The construction of new infrastructure typically only expands networks by a small amount. For instance, in the past decade the total length of New Zealand's sealed road network increased by less than 6 percent.[111] The optimisation of existing infrastructure, therefore, offers significant opportunities to improve outcomes.

Figure 12: It's not just about infrastructure that needs to be built



Achieving good outcomes and coping with future challenges require us to better use and manage existing infrastructure.

Building new assets often isn't the best way to meet infrastructure needs. Major projects will continue to be an important part of the infrastructure planning landscape but, wherever possible, we need to look at non-build solutions first. Taking steps to manage the demands placed on infrastructure, and using the assets we already have more efficiently can be cheaper and better options. Non-build options involve, for example, more effective planning to combine infrastructure needs, managing demand for existing infrastructure, or making better use of the existing system through productivity improvements or better maintenance (see Figure 13). An assessment of the availability of non-built alternatives should be part of every project selection processes.

Figure 13: Better use and management of infrastructure

The first step to better manage existing infrastructure is to understand what condition it is in.

Getting the most out of existing infrastructure requires asset managers to have a robust understanding of the current asset condition, the demand for assets and options for improving asset performance. Good data that is kept up to date is needed. Only then can good investment decisions be made.

Other options to improve asset management include:

- Enabling several organisations to share infrastructure to avoid the need for duplication, as well as sharing of services.
- Reviewing regulation to identify whether the use of infrastructure can be improved.
- Centralising government asset-management functions (through, for example, a government asset management team).
- Requiring certain infrastructure providers to publish data on the condition of their infrastructure (including GIS spatial data).

What we've heard - some of the results from our Aotearoa 2050 survey.

"We need some radical changes of mindset, different solutions than only building more and more roads."
– Anonymous, Wellington

Reduce the need to travel
58% said definitely

Improve public transport
75% said definitely

Make better use of the roads we have
43% said definitely

"Transport is not all about roads- although they are popular for votes, they generate congestion so alternative modes should be prioritised where applicable (buses, trains, ferries etc)."
– Anonymous, Auckland

Enable people to live closer to their work
48% said definitely

Build more roads
only 28% said definitely

Demand management can improve the performance of existing infrastructure.

Demand management is the active process of trying to change user behaviours and demand for infrastructure, particularly during peak periods of use, whether that be daily, seasonal or otherwise. Left unmanaged, peak demand can cause the performance of infrastructure to decline or result in the overbuilding of expensive infrastructure.

The active management of demand can occur through a range of tools. These include:

- **Pricing:** Directly and indirectly varying the cost of using infrastructure networks at peak and non-peak times (such as offering discounts for off-peak travel in Auckland or discounting of electricity for lower demand periods of the day).
- **Regulation:** Setting the parameters within which infrastructure assets can be used (such as water restrictions through a drought).
- **Education:** Informing users of the impacts of their decisions on infrastructure networks.

Often these three demand-management tools are used in combination to bring about change in the demand for, and use of, infrastructure. Different infrastructure sectors currently use different tools. For instance, water providers might use public campaigns to bolster conservation efforts in a dry year and transport agencies might report congestion levels or suggest alternative routes during busy times. The energy sector uses real-time spot prices to manage congestion on the transmission grid and to balance supply and demand (which leads to conservation of hydro-generation resources in dry years). City planners might regulate for more housing capacity around rapid-transit nodes.

The electricity system has used demand-management tools for several years to reduce peak demand and the need for investment in transmission infrastructure. In addition to the role of spot prices mentioned above, peak demand on the electricity transmission grid is also influenced by a regional coincident peak demand (RCPD) charge, which allocates a large portion of the cost of transmission to transmission customers at times when demand for energy in a region is known to be high. The RCPD charge has been found to reduce peak demand by between 2 and 9 percent.[112,113] Demand management, including pricing, for other networks (such as transport, water and waste) could be used to manage pressure at peak periods and better use existing infrastructure.

Discussion questions

Q31. What options are there to better manage and utilise existing infrastructure assets?

Q32. Are there benefits in centralising central government asset management functions? If so, which areas and organisations should this apply to?

S3.1	Consider non-built options
2022-2026 PII	Require project selection to take explicit and detailed account of available alternatives, including the enhanced use of existing infrastructure, extending the life of existing assets, pricing solutions, project staging and cheaper build options.

S3.2	Investigate New Zealand Government Asset Management Team
2027-2032 IAM	Investigate the establishment of a New Zealand Government Asset Management Team to take asset-management responsibilities from government agencies that have no specific asset-management focus or have a poor track record of asset-management.

S3.3	Improve pricing to optimise use of existing infrastructure
2027-2032 TCQ, LGW, LFF, FOT	Implement changes to infrastructure pricing to optimise the use of existing infrastructure and potentially defer major upgrades. Specific areas where this is likely to be desirable are: • Water infrastructure, (which is addressed further in recommendation C2.2). • Transport infrastructure (which is addressed in recommendations S2.3 and C3.1). • Landfill waste levies (which are addressed in recommendation F3.2).

S4. Require informed and transparent decision-making

Te whakahau me whakatau i runga te māramatanga me te mōhiotanga

Infrastructure investment decision-making is often complex, increasing the need for good analysis.

Infrastructure investment decisions can have complex and wide-ranging impacts on users, communities, and the natural environment. Decisions about whether to build new infrastructure and how to design it often involve trade-offs between different outcomes. This means it can be challenging to assess the costs and benefits of options in a comprehensive and accurate way.

This complexity increases the need for good information to inform decisions and improved transparency around decision-making. This is especially true for infrastructure provided by local and central government, where funding comes from taxes or rates rather than directly from end users.

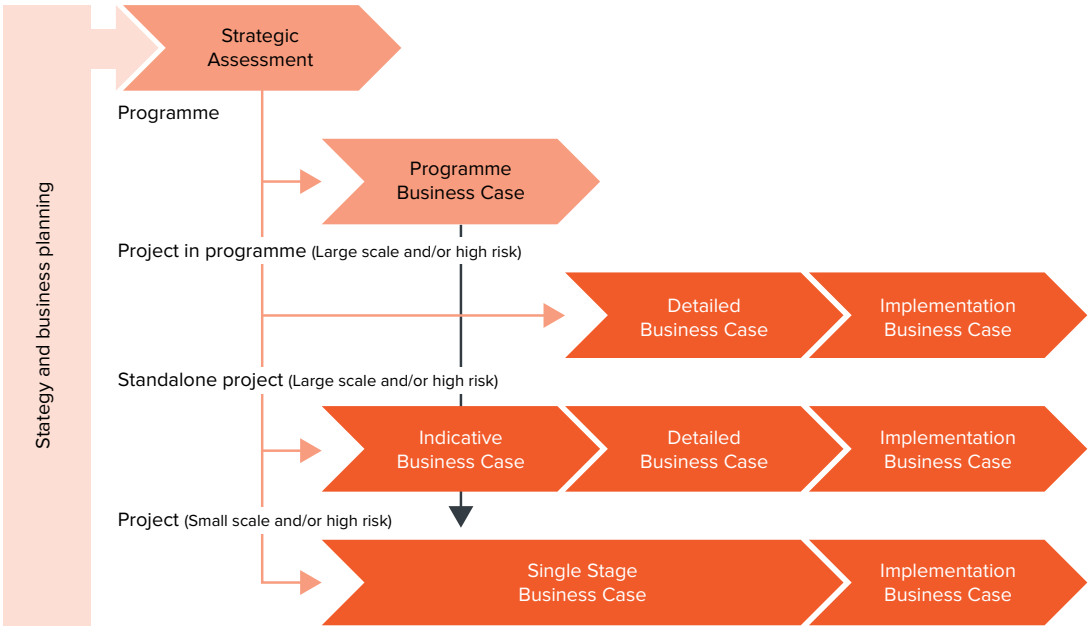
The Treasury's Better Business Cases guidance lays out a structured approach to decision-making.

The Treasury's Investment Management Framework includes guidance on the preparation of business cases for investment proposals in the public sector.[114] This guidance outlines a staged, scalable process for identifying investment needs and planning projects that address identified needs.

As shown in Figure 14, the Treasury recommends a multi-stage process for large-scale or high-risk projects that includes progressively more detailed assessments of options prior to the identification of a preferred way forward.[115] The aim of the multi-stage process is to:

- Ensure that decision-makers have adequate information on the costs, benefits and risks of projects before making decisions to proceed.
- Provide decision-makers with multiple 'off-ramps' at appropriate points.

Figure 14: Multi-stage business case process



Source: New Zealand Treasury

While business case guidance is available, it is not always used for decision-making. In some cases decisions are made prior to the completion of a business case. In others, no business case is prepared before proceeding with the project. A more consistent uptake of this guidance for all significant infrastructure projects would be desirable.

Cost-benefit analyses should be used for assessing alternative investment options.

The aim of cost-benefit analysis (CBA) is to understand whether the benefits of an investment proposal outweigh its costs. In many infrastructure sectors, CBA is an important tool for understanding whether a project is desirable. However, the uptake and use of CBA to guide planning and decision-making is uneven across infrastructure sectors.

CBA should not be narrowly focused on financial outcomes, although these are often important. Instead, it should comprehensively consider all relevant benefits and costs, including non-financial economic, social, cultural and environmental impacts. The Treasury's Guide to Social Cost Benefit Analysis outlines principles for assessing and weighing up these impacts.[116] Some infrastructure sectors have additional CBA guidance, such as Waka Kotahi's Monetised Benefits and Costs Manual[117] and the Transpower Capital Expenditure Input Methodology published by the Commerce Commission.[118]

The quality of CBA is only as good as the quality of inputs to the analysis. In some cases it may be difficult to model or value some impacts. This is often true for environmental impacts, which can be difficult to value accurately, and the long-run impacts of major infrastructure on urban form, which can be difficult to model accurately.[119] [120] When unquantified impacts are potentially significant, decision-makers may have to make judgements about how large these impacts are likely to be, relative to quantified costs and benefits.

When a quantitative CBA is not possible, a qualitative assessment of costs and benefits can still be useful to inform decision-makers about trade-offs between alternative options.[121]

CBA should value the future appropriately.

Many infrastructure projects are long-lived, meaning it is necessary to consider costs and benefits that arise over multiple decades. CBA addresses this by 'discounting' the value of costs and benefits to assign a lower weight to future outcomes relative to present-day outcomes.

The discount rates used in CBA reflect society's preferences in trading off current wellbeing against future wellbeing, including the wellbeing of our children and grandchildren. There are several ways to make this trade-off that reflect different perspectives about valuing the future.[122] Depending on the approach, CBA may result in different outcomes for long-lived infrastructure projects.

A review of the discount rate policy would be desirable to ensure that the approach to valuing future outcomes is aligned with New Zealanders' values and preferences and is consistently applied across infrastructure sectors.

The water sector requires cost benefit analysis (CBA) guidance.

The reform of the water sector will increase the need for a robust analysis of the costs and benefits of new water infrastructure. A new economic regulator will be established to ensure that new water providers deliver good long-term outcomes for customers, including good decisions on new infrastructure.[123]

Water infrastructure often delivers a mix of economic, environmental and amenity benefits. For instance, a new interceptor sewer may increase capacity for new housing development (generating economic benefits) and reduce sewage overflows to the harbour (generating environmental and amenity benefits). Both impacts must be valued to understand whether the benefits of the proposed investment exceed its cost. Without this analysis there is potential for inefficient 'gold-plating' of infrastructure or, conversely, under-investment in environmental and amenity benefits.[124]

To improve decision-making in the water sector, the new economic regulator could develop, in conjunction with the sector, a CBA manual that sets out evaluation methods and parameters for relevant economic, environmental and amenity benefits. The manual could enable appraisals of both simple and complex projects, for instance by following transport appraisal practice and providing 'simplified procedures' for small projects.

Projects must be scoped accurately to ensure they are feasible to deliver at the expected cost.

There is a tendency for infrastructure projects, especially large-scale projects, to experience cost overruns during the delivery phase. Internationally, this has been observed for road and rail projects,[125] electricity generation[126] and transmission projects, major sporting events,[127] and oil and gas projects.[128] [129] [130] Locally, Waka Kotahi experienced total cost overruns of $1.1 billion on 13 contracted road projects during the 2017-2020 period, which was equal to around one-quarter of the annual National Land Transport Fund spending.[131]

Cost overruns during the delivery phase of a project are often the result of inadequate project scoping and design that results in contract variations and delays to construction schedules.[132] Expected changes can also drive up bid prices for construction contracts.[133]

Business case processes should devote sufficient resources to scoping and designing projects to ensure that accurate cost estimates are available prior to decisions being made to proceed with the projects. This is important for ensuring it is feasible to deliver projects and for understanding financial risks.

Improvements in the infrastructure decision-making culture are needed.

Although robust business-case and project-analysis frameworks are available, they are not always used, even for large projects. Local and central government agencies that invest in infrastructure use a range of approaches to make decisions.

Even in sectors where CBA is commonly used, such as transport, CBA results are not always used for project selection.[134] This can lead to poor outcomes, such as cost overruns or the selection of projects that do not deliver best value to the communities they serve.

Further research is needed to understand why decision-making frameworks are not always used in practice. The international research highlights that politicians may not use CBA for a variety of reasons, some of which are likely to be relevant in New Zealand:[135]

- Concerns about the impartiality and accuracy of the analysis.
- Disagreements on the assumptions and premises of CBA, such as how environmental impacts or distributional impacts are accounted for.
- Issues with timeliness of information. CBA results are typically provided late in the planning process, often after a decision-maker has announced the intention to proceed with a project.

Infrastructure decisions should be transparent and subject to post-implementation review.

Greater transparency in local and central government infrastructure decisions can drive improvements to decision-making processes. Improvements to transparency could include:

- Requiring business cases to be published for all major infrastructure projects prior to funding approval, or requiring a notice to be published that a business case was not prepared.
- Requiring local and central government to undertake rigorous CBAs prior to making decisions on all large public infrastructure proposals, and to publicly release the results of the assessments.

In line with the Treasury's investment-management system, a systematic process for post-implementation review of investment decisions is also needed to identify whether projects have met their objectives at the expected cost and to identify lessons that could be applied to future projects.[136]

S4.1	Undertake a post-implementation review of all major infrastructure projects
2022-2026 DSA	Conduct and fund independent post-implementation reviews of major infrastructure projects at completion, with the purpose of improving future evaluation methods and processes. Publish ex-post reviews in full and measure performance, benefits and cost estimates against business case estimates.

S4.2	Undertake cost benefit analyses of all projects over $150 million
2022-2026 PII	Ensure a commitment by all local and central government agencies to undertake and publicly release rigorous CBAs on all public infrastructure investment proposals where the whole-of-life costs of the proposals exceed $150 million. In general, analyses should be done prior to projects being announced. If a project is announced before analysis is done, for example, in the lead-up to an election, this would be conditional on the findings of a subsequent analysis.

S4.3	Review the discount rate
2022-2026 TNT	Undertake an inquiry into the appropriateness and consistent application of New Zealand's social discount rate policy.

S4.4	Develop a cost benefit analysis manual for new water infrastructure
	The economic regulator for the water sector should develop a CBA manual that makes transparent the evaluation methods and parameters for valuing relevant economic, environmental and amenity benefits. The manual should enable appropriately-scaled appraisals of both simple and complex projects. In line with practices in the electricity transmission sector, it should be used as part of the investment test for new and improved water infrastructure to ensure that it delivers benefits that exceed its cost.

S5. Develop and prioritise a pipeline of work

Te whakawhanake me te whakamatamua i tētahi whakaraupapa mahi

An infrastructure pipeline is a managed database that provides a detailed and informed picture of upcoming infrastructure investment or major construction opportunities.

The Construction Sector Accord, made up of 13 sector leaders across industry and government, has identified a need for a visible, coordinated pipeline of work to improve the productivity and performance of the construction industry. A pipeline provides improved transparency in what infrastructure activity will occur where. It may also provide a likely or confirmed timeline, allowing the market to prepare the financial resources and people needed.

A credible pipeline:

- Provides a single, trusted source of information for the construction industry on credible medium-term investments.
- Enables the construction industry to plan its resource needs accurately.
- Enables more coordinated planning of investment in New Zealand.

Te Waihanga publishes an up-to-date pipeline that provides information on the project planning and delivery intentions of more than 100 infrastructure providers.

The pipeline includes information from most large local and central government agencies that provide infrastructure, as well as some private-sector organisations.[137] As at March 2021 there were more than 2,400 projects in the pipeline database, with a total expected cost of $56 billion.

At present, Te Waihanga's pipeline collates information from infrastructure providers. Further work could be undertaken to determine whether projects in the pipeline are attractive and achievable to infrastructure providers and the construction sector:

- Projects are attractive when they have been through a robust planning and design process to ensure they can be funded and delivered, and they will deliver benefits to the communities they serve.
- Projects are achievable when it is possible to find the construction sector resource to build them on the planned schedules.

Feedback from the construction sector and infrastructure providers suggests that there are challenges with both project attractiveness and achievability. Only some projects have been through a robust planning and design process and there is unlikely to be sufficient sector capacity to deliver all planned projects within the proposed timeframes.

Further work is needed to improve the transparency and credibility of projects.

This might be achieved by developing a priority list of projects. This approach has been adopted in Australia, where a priority list includes two broad groups: priority projects and priority initiatives.

- **Priority project:** Is an infrastructure solution to a defined problem or opportunity that has a completed business case.
- **Priority initiative:** Is a potential infrastructure problem, opportunity or 'early-stage' solution, that does not yet have a completed business case.

Better ways to measure current and future construction sector capacity are also needed.

These would assess whether it is realistic to deliver planned and proposed infrastructure programmes in the proposed timeframes (using measures of utilisation), as well as identify any requirements to build the capacity of the construction sector. Communicating this information to the market would assist infrastructure providers and the construction sector to make realistic and informed investment decisions.

S5.1	**Develop a priority list of projects and initiatives.**
2022-2026 AIP	Develop a priority list of projects and initiatives that is consistent with the Aotearoa New Zealand Infrastructure Strategy.

S5.2	**Improve the use of the pipeline for commercial decision-making**
2022-2026 PSS	Evolve the pipeline of forward work intentions so that it is more useful in supporting the market to make commercial decisions (i.e. assessing capacity, funding and timing) and enabling better use of infrastructure spending for fiscal stimulus in economic downturns.

S5.3	**Measure sector utilisation**
2022-2026	Develop measures of current and projected future infrastructure delivery capacity and projected utilisation.

S6. Improve project procurement and delivery
Te whakapai ake i te kaitaonga me te tuku ratonga

The effective procurement and delivery of infrastructure is fundamental to the delivery of quality public services and achieving the best value for money.

Central government procures approximately $10 billion a year of physical infrastructure.[138] Government project procurement and delivery functions are spread across public sector agencies. These functions are agency-led as opposed to centralised, meaning each agency is responsible for its infrastructure decisions and practices. The current procurement policy framework, administered by the Ministry of Business, Innovation and Employment, consists of a combination of principles, rules and good-practice guidance that supports and encourages procurement practice.

In general, there appears to be a lack of knowledge of and experience in delivering infrastructure projects at the senior leadership level in the public sector, and a scarcity of highly trained and experienced staff managing procurement and contracts.[139]

New Zealand has no consistent project-delivery framework, career path or training and development model for project deliverers. This lack of consistency, knowledge and experience can lead to ineffective governance, delays in decision-making, and a lack of understanding of the impacts of decisions on overall project outcomes. New Zealand also lacks a suitably qualified centre of procurement and project delivery excellence that can be deployed to high-risk and high-value projects. This is a significant issue given that approximately 82 percent of New Zealand's infrastructure pipeline is still in the pre-procurement phase.

The development of a national project management office could provide people with the skills and expertise to procure and deliver high-value and high-risk projects.

These experts could be made available to those public sector agencies that currently lack their own internal procurement and project management expertise to support their delivery activities. This differs from a centralised approach in which a single agency is responsible for all procurement and delivery activities.

The establishment of a major projects academy in New Zealand could improve knowledge and the future capabilities of project managers delivering large and complex infrastructure.

A major projects academy would develop infrastructure project professionals, such as project managers, by raising the planning, delivery, and leadership capabilities needed to deliver complex major projects. This could be based on a competencies framework that enables participants to develop the leadership competencies most relevant to their sector.[140] This approach follows that of the Australian Major Projects Leadership Academy established in Victoria in 2019.[141]

Encouraging market participants to be active in helping to solve our infrastructure challenges may be beneficial to the public sector.

Unsolicited and market-led proposals can drive innovation, provide unique value, and accelerate the delivery of critical public infrastructure projects. This requires an openness to receiving proposals from the market. Market participants need to be confident that proposals will progress where they provide tangible benefits that no-one else can deliver.

Discussion questions

Q33. What could be done to improve the procurement and delivery of infrastructure projects?

Q34. Do you see merit in having a central government agency procure and deliver infrastructure projects? If so, which types of projects should it cover?

S6.1	Establish a major projects leadership academy
2027-2032 MPL	Establish a major projects leadership academy in New Zealand to raise the planning, delivery, financial and leadership capabilities for major projects in both government and industry. Develop this initiative with the Construction Sector Accord and international experts. Attendance at the academy should be a mandatory requirement for directors of major infrastructure projects within 10 years.

S6.2	Revisit New Zealand's approach to market-led proposals
2022-2026 MLP	Encourage the submission of unsolicited and market-led proposals by developing a standardised and centralised approach that gives the market confidence that proposals will progress where they provide tangible benefits that no-one else can deliver, and that a government-led competitive process may not produce better results.

S7. Reduce costs and improve consenting

Te whakaheke i ngā utu me te whakapai ake i te hātepe tuku whakaae

The cost to build infrastructure in New Zealand is high by international standards and rising rapidly.

Unless addressed, this will make it difficult to supply new and improved infrastructure to meet the needs of New Zealanders. Case studies highlight the magnitude of our infrastructure cost and productivity challenge.

- Infrastructure New Zealand observed in 2017, that Auckland's proposed East-West Link, a 5.5 kilometre road link that was estimated to cost $1.8 billion to construct, could "rival the most expensive roading project in the world".[142]
- Data collected by researchers at New York University's Marron Institute of Urban Management suggests that Auckland's City Rail Link is the 11th most expensive rail-tunnelling project ever, on a per-kilometre basis.[143]

There are several reasons why the costs to deliver infrastructure may change over time.

These include:

- **Demand-driven cost inflation:** This arises when many projects compete for a limited pool of planning, design and construction resources. As firms and workers in the infrastructure sector are mobile, any increases in demand in Australia and the broader Asia-Pacific region can affect the New Zealand market.
- **Changing design and delivery requirements:** This can occur, for example, due to the need to build in challenging and costly environments, provide a high level of service for users, use bespoke rather than standard designs, or meet increasing requirements around health and safety or environmental mitigation.
- **Productivity growth:** This allows more or better infrastructure to be delivered at a lower cost, using fewer resources. Technological improvements, better training, and management and process improvements are important levers for productivity growth.

In New Zealand, civil construction prices have risen significantly faster than the general consumer price index, indicating ongoing demand-driven cost inflation.[144] International evidence and local case studies suggest that changing design and delivery requirements have also contributed to cost growth.[145] Meanwhile, labour productivity has grown slowly in the construction sector. This is likely due to lower average skill levels and lower capital intensity in construction than are found in other industries.[146]

There is an urgent need to understand New Zealand's cost performance, identify causes of underperformance, and implement changes to improve productivity and reduce costs.

There is little systematic information on:

- How and why infrastructure costs have changed in recent decades.
- How costs compare to costs in better-performing OECD countries.
- How cost performance differs between different infrastructure sectors.

Improvements in the consenting process through the Resource Management Act reform can lower infrastructure costs and enable the achievement of government objectives.

Many of the Government's objectives are achieved through infrastructure that can enable better environmental and social outcomes. This infrastructure includes, for example, investing in public transport options and cleaner electricity generation to lower carbon emissions, wastewater treatment plants that help limit wastewater discharges, and infrastructure that enables more affordable housing.

The scale of the challenge ahead is significant. For instance, Transpower estimates that the same amount of generation will need to be built in the next 15 years as was built in the past 40 years to meet 2050 climate change targets.[147] Closing Auckland's housing shortfall will require some 30,000 dwellings,[148] with each home requiring energy, waste, telecommunication and transport services. If we are to meet this ambition, a planning system that is more enabling of infrastructure and establishes a fit-for-purpose infrastructure consenting process is needed.

Excessive costs and delays that result from consenting under the current system undermine these social and environmental goals.

The Government is already underway with the reform of the resource management system. Some progress has been made towards a commitment to clear national direction, long-term strategic and integrated planning, simplified and integrated regulatory plans, and ensuring the system as a whole is efficient and proportionate. But further progress is needed. A more comprehensive approach to stepping outside the current Resource Management Act planning paradigm and fully considering the need to reset the existing environmental planning regime will help drive the social and environmental outcomes New Zealand targets.

To achieve sustainable reductions in costs, we also need a well-resourced and capable infrastructure planning, design, and construction sector that can achieve ongoing productivity improvements.

The Construction Sector Accord is taking the lead by seeking to grow the capability and capacity of the construction sector workforce.[149] It has a cross-agency plan to encourage more people into construction careers, including the development of a workforce with greater diversity.

Discussion question

Q35. What could be done to improve the productivity of the construction sector and reduce the cost of delivering infrastructure?

S7.1	Measure and benchmark infrastructure cost performance
2022-2026 TCP	Undertake investigations into the cost performance of New Zealand's infrastructure sector that: • Covers multiple horizontal infrastructure sectors to enable the identification of common issues and points of difference. • Identify recent cost trends and drivers of cost trends within infrastructure sectors. • Benchmark New Zealand's cost performance against better-performing OECD countries and identify drivers of differences.

S7.2	Standardise design
2022-2026 DCP	Develop a standardised approach to infrastructure design that: • Prioritises high productivity. • Allows for a division of labour, offsite construction/modularisation and repeatability and therefore quality improvements and reduces the risk of systematic failure.

S7.3	Develop a planning system that is more enabling for infrastructure
2022-2026	• Require the proposed Natural and Built Environment Act to recognise that the natural and built environments are different. Therefore, different environmental management rules should apply to each. • Require resource consent decisions to take into account the length of time in which an activity will affect the environment, rather than assume the effects are in perpetuity. • Ensure consenting pathways for infrastructure through the National Planning Framework, potentially through setting standards for planning policies and regulations for infrastructure. • Limit the scope of effects considered under the proposed Natural and Built Environment Acts to matters related to natural and physical resources, not extraneous matters like commercial and amenity matters. • To support national direction, establish a national GIS database for mapping nationally important resources (built and natural), including corridors and assets of nationally significant infrastructure. • Ensure that regional spatial strategies can respond rapidly to changing national and regional priorities. • Require a pre-notification audit of proposed regional unitary plans to ensure consistency with national direction. • Allow infrastructure consents to be bundled with complementary plan changes in surrounding areas.

S8. Activate infrastructure for economic stimulus

Te whakahohe i te hanganga me te whakaara ake i te ōhanga

In response to the 2008 global financial crisis and the Covid-19 pandemic, countries around the world have looked to use investment in infrastructure to stimulate economies and preserve jobs.

Infrastructure projects can have significant job-creation effects. In New Zealand, an average of seven full-time employees is required to deliver every $1 million of infrastructure spending.[150] Infrastructure investment can soften the impacts of economic downturns on unemployment, but this depends on projects being delivered in a timely way.[151] This in turn requires us to:

- Have a clear pipeline of priority projects, including projects that are currently unfunded but can be brought forward.
- Identify projects that are genuinely ready to be built and don't have long lead times.
- Ensure that projects are of a high quality, with benefits that exceed costs.

Using infrastructure investment effectively in times of economic crisis requires improved investment decision-making and a robust pipeline and list of priority initiatives and projects.

These initiatives have been discussed earlier in this Action Area and would materially improve our ability to identify suitable infrastructure projects quickly and effectively, as a response to future economic events. The construction sector is also disproportionately susceptible to boom and bust cycles. When developing infrastructure programmes for economic stimulus, projects should be assessed and prioritised according to their impact on employment, as well as a standard cost benefit analysis. Clearly identified priority projects that are genuinely ready for delivery would help the construction sector to manage peaks and troughs, avoid losing valuable skills and support overall value for money for procuring agencies.

Discussion question

Q36. What components of the infrastructure system could have been improved to deliver effective stimulus spending during the Covid-19 pandemic?

S8.1	Develop ready to build infrastructure
2022-2026 INS	Develop a well-serviced and credible infrastructure priority pipeline to reduce infrastructure lead times, so that quickly assembled infrastructure programmes are built before a recession is over.

S8.2	Evaluate stimulus impacts
2022-2026 LLS	When developing infrastructure programmes for economic stimulus, require that infrastructure projects be assessed and prioritised according to their impacts on employment, as well as standard cost benefit analyses (CBAs). Ideally, the positive economic impacts of increased employment will be captured in CBAs.

What happens next
Ka aha ināianei?

Your feedback is an important part of the development of the Infrastructure Strategy.

Submissions will be open from 12 May to 2 July 2021 and you can provide your feedback at www.infrastructure.govt.nz/have-your-say.

We will be analysing it carefully in the coming months to understand your priorities for New Zealand's infrastructure in the next 30 years.

We will also be undertaking more technical work to fill in any gaps that have been identified and flesh out areas that need more careful thought.

Once this work has been completed, we will provide the draft Infrastructure Strategy to the Minister for Infrastructure in September 2021, as required by our legislation. It will contain recommendations for the Minister to consider and respond to.

A final Infrastructure Strategy will then be tabled by the Minister for Infrastructure in Parliament before the end of March 2022.

List of discussion questions
Pātai whakaaanga

Q1. What are your views on the proposed 2050 infrastructure vision for New Zealand?

Q2. What are your views on the decision-making principles we've chosen? Are there others that should be included?

Q3. Are there any other infrastructure issues, challenges or opportunities that we should consider?

Q4. For the 'Building a Better Future' Action Area and the Needs:

- What do you agree with?
- What do you disagree with?
- Are there any gaps?

Q5. How could we better encourage low-carbon transport journeys, such as public transport, walking, cycling, and the use of electric vehicles including electric bikes and micro-mobility devices?

Q6. How else can we use infrastructure to reduce waste to landfill?

Q7. What infrastructure issues could be included in the scope of a national energy strategy?

Q8. Is there a role for renewable energy zones in achieving New Zealand's 2050 net-zero carbon emissions target?

Q.9. Of the recommendations and suggestions identified in the Ministry of Business, Innovation and Employment "accelerating electrification" document, which do you favour for inclusion in the Infrastructure Strategy and why?

Q10. What steps could be taken to improve the collection and availability of data on existing infrastructure assets and improve data transparency in the infrastructure sector?

Q11. What are the most important regulatory or legislative barriers to technology adoption for infrastructure providers that need to be addressed?

Q12. How can we achieve greater adoption of building information modelling (BIM) by the building industry?

Q13. How should communities facing population decline change the way they provide and manage infrastructure services?

Q14. Does New Zealand need a Population Strategy that sets out a preferred population growth path, to reduce demand uncertainty and improve infrastructure planning?

Q15. What steps can be taken to improve collaboration with Māori through the process of planning, designing and delivering infrastructure?

Q16. What steps could be taken to unlock greater infrastructure investment by Māori?

Q17. What actions should be taken to increase the participation and leadership of Māori across the infrastructure system?

Q18. For the 'Enabling Competitive Cities and Regions' Action Area and the Needs:

- What do you agree with?
- What disagree with?
- Are there any gaps?

Q19. What cities or other areas might be appropriate for some form of congestion pricing and/or road tolling?

Q20. What is the best way to address potential equity impacts arising from congestion pricing?

Q21. Is a 10-year lapse period for infrastructure corridor designations long enough? Is there a case for extending it to 30 years consistent with spatial planning?

Q22. Should a multi-modal corridor protection fund be established? If so, what should the fund cover?

Q23. What infrastructure actions are required to achieve universal access to digital services?

Q24. For the 'Creating a Better System' Action Area and the Needs:

- What do you agree with?
- What do disagree with?
- Are there any gaps?

Q25. Does New Zealand have the right institutional settings for the provision of infrastructure?

Q26. How can local and central government better coordinate themselves to manage, plan and implement infrastructure?

Q27. What principles could be used to guide how infrastructure providers are structured, governed and regulated?

Q28. What steps could local and central government take to make better use of existing funding and financing tools to enable the delivery of infrastructure?

Q29. Are existing infrastructure funding and financing arrangements suitable for responding to infrastructure provision challenges? If not, what options could be considered?

Q30. Should local authorities be required to fund depreciation as part of maintaining balanced budgets on a forecast basis?

Q31. What options are there to better manage and utilise existing infrastructure assets?

Q32. Are there benefits in centralising central government asset management functions? If so, which areas and organisations should this apply to?

Q33. What could be done taken to improve the procurement and delivery of infrastructure projects?

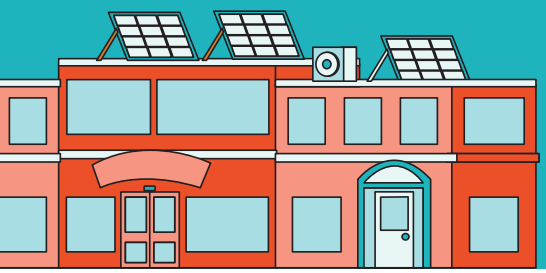
Q34. Do you see merit in having a central government agency procure and deliver infrastructure projects? If so, which types of projects should it cover?

Q35. What could be done to improve the productivity of the construction sector and reduce the cost of delivering infrastructure?

Q36. What components of the infrastructure system could have been improved to deliver effective stimulus spending during the Covid-19 pandemic?

List of options
Kōwhiringa

8



F1. Prepare infrastructure for climate change
Te whakarite i ngā hanganga mō te hurihanga o te āhuarangi

F1.1	Adapt business case guidelines to ensure full consideration of mitigation and adaptation
2022-2026 CCC, SRC	Require all infrastructure projects to directly assess climate change impacts (mitigation and adaptation). Ensure all infrastructure projects evidence they are compatible with a net-zero carbon emission future to prevent infrastructure with a long asset life locking-in a high-emissions future. Require all infrastructure projects to apply a consistent cost of carbon that is commensurate with New Zealand's international commitments in cost-benefit analysis and sensitivity analysis.

F1.2	Recognise climate uncertainty in decision-making processes
2022-2026 CHZ, PSR	Ensure that, whenever possible, decisions open up a wide range of future options and, when it is optimal to do so, keep options open for as long as possible.

F1.3	Require a bright-line (pass/fail) infrastructure resilience test
2022-2026 IVA	Require that, where appropriate, proposals for new major capital works are subject to modelling that indicates, through siting, design, specifications and construction, that the infrastructure will be able to withstand a range of major stresses and shocks, including the future impacts of climate change.

F1.4	Ensure non-built transport solutions are considered first
2022-2026 INH, NOF	To decarbonise existing transport networks, require non-built solutions to be considered first. In the case of existing roading networks, alongside transitioning to electric vehicles, non-built solutions could take the form of: • Charging to reduce demand. • Lowering the cost of public transport at non-peak times. • Real-time parking pricing. • Making better use of existing space to speed up public transport. • Density targets and supply requirements through zoning policy.

F1.5	Enable active modes of travel
2022-2026 ECB	Improve the uptake of low-carbon transport options by increasing the density of housing (up-zone) areas within a cycling catchment of all major employment areas.

F1.6	Require local government to consider information from insurance markets to inform climate-risk-related planning policy
2022-2026 RIP	Insurance markets are constantly assessing spatial risks associated with climate change. This pricing information should be an input to planning processes to inform adaptation policies in district plans.

F1.7	Drive a culture of waste minimisation
2022-2026 RWL	Update procurement guidance to require the avoidance of waste creation as a design/procurement objective: • Require the design of public sector projects to evaluate the use of recycled products where feasible. • Require that all projects of a certain size develop waste minimisations plan as tender deliverables that are considered as part of the procurement evaluations.

F1.8	Efficient pricing of waste
2022-2026 FOT	Review waste-disposal charges to landfill and investigate different pricing mechanisms with a view to better reflecting the true cost of waste disposal to landfill. Include research and community engagement on the roles of different pricing mechanisms, including household and construction waste-disposal fees.

F2. Transition energy infrastructure for a zero-carbon 2050

Te whakawhiti i te hanganga ngao kia kore ai te whakapaunga o te waro, ki te whakatutuki i te whāinga warokore 2050

F2.1	**Enable electricity distribution networks to minimise barriers to the connection and use of large numbers of local generation, storage and demand response facilities (distributed energy resources or DERs)**
2022-2026 EAN, ARE	Require (and possibly fund) electricity distributors to work with DER providers to develop and implement (by 1 July 2023) standard arrangements for procuring support services from DERs and any other associated requirements.

F2.2	**Reduce barriers to building spare transmission capacity where that would reduce inefficient barriers to large-scale renewable generation and the electrification of large process heating units**
2022-2026 TPM, LEE, ARE, GTG	Subject to appropriate regulatory oversight, enable and encourage Transpower to temporarily defer charging customers for the costs of spare transmission capacity built specifically to cater for future renewable generation connections (the deferral would end when sufficient new connections have occurred). By making it easier for Transpower to build spare capacity ahead of provable need, generators would find it easier and faster to commit to renewable investments if electricity demand increased at a higher rate than they anticipated. Similar issues arise with respect to building spare grid capacity to cater for future connections (or augmentations of existing connections) for industrial consumers.

F2.3	**Investigate the need for a specific regulatory framework for offshore energy generation**
2027-2032 ARE, OCE	Investigate the future need for an offshore renewable-energy regulatory framework to facilitate an environmentally responsible exploration, construction, operation and decommissioning of offshore wind and other clean-energy technologies and associated infrastructure in our territorial waters.[152]

F3. Adapt to technological and digital change

Te urutau ki te panoni hangarau, me te panoni tahiko

F3.1	Move towards open data for the infrastructure sector
2022-2026 PTC	Identify clear legislative steps required to move toward full open data for public infrastructure across central and local government

F3.2	Accelerate common infrastructure metadata standards
2022-2026 PTC	Develop and mandate national infrastructure metadata standards.

F3.3	Accelerate investigations on the use of digital twins and prepare for a nation-wide digital twin
2022-2026 PTC	Develop early use cases of digital twins in public-sector infrastructure.

F3.4	Design and launch artificial intelligence use-cases
2022-2026 PTC	Investigate the opportunities to use artificial intelligence and machine learning across infrastructure sectors. Examples could include: • In planning, digitising elements of the consenting process. • In transport, reducing deaths and serious injuries through active collision-avoidance technologies. • In health, identifying patterns that lead to harm incidents. • Across sectors, managing real-time infrastructure pricing strategies (such as congestion charging and parking).

F3.5	Deliver and retain digital information
2022-2026 PTC, PII	Facilitate the consistent use of building information modeling (BIM) by public-sector procurers and central government by developing a common set of standards and protocols in close consultation with industry, including private-sector bodies that undertake similar types of procurement. Support the uptake of these standards by developing detailed implementation advice for agencies on the efficient use of BIM.

F4. Respond to demographic change
Te urupare ki te rerekē haere o te hangapori

F4.1	Improve analysis of upside and downside risks in infrastructure provision
2022-2026 CBD	Require territorial authorities to test district plans and long-term plans against a 'high' and 'low' growth scenario, in addition to the 'most likely' growth scenario to address uncertainty in demand projections. Document and communicate identified risks to decision-makers and the public.

F6. Ensure security and resilience of critical infrastructure
Te whakatūturu i te haumarutanga, me te kaha o ngā hanganga whaitake

F6.1	Define critical national infrastructure
2022-2026 HGI, DIV	Develop a common definition of critical national infrastructure. This needs to be well understood across the sector and enable parties to identify clearly their roles and responsibilities in relation to critical national infrastructure.

F6.2	Identify critical national infrastructure
2022-2026 HGI, DIV	Identify infrastructure assets that meet the definition of critical national infrastructure. The identification process would cover the resilience of infrastructure networks to shocks, as well as individual assets.

C1. Enable a responsive planning system
Te whakaahei i tētahi pūnaha whakamahere rata

C1.1	Continue to review and reform urban planning
2022-2026 BUP, RAN	Accelerate reforms of urban planning policies and practices that are not delivering, including those that have adverse impacts on housing affordability. Suggested actions include: • Accelerating the implementation of the National Policy Statement on Urban Development (NPS-UD) requirements to upzone around rapid-transit and centre zones. • Monitoring and enforcing council compliance with NPS-UD requirements. • Adopting independent hearings panels to review impending district plan changes. • Requiring that current resource management reforms be appropriately enabling of urban development. • Clarifying definitions of 'environment' and 'amenity' to ensure that environmental protections are not applied to subjective amenity issues.

C1.2	Standardise planning rulebooks to increase capacity and reduce cost and uncertainty
2022-2026 BUP, RAN, JUL	Merge regional and district plans into a combined plan, resulting in 14 combined plans rather than roughly 100 council plans. Prior to developing combined plans, develop the National Planning Standards into a nationally standardised planning rulebook that local authorities are required to adopt with limited variations.

C1.3	Set targets for housing development capacity and triggers for release of additional development capacity
2022-2026 BUP, RAN, CBU, PIR	If the National and Built Environments Act is signed into law, develop a national direction, in the form of the new National Planning Framework, that: • Sets targets that local authorities must achieve for housing and business development capacity to accommodate future growth, and that take precedence over subjective amenity barriers. • Directs local authorities to use information on land prices to guide the planning and release of development capacity in high-demand areas. • Carries over existing NPS-UD direction on enabling intensification and disallowing the use of minimum parking requirements in district plans. • Incorporates additional direction on enabling intensification and private plan changes in addition to what is already in the NPS-UD.

C1.4	Review and realign Crown landholdings
2027-2032 ULH	Review major public landholdings to identify opportunities for land swaps, releases of land for development and relocations of major public facilities to more optimal locations. This includes reviewing the locations of major legacy facilities, particularly when they occupy large sites in growing urban areas with high land prices.

C2. Coordinate delivery of housing and infrastructure

Te whakahaere i ngā mahi whakatū whare, whakatū hanganga

C2.1	Ensure the provision of three waters infrastructure to enable growth
2022-2026 WSA, LFF, MHT	Ensure the current three waters reform programme proactively enables urban development by: • Establishing an economic regulator for the sector with a mandate to ensure the availability of infrastructure for growth, funded by appropriate infrastructure growth charges or other 'user pays' funding tools. • Enabling regulators to allow new water entities to use their balance sheet capacity to finance infrastructure for growth, as well as funding asset renewals and improvements to water quality. • Clarifying the interface between new water entities and developer-financed water infrastructure provided under the Infrastructure Funding and Financing Act 2020. • Ensuring that developers can benefit appropriately from the provision of infrastructure that has spare capacity.

C2.2	Volumetric charging to fund proportion of water infrastructure
2022-2026 LFF	Enable publicly-owned water providers to charge water users directly for their services and enable volumetric wastewater charges for large wastewater sources.

C2.3	Improve information on infrastructure capacity and costs to service growth
2022-2026 CBD, WCB	Improve information for land-use planners, infrastructure planners, and the development sector so that they can understand the locations and timing of growth opportunities and the cost of growth in different places. Includes two key pieces of information: • Water entities to publish geo-spatial information on water asset condition, capacity for growth in existing water networks, and increases in capacity for growth due to planned network upgrades. As part of this, a common approach to measuring the condition and capacity of water infrastructure assets should be developed. • Develop, validate and publish a spatial model of long-run average infrastructure costs to service growth in different locations, to inform issues like regional spatial planning, local-government development contributions policy, and the alignment of development capacity increases with infrastructure capacity and low-cost opportunities for development.

C2.4	Conduct post-implementation reviews of transit-oriented development opportunities
2022-2026 TSS	Many existing urban strategies highlight the importance of transit-oriented development (TOD). To understand whether strategies are translating into on-the-ground implementation, undertake a post-implementation review of recent TOD opportunities in New Zealand cities. This review would cover the performance of developments against international best practice, the scale and pace of housing and commercial developments, relative to planning projections, transport outcomes for people living or working in the areas, broader wellbeing outcomes and barriers to achieving better outcomes, and provide recommendations for policy and delivery changes to improve outcomes for future TODs.

C2.5	Implement regional spatial planning
2022-2026 BUP, RAN	Develop a new Strategic Planning Act that provides a framework for regional spatial plans and directs local authorities and infrastructure providers to develop them. Require that combined plans and regional and local funding plans should not be inconsistent with regional spatial plans. Consider central government funding and resourcing to support regional spatial plan development.

C2.6	Increase the use of water-sensitive urban design measures to reduce pressure on water networks
2022-2026 GIW	Develop combined district and regional plans to enable and incentivise water-sensitive urban design to reduce the pressure that growth places on stormwater and other networks. Review other barriers to water-sensitive urban design practices, such as poor coordination between water infrastructure providers, land-use planners, and developers.

C3. Co-ordinate delivery of housing and infrastructure
Te whakahaere i ngā mahi whakatū whare, whakatū hanganga

C3.1	Implement congestion pricing and/or road tolling to improve urban accessibility
2022-2026 TCQ, LGW, LFF	Use congestion pricing and road tolling to improve urban transport outcomes and the performance of the transport network. Specific measures include: • Progressing the implementation of The Congestion Question's recommended congestion pricing scheme for Auckland. If the availability of transport alternatives is a concern, stage the implementation to focus initially on areas with the best supply of public transport and walking and cycling options (e.g. Auckland city centre), and confirm a timeframe for full implementation following the delivery of further public transport and cycling improvements. • Immediately remove legislative barriers to implementing congestion pricing and/or highway tolling. • Progress the implementation of a congestion pricing scheme for Wellington following the Let's Get Wellington Moving programme business case.

C3.2	Use congestion pricing to plan for new transport infrastructure
2027-2032 TCQ, LGW, LFF	To make it easier for people to respond to signals from congestion pricing: • Improve the quality, speed, and reliability of public transport to major employment centres. • Improve active transport infrastructure, starting with low-cost solutions such as improving pedestrian crossings and reallocating existing roadspace to provide safe cycling facilities. Use signals from congestion pricing to help optimise the timing and delivery of new multi-modal transport infrastructure.

C3.3	Plan for congestion pricing schemes in other New Zealand cities
2022-2026 TCQ, LGW, LFF	Identify and prioritise other urban areas where congestion pricing may be beneficial at some point on a 30-year horizon, and develop a work programme for developing appropriate schemes for those areas.

C4. Plan for lead infrastructure

Te whakamahere i ngā hanganga tino pai o āpōpō

C4.1	Develop a lead infrastructure policy, supporting implementation guidance, and a corridor protection evaluation methodology
2022-2026 BUP, CPR, ATA	Develop a lead infrastructure policy that provides a clear definition of lead infrastructure and uses the definition to identify what is and is not lead infrastructure. Support this policy by implementating guidance for infrastructure providers. To support corridor protection decisions, develop evaluation guidance on the use of real option valuation techniques to make decisions about corridor protection in light of the uncertainty of future demands.[153] Use this guidance as a key input to an economic analysis of concept plans for corridor designations and investment through a new Corridor Reservation Fund.
C4.2	**Enable lead infrastructure corridor protection through resource management reform**
2022-2026 RAN, ITA	Extend the duration of designations to 10 years and allow designations to be granted based on concept plans. Base statutory tests for infrastructure corridor designation on a corridor protection evaluation methodology.
C4.3	**Establish a corridor reservation fund to protect lead infrastructure corridors**
2027-2032 BUP	Establish a corridor reservation fund with a secure funding source that can be used for early corridor-protection activities, such as purchasing key sites for future projects

C5. Improve regional and international connections
Te whakakaha i ngā hononga ā-rohe, ā-tāwāhi hoki

C5.1	Develop a long-term national supply chain strategy
2022-2026 IFT, NSC, FSE	Develop an evidence-based, long-term national freight supply chain strategy covering airports, ports, road, rail and coastal shipping to support the creation of a fully integrated, multi-modal freight supply chain system. The strategy could look at competition between modes, ownership structures, regulatory regimes and the infrastructure investment required to improve the efficiency and sustainability of New Zealand's supply chains.

C5.2	Update the 2006 digital strategy
2022-2026 PTC	The 2006 digital strategy should be updated to prepare New Zealand for realising the full benefits of a connected digital society.

S1. Integrate infrastructure institutions
Te kōmitimiti whakanōhanga

S1.1	Clarify funding of spatial plans
2022-2026 DSA	Regions will be required to produce regional spatial plans that outline how and where they will grow. It is currently unclear how the development and implementation of these plans will be funded. Funding arrangements to both design and implement regional spatial plans should be clarified as part of the Resource Management Act reform process.

S1.2	Review roles and functions of local government and other related infrastructure providers
2027-2042 RAN, LFF, ROY	As part of the Review into the Future for Local Government, review local government functions related to infrastructure and the relationship with central government, including funding, planning and delivery. The review of local government infrastructure functions should address: • The role and function of local government following the three waters reform and reform of the Resource Management Act. • Institutional settings and structures for other related infrastructure providers, e.g. in land transport. • The appropriateness of existing local government boundaries given expanding labour markets, particularly in growing cities. • The ability of local government to provide, fund, maintain and operate both social and economic infrastructure.

S2. Ensure equitable funding and financing

Te whakatūturu i te tahua pūtea, ahumoni hoki e tōkeke ana

S2.1	Fund tourism infrastructure
2022-2026 LFF	Enable the International Visitor Conservation and Tourism Levy to be used for tourism infrastructure, especially networked infrastructure. The levy was established in 2019. It was forecast to provide $450 million in the first five years of operation. The levy could be made available to certain local authorities (for instance, those with high international visitor to resident ratios), if they can demonstrate they have explored all other means to finance infrastructure pressures caused by tourism.

S2.2	Rating Crown land
2027-2032 ULH	Require the Crown to pay rates to local authorities for land that it owns that is currently exempt, where it generates a demand for infrastructure. This includes Defence Force land, schools and hospitals. Currently, Crown land is mostly exempt from general rates. This is a potentially significant source of 'lost' income for local authorities with significant proportions of Crown land in their areas.

S2.3	Develop a transition plan for transport funding
2022-2026 KCM	Develop a pathway and transition plan for shifting all vehicles onto time, distance, and level-of-service-based pricing, improving transport pricing and the required governance arrangements needed to support this. Include a consideration of the merit of differential pricing for commercial and non-commercial traffic. This recommendation would need to be considered alongside recommendation C3.1, which relates to congestion pricing for urban areas.

S2.4	Use value-capture mechanisms to fund infrastructure for growth
2022-2026 BUP, LFF, MHT	Incentivise local authorities to make greater use of targeted rates or value-capture mechanisms to fund growth infrastructure.

S2.5	Enable land-value change as a basis for a targeted rate
2022-2026 BUP, LFF, MHT	Implement a legislative change to allow local authorities to be given the option of using land-value change as a basis for a targeted rate.

S3. Make better use of existing infrastructure

Te whakapai ake i te hanganga e tū ana i tēnei wā

S3.1	Consider non-built options
2022-2026 PII	Require project selection to take explicit and detailed account of available alternatives, including the enhanced use of existing infrastructure, extending the life of existing assets, pricing solutions, project staging and cheaper build options.

S3.2	Investigate New Zealand Government Asset Management Team
2027-2032 IAM	Investigate the establishment of a New Zealand Government Asset Management Team to take asset-management responsibilities from government agencies that have no specific asset-management focus or have a poor track record of asset-management.

S3.3	Improve pricing to optimise use of existing infrastructure
2027-2032 TCQ, LGW, LFF, FOT	Implement changes to infrastructure pricing to optimise the use of existing infrastructure and potentially defer major upgrades. Specific areas where this is likely to be desirable are: • Water infrastructure, (which is addressed further in recommendation C2.2). • Transport infrastructure (which is addressed in recommendations S2.3 and C3.1). • Landfill waste levies (which are addressed in recommendation F1.8).

S4. Require informed and transparent decision-making

Te whakahau me whakatau i runga te māramatanga me te mōhiotanga

S4.1	Undertake a post-implementation review of all major infrastructure projects
2022-2026 DSA	Conduct and fund independent post-implementation reviews of major infrastructure projects at completion, with the purpose of improving future evaluation methods and processes. Publish ex-post reviews in full and measure performance, benefits and cost estimates against business case estimates.

S4.2	Undertake cost benefit analyses of all projects over $150 million
2022-2026 PII	Ensure a commitment by all local and central government agencies to undertake and publicly release rigorous CBAs on all public infrastructure investment proposals where the whole-of-life costs of the proposals exceed $150 million.[154] In general, analyses should be done prior to projects being announced. If a project is announced before analysis is done, for example, in the lead-up to an election, this would be conditional on the findings of a subsequent analysis.

S4.3	Review the discount rate
2022-2026 TNT	Undertake an inquiry into the appropriateness and consistent application of New Zealand's social discount rate policy.

S4.4	Develop a cost benefit analysis manual for new water infrastructure
	The economic regulator for the water sector should develop a CBA manual that makes transparent the evaluation methods and parameters for valuing relevant economic, environmental and amenity benefits. The manual should enable appropriately-scaled appraisals of both simple and complex projects. In line with practices in the electricity transmission sector, it should be used as part of the investment test for new and improved water infrastructure to ensure that it delivers benefits that exceed its cost.

S5. Develop and prioritise a pipeline of work

Te whakawhanake me te whakamatamua i tētahi whakaraupapa mahi

S5.1	Develop a priority list of projects and initiatives.
2022-2026 AIP	Develop a priority list of projects and initiatives that is consistent with the Aotearoa New Zealand Infrastructure Strategy.

S5.2	Improve the use of the pipeline for commercial decision-making
2022-2026 PSS	Evolve the pipeline of forward work intentions so that it is more useful in supporting the market to make commercial decisions (i.e. assessing capacity, funding and timing) and enabling better use of infrastructure spending for fiscal stimulus in economic downturns.

S5.3	Measure sector utilisation
2022-2026	Develop measures of current and projected future infrastructure delivery capacity and projected utilisation.

S6. Improve project procurement and delivery

Te whakapai ake i te kaitaonga me te tuku ratonga

S6.1	Establish a major projects leadership academy
2027-2032 MPL	Establish a major project leadership academy in New Zealand to raise the planning, delivery, financial and leadership capabilities for major projects in both government and industry. Develop this initiative with the Construction Sector Accord and international experts. Attendance should be a mandatory requirement for directors of major infrastructure projects within 10 years.

S6.2	Revisit New Zealand's approach to market-led proposals
2022-2026 MLP	Encourage the submission of unsolicited and market-led proposals by developing a standardised and centralised approach that gives the market confidence that proposals will progress where they provide tangible benefits that no-one else can deliver, and that a government-led competitive process may not produce better results.

S7. Reduce costs and improve consenting

Te whakaheke i ngā utu me te whakapai ake i te hātepe tuku whakaae

S7.1	Measure and benchmark infrastructure cost performance
2022-2026 TCP	Undertake investigations into the cost performance of New Zealand's infrastructure sector that: • Covers multiple horizontal infrastructure sectors to enable the identification of common issues and points of difference. • Identify recent cost trends and drivers of cost trends within infrastructure sectors. • Benchmarks New Zealand's cost performance against better-performing OECD countries and identify drivers of differences.

S7.2	Standardise design
2022-2026 DCP	Develop a standardised approach to infrastructure design that: • Prioritises high productivity. • Allows for a division of labour, offsite construction/modularisation and repeatability and therefore quality improvements and reduces the risk of systematic failure.

S7.3	Develop a planning system that is more enabling for infrastructure

2022-2026	• Require the proposed Natural and Built Environment Act to recognise that the natural and built environments are different. Therefore, different environmental management rules should apply to each. • Require resource consent decisions to take into account the length of time in which an activity will affect the environment, rather than assume the effects are in perpetuity. • Ensure consenting pathways for infrastructure through the National Planning Framework, potentially through setting standards for planning policies and regulations for infrastructure. • Limit the scope of effects considered under the proposed Natural and Built Environment Acts to matters related to natural and physical resources, not extraneous matters like commercial and amenity matters. • To support national direction, establish a national GIS database for mapping nationally important resources (built and natural), including corridors and assets of nationally significant infrastructure. • Ensure that regional spatial strategies can respond rapidly to changing national and regional priorities. • Require a pre-notification audit of proposed regional unitary plans to ensure consistency with national direction. • Allows infrastructure consents to be bundled with complementary plan changes in surrounding areas.

S8. Activate infrastructure for economic stimulus

Te whakahohe i te hanganga me te whakaara ake i te ōhanga

S8.1	Develop ready to build infrastructure
2022-2026 INS	Develop a well-serviced and credible infrastructure priority pipeline to reduce infrastructure lead times, so that quickly assembled infrastructure programmes are built before a recession is over.

S8.2	Evaluate stimulus impacts
2022-2026 LLS	When developing infrastructure programmes for economic stimulus, require that infrastructure projects be assessed and prioritised according to their impacts on employment, as well as standard cost benefit analyses (CBAs). Ideally, the positive economic impacts of increased employment will be captured in CBAs.

Want to know more?
Hiahia mōhio?

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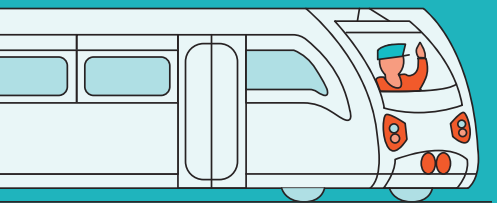

The following documents are ones that we found particularly useful in the development of our draft options. References link to where we have used them in the development of our thinking. These documents give additional information on the problems identified, the case for action, or how recommendations might work in practice.

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AIP **Australian Infrastructure Plan**[156]
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ARE **Accelerating renewable energy and energy efficiency**[157]
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ATA **Australian Transport Assessment and Planning Guidelines: O8 - Real Options Assessment**[158]
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BUP **Better Urban Planning**[159]
The New Zealand Productivity Commission
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CBD **The costs and benefits of urban development**[160]
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CBU **Cost-benefit analysis for a National Policy Statement on Urban Development**[161]
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CCC **Draft Advice for Consultation**[162]
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CHZ **Coastal Hazards and Climate Change: Guidance for Local Government**[163]
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CPR **Corridor Protection: Planning and investing for the long term**[164]
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DSA **Developing Strategic Approaches to Infrastructure Planning**[168]
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EAN **Advice on Creating Equal Access to Electricity Networks**[169]
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ECB **The impact of e-cycling on travel behaviour: A scoping review**[170]
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EIR **NSW Electricity Infrastructure Roadmap**[171]
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FSE **Developing the Freight Sector Elements**[173]
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GIW **Guiding Integrated Urban and Water Planning**[174]
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ITA **Report of the Minister for the Environment's Infrastructure Technical Advisory Group**[182]
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IVA **All Things Considered - Exploring options for Victoria's 30-year infrastructure strategy**[183]
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BERL
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