INFRASTRUCTURE EVIDENCE BASE

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

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INFRASTRUCTURE EVIDENCE BASE

Overview and Introduction

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EVIDENCE BASE

Overview and Introduction

February 2014

Foreword by the National Infrastructure Advisory Board

The National Infrastructure Advisory Board is pleased to present the first National Infrastructure Evidence Base.

Infrastructure is a crucial part of the New Zealand economy, supporting growth and contributing to improved living standards for all. As such, it is vital that we manage it as well as possible. However, a significant constraint identified in the National Infrastructure Plan (2011) was the lack of information regarding infrastructure condition and performance.

To address this, a key part of the National Infrastructure Unit's work programme over the past two years has been to develop a more robust Evidence Base. This evidence base includes performance indicators on current assets, analysis of potential future pressures, resilience assessments and a capital intentions plan.

This is the first time a consolidated evidence base, looking across all infrastructure sectors, has been completed, and we believe it is a big step in the right direction for the management of New Zealand infrastructure.

Since the publication of the first National Infrastructure Plan in 2010 we have seen infrastructure becoming increasingly joined up, with improved coordination and reducing barriers between sectors. The evidence base reflects this and the progress that has been made across each sector. It also highlights some of the challenges that are ahead, not least of which is the continued need to better understand the drivers of future demand on our infrastructure and explore the options for meeting these demands. A number of our assets are ageing, our population base is changing and moving, and technology is opening up a new range of possibilities for both service delivery and asset management. With some large investment decisions on the horizon, especially in transport and productive water, we have a great opportunity for some bold discussions on meeting these future demands, improving our decision making and increasing our use of demand side options.

We would like to thank all our sector stakeholders who have contributed to this evidence base, both with quantitative data, and with qualitative judgments. While the evidence base is a step forward, there are still many areas where we do not have quantitative data available to us, and we greatly appreciate the input and assessment provided to us by sector experts: the evidence base would not have been possible without this collaboration.

We would also encourage members of all sectors to engage with this piece of work as it progresses. The evidence base is iterative, and the National Infrastructure Unit is very keen to hear your views on how to improve and expand it. Our aim for this is to provide a useful source of information for all sectors, so if there is information you believe is relevant to a whole of New Zealand infrastructure conversation please do contact the National Infrastructure Unit.

Where quantitative measures are not currently available, we will be encouraging sector managers to consider how they could increase and improve transparency in their sectors by developing or publishing metrics, and we welcome thoughts and ideas on this also.

The evidence base is, of course, only the starting point; its purpose is to inform decision making and debate, to ensure we are making the best use of existing assets and the best possible decisions on investment in new assets. Throughout 2014, the National Infrastructure Unit will develop a consolidated response to the evidence base, and will consult widely across infrastructure sectors. We encourage sectors to engage with this, as a real opportunity to ensure New Zealand has the infrastructure it needs now and into the future.

For now though, we are excited to present this evidence base, the first of its kind in New Zealand, and we welcome your thoughts and comments on it.

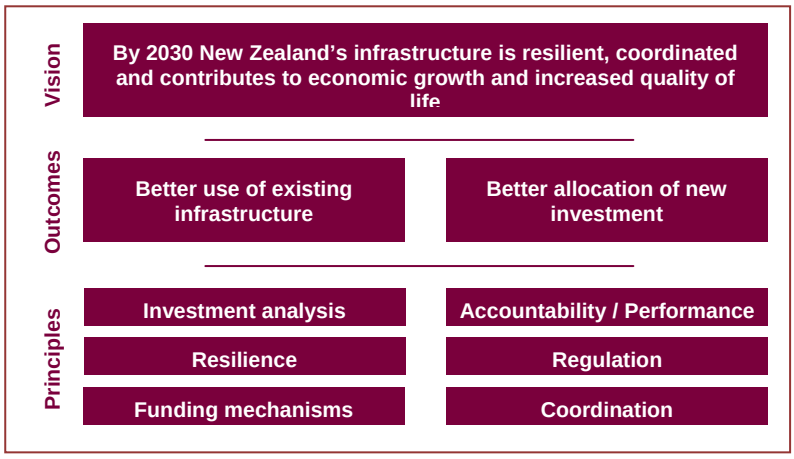
Lindsay Crossen

Chair, on behalf of the National infrastructure Advisory Board

EVIDENCE BASE: OVERVIEW AND INTRODUCTION

Introduction by the National Infrastructure Unit

In 2011, the National Infrastructure Plan presented a vision for infrastructure: by 2030 New Zealand's infrastructure is resilient and coordinated and contributes to economic growth and increased quality of life. This vision is underpinned by two outcomes and six principles.



In order to progress these outcomes, we must have an understanding of the current state of infrastructure in New Zealand; however when the National Infrastructure Plan 2011 was written, there was difficulty in finding quantitative evidence. To help address this, the National Infrastructure Unit (NIU) committed to the following actions:

Central government will commit to developing and publishing a ten year Capital Intentions Plan for infrastructure development to match the planning timeframe required of local government.

Improve access to information on current infrastructure performance to create certainty about when, where and how infrastructure development is occurring, including consideration of whole of life costs.

Develop performance indicators for each sector and local government infrastructure assets as well as those managed by private sector.

Improve scenario modelling to more accurately project likely infrastructure investment requirements from the short to the very long term.

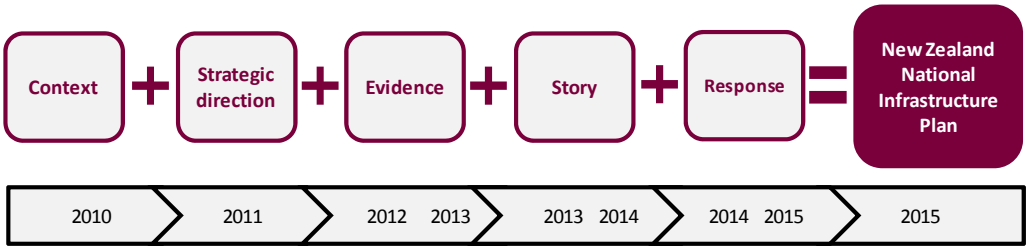
This evidence base delivers on these four actions, providing an assessment of current performance, scenario and trend analysis of potential future pressures, a resilience assessment and a ten-year Capital Intentions Plan.

This is the first time a cross sector, whole of New Zealand infrastructure evidence base has been created, and it is only the first iteration. NIU has drawn from the expertise of the sectors and other available work, and will continue to expand and refine it as more information becomes available. This evidence base should be a useful tool to support decision making across infrastructure sectors and NIU welcomes all feedback and ideas on ways it can be improved.

The evidence base has been created in collaboration with stakeholders across all sectors and NIU would like to thank everyone for their support and help in creating this.

EVIDENCE BASE: OVERVIEW AND INTRODUCTION

The evidence base forms part of the NIU's work programme, following on from the National Infrastructure Plan 2011, and leading to the next iteration of the National Infrastructure Plan, intended to be published in 2015.



The evidence base will be used as the basis for considering existing and emerging issues relating to New Zealand's infrastructure, and for proposing a "response" to these. Development of the response will be a fully consultative process, and NIU hopes as many sector stakeholders as possible will engage with the work. The response to this evidence base is a real opportunity to help shape the future of infrastructure in New Zealand, and it should reflect the views of all sectors.

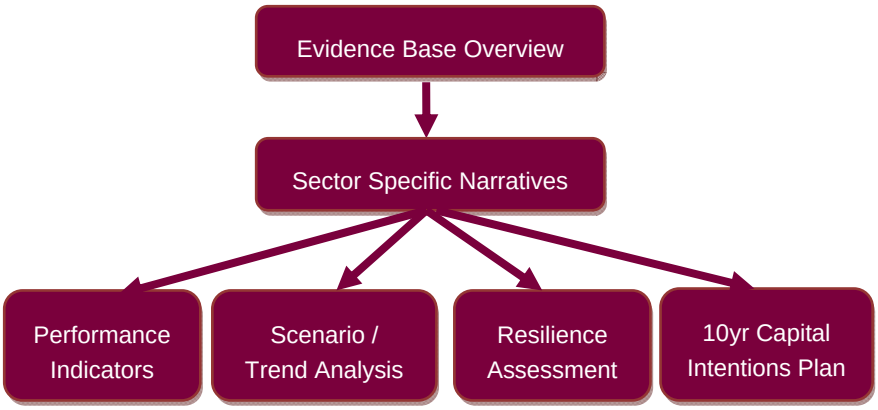
Details of the NIU's work programme will be made available in the NIU newsletter and on the infrastructure.govt.nz website, but if you have any comments please do contact NIU at info@infrastructure.govt.nz

EVIDENCE BASE: OVERVIEW AND INTRODUCTION

Methodology

The evidence base is presented in two layers:

- this overview document containing overall infrastructure messages, common to all sectors, as well as the key strategic questions for each sector, and
- sector specific narratives.



These layers are informed by the four elements of the evidence base:

- performance measures of current infrastructure assets
- scenario/trend analysis of potential future pressures on infrastructure
- a resilience assessment, and
- a ten-year Capital Intentions Plan.

These four elements have been collated over 2012/2013 and are intended to be iterative, to be updated in future.

Performance Measures

The performance measures are intended to provide an assessment of the state of current infrastructure. They are designed to be considered across sectors to provide a whole of New Zealand view. They are to be publicly available, to facilitate discussion and debate, and as such contain no restricted information.

In 2013, the NIU commissioned Beca and Covec to propose a framework for measuring the performance of infrastructure in New Zealand. This framework must utilise only publicly available information, and enable cross sector analysis. A pressure-state-response model was proposed following consultation with the sectors, and the final report can be found on the infrastructure.govt.nz website here.

Indicators were suggested for both the pressure and state sections of the model, however subsequent discussion has led to the pressure section of the model being incorporated into the scenario/trend analysis element of the evidence base. As such, this element now contains only information relevant to the current state of infrastructure.

Indicators were not proposed for the response section of the model, as it was felt this would be better represented through narrative and judgment.

The model's implementation has been limited by the amount of publicly available data, and so, following further consultation with sectors, the NIU has reduced the number of indicators included in the model. Data has been collected for these where possible, and this has been supplemented by sector knowledge.

The NIU has consulted on the model and the judgements derived from it with sector stakeholders in central and local government and the private sector, and is grateful for the support and input of stakeholders.

The raw data available to NIU is presented in the data sheets. This is not exhaustive, and NIU welcomes feedback on ways to improve and expand the data set.

Scenario/Trend Analysis

The scenario/trend analysis is designed to present potential future pressures on New Zealand Infrastructure, over the next 20 – 30 years, to inspire discussion and consideration of ways to meet and manage this demand.

The NIU did not create its own models for this piece of work, but used existing trend data and scenario models from infrastructure sectors, combining these to create a view of the possible potential pressures on infrastructure across the sectors. Again, NIU would like to thank stakeholders for their contributions to this piece of work.

The analysis focuses on three possible futures, looking at how demand on infrastructure might be affected. These are:

- a central case in which trends continue as currently forecast (in central cases)
- an upside case in which trends shift to increase pressure on infrastructure, and
- a downside case, where trends shift to decrease pressure on infrastructure.

The NIU has limited the analysis to four key drivers of demand:

- Population – total population, the age profile of our population and the regional distribution
- Economy – demand for commodities, the role of heavy industry, service sector expansion, income growth and funding constraints
- Technology – intelligent networks, technology-driven behaviour change
- Resources – water quality and quantity, carbon price & emission limits, climate change, oil / gas discovery and price movements.

Further detail on the methodology and the full set of conclusions can be found in the scenario/trend analysis document, published on the NIU's website, here.

Resilience Assessment

The Resilience Assessment is intended to provide a national perspective and considers both individual infrastructure sectors and interdependencies between sectors. Assessments from a regional, community or individual perspective may therefore differ.

NIU defines the resilience of infrastructure to include not just the physical or hard assets but also other aspects such as how infrastructure organisations function, capacity and capability to fund, and community awareness.

To provide an assessment of resilience, each sector has been disaggregated and the subsets rated using qualitative methods to compare desired level of resilience with assessed level of resilience to identify desired improvements. In addition every sector has significant vulnerabilities ("Pinchpoints") and there are certain geographic areas ("Hotspots") where the presence of numerous elements of infrastructure requires increased levels of attention, examples being the Auckland Harbour Bridge and Thorndon/Kaiwharawhara in Wellington. These tabulations have been publicly available and presented in various forums through 2012 and 2013 and continue to evolve as new information comes available.

The same methodology was applied to sector interdependencies and both sector tables and the interdependency table are presented in this evidence base.

The resilience evidence base is being substantially informed by the activities of regional emergency management groups and Lifelines (requirement under the Civil Defence and Emergency Management Act) with regional vulnerability assessments, as well as topic specific assessments such as the recent oil security of supply work and the current gas security of supply work.

10 year Capital Intentions Plan

The ten-year Capital Intentions Plan provides a much greater level of transparency and visibility of the forward looking infrastructure investment programme, to facilitate the continued improvement of capital asset management. It recognises that a key focus of the Plan is providing businesses with greater certainty and confidence about current and future infrastructure provision.

EVIDENCE BASE: OVERVIEW AND INTRODUCTION

As this is the first ten-year Capital Intentions Plan, it is very much testing the waters and a first step. As agencies continue to develop and strengthen their asset management, we expect future reports will be more detailed and comprehensive. Considering this, we would welcome your feedback and your suggestions for how future Capital Intentions Plans could be more valuable or useful.

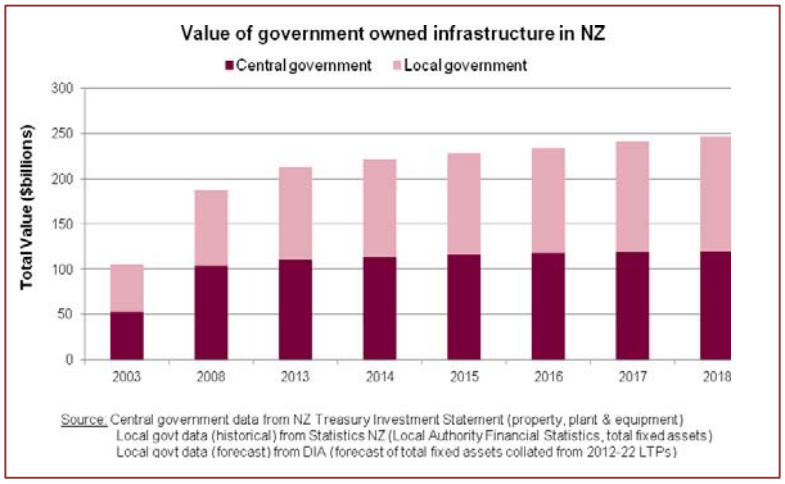
Overall, the primary focus has been on central and local government projects, and in particular those from the large capital intensive government agencies. Some information has also been included from the private sector to provide a more comprehensive picture.

Central government data has been gathered from the individual agencies, initially using data from July 2013 with updates as relevant. Local government data is from the 2012-2022 Long Term Plans and updated from 2013 Annual reports. Private sector data has been gathered from websites, annual reports and other publicly available sources. For both the central and local government data, agencies and local authorities were provided with an opportunity to review the data before the analysis was undertaken and the final report finalised.

Overall Messages

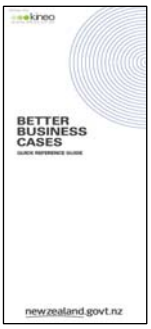
Analysis of the data available and conversations with sector stakeholders provides evidence that the overall state of New Zealand infrastructure is positive. New Zealand has broadly the right infrastructure, in the right place, providing the right quality of service. However, there are a number of challenges ahead and traditional systems will not be sufficient to meet these. It will not be possible to address these challenges with supply side options alone, and infrastructure sectors will need to consider new ways to manage demand, deliver alternative sources of funding, and optimise investment where it is made. Changes in behaviour and technology will be crucial to delivering infrastructure services efficiently.

Data for this evidence base has been collated from a number of existing sources, and supplemented with sector knowledge. There are still significant gaps in the data set caused by a variety of factors such as commercial sensitivity in privatised markets, and consistency of information in disaggregated markets. NIU is encouraged by the programmes already in place to address these issues, such as the Three-Waters programme, managed by Local Government New Zealand; however, NIU believe it is vital that transparency is improved across all sectors by improving the quality, consistency and regularity of information made available.



NIU would also like to increase the use of international benchmarks where appropriate. This has not been possible in this iteration of the evidence base, but it is hoped future iterations will contain more of this.

The variability of data is a significant concern for NIU with regard to its impact on good asset management, and good investment decisions. The value of infrastructure owned by both government and the private sector is significant, and plays an important role in delivering economic wellbeing and improved living standards.



Management of infrastructure overall has been good enough to this point, and markets operate effectively; however, there is variability across the sectors, and future challenges will require continued improvement. In those sectors where management of assets is challenging, and practise still maturing, especially those sectors with ageing assets, there will need to be a significant lift in performance. NIU would like to see continued (and improving) use of rigorous cost-benefit analysis and use of the Better Business Case model to inform investment decisions. Increased use of ex-post analysis would also be useful in informing improved cost-benefit analysis.

Improved data and governance around decision making are important in delivering the National Infrastructure Plan 2011's two outcomes of better use of existing infrastructure and better allocation of new investment. These objectives are crucial to an effective infrastructure system in an environment of continuing fiscal constraint, and NIU would like to

see continuing consideration across all sectors of alternative sources of funding and effective demand management, to ensure long-term sustainability and the most efficient use of infrastructure.

The existing use of infrastructure is relatively good across most sectors, with the evidence showing sufficient capacity and service availability. However, there are, and will increasingly be, challenges to effective capacity management, driven by demographic migration and increasing demand for services. This will lead to increasing pressure on infrastructure in some areas, with the risk of stranded assets in others. Robust asset management and performance data to inform the tough choices and prioritisation required will be needed.

Consideration should be given to alternative methods of delivering services, such as technological advances, and the impact they will have on demand for infrastructure. Across all sectors, we need to better understand the drivers of future demand and improve forecasting, and NIU would like to see increased consideration of demand side solutions as well as supply side options.

Future infrastructure planning should also take account of the increasing interdependencies across infrastructure sectors, which provide both opportunities and risks to the sectors. Increased integrated planning across sectors, both to facilitate the most effective infrastructure outcome, and to make provision of this more efficient will be important. Consideration should also be given to how to ensure infrastructure is “future proofed” as far as appropriate. In addition, a more joined up and consistent approach to planning legislation, where current discrepancies can reduce efficiency for infrastructure providers, would be beneficial. Well integrated land use policies and infrastructure plans are essential.

Finally, consideration should continue to be given to the resilience of infrastructure. While current infrastructure is resilient, all sectors have weakest link vulnerabilities. Preliminary assessments have been made of sectors, and action plans are in place where required. NIU is supportive of this work, and encourages the continued focus on ensuring safe and resilient infrastructure.

In summary, the evidence base shows a positive picture of infrastructure in New Zealand at present. There are challenges that need to be addressed, and we are encouraged by the willingness of infrastructure sectors to respond to these.

For more detail on specific infrastructure sectors, please refer to the table below and the sector specific narratives.

EVIDENCE BASE: OVERVIEW AND INTRODUCTION

Sector	Strategic Messages
Urban Water	Urban water networks continue to operate without widespread service failures. There is some concern, however, that aging infrastructure and increasing levels of asset deterioration may impact service reliability and require sizeable investment.
	No consistent national data framework or asset data standards exist (definitions, formats, analytics, benchmarks). Also, application of guidance in the International Infrastructure Management Manual is variable across urban and rural councils.
	Increasing consent requirements, particularly for wastewater and stormwater, are driving up costs and raising affordability questions for smaller/provincial local authorities.
	The bottom line: There are two distinct stories - larger, urban areas with higher capacity, capability and rating base - often growing; and a second provincial story of static/declining population and rating base leading to lower capacity and capability. In each case, ageing networks and increasing consent requirements are adding to affordability pressures.
Productive Water	There is a large variation in the condition, age and efficiency of irrigation infrastructure, and a correspondingly wide range of asset management practices from immature through to comprehensive programmes.
	There is investment uncertainty regarding future nutrient management expectations - the ability to intensify land use alongside mitigation cost implications for existing land use.
	Sub-optimal infrastructure development may occur if inefficient processes are adopted to address the necessary iterative cycle of uptake, design, finance and consent considerations within business case risk management.
	The bottom line: Existing and future schemes (and the associated land use) face increasing liability, changing management structures, higher environmental standards and greater investor scrutiny. This raises affordability and intergenerational issues, and a need to better understand where the costs and benefits sit – requiring transparent and robust investment analysis.
Energy	Electricity distribution assets (across 29 companies) are under increasing stress, due to ageing assets, shifting demand, changing technology, increased consumer expectations and lower volumes impacting revenue.
	The role of thermal electricity generation is changing with increased geothermal and wind generation and reducing base load thermal, which may require a different generation mix in future. Appropriate plant and fuel supply contracts will be key.
	Oil and gas transmission capacity is expected to be sufficient for short-to-medium term supply/demand scenarios. The next step change in investment is likely to be associated with a significant new gas find.
	The bottom line: Overall, asset condition is considered to be good and capacity adequate for the short to medium term. Technology changes and a shifting focus to customer control and demand management loom on the horizon.
Transport	Transport asset quality appears adequate overall, but with limited resilience and redundancy in some key assets across all modes.
	Capacity constraints exist on key parts of the network and opportunities exist to improve asset performance through better allocation of investment and demand management of the network to relieve these. This requires a balance between new or improved transport links and existing network optimisation, especially urban commuter and strategic freight routes.
	In Auckland, and elsewhere, investment analysis and the timing and phasing of project implementation will be critical to achieving network benefits.
	The bottom line: The challenge now is to consolidate gains from completed and planned investment and to maximise existing network performance through demand management and better allocation of investment.
Telecommunications	Significant investment is ongoing, including the rollout of 4G services (private sector) and the RBI and UFB programmes (public / private). Realising the full benefit of these investments is a key focus for all parties
	There is some regulatory uncertainty, with reviews being conducted on the Telecommunication Act, the Telecommunications Service Obligations, and the Commerce Commission undertaking a Final Pricing Principle review of UCLL and UBA prices.
	Inconsistency in planning legislation and limitations can cause inefficiencies and hinder new solutions to issues such as location and infrastructure sharing.
	The bottom line: The market appears to be providing good outcomes in terms of quality, reliability and coverage. Effective and efficient delivery of the next generation mobile and internet networks will be a key enabler of productivity gains in NZ.
Social Sectors	There has been substantial improvement in recent years, especially in asset management and capital planning.
	There is still a gap between most agencies desired level of asset management and current practices.
	There will be significant challenges ahead caused by aging assets and demographic changes.
	The bottom line: The challenge for the social sectors will be to continue to improve asset management practices to effectively address future challenges.

Next Steps

This evidence base is intended to provide a consolidated understanding of the ability of New Zealand infrastructure to meet requirements now and into the future. It will be used as the basis for policy prioritisation and planning by the NIU over 2014 and leading to the 2015 National Infrastructure Plan.

It is therefore important to ensure it provides an accurate representation of infrastructure in New Zealand. The evidence base has been consulted on widely, and to continue this process, the first step following publication of the evidence base is to provide an opportunity for comment. NIU welcomes feedback via email at info@infrastructure.govt.nz or at an NIU workshop. These workshops will be held across New Zealand. Initial dates and locations are shown below, and these will be confirmed on the infrastructure website and in the NIU newsletter.

Date	Location
24 March	Wellington
26 March	New Plymouth
27 March	Christchurch
28 March	Invercargill
31 March	Tauranga
3 April	Auckland
4 April	Whangarei

Following these workshops, NIU will explore response options, where appropriate, with sector stakeholders from central and local government and private sector. These will be presented in late 2014 in a series of white papers. Further information on how to engage in this process will be provided throughout the year in the NIU newsletters.

INFRASTRUCTURE EVIDENCE BASE

Transport Sector

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

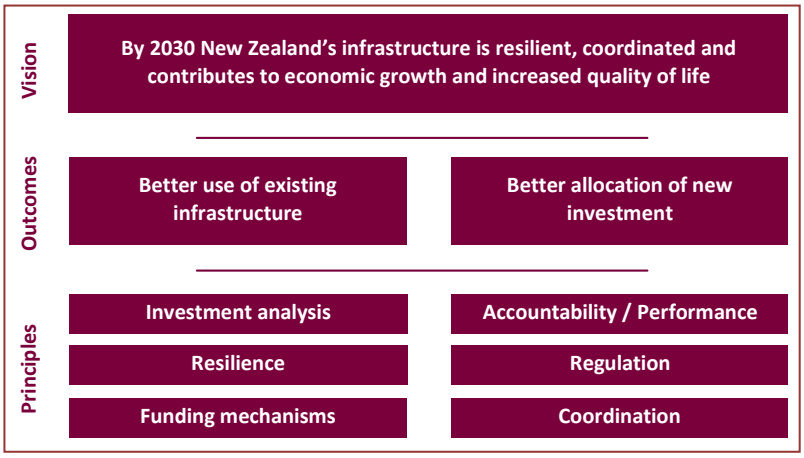
EVIDENCE BASE

Transport Sector

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for the transport sector, defined by NIU as road, rail, air (airports and air traffic infrastructure) and sea (ports). It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend analysis, and resilience assessment.

Where data has been provided, this is publically available information, and has been provided with permission of the information owner.

EVIDENCE BASE: TRANSPORT SECTOR

Overview messages

Transport asset quality appears good and management practices adequate across all modes. However, there is limited resilience and redundancy in some key assets across roads, rail and ports. We are interested in working with the sector to address these areas.

Investment funding varies across modes and consists of a mixture of Crown, local government, regional government, and private funding. In recent years, the Government has increased investment in key road and rail freight corridors to improve the flow of imports and exports across the country, and has targeted increased investment ~~in~~ towards improvements in State Highways, local roads and public transport.

The challenge now is to consolidate gains from completed and planned investment, across all modes and to maximise existing network performance. In Auckland, and elsewhere, investment analysis and the timing and phasing of project implementation will be critical to achieving network benefits. It will also be important to review how we consider and measure network performance.

It will be essential to balance the level of investment in new infrastructure with spending on maintenance to achieve optimal performance of the transport network. Investment in safety initiatives, particularly in the road sector, is achieving positive results.

Another challenge will be to optimise the performance of the freight network, and to continue achieving productivity gains in the freight transport sector. This will involve ensuring that our freight transport and distribution assets are in the right place and support the Business Growth Agenda target to lift the value of exports to 40% of Gross Domestic Product by 2025. We would encourage more comprehensive analysis of the relative contribution of road and rail in managing current and future freight demand to help inform decisions on the appropriate level of investment in each.

Key parts of the network have capacity constraints and these manifest mainly in the larger urban centres. Our cities show similar levels of urban roading congestion to cities in Australia, despite having lower populations. We consider that opportunities exist to improve asset performance, in the first instance by managing demand on the network to better utilise existing infrastructure, and through better allocation of investment to projects which generate the most benefits, by value of investment. Land use integration could be improved, with transport systems needing to be given fuller consideration when incorporated into urban design and planning regimes.

Demand forecasting is generally robust across all modes. Historic assumptions about future revenue growth from fuel taxes are being re-evaluated in light of international trends such as driving less, increasing fuel prices, e-commerce, increasing fuel efficiency and alternate fuels. We encourage further analysis of the potential impact on revenue from ~~of~~ these longer term trends as well as consideration of alternative means to deliver improved network performance at less cost.

Context

Transport is important to all New Zealanders. Strong links between road, rail, shipping, and aviation are vital for moving people and freight around the country and overseas and for supporting our country's social and economic performance, and contribute to higher living standards.

The transport sector employs more than 80,000 people and accounts for about 5.2% of New Zealand's gross domestic product. The transport sector also has strategically important assets of high value, such as the State Highway network, local roads, ports, airports and the rail network. The sector is extensively regulated by government to: protect and maintain the infrastructure; ensure the modes can coexist; maintain safety; and meet international standards.

The strategic focus for transport is to ensure a well functioning network for the safe and efficient movement of people and freight, in order to maximise the economic contribution of investment in the sector.

EVIDENCE BASE: TRANSPORT SECTOR

There are many interdependencies within the transport sector and between it and other sectors. Examples of these include the inter-modal nature of freight transport and the reliance on the transport network to deliver fuel and maintenance materials for other sectors (e.g. construction, energy).

What do we have?

Overall, New Zealand has a mature transport system with good intra-urban and inter-urban connectivity which enables people and goods to get to their destinations.

Road

New Zealand has approximately 62,000km of sealed and 32,000km of unsealed roads, owned by both local and central government.

The State Highway network links New Zealand's town and cities and provides access to key transport hubs such as ports and airports. It is managed by the New Zealand Transport Agency and consists of 11,000 kilometres of State Highways and over 4,000 bridges. The current State Highway network is valued at approximately $26 billion.

The local roading network consists of 66,000 kilometres of rural routes and 18,000 kilometres of urban routes. This network is valued at $50 billion, excluding land values (based on an estimate by the Office of the Auditor General).[1]

While the State Highway network accounts for only 11.6% of the total road network, almost half of all kilometres New Zealanders drive each year are on State Highways, signifying their contribution to the economy by enabling the mobility of freight and people.[2]

Rail

New Zealand has approximately 4000 kilometres of rail track,1656 bridges, and 1400 public road level crossings. KiwiRail owns 198 mainline locomotives and 4585 freight wagons.

KiwiRail owns and operates the rail network and freight fleet, while local governments contract metro services and own the metro fleet. KiwiRail also operates passenger services through KiwiRail Scenic Journeys.

The rail network and operations are valued at $1.035 billion, excluding the land beneath the rails which is valued at $3.2 billion.

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1 Data about the roading network length can be found here http://www.nzta.govt.nz/planning/data/networks.html

2 Data about travel on the roading network can be found here http://www.nzta.govt.nz/planning/data/networks.html

Air

New Zealand has 8 international airports and 28 regional airports.[3] Most airports are owned by local government, while some have part ownership by central government, private parties or shareholders (notably for the largest airport in Auckland).

Airways New Zealand, a state-owned enterprise, provides air navigational infrastructure.

26 domestic and 23 international passenger carriers operate in New Zealand.[4] Air New Zealand carries approximately 80% of domestic traffic and 40% of international traffic. About 95.6% of passenger seat hours are flown on large planes (greater than 30 seats) operated by airlines.[5] Total air capacity of 13.6m domestic seats and 6.6m inbound international seats (approximately half of the total) was available in 2013.[6]

In the year to June 2013, air freight made up 0.3% of New Zealand's exports by volume (109,000 tonnes), and 13.8% by value ($5.5 billion). It also made up 0.5% of imports by volume (91,000 tonnes) and 26% of imports by value ($9.5 billion) in the same year.

Sea

New Zealand has 16 ports servicing both international and domestic movements. Many are owned by local government, while some ports have part private ownership.

36 million tonnes were exported and 20 million tonnes imported by sea in the year to June 2013. Of that, 70% was bulk and 30% was containerised. The total value of exports by sea was $41 billion, of which $32 billion was containerised. The total value of imports by sea was $37 billion, of which $21 billion was containerised.

There were 1.7 million shipping container movements in New Zealand during the year to June 2013. 1.2 million were made with full containers and 500,000 with empty containers. The mean size of international container ships visiting New Zealand was 2,400 TEU (twenty-foot equivalent units).

There is a fleet of two rail-enabled ferries and three roll-on roll-off vehicle ferries linking the North and South Islands.

Is it where it needs to be?

Road

As noted above, the State Highway network links New Zealand's towns and cities and provides access to key transport hubs such as ports and airports. The local roading network meets local needs and often serves as the 'last mile' of freight and light vehicle journeys. Information on whether roads (built and maintained to the required specification for current and future demand) are in the right place is not readily available; however, a national road classification system is being implemented by the NZ Transport Agency and local government which will improve the Agency's ability to maintain roads at levels of service appropriate to their use.

The NZ Transport Agency and local government are also developing routes for high productivity motor vehicles (HPMVs). The Agency's analysis, together with feedback from the freight plan work, has shown that using these vehicles will provide significant long-term safety and productivity benefits and can be achieved relatively quickly and with modest investment in infrastructure and new vehicles, relative to the benefits. HPMVs will undertake 10-20 percent less travel to move the same amount of freight as standard trucks. This reduction in travel offers significant commercial benefits, such as reduced vehicle operating costs, driver hours and fuel.

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[3] Note that only six airports currently receive international flights – Auckland, Christchurch (long-haul), Wellington, Queenstown, Dunedin and Rotorua (short-haul).

[4] Ministry of Transport.

[5] Aviation Safety Summary April-June 2013, Civil Aviation Authority, www.caa.govt.nz.

[6] Tourism Industry Association, Tourism 2025 Analysis. 2013 is an estimate as at July 2013.

EVIDENCE BASE: TRANSPORT SECTOR

Rail

The maximum extent (5,656km) of the rail network was reached in 1953. Since that time, the network has evolved to link New Zealand's main industrial and agricultural centres and ports. As part of the Turnaround Plan, KiwiRail is identifying which parts of the existing network will remain viable in the longer term. As part of the process, to ensure resources are deployed to the most utilised parts of the network, KiwiRail has recently mothballed the Stratford-Ohakura and Napier-Gisborne lines and is investigating the viability of the North Auckland Line.

Air and Sea

The Ministry of Transport estimates that 94.6% of New Zealanders live within 50 kilometres of an airport with scheduled services.

In the year to June 2013, 81% of export air freight and 92% of imports by volume was handled by Auckland Airport. Christchurch Airport was the second largest freight handling airport.

Ports are spread across the country with each port serving a hinterland (which requires effective road and rail connections) with many ports competing with each other for trade. The question of which ports the country chooses to operate is at the discretion of individual ports and international shipping companies.

What quality is it?

Overall, based on the data available, the quality of assets in the transport sector appears adequate to enable the movement of people and freight.

The World Economic Forum Global Competitiveness report 2013/14 also shows a perceived improvement in the quality of New Zealand's overall infrastructure since the previous report in 2011/12. However, the assessment process used by the Forum is survey based, rather than a quantitative comparison of the quality of infrastructure. It should also be noted that New Zealand's overall competitiveness ranking was reduced by a perceived constraint from inadequate supply of infrastructure (particularly road and rail), where New Zealand is rated as below the peer group mean. New Zealand is ranked 18th for overall competitiveness out of the 148 countries assessed, an improvement of seven places since 2011/12.[7]

World Economic Forum Global Competitiveness Report 2013/14

TYPE	SCORE 2011/12 (MAX 7)	SCORE 2013/14 (MAX 7)	GLOBAL RANK 2011/12	GLOBAL RANK 2013/14
Quality of Roads	5.5	5.0	45	37
Quality of Railways	3.3	3.7	47	39
Quality of port infrastructure	5.5	5.5	24	19
Quality of air transport infrastructure	6.2	6.0	12	17
Overall Infrastructure	**4.7**	**5.2**	**50**	**43**
Overall Competitiveness	**4.9**	**5.11**	**25**	**18**

Source: OECD

[7] http://www.weforum.org/reports/global-competitiveness-report-2013-2014

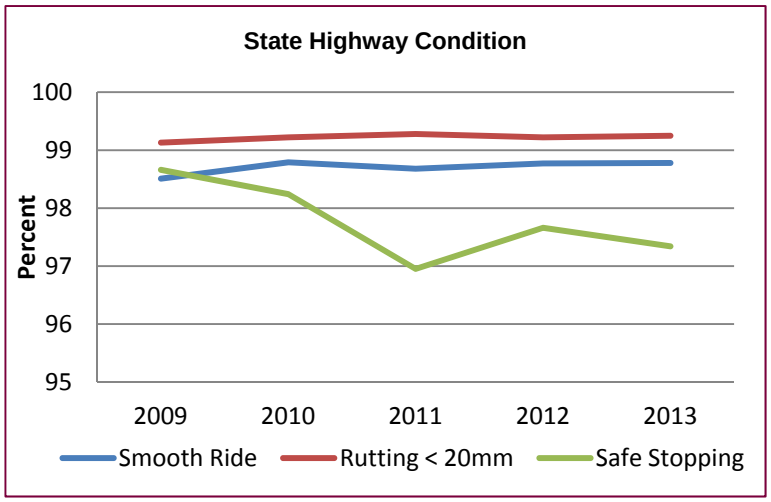
EVIDENCE BASE: TRANSPORT SECTOR

Roads

State *Highway* Network

The condition of the roads is assessed by the NZ Transport Agency through a number of measures:

- Smooth ride: the percentage of travel on the network that is made on a surface smoother than a defined roughness standard.
- Rutting:8 the proportion of rutting over the network that is deeper than 20mm.
- Skid Resistance: the percentage of travel on the network that is on a surface above a specified skid threshold, based upon meeting surface texture standards.



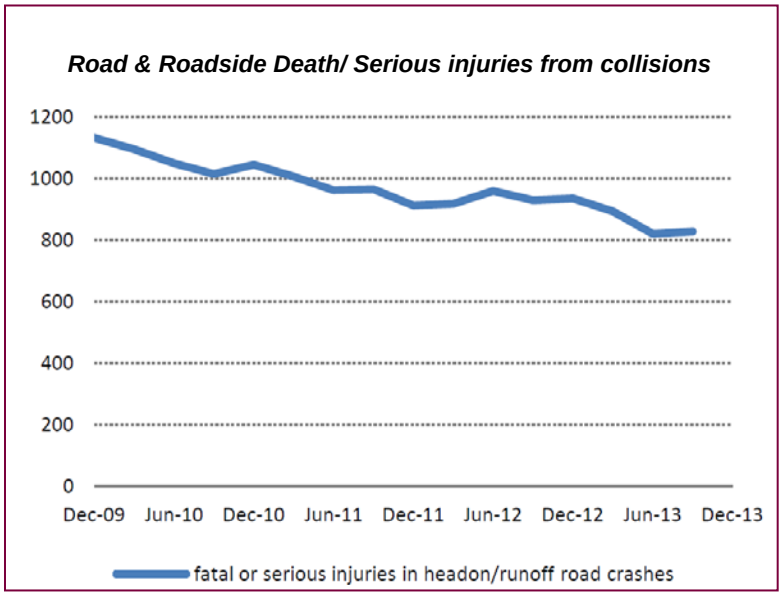
Source: NZTA

Most travel in New Zealand is made on surfaces that have a smooth surface and meet skid resistance standards. The level of rutting is one of the key indicators of the health of the underlying pavement and can reduce skid resistance. Over the past five years there has been a decrease of around 10% in the amount of rutting that exceeds the 20mm depth threshold.

Road Safety

The level of fatalities or serious injuries in crashes provides a measure of how safe the road system is. While there are significant differences between regions in the levels of fatalities and deaths, overall there has been a declining trend over the past 10 years.

Management of the road network plays a significant part in road safety but it is not the only contributor to lower deaths and injuries. Compared globally, New Zealand ranks slightly above the OECD average for road fatalities per million vehicles and per million inhabitants.[9] The Safer Journeys strategy launched by the Government in 2010 focuses on creating a road system that is increasingly free of death and serious injury by creating safer roads and roadsides, safer speeds, safer vehicles and safer road use.

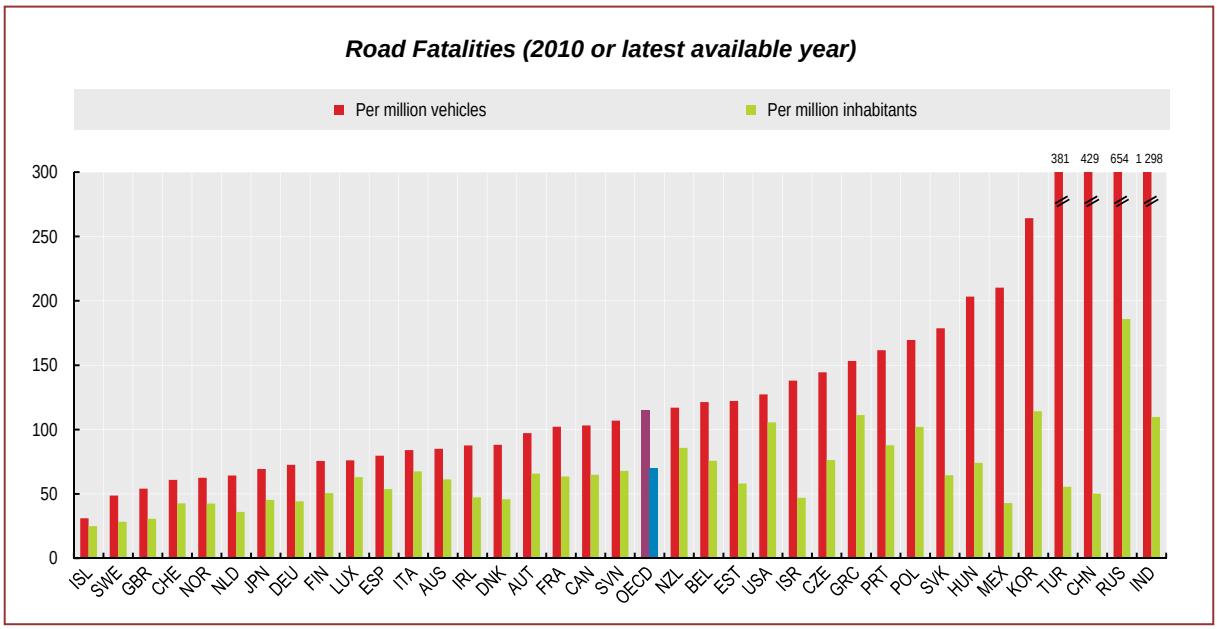


Source: NZTA

8 Long shallow channels generally found in wheel paths.

9 OECD Factbook 2013: Economic, Environmental and Social Statistics, www.oecd-ilibrary.org

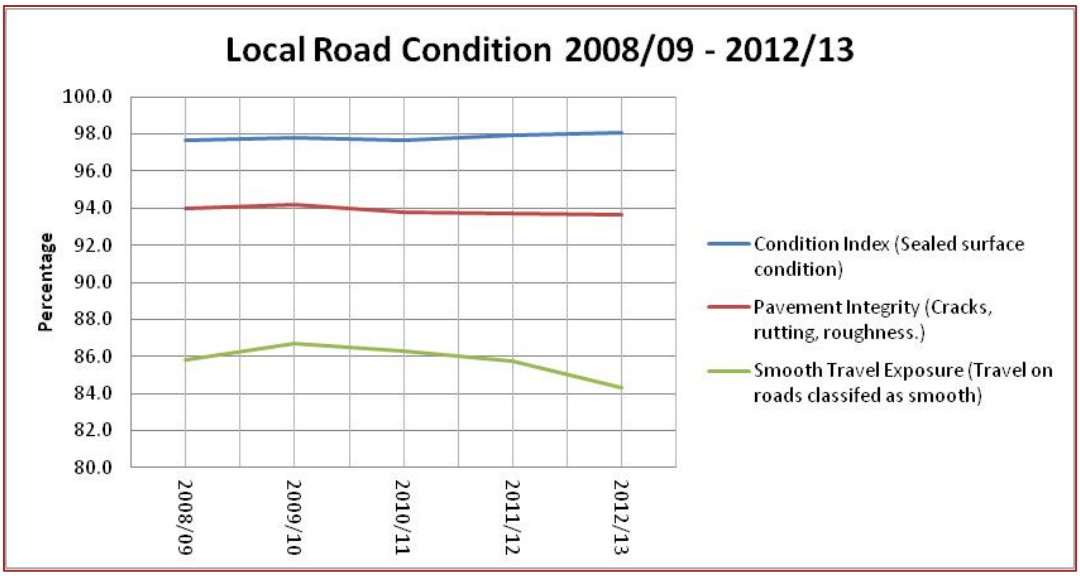
EVIDENCE BASE: TRANSPORT SECTOR



Source: OECD

Local Roads

Information available on the condition of local roads shows that the condition and integrity of local roads has remained fairly constant over the period 2008/09 to 2012/13. Smooth travel exposure rose initially, but has fallen since 2009/10. This information is derived using a different method to the State Highway condition information, and therefore cannot be directly compared.

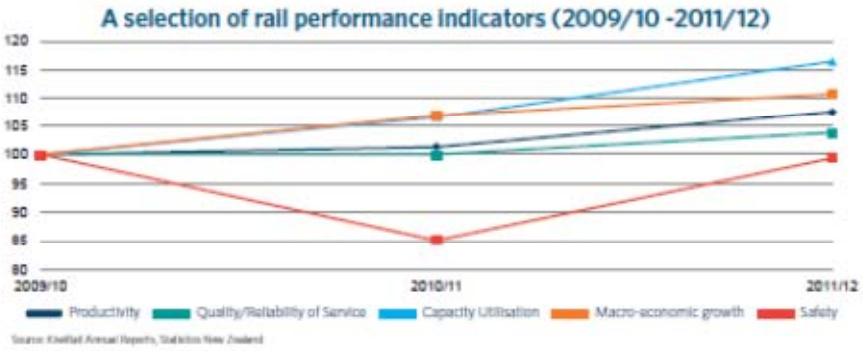


Source: NZTA

Rail

KiwiRail shows better than target results for delays to freight services, and for reducing shunting derailments as a result of infrastructure defects (an improvement of 30% between 2009 and 2012), although the Annual Safety Performance Report 2011/12 does note a small increase in overall shunting derailments for that year compared to the previous year. The same is true for running

derailments, although again these have decreased significantly over the longer period. Of the 26 running derailments in 2011/12, 15 were caused by track faults or rail vehicle defects.



Air

There is a lack of published information on condition of assets across all airports, although a range of metrics detail the quality of assets for the three airports which fall under Commerce Commission disclosure regime (Auckland, Wellington, Christchurch) showing passenger satisfaction and reliability of assets. All three airports are reported by consumers to provide very good terminal facilities. The quality of New Zealand's airport infrastructure was ranked at 17th in the world in 2013/14 by the World Economic Forum.

Sea

Information is not readily available on the asset condition of ports. By volume, 99% of all import and export trade is shipped by sea through ports. The quality of New Zealand port infrastructure was ranked at 19th in the world in 2013/14 by the World Economic Forum.

What capacity is it at?

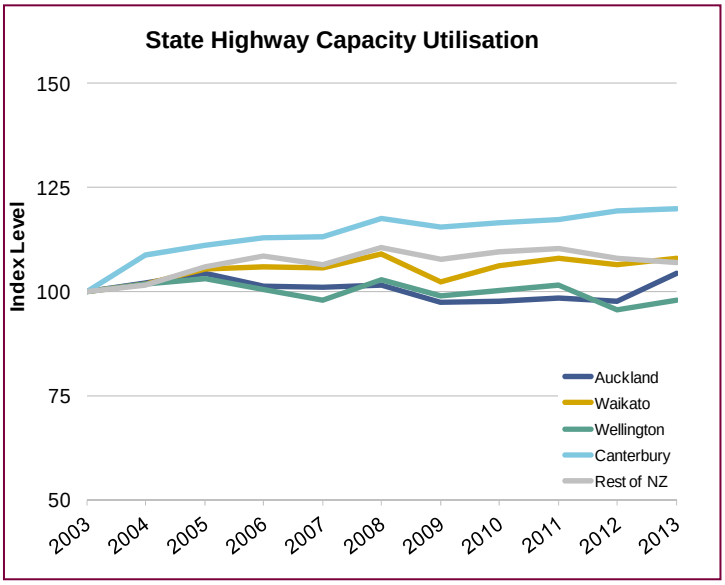
Some capacity issues apply to the transport network. As mentioned in the congestion section below, this is particularly the case for roading in the main urban centres (Auckland, Christchurch, Hamilton and Wellington).

Road

The NZ Transport Agency measures capacity, congestion, and morning and afternoon peak road productivity indicators, on both the state highway network and urban roads. All of this can be used to assess the capacity of the network.

State Highway Capacity Utilisation

Pressure on the road network is obtained by assessing the total area of road in use compared with the level of traffic it has capacity for. The utilisation of this capacity can be measured through the number of vehicle kilometres travelled (VKT) per

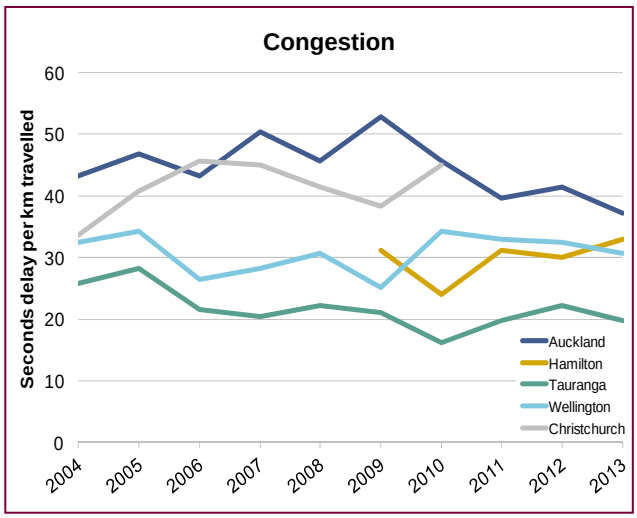


Source: NZTA

network kilometre of state highway. The index based chart to the right shows a slight increase in utilisation over the past ten years as a result of a greater increase in VKT compared to the level the network increases, largely outside of the Auckland and Wellington regions.

Congestion

Congestion also provides a reflection of the ability of the road network to meet traffic demand pressures. The NZ Transport Agency measures congestion levels in the five major metropolitan areas – Auckland, Hamilton, Tauranga, Wellington and Christchurch - based on seconds of delay, per kilometre travelled.[10] These measurements include State Highways and local roads during the morning peak period.



Source: NZTA

Over the past ten years, there have been fluctuations across the five areas. There has been notable progress in Auckland since 2009, which shows evidence of improvement in travel times during the morning peak period, despite population increases.

New Zealand cities show similar levels of overall congestion as cities in Australia.[11] Sydney is the most congested, with Auckland and Christchurch ranked 2nd and 3rd. Sydney and Auckland rank 14th and 15th against all cities globally. We note that the population of Auckland is 1.4 million and Sydney is 4.7 million, and the congestion rating is only slightly higher in Sydney. Consistent with the congestion data above, the morning peak congestion component of this indicator has generally declined for Auckland, Christchurch and Wellington over the period observed, although overall congestion has increased.

Road Congestion in Australasian Cities 2012-13

CITY	POPULATION (MILLION)	RANKING Q2 2012	RANKING Q2 2013	CONGESTION % Q2 2012	CONGESTION % Q2 2013	% CHANGE 2012-2013
Sydney	4.7	1	1	34	35	1
Auckland	1.4	3	2	30	34	4
Christchurch	3.8	5	3	29	32	3
Perth	1.9	2	4	31	29	-2
Adelaide	1.3	6	5	28	29	-1
Melbourne	4.2	4	6	29	28	-1
Wellington	0.4	8	7	25	28	3
Brisbane	2.2	7	8	25	25	-
Canberra	0.4	9	9	18	19	1

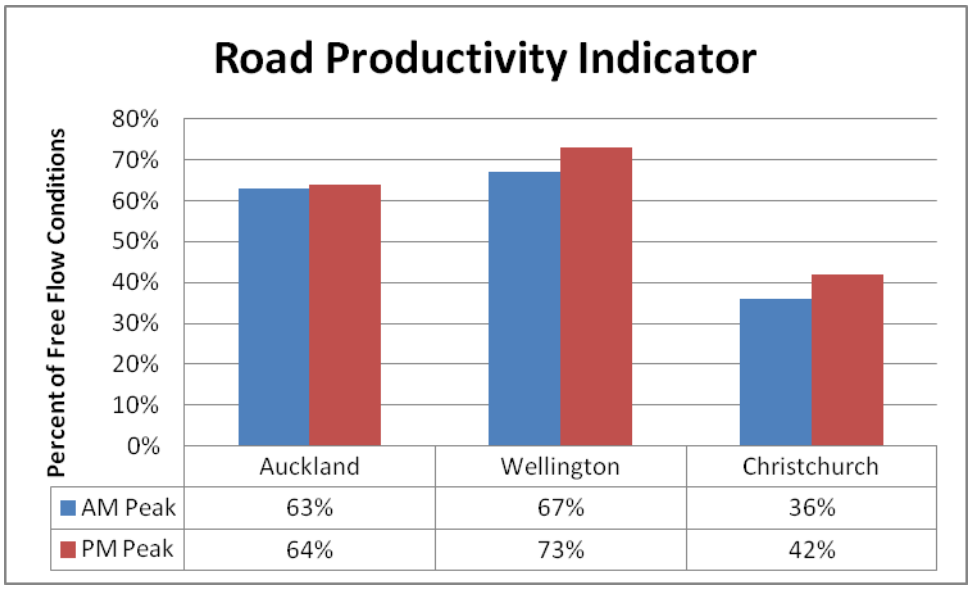
Source: TomTomTraffic Index

[10] Based on the annual March surveys of morning peak periods. This measure has not been applied to Christchurch subsequent to the earthquakes.

[11] TomTom Traffic Index Q2 2013 – a report comparing congestion levels in over 169 cities across six continents. http://www.tomtom.com/en_nz/trafficindex/

EVIDENCE BASE: TRANSPORT SECTOR

Road Productivity



Source: NZTA

Roads in Auckland and Wellington operate more than a third below free flow conditions, and the network in Christchurch is currently operating at only 40 percent of free flow conditions in the peak periods. High productivity is achieved if both speed and flow are maintained near 100 percent.

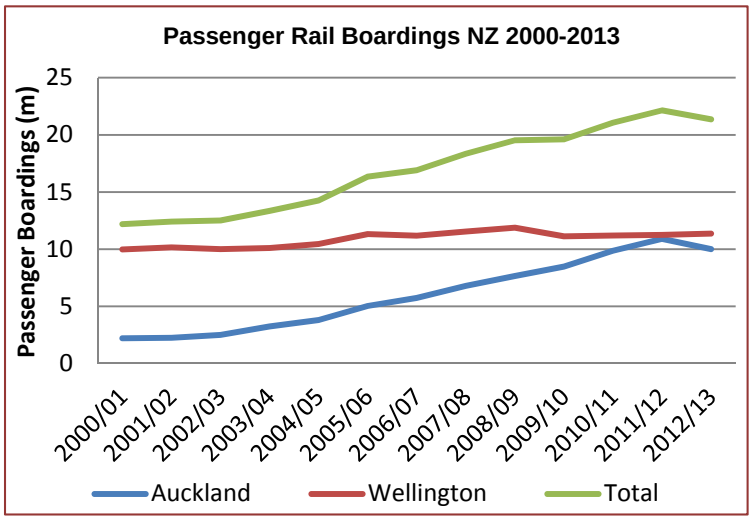
A multi-faceted approach of demand management of the existing network (including intelligent transport systems), regulatory reforms within the transport-using sector as well as new investment in public transport and road capacity, has been adopted by the NZ Transport Agency to manage the State Highway network in New Zealand.

In general land use integration could be improved, with transport systems needing to be given fuller consideration when incorporated into urban design and planning regimes.

Rail

Metro rail passenger boardings per year have increased from 12.2 million passengers to 21.4 million passengers over the period 2000 to 2013.[12] The majority of increased boardings have been in Auckland, reflecting the significant metro rail investment by the Government and resulting service improvements and capacity.

As shown in the rail section above, capacity utilisation on the rail freight network has improved by 15 index points since 2009/10.



Source: Ministry of Transport

[12] Ministry of Transport, Transport Monitoring Indicator Framework, www.transport.govt.nz

Air

A process of independent 'slot scheduling' applies to international airline arrivals and departures at Auckland, Wellington and Christchurch Airports, and domestic and international movements at Queenstown Airport. Internationally accepted practices are applied to resolve potential runway and terminal congestion that might otherwise arise at peak times, and to ensure arrivals and departures in New Zealand match airport slot availability at the overseas origin/destination.

Freight

In addition to the data above, the Ministry of Transport conducted a study in 2008 into freight demand; "The National Freight Demand Study". It forecasted that freight volumes would double over the next 30 years. An updated version of the study is due to be published in early 2014.

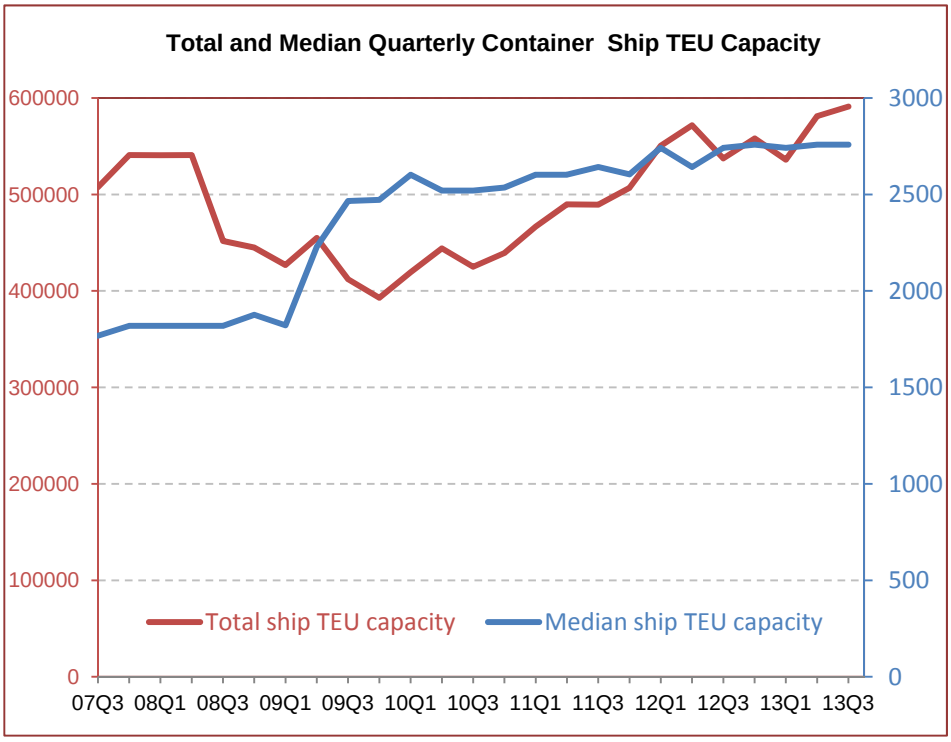
The Government has also set the target of lifting export earnings to 40% of GDP. The transport sector will need to respond to the challenge of increasing domestic and export volumes if the current range of export freight products remains the same. A change in the mix of export freight products may be required to achieve this target. For example, in the year to June 2013, wood products made up about 50% of New Zealand's sea exports by volume and only 8% of sea exports by value. The export value of logs was about $125 per tonne, processed timber $712 per tonne and pulp and paper product $691 per tonne. By comparison, the average value per tonne of export air freight was $59, 601 in the same year.

The NZ Transport Agency is coordinating a series of 'Freight Stories', bringing together government, regional and private interests, to identify opportunities to improve the performance of the freight network (road, rail, air and sea).[13]

Current policy settings allow the market to decide what the best combination of ports and airports is for New Zealand. Improving the evidence base will help to inform whether these policy settings are correct and what is the best balance between collaboration and competition.

Market decisions on which ports and airports to use (particularly ports) have flow on implications for road and rail network requirements. This may be especially so if bigger container ships (i.e. 6000 container capacity plus) begin to service the New Zealand market, with corresponding demand for more capacity on the road and rail systems connecting the ports. The Ministry of Transport is currently investigating potential future freight scenarios associated with the longer term make-up of port infrastructure in New Zealand. We expect this investigation to inform our understanding of the sector.

The graph shows total and median capacity of container ships visiting New Zealand between 2007 and 2013. Following a decline in total capacity after the Global Financial Crisis in 2008, total



Source: Ministry of Transport

[13] http://www.nzta.govt.nz/planning/process/freight.html

capacity visiting New Zealand has recovered to almost 600,000 twenty-foot equivalent containers (TEU). The median capacity (indicating size) of ships has grown to about 2750 TEU. The latest generation container ships running on key trade routes between Asia, North America and Europe have capacities of up to 15,000 TEU.

At present the largest container ships visiting New Zealand on a regular basis have capacity of about 4500 TEU. Based on the evidence, the NIU does not expect a dramatic increase in the size of container ships visiting New Zealand over the short to medium term, but considers planning should be undertaken now, to accommodate this scenario in the future.

Finally, discussions with stakeholders have identified a number of specific challenges in managing New Zealand's freight task:

- Freight routes in south Auckland – these issues are being investigated as part of the East West Link project.14
- Availability of high quality rail rolling stock – this is being addressed through investment in the KiwiRail Turnaround Plan15.
- Conflict of freight and commuter rail – this is a potential issue in Auckland and Wellington as converging commuter and freight routes become more congested.
- Availability of cargo space for air freight – this is interdependent with growth in air passenger services (as some space on these services is allocated to cargo).
- Freight routes connecting major ports and inland ports in urban centres – a key challenge for the sector, particularly as freight volumes grow and in the event that bigger ships come to New Zealand.
- Availability of land for marshalling and storage space at ports – some major ports are currently constrained by the area available to them resulting in the implementation of demand management practices, the development of inland port options and/or area expantion through land reclamation.
- Space for high seasonal freight volumes on domestic and international shipping routes – due to the seasonal nature of many of New Zealand's key agricultural exports, export capacity is at a premium in the productive season. Smoothing the availablity of export services to meet demand is a continuing challenge for the sector.[16]

How resilient is it?

Resilience is a key issue for the transport network. Disruption in one area of the network (e.g. Manawatu Gorge or inter-island ferries) can have significant knock-on effects further along the network and create impediments to freight and population mobility with economic and social consequences.

A network wide view that considers the most efficient and effective means of providing an appropriate level of resilience needs to be developed. The Ministry of Transport and NZ Transport Agency have a number of initiatives underway to develop a resilience evidence base. NZ Transport Agency have undertaken a preliminary review of the road transport sector and have a research project yet to be published entitled "Measuring the Resilience of Land Transport".

In addition, KiwiRail, NZ Transport Agency and Transpower have developed a Joint Resiliency Operating Framework and are continuing to apply this.

[14] www.aucklandtransport.govt.nz/improving-transport/east-west-link/Pages/default.aspx

[15] http://www.kiwirail.co.nz/media/publications.html

[16] Freight Information Gathering System Report, Ministry of Transport, www.transport.govt.nz

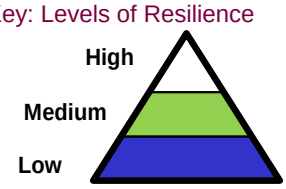
EVIDENCE BASE: TRANSPORT SECTOR

In the table to the right resilience expectations from a national perspective are identified as low medium or high. When making these judgements a wide range of aspects require consideration. To demonstrate; under Local Roads "Strategic freight routes" are those routes generally to and from airports and ports generally with a very high economic value associated with them and generally carrying freight of a time critical nature. Also, generally throughout the country these are identified routes to better manage heavy vehicles particularly through the urban areas with associated safety and urban amenity values. A high level of "Resilience Expectation" is therefore attributed to them. An "Assessed Resilience" of medium reflects the significant vulnerabilities of some of these routes both from limited alternate options and urban pressures for example. In contrast "Suburban roads" have a low "Resilience Expectation" in part due to the relatively low economic value associated with them and also the generally large number of alternate access options. "Suburban roads" are also a good example of level of resilience being dependent on your perspective; if you reside in a particular suburban road you a likely to expect a high level of resilience and in many cases this probably exists.

Ports have been the subject of specific attention recognising their critical importance to New Zealand's productive economy. The University of Auckland and others have been undertaking research considering tsunami vulnerabilities to port network operations and structures. The Port of Lyttelton, and the strategic freight routes servicing it is a particular case in point as it looks to recover from damage sustained during the earthquake events.

The assessment included here has been created by the National Infrastructure Unit, taking a national level perspective, and thus may differ from other perspectives. Further work is needed to develop this with robust supporting evidence; however, this does provide a starting point for prioritising efforts. Based on this assessment, key areas of attention are; Strategic freight routes, National Roads with no reasonable alternate routes, Rail and Ports.

Key: Levels of Resilience



Transport	Resilience Expectations	Assessed Resilience	Desired Movement
Local Roads			
Suburban			–
Main arterial with alternate			–
Main arterial – no alternate			–
Strategic freight routes			↑
National Roads			
National with alternate			–
National – no alternate			↑
Road/Rail Link Span			
Cook Straight ferries & terminals			–
Rail			
Suburban (incl rolling stock)			↑
National (incl rolling stock)			↑
National Train Control Centre			↑
Ports			
Individual Ports			–
Ports with specialist facilities			↑
Ports Network			↑
Airports			
Regional airports			–
Airways NZ			–

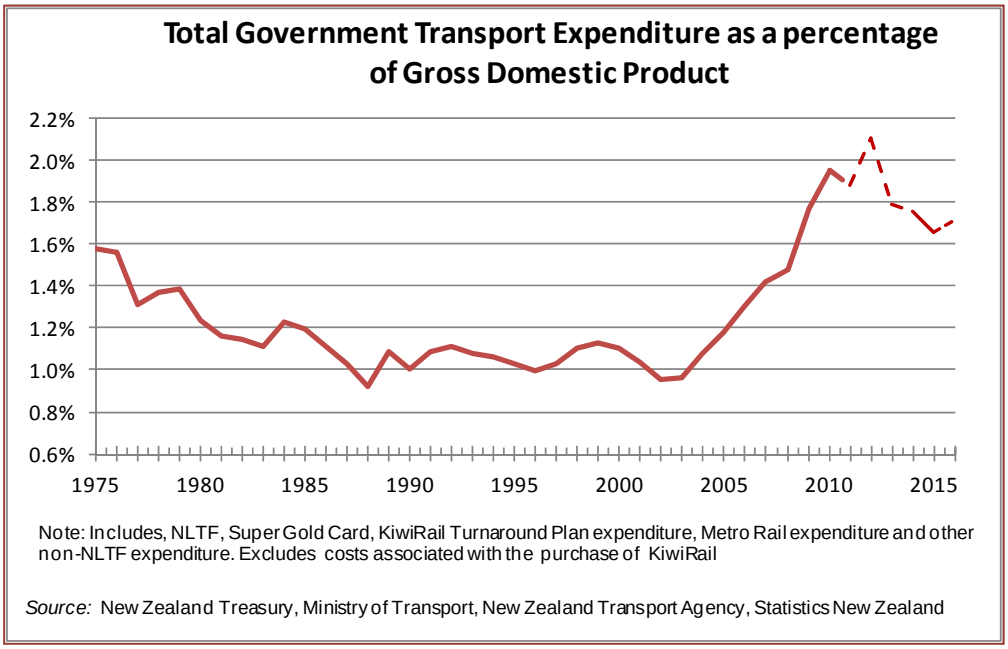
What are we investing?

A key principle underlying the funding of transport infrastructure is that the cost of providing the infrastructure should be borne by those that use it as far as possible.

Investment funding varies across modes via a mixture of Crown, local and regional government, and private funding. In recent years, the Government has increased investment in key road and rail freight corridors to improve the flow of imports and exports across the country. It has also increased overall investment in State Highways, local roads and public transport.

Land Transport Investment

Crown funding for land transport infrastructure investment in roads is hypothecated through Fuel Excise Duty, Road User Charges and Motor Vehicle Registration fees. The New Zealand Transport Agency is charged with assessing which projects should be progressed and allocating funds accordingly. Ports, airports and the rail freight network operate on a commercial basis.



The 2012-15 National Land Transport Programme (NLTP) represents a $12.28 billion investment by Government and local authorities in New Zealand's land transport system. Priority is given to activities that advance the strategic direction of the Government Policy Statement on Land Transport Funding: economic growth and productivity, value for money, road safety and travel choice.

Rail

The rail network continues to undergo a significant investment programme to address the legacy of underinvestment. In total, over $2 billion has been invested in the rail network since 2011. Through the Turnaround Plan, the Government has made a significant investment to support KiwiRail in repositioning itself to operate as a successful business ($845 million has been appropriated over 2010/11-2013/14). Government has also provided separate capital investments in Auckland and Wellington to support metro rail improvements (an example of this is the Auckland electrification project).

Air and Sea

Central government makes a much more limited investment in aviation and maritime infrastructure, which is generally provided at cost to users. In the past there have been some Crown contributions to Joint Venture Airports and Crown entities (e.g. Maritime NZ). Recent and ongoing funding reviews by the Civil Aviation Authority and Maritime NZ are providing greater clarity around appropriate price adjustments to user charges, balanced against the cost incurred by agencies to deliver services.

EVIDENCE BASE: TRANSPORT SECTOR

How productive is it?

As with all sectors, data on the transport sector's overall productivity is incomplete; however, there is information in the public domain, such as the information published by airports under the Commerce Commission disclosure regime (Auckland, Wellington and Christchurch).

In addition, in 2012 the New Zealand Productivity Commission published the findings of its inquiry into International Freight Transport Services.[17] The key findings were:

- Productivity in New Zealand's transport and storage industry grew strongly in the 1990s, but hardly at all in the 2000s.
- Productivity measures indicate that New Zealand ports and airports compare favourably with Australian counterparts. By international comparison, New Zealand customs services are efficient.
- Container productivity indicators show considerable variation in the performance of New Zealand's ports, with Tauranga the strongest performer. There may be opportunities to either lift the performance of the lower performers or to shift freight towards the top performers.
- Compared internationally, New Zealand has low volumes of freight per kilometre of rail, and smaller trains and trucks.
- There is little information about the productivity of freight handling at airports. Auckland Airport's overall productivity (passenger and freight) compares favourably with other Asian and Pacific airports, while Christchurch is average.
- Ad valorem sea freight costs (measured as the price paid for freight relative to the value of the goods being transported) have been coming down over the last 20 years, although the rate of improvement slowed in the 2000s. However, after accounting for compositional factors, ad valorem sea freight costs are about 21% higher in New Zealand than in Australia. Given that a high proportion of New Zealand's exports are shipped by sea, this is a considerable cost difference. The onshore components of New Zealand's air and sea freight costs, particularly its port handling costs, compare favourably with Australia and other OECD countries.

[17] Source: NZ Productivity Commission, International Freight Transport Services Inquiry, April 2012.

EVIDENCE BASE: TRANSPORT SECTOR

The following is a summary of the Government's response to the New Zealand Productivity Commission's 2012 International Freight Transport Services Inquiry:

The Commission identified five top opportunities for improving the international freight system, which it considers would make the largest difference to New Zealand's future economic performance and prosperity. The Government agrees with the Commission about the importance of these opportunities and intends to make progress against them all:

1. *Lift the quality of infrastructure planning and coordination*

The Government intends to make more use of 'facilitated discussion' models of cooperation in coordinating investment planning. The New Zealand Transport Agency is currently initiating facilitated freight planning processes, which will include representatives from the Government, councils, freight producers, and transport operators. The Government is also currently progressing reforms to improve the planning and coordination of infrastructure investment through the Better Local Government reform programme and phase two of the Resource Management Act reforms. The Commission has made a number of useful recommendations that will inform this work.

2. *Better governance of ports and airports*

The Government will work together with councils to clarify the objectives of port ownership, to better manage conflicts of interest, and to improve monitoring and information in order to support better decision making. Part of this work will be progressed through the Better Local Government reform programme.

3. *Make competition regimes for freight more pro-competition*

The Government is currently progressing the Commerce (Cartels and Other Matters) Amendment Bill, which is designed to encourage pro-competitive collaborations between businesses, while at the same time deterring anti-competitive cartel behaviour, by narrowing the exemptions from competition law.

4. *Build more productive workplaces at ports*

Good workplace relationships between employers and employees are essential for developing high-productivity workplaces. The Government supports the proposed improvements to governance and information infrastructure, a number of which are for local authorities and port companies to consider. Recent changes to the Employment Relations Act have also been designed to encourage more productive employer and employee relations in all workplaces.

5. *Develop a richer information infrastructure*

The Government intends to develop more comprehensive systems for gathering and disseminating freight data in order to support better individual and co-ordinated decision making, monitoring and policy development. In designing these systems, the Government will seek to minimise compliance costs imposed on the freight services sector.

The full government response to the Productivity Commission's inquiry into International Freight Transport Services can be found at http://www.treasury.govt.nz/publications/informationreleases/transport.

An area for further investigation is the performance and productivity of the transport construction sector. Recent measurement adjustments by Statistics New Zealand[18] have revised the picture of declining productivity in the construction sector. While there are still challenging measurement issues, it appears from these that productivity performance of the sector has flat-lined for 20 years and there is still a growing productivity deficit relative to Australia; there is scope for improvement. The productivity performance may be due to a range of systemic issues, rather than under-investment in capital. The civil construction sector is closely coupled to government as central and local governments are by far the major purchasers of civil works. Government policies, regulations and procurement systems influence the productivity performance of the sector. Improving performance therefore requires a coordinated approach between government and industry.

[18] Industry Productivity Statistics 1978-2008 (2010), Statistics New Zealand

How well are we managing it?

Roads

The Government Policy Statement on Land Transport Funding (GPS) 2012-2015 describes Government's funding priorities for ten years 2012/13 – 2021/22 and outlines the expected expenditure levels by broad transport type. [19] The NZ Transport Agency is required by legislation to allocate funding to activity classes within the funding ranges set out in the GPS. The NZ Transport Agency gives effect to the GPS through the National Land Transport Programme (NLTP). The NLTP has a 10 year outlook and lists transport activities and packages of activities which are expected to be considered for funding over the next three years. The NZ Transport Agency uses a three factor assessment framework for investing National Land Transport Fund revenue. These are:

- Strategic fit – how projects and policies align with the Government Policy Statement priorities (economic growth and productivity, value for money and road safety)
- Effectiveness criteria – ensuring that whole-system options have been considered and have been given appropriate considerations
- Efficiency criteria – the value of the solution in relation to the resources used (based on cost-benefit analysis calculations in the Transport Agency's Economic Evaluation manual).[20]

The NZ Transport Agency currently considers all three of the above criteria in its decision-making process for transport projects and programmes. Therefore, cost-benefit analysis is at present only one factor in the project prioritisation process and there is a risk that construction and maintenance initiatives implemented do not deliver the highest possible value to the network.

We would encourage consideration of more comprehensive use of cost benefit analysis, with a view to consistently accounting for effectiveness, efficiency and strategic criteria, thereby improving transparency and confidence that the highest value projects are being prioritised.

The accuracy of NZ Transport Agency demand forecasting is generally good. It is the role of the Ministry of Transport to forecast revenue. Historic assumptions about revenue growth from fuel taxes are being tested in light of international trends such as driving less, increasing fuel prices, e-commerce, increasing fuel efficiency and alternate fuels. The Ministry of Transport is undertaking further analysis of the potential impact on revenue of these longer term trends.

Rail

KiwiRail is operating in a commercial environment and is implementing the Turnaround Plan. Capital investment through the plan is focused on improving key freight services and maintaining the reliability and safety of the rail network. Revenue growth has been positive but it is less than originally forecast in the Plan, though volumes are increasing. Rail continues to provide for the high bulk, less time sensitive sector of the freight market and complements road in managing New Zealand's overall land freight task. We would encourage more comprehensive analysis of the relative contribution of road and rail in managing current and future freight demand to help inform decisions on the appropriate level of investment in each.

Sea and Air

The Port Companies Act and Airport Authorities Act assign a commercial focus to port and airport companies. The principal purpose of a port company, specified in the Port Companies Act, is to operate as a successful business. Similarly the Airport Authorities Act specifies that an airport company is to be managed as a 'commercial undertaking', which has been interpreted in case law to mean maximising the commercial value of the company over time. By and large this model operates effectively although improved governance arrangements could, in some cases, improve the sector's overall efficiency.

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[19] A new GPS is drafted every three years and GPS 2015-2018 is currently under development

[20] For more information see: http://www.nzta.govt.nz/about/newsletters/keeping-connected/3048/news.html

Sector-wide View

The Office of the Auditor General (OAG) recently published an overview of its work in the transport sector. The key findings were:

- Central government transport entities have good systems and controls. These entities have improved the quality of their service performance reporting in recent years.
- The OAG found that some local authorities' service performance reporting has improved through explaining their longer-term results.
- In 2010 and 2011, OAG completed two performance audits into how NZ Transport Agency is maintaining and renewing the State Highway network. The audits found that, overall, NZ Transport Agency effectively and efficiently maintains the State Highway network to the required condition by ensuring that quality and timely maintenance and renewal work is completed on the network.
- OAG's 2011/12 annual audit of KiwiRail found that it is making steady progress to improve its asset management and recommended where we think further attention is required.
- OAG's audits of local authorities' 2012-22 long-term plans found that local authorities face many challenges planning transport activities – these include how best to replace ageing infrastructure, responding to changing land use, and managing higher input costs. There is evidence that local authorities are well placed for long-term sustainability of transport assets because of forecast investment and reinvestment. However, the investment forecast relies on good asset management planning.[21]

What future trends and scenarios may impact transport infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand).

Each scenario has an associated set of projections of future infrastructure demand. Rather than developing new demand models or forecasts, the NIU relies upon existing sector forecasts where they are applicable and relevant. In the transport sector, our analysis relies on extensive modelling and forecasting undertaken by NZ Transport Agency and the Ministry of Transport.

The full results of our scenario modelling investigation have been published in a separate document available on the NIU website, but relevant extracts for the Transport sector are reproduced below.

Implications for transport infrastructure in the central scenario

The demands placed on our transport infrastructure in the central scenario can be separated into freight movements (export and domestic) and household travel (including tourism). In this analysis, we draw upon information from the National Freight Demands Study[22] (Richard Paling Consulting, 2008), published outputs from the land transport demand model[23] (Stephenson & Zheng, 2013), and supporting data from NZ Transport Agency and the Ministry of Transport. We note that the Freight Demands Study is currently being updated by the Ministry of Transport and will be published in early 2014. Results from the revised study will supersede the forecasts shown below.

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21 Office of the Auditor General, Transport Report 2013, http://www.oag.govt.nz/2013/transport-audits

22 The Ministry of Transport commissioned Deloitte to carry out an update of the National Freight Demand study and to undertake a Future Freight Scenarios study. Each of these studies may provide an improved outlook on future transport demands. The reader is referred to the Ministry of Transport website (http://www.transport.govt.nz/research/nationalfreightdemandsstudy/), where these reports will be published upon their completion (expected to be in early 2014).

23 Several agencies are working with NZIER to undertake further demand modelling across the transport modes (completion date unknown).

EVIDENCE BASE: TRANSPORT SECTOR

Key implications for our transport infrastructure as reported in the 2008 National Freight Demands Study include:

- From 2006 to 2031, the number of freight tonnes lifted (and tonne-kms transported) is expected to increase by 70 - 75%. Freight growth will be in both basic commodities (typically transported short distances) and sophisticated products (longer distances)
- Rail freight demand is projected to increase by 70% between 2006 and 2031 – with its modal share remaining approximately the same over that period
- Coastal shipping is projected to reach between 8.5 and 9.0 million tonnes by 2031 – approximately double the level in 2006 (this is driven in part by planned expansion of the Marsden Point refinery)
- Substantial growth in traffic generation is forecast for Waikato with an increase in forestry and dairy traffic as well as increased movement of aggregates to serve both Waikato and Auckland. Canterbury is also forecast to experience high growth in traffic generation due to an increase in dairy production
- Auckland is projected to have the highest growth in terms of traffic that is attracted to the region – reflecting the movement of primary products from Northland and Waikato

At the household level, transport demand is affected by demographic shifts, economic changes and fuel prices (among other factors). The land transport demand model developed by NZIER contains an extensive range of inputs that allow various scenarios to be modelled. The base case modelled by NZIER relies on the following assumptions:

- **Macroeconomic** – generally based on long-run historical averages and best estimates (e.g. an oil price of $300 in 30 years, roughly aligned with the IEA's World Energy Outlook projection published in 2012)
- **Industry** – industry GDP is a function of total GDP, but with shares modeled using a VAR
- **Technology** – gradual improvements in fuel economy (0.2% per annum) and various assumptions on the share of alternative fuels used by vehicles
- **Price and income responsiveness** – base case assumptions linking travel behaviour to changes in income or the cost of travel
- **Regional dimensions** – GDP and industries are included by region, as are other variables such as household incomes, freight demand, etc
- **Tax rates** – assumed to grow in line with inflation

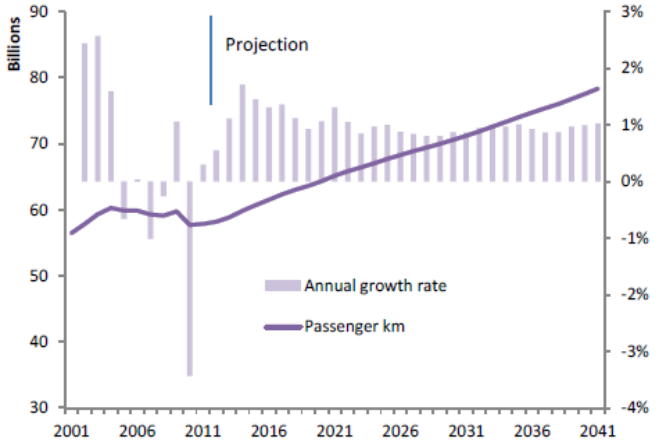
From the NZIER report produced for NZ Transport Agency, the key implications for our infrastructure in the base case include:

- Household travel demand is projected to grow nationally by 1.0% per annum over the next 30 years, although the kilometres travelled per vehicle are projected to decline
- Two thirds of travel demand growth is due to population growth. Regionally, this translates to increased pressure on transport networks in our urban centres
- Public transport demand is projected to grow by 0.95% per annum over the next 30 years. The public transport share of travel is projected to gradually decline over time (as incomes grow, enabling private vehicle use)[24]

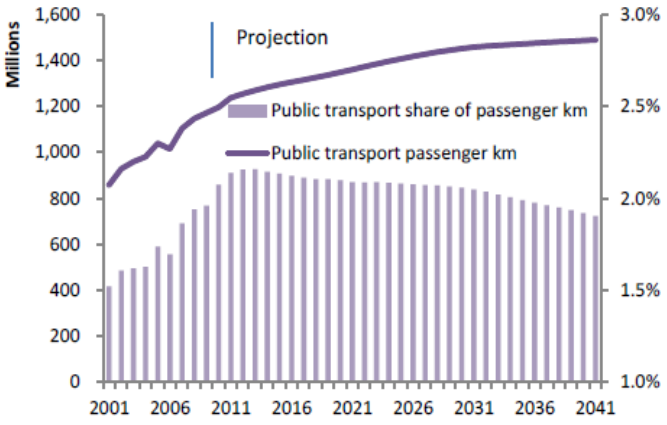
[24] We note that, although the NZIER / NZTA model predicts a gradual decline in the future, the public transport share of passenger kilometres has shown a steady growth trend over the past decade. This may merit further monitoring and consideration as time progresses.

Graphs of selected results are shown below:

Growth in travel demand (passenger-kilometres)



Growth in public transport demand (passenger-kms)

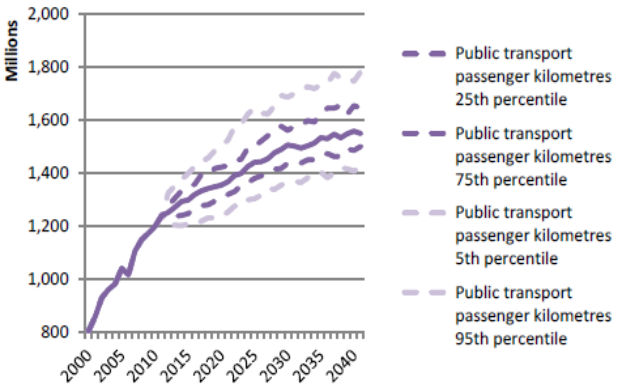


Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)[25]

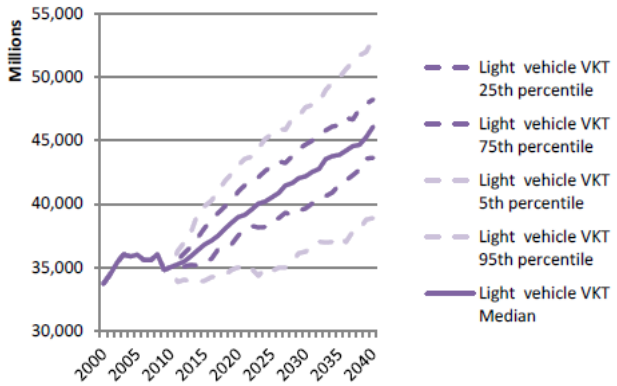
Implications for transport infrastructure in the upside and downside scenarios

A limited set of stochastic results from the long term demand model have been published by NZ Transport Agency and NZIER. Of the results that have been published, demand uncertainty is due mainly to price and income variations. Graphs that show a possible range of demand for vehicle travel and public transport usage are reproduced below:

Public transport demand (stochastic estimate)



Vehicle kilometres travelled (stochastic estimate)



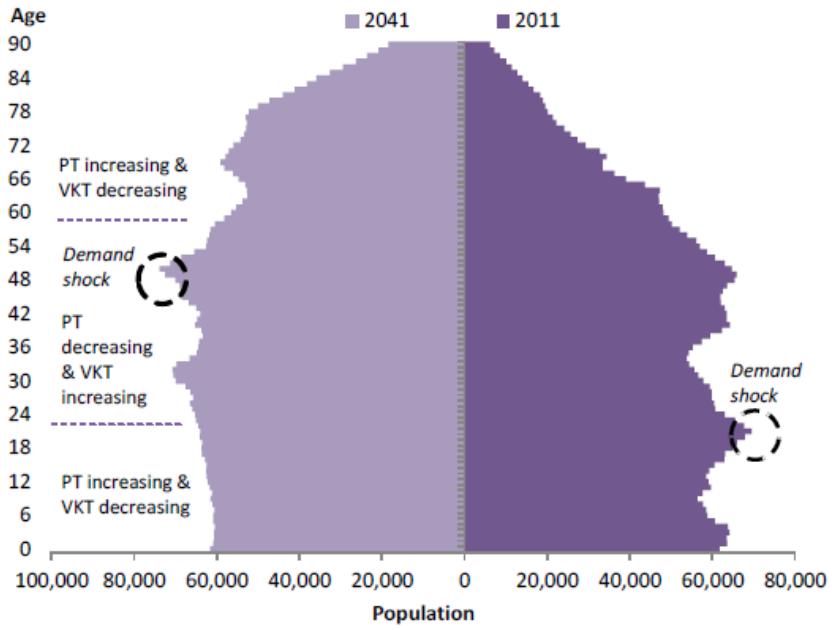
Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)

[25] The information provided by NZIER information provides an indication of structural trends and underlying demand pressures only, and deliberately exclude policy/supply-side initiatives.

EVIDENCE BASE: TRANSPORT SECTOR

Notably, as our population ages in the downside scenario, the NZIER model shows an increase in public transport demand by the elderly (and an increase in private vehicle usage for those who are 'middle-aged' – driven by relatively high income growth in this scenario). The following graph demonstrates this concept:

Demand impacts by age distribution



Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)

EVIDENCE BASE: TRANSPORT SECTOR

Sources

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INFRASTRUCTURE EVIDENCE BASE

Telecommunications Sector

February 2014

NATIONAL INFRASTRUCTURE UNIT

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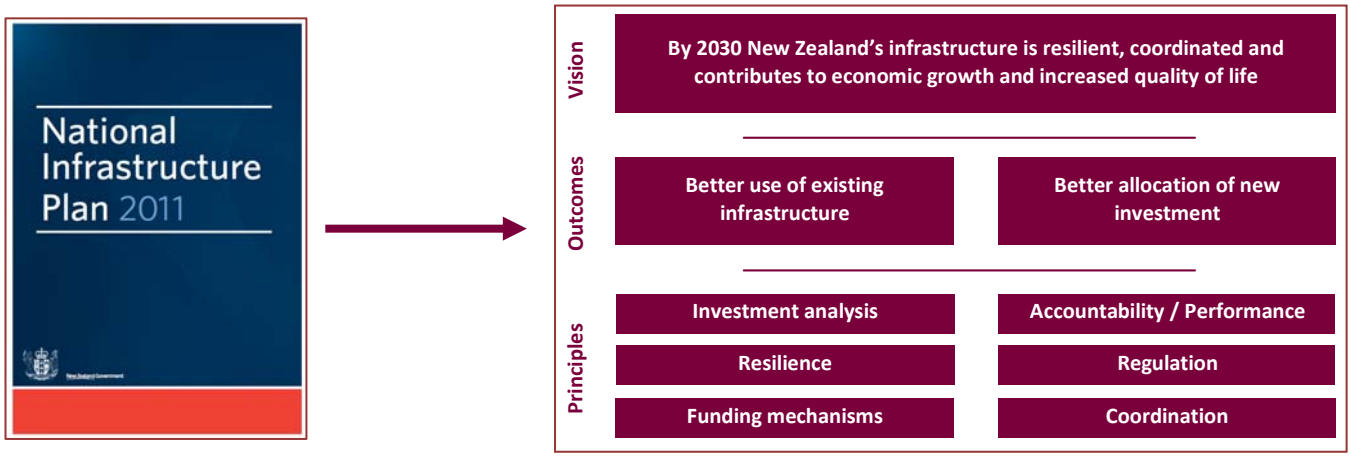
EVIDENCE BASE

Telecommunications Sector

February 2014

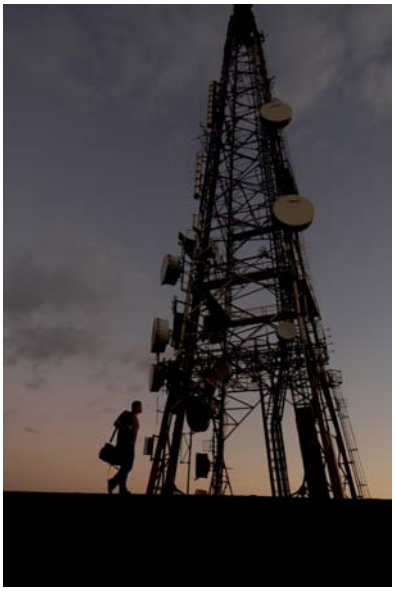
Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).



This document forms the substantive component of the Evidence Base for the telecommunications sector, defined by NIU as the assets needed to provide fixed line, mobile and internet services to consumers in New Zealand. It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend analysis, and resilience assessment.

Where data has been provided, this is publicly available information, and has been provided with permission of the information owner.

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

Overview messages

Overall, the sector appears to be in a strong position; however, there is a significant lack of publicly available data in comparison with other infrastructure sectors. As a result, the evidence base for this sector is more heavily reliant on engagement with sector stakeholders than other sectors.

The telecommunications sector delivers services directly to consumers, as well as supporting provision of infrastructure in other sectors. It is crucial in enabling greater efficiencies and productivity across all sectors.

Demand continues to rise in both urban and rural areas, with particular increases in demand for mobile services in urban areas and internet in rural areas. Data requirements are also increasing across the board, alongside a trend of increasing data caps.

However, forecasting is particularly difficult in this sector due to the speed of technology change, and as a result NIU's scenario modelling simply assumes up and downside options around existing known technologies. The high interdependency between this sector and others is noted in these scenarios.

Consultation with the sector has raised concerns around the constraint on building, especially where increasing demand will require new mobile towers to be built in urban areas. Current limitations on the height of towers can limit co-location, which would be desirable for reasons of efficiency, cost, and location.

The sector has also raised concerns about inconsistency of planning legislation, which increases costs and can cause delays. This is an issue raised across the infrastructure sectors, and is not limited to telecommunications.

In addition, there is currently regulatory uncertainty, with reviews being conducted on the Telecommunication Act and the Telecommunications Service Obligations, and the Commerce Commission undertaking a Final Pricing Principle review of both UCLL and UBA prices.

Notwithstanding these concerns, the market appears to be effective in delivering the quality and reliability required, with good coverage. There is a variety of technology in the backhaul, providing good resilience, and the market has demonstrated effectiveness in re-establishing networks in the face of natural hazards.

However, the speed of internet could be improved, with New Zealand lagging behind OECD averages, although UFB and RBI programmes will improve the speed.

These programmes contribute to the significant investment being made in this sector by both private and public sectors, which also includes extending mobile coverage and introducing 4G services. Given this, a key question may be how to ensure New Zealand gains the full benefits from these investments and whether the sector and/or the Government can lead this.

Another issue to consider in the sector is how to address slow adopters of technology. Further, reasonable judgments are required as to the right time to stop supporting legacy services, such as fax and dial up modems built in to medical and household alarms, which over time will become uneconomical to support or unnecessarily slow the deployment and uptake of new services.

As the sector is privately owned, albeit with some government investment in certain areas, these and associated questions will need to be considered by both public and private parties, and any solutions will need to be driven by both.

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

Context

The telecommunications sector provides services directly to consumers, and also indirectly by supporting delivery of other infrastructure based services. As interdependencies between sectors continue to increase, its important is growing, providing both opportunities and risks. It is one of the fastest moving and dynamic infrastructure sectors in terms of technological changes.

In New Zealand, the telecommunications services market opened to competition in 1989. Since then, private telecommunications planning and product advances have developed the market, with the Government role largely confined to that of regulator. Technology adoption timescales can be driven by external factors as a result of the relatively small size of the market. For example neither mobile phones manufacturers nor content operators (other than Sky) particularly target the New Zealand market

As a result of the shift from analogue to digital infrastructure, the different industries within this sector (telecommunications, IT, and broadcasting) are no longer separate, but are converging. A brief history of the telecommunications sector in New Zealand can be found online at the Encyclopaedia of New Zealand.

What do we have?

For the purposes of this document, when the telecommunications industry is discussed, the NIU means international connectivity, fixed line voice, internet and mobile assets.

International Connectivity

New Zealand currently has two international submarine cables: Southern Cross (owned by Telecom, Singtel-Optun and Verizon Business) connects New Zealand to the USA; and Tasman 2 (owned by Telstra & Telecom) connects New Zealand to Australia. A map of submarine cables, alongside other information on the cables, can be found at www.submarinecablemap.com

The Southern Cross Cable has a total lit capacity of 2.6Tbps across the two cables, and was engineered to 2025, while the Trans-Tasman cable has a total capacity of 560Mbps. The market is currently considering additional international cables: Vodafone, Telecom and Telstra have announced an intention to build a new cable from Auckland to Sydney (see press release: http://www.telecom-media.co.nz/releases_detail.asp?id=3880&page=1&pagesize=10&filtertext=vodafone&m1=1&y1=1996&m2=12&y2=2013&filter=filter)

There are also several companies currently considering a cable from New Zealand to Australia and the USA.

Fixed Line Services

Fixed line services are provided using copper, cable pair, wireless, satellite and fibre access networks. The data provided by the Commerce Commission Annual Monitoring Report shows that the number of fixed lines has been static for several years; however, broadband penetration to residential customers continues to increase.

FIXED LINE METRICS	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Fixed lines (millions)	1.85	1.85	1.86	1.87	1.88	1.88	1.88
Total fixed broadband connections (millions)	0.48	0.68	0.85	0.98	1.05	1.14	1.24
Fixed line broadband connections per 100 pop	11.6	16.3	19.8	22.8	24.5	26	28
Residential broadband as % residential lines	-	-	-	-	65	70	78

Data reproduced from Commerce Commission Annual Telecommunications Monitoring Report 2012.

From 2009/10, Total fixed broadband connections do not include fixed wireless subscribers.

Mobile Services

Mobile services are provided using cellular mobile networks operated by Vodafone, Telecom and 2degrees. Data provided by the Commerce Commission Annual Monitoring Report shows that mobile connections continue to increase, although at a slower pace than in previous years. The report also notes a dramatic increase in data use, which has almost doubled in the last year.

MOBILE METRICS	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Mobile connections (millions)	3.8	4.25	4.58	4.7	4.7	4.8	4.9
Active mobile connections per 100 pop	92	102	108	109	108	110	111
Share mobile pre-paid (%)	68.2	67.8	67.6	66.1	67.2	65.7	64.9

Data reproduced from Commerce Commission Annual Telecommunications Monitoring Report 2012.

From 2009/10 mobile connections refers to those active in previous 90 days. Prior to this, measure was of connections active in previous six months.

In addition, the Ultra Fast Broadband (UFB) and Rural Broadband (RBI) initiatives will roll out a fibre network to 98% of the population by 2020, and the Ministry of Business, Innovation and Employment (MBIE) is currently auctioning the 700MHz spectrum band. The 700MHz spectrum management rights will be used in conjunction with other spectrum rights to provide 4G services, especially to rural New Zealand, and coverage requirements are included as part of the auction. 4G services are already being rolled out in urban areas using 1800MHz.

Is it where it needs to be?

Coverage in New Zealand for both fixed line and mobile services is good in urban regions, and across most of New Zealand, although some remote rural areas do not have good mobile coverage.

The Telecommunications Services Obligation (TSO) ensures voice calls and dial up internet and fax services are available to almost all of New Zealand, and as mentioned above, UFB and RBI will ensure fibre is rolled out across New Zealand (to 98% of the population). Coverage maps can be found on the Chorus website for UFB and RBI coverage.

The TSO is currently being reviewed by MBIE, and the 2013 database of electoral street addresses shows 1.67 million unique addresses, compared to 1.37 million geographical locations covered by the TSO. However, despite this indication that some households fall outside the TSO, the market appears to offer services to the majority of these areas, and there is no indication of a significant coverage issue in fixed line services.

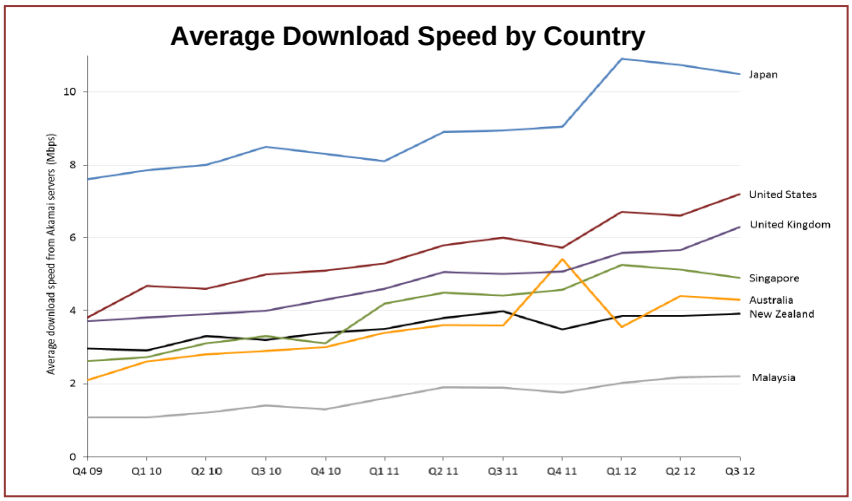
In the mobile market, high consumer expectations drive availability and the 700MHz auction has coverage requirements as a condition of successful bids. However, mobile coverage is not consistently available across all rural regions, and the coverage maps provided by Vodafone, Telecom and 2degrees (which can be found on their websites) illustrate some areas of limited coverage. Satellite based services are available to the most remote regions. NIU has not been made aware of any significant issues resulting from this.

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

What quality is it?

Quality does not appear to be an issue in the telecommunications industry in general, although publicly available data to support this is limited at best.

NIU has not been made aware of any issues relating to the quality of fixed line or mobile calling; however, data suggests internet speeds are slow in comparison to other countries, and the Commerce Commissions Annual Telecommunications Monitoring Report 2012 shows no improvement against the previous year.



Data reproduced from Commerce Commission Annual Telecommunications Monitoring Report 2012.

The TSO deed requires Telecom to provide line connect speed for standard Internet calls of 14.4 kbps for 95% of existing residential lines and 9.6 kbps for 99% of existing residential lines; however, these speeds are now very out of date and most services are significantly faster than this. Most companies provide details of their average speeds online, and truenet.co.nz publishes monthly data. This data shows ADSL and VDSL performing at close to 100% of advertised speeds, although there is a drop at peak time (8pm). Cable speeds are not currently operating at advertised rates, but are close.

The OECD's Communications Outlook 2013 shows New Zealand's average advertised download speed to be below that of the OECD average, although the median advertised speed is slightly above the average. The Outlook also shows actual speeds are lower than many other OECD countries. This data can be found on the OECD website here.

The introduction of UFB and RBI will significantly improve the speed available to New Zealanders, with RBI requiring download speeds of 5Mbps and UFB requiring 30Mbps.

What capacity is it at?

There is no publicly available data to measure capacity on either mobile or fixed line services, nor on the international cables; however, the sector does not consider capacity a problem.

Capacity is relatively easy to upgrade if the backhaul is already in place, however it can take a long time to provide this due to planning legislation. This is a concern in areas of increasing growth and the sector has indicated that there is potential for more innovative solutions, for example to tower sharing and location for mobile services, if flexibility in planning can be achieved.

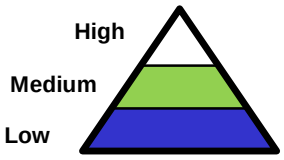
In international connectivity capacity does not appear to be a problem, despite some anecdotal complaints of speeds at peak time from business users. Southern Cross has just updated its network to provide total lit capacity across the two cables of 2.6Tbps, and the issue is more likely to be one of price for capacity, or domestic speed. The drop in speed at peak times also suggests a capacity limit at domestic level.

However, we note investment continues in fixed network capacity, which will address these issues. UFB, VDSL and cable are being deployed across the country, and service providers are also investing in core networks and in 4G LTE networks which are optimised for mobile broadband services.

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

How resilient is it?

Key: Levels of Resilience



Required levels of resilience will vary depending on perspective. This assessment is made at a national level and is yet to be developed with robust supporting evidence. It does however assist in prioritising efforts.

In the table to the right resilience expectations from a national perspective are identified as low medium or high. When making these judgements a wide range of aspects require consideration. To demonstrate; under "International", "Cables" have a very high economic value associated with them and generally carry time critical data. A high level of "Resilience expectation" is therefore attributed to them. An "Assessed Resilience" of medium reflects the significant vulnerability related to limited alternate options and the geographic proximity of landing points in New Zealand. In contrast "Landline – voice" is being superseded by new technologies and a medium "Resilience Expectation" reflects its transitionary state, its relatively low economic value and availability of alternatives. "Landline – voice" is also a good example of level of resilience being dependent on your perspective; if your residence has this means of communication you could expect a high level of resilience and in many cases this probably exists.

Telecommunications	Resilience Expectations	Assessed Resilience	Desired Movement
International			
Cables			↑
Satellite			↑
Backhaul (Main Trunk lines)			
National			↑
Regional			↑
Local exchanges			↑
Access (to local exchanges)			
Landline – voice			–
Landline – data (incl Broadband)			–
Mobile			–
Radio Telephony			–
111			↑
6 Telecon Core Exchanges			↑
2 Telecom ICAP Exchanges			↑
2 Telecom ICAP Exchanges			↑
Television			
Regional			–
National			–
Radio			
2 Telecom ICAP Exchanges			–
2 Telecom ICAP Exchanges			–
Retail			
Customer Interface			↑

The sector has indicated in discussions that it considers resiliency to be suitable for New Zealand, with diverse technology in the backhaul providing a good basis. Empirical evidence from the recent Christchurch earthquakes also appears to support this view, with mobile services operating within 24 hours of the earthquake.

International connectivity is also fairly resilient, with the structure of the Southern Cross cable, and the second cable to Australia able to carry crucial data levels if required. While additional international cables will increase resilience, the quantum is hard to define.

The sector has raised a query regarding the resilience of 111 calls, which have a single point of failure as all calls must go through the PSTN, although only about 20% originate on it.

What are we investing?

Although the telecommunications sector is privately owned, there are currently large levels of investment from both public and private parties.

Investment levels by private entities are not known, however it is clearly spread across all parts of the sector: Southern Cross has just finished an upgrade to the international cable that connects New Zealand to the USA, and a second cable connecting New Zealand to Australia is being considered by the market; mobile operators are currently taking part in an auction for 4G spectrum; and ultra-fast broadband is currently being rolled out across the country in a partnership between the public and private sector.

Public sector investment is also very high, with $1.35bn being invested in Ultra-Fast Broadband and a further $300m in Rural Broadband Initiative. There is also ongoing investment in Network for Learning, Deaf Relay Service and 111 emergency services.

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

How productive is it?

At present NIU has not collected any data to assess the productivity of this sector.

How well are we managing it?

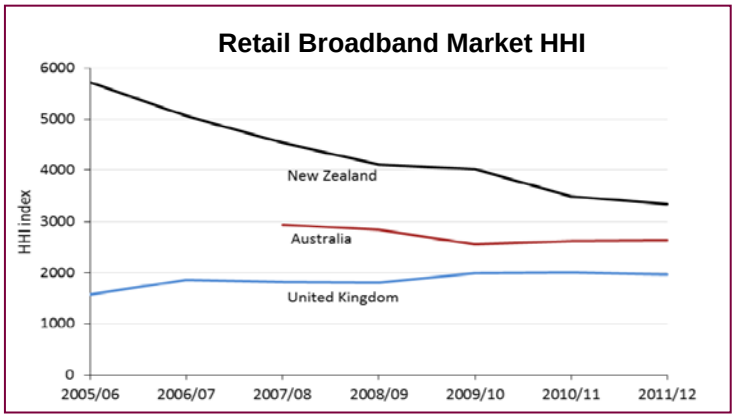
Telecommunications infrastructure is provided primarily by the private sector, regulated by the Commerce Commission, various Government initiatives (such as the Local Service and Deaf Relay TSOs, RBI and UFB initiatives), and general consumer and competition law.

The copper network is owned and operated by Chorus and, as per the Act and specific undertakings, provided to retail service providers on an open access basis. RBI funded services are also subject to open access obligations. Wholesale UFB fibre services are provided by Local Fibre Companies in accordance with arrangements entered in to with the Crown (through the Crown agent Crown Fibre Holdings). Mobile services are provided by the market.

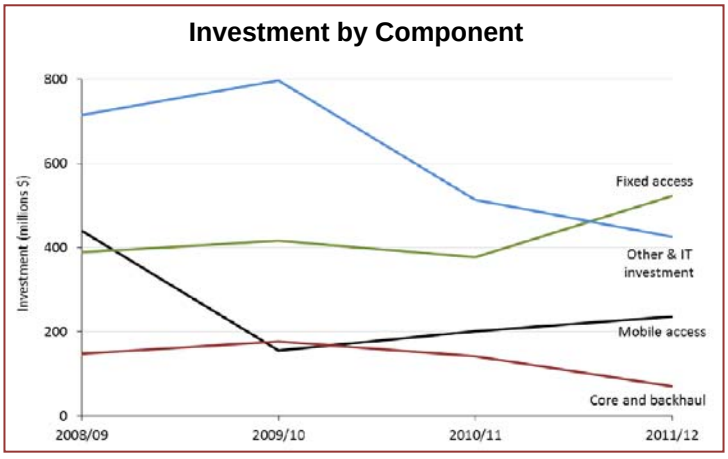
The Commerce Commission monitors telecommunications markets and regulates specific wholesale and interconnection services, while the Ministry of Business, Innovation and Employment has policy responsibility for the sector. Information on the market can be found on the Commerce Commission's website.

Competition appears healthy in both the mobile and fixed lines services. The Commerce Commission has calculated HHI in their Annual Monitoring Report for fixed line, mobile and broadband services. They have also calculated HHI using retail revenues for the 2011/12 financial year of 4353 for fixed line retail revenues and 4214 for mobile retail revenues. Additional information can be found on their website.

However, there is limited competition in the international connectivity area, which may be resulting in higher prices. NIU has not assessed this at this time, and there are mixed opinions: Southern Cross, which provides international connectivity to the USA, benchmarks NZ prices against Australian prices, where there is competition in the market; however, anecdotal evidence suggests prices are still higher for the NZ market than for some comparisons.



Data reproduced from Commerce Commission Annual Monitoring Report 2012



Data reproduced from Commerce Commission Annual Telecommunications Report 2012

The market appears to be operating effectively in this sector, and there is no indication of management problems. Performance levels appear sufficient, with continuing investment. However, inconsistency in planning legislation across the country can lead to inefficiencies for those providing infrastructure.

There is also significant regulatory uncertainty in the sector with several reviews underway, including reviews of the Telecommunications Services Obligation and the Telecommunications Act. Given the pace of technical change in this sector, regulation that is technology neutral should be considered to encourage the efficient delivery of services and investment into new solutions.

The industry also noted the risk of the current approach of geographical averaging, which could lead to all services levels being delivered at the level of the lowest common denominator.

There is no available data on future forecasts, and the sector notes how difficult it is to make predictions due to the speed at which new technology and other innovations emerge in the international marketplace. At present, increasing demand appears to be a constant, driven by the availability of content, and the sector has plans in place to manage this. However, the importance of the telecommunications network both as a direct provider of services, and as an integral part of wider infrastructure provision, makes it crucial that services are provided to quality and capacity.

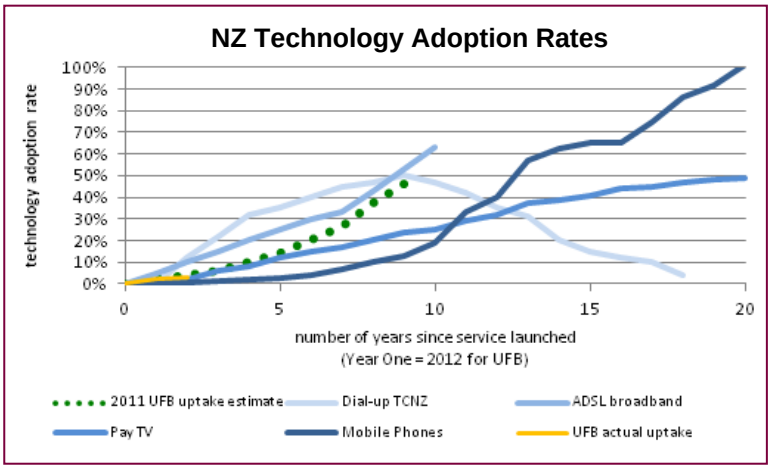
What future trends and scenarios may impact telecommunications infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand).[1] The results of this investigation have been published in a separate document available on the NIU website, but relevant extracts for the Telecommunications sector are reproduced below.

Implications for telecommunications infrastructure in the central scenario

The key driver of telecommunications infrastructure is data demand. Rather than being linked directly to supply-side technology or network change, data demand is most immediately driven by customers adopting and using new services and applications – such as for e-commerce, online entertainment, and digital methods of providing education or health services.

In the central scenario, the UFB network (in tandem with the RBI) will be progressively developed by 2020, with nearly 98% of our population having access to faster broadband by this time. To provide some context for the UFB initiative, a recent graph produced by MBIE (right) shows adoption rates in New Zealand for various technologies.



Source: MBIE

Along with the UFB initiative, the recent 700 MHz 4G spectrum auction in New Zealand is a key step in the roll-out of fourth generation networks by telecommunications providers. The auction conditions were designed to make 4G coverage available to 90% of our population within 5 years. While it is difficult to project the demand in New Zealand, Cisco estimates that global mobile data traffic will increase 13-fold between 2012 and 2017 (Cisco, 2013). The same report projects that 4G connections will comprise 10% of total mobile connections and account for 45% of total traffic.

Demand in the telecommunications sector is expected to have both an urban and rural strand. The increasing urbanisation of our population will drive the need for new or upgraded towers in Auckland (for example) to cater for mobile voice and data demand. At the same time, demand for broadband in rural areas is expected to strengthen as 3G and 4G / LTE wireless options become available.

As the UFB network is developed and as mobile data traffic increases, the central scenario assumes that the burden placed on the copper network will reduce. The central scenario assumes that technology, in general, will enable future infrastructure demand. In that context, demand for telecommunications infrastructure occurs primarily through the adoption by consumers of content and applications supported by the UFB network and 4G mobile networks.

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[1] Each scenario has an associated set of projections of future infrastructure demand. The NIU has not produced any new models or forecasts in this regard. Rather, we rely upon existing sector data and forecasts where applicable and relevant.

Implications for telecommunications infrastructure in the upside scenario

In the upside scenario, we assume that the UFB network (in tandem with the RBI) will continue to be progressively developed by 2020, but with adoption rates lower than expected. In general, the upside scenario assumes low demand for new technology, which is reflected in relatively higher demand for other assets (which have not leveraged productivity-enhancing technology improvements). However, this scenario does note the increased demand for services such as mobile which are aligned to population growth and migration, and expects increased demand in urban centres in particular.

With limited data and modelling publicly available, it is difficult to forecast the specific local, regional or national implications for our copper, mobile, fibre and other telecommunications assets in the upside scenario.

Implications for telecommunications infrastructure in the downside scenario

In the downside scenario, we assume that the UFB network (in tandem with the RBI) will continue to be progressively developed by 2020, but with adoption rates much higher than expected. In general, the downside scenario assumes high demand for new technology, which is reflected in relatively lower demand on other assets (where productivity-enhancing technologies have been leveraged). Although it also notes lower demand for services such as mobile, which are aligned to population growth and mobility.

As in the upside scenario, limited data and modelling is publicly available. Therefore, it is again difficult to forecast the specific local, regional or national implications for our copper, mobile, fibre and other telecommunications assets in the downside scenario. However, we assume that the aggregate demand will be relatively high for fibre and mobile in line with global trends.

It should also be noted that what we currently consider to be ‘ultra fast’ broadband will one day be ordinary by international standards. Although the timing of such a scenario is uncertain, the end result would be a need to upgrade our fibre networks to achieve faster speeds (or to invest in other technologies, whatever they may be).

EVIDENCE BASE: TELECOMMUNICATIONS SECTOR

Sources

Cisco. (2013). Cisco visual networking index: Global mobile data traffic forecast update 2012-2017.

Commerce Commission. (2012). Annual telecommunications monitoring report.

Ministry of Business, Innovation and Employment. (2013). Discussion document: Review of the telecommunications service obligations (TSO) for local residential telephone service.

OECD. (2013). Communications outlook.

INFRASTRUCTURE EVIDENCE BASE

Energy Sector

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

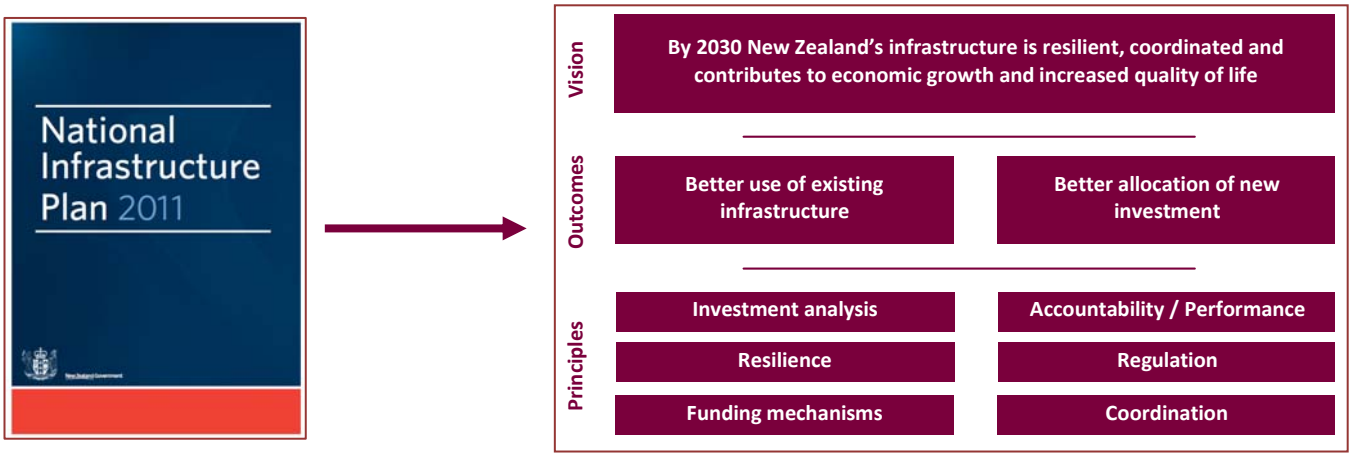
EVIDENCE BASE

Energy Sector

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for the energy sector, defined by NIU as the generation, transmission, distribution and availability for use of electricity, gas, and oil. It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend analysis, and resilience assessment.

Where data has been provided, this is publically available information, and has been provided with permission of the information owner.

EVIDENCE BASE: ENERGY SECTOR

Overview messages

The overall condition of energy networks is seen as good; quality is generally above targets, with sufficient service availability and adequate management. However there are challenges for each of the energy systems; electricity, gas and oil.

In electricity, the generation mix is changing with the increase in geothermal and wind capacity, while the role of thermal (coal and gas) is transitioning from base-load and mid-merit to peaking generation. Appropriate plant and fuel supply contracts will be key to meeting the flexibility requirements of the electricity market in future. In addition, ensuring contractual commitments are made regarding thermal fuel supplies beyond 2014 is important, and is an area of risk currently.

Recent investments in the national grid (Transpower) now provide significant capacity margins in most areas but needs to remain cognisant of shifting electricity supply and demand through the country. Supply reliability of electricity distributors continues to show a trend of improvement (2008–13) but varies widely between distributors, with some having a significantly larger number of interruptions and a significantly longer duration of interruptions.

In addition, the outlook for electricity distribution businesses is challenging due to a variety of reasons. These include a dynamic and changing market, with increasing level of investment uncertainty going forwards; ageing assets; consumers' increasing supply quality expectations; and emerging technologies such as household scale photovoltaic generation, which may reduce demand projections. Adapting to technology changes and shifting focus to customer control and managing demand will be crucial to responding to these challenges.

In oil, although there is little infrastructure redundancy built into the system, with 70% of the fuel consumed in New Zealand each year processed by a single refinery, NZ has options for responding to domestic supply emergencies affecting supply pinch points. Storage capacity in the South Island is reported to be reaching capacity, and further investment may be required to avoid supply-side risk if demand grows or older infrastructure is not maintained. Due to the quality of NZ's crude oil production it is largely exported with very little processed onshore. Standards across the oil system are in accordance with international best practice.

In gas, transmission capacity, including into Auckland, is generally considered to be sufficient for short-to-medium term supply/demand scenarios. The next step-change in investment is likely to be associated with a significant new gas find. At times LPG (a product of gas production) has been intermittently exported in relatively small quantities but otherwise all gas is consumed onshore. Production is from numerous fields with distribution by grid network in the North Island and various LPG networks in the South Island.

In addition, there are opportunities relating to energy efficiency and demand side management to improve utilisation of energy infrastructure.

Context

The energy sector comprises large scale network assets including 12,000km of high voltage transmission lines, 2,500km of high pressure gas transmission pipelines and 16,800km of regional gas distribution systems. NZ's only oil refinery produces around 70% of the fuel consumed in NZ each year, and a single pipeline carries over 30% of national fuel demand from the refinery to Auckland.

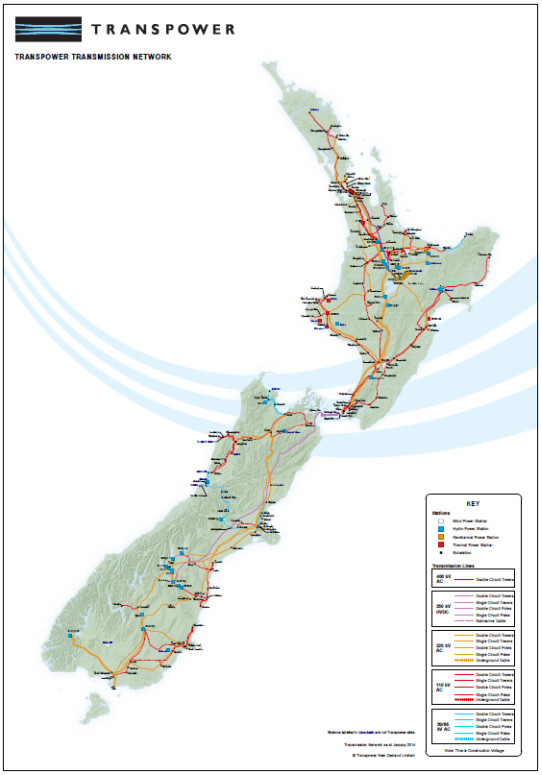
For both electricity and gas, NZ is self sufficient in terms of production and supply, whereas for oil it is almost completely dependent on imports. Electricity generated is substantially from renewable sources and for the balance is dependent on gas and coal supplies which tend to be subject to on-going supply uncertainty.

The majority of energy companies are privately owned and operated, and the electricity and gas distribution sectors are subject to Commerce Commission price-quality regulation.

There are multiple interdependencies with other sectors, such as transport, and a growing reliance on telecommunications and data flows.

EVIDENCE BASE: ENERGY SECTOR

What do we have?



Electricity

There are over 200 power stations connected to the national grid, and around 70 to 75% of New Zealand's electricity is generated from renewable sources including hydro (≈55%), geothermal (≈15%) and wind (≈5%). There is a considerable range of asset types, locations, sizes and ages with this diversity being of considerable value.

Electricity supply is dependent on thermal generation units fuelled predominantly by gas, but also coal and diesel. Ensuring contractual commitments are made regarding thermal fuel supplies beyond 2014 is important, and is an area of risk currently.

Electricity is distributed throughout New Zealand via a national transmission grid comprising approximately 12,000km of high voltage lines owned and operated by Transpower, a state-owned enterprise. This capacity has been significantly upgraded over recent years.

There are 29 local electricity distribution businesses (EDB's) under a range of ownership models. All regions in New Zealand are covered and EDB's often have major customers within their networks. There is some embedded generation at the network level and an increasing number of generators at the customer level.

Gas

Natural gas is extracted from 18 fields in the Taranaki area, and existing infrastructure is focused on delivering gas from there to North Island markets. At around 10-12 years, the countries reserves-to-production ratio compares well internationally. However, significant on-going investment is required to replenish reserves. Substantial upstream investment is occurring with nearly 100 oil/gas wells being scheduled over the coming 12 months.

Gas is the source of fuel for approximately 20% of NZ's electricity supply. It is otherwise transmitted and distributed for direct use through the North Island with the most significant customer being Methanex in Taranaki, where natural gas is converted to methanol largely for export.

Gas is reticulated to 260,000 customers (residential and business). While gas is a discretionary fuel for households, large gas users are highly reliant on distributed natural gas primarily for process heat purposes. Residential use is generally for space heating, water heating and cooking. Most gas transmission and distribution pipes are buried and were installed prior to 1986, with 60 to 80 year operating lives.

Gas Distributors – Physical Characteristics

DISTRIBUTOR	NETWORK LENGTH (KM)	REGION	CONNECTIONS	PROPORTION OF CONNECTIONS (%)	DENSITY (CUSTOMERS/KM)
Vector	10,326	Northland, Greater Auckland, Waikato, Bay of Plenty (including Rotorua, Taupo), Gisborne, Kapiti	153,585	57.6	14.9
Powerco	6,116	Greater Wellington, Hawke's Bay, Manawatu, Horewhenua, Taranaki	102,696	38.5	16.5
Gasnet	388	Wanganui, Rangitikei	10,338	3.9	26.6
Nova [1]	100	Wellington, Porirua, Hutt Valley, Hastings, Hawera, Papakura, Manukau City	Not known	Not known	Not known
Total	16,930 [2]		266,619	100	15.7

Source: Gas Industry Information Disclosures

[1] Nova Gas is not subject to the Gas (Information Disclosure) Regulations 1997, and does not otherwise publish information about its Distribution Networks. The Commerce Commission Gas Control Enquiry, Final Report, November 2004, records the length of Nova's Distribution Network as 100km as at June 2003.

[2] Total of open access networks only. Excludes Nova.

In addition to reticulated natural gas, Liquefied Petroleum gas (LPG) is distributed as bottled gas or to local distribution networks such as in Christchurch. LPG is now priced at international rates as New Zealand is now exporting material volumes of LPG. The LPG Association represents all major LPG producers/retailers in New Zealand.

Oil

Oil is extracted from 18 fields onshore and offshore Taranaki, and almost all is exported due to its relatively high quality. Apart from international security of supply arrangements, the oil sector is entirely owned and operated by the private sector.

Imported crude oil is processed at the Marsden Point Oil Refinery which produces around 70% of the 8.5 billion litres of fuel consumed by NZ each year. A single pipeline carries around 35% of total product fuel volumes from the refinery to Auckland, and the remainder is transported by two ships to a network of ten coastal terminals.

The largest storage facility is in South Auckland, and approximately 35% of NZ's liquid fuel consumption passes through it each year.

At service stations, old single skin steel tanks have been replaced since the 1980's with modern, longer life tanks, including wrapped steel, single skin fibreglass and most recently double skinned fibreglass tanks. Some sites still need to upgrade tankage over the next 5 years and these will occur where economically viable.

Is it where it needs to be?

Electricity

Electricity generation has a diversity of assets and system control functions, ensuring very high service availability. In electricity distribution, an obligation to supply rural communities ensures almost 100% availability across NZ. In a few instances it is proving cost effective in rural supply to provide stand-alone systems. Elsewhere there are an increasing number of customers installing generation such as stand-by diesel generators, wind turbines and photovoltaic panels (PV) leading to distribution companies in particular to improve management of their systems.

EVIDENCE BASE: ENERGY SECTOR

Gas

There is good coverage of the North Island for gas distribution. In the South Island there are a number of discrete LPG networks and otherwise bottled gas is available throughout the country. Major industrial consumers such as Fonterra and New Zealand Steel are generally well served, providing a baseload of demand. Storage capacity within the pipelines ("line pack") meets intra-day fluctuations in demand. The GIC is actively working through concerns with gas pipeline capacity, particularly north of Huntly into the Waikato, Auckland and Northland area.

Oil

There are currently no known issues with oil availability, although there are some concerns with storage capacity at certain regional locations and reduction of service in remote areas and on tourist routes.

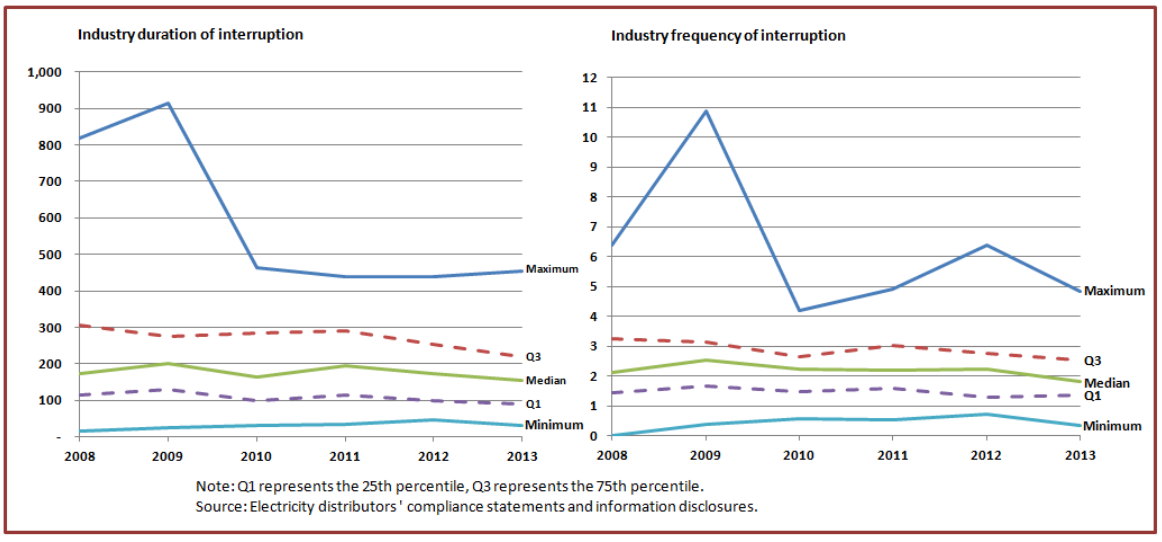
What quality is it?

The overall quality and service availability appear good in this sector.

Electricity

In electricity, forced outages for the generation, transmission and distribution are mostly below target maximums and availability is above targets; however, there are known vulnerabilities to hazards, such as wind and storm events as well as earthquakes. In generation, some assets are over 100 years old, and there is an on-going need to upgrade components to meet international standards and ensure operational capability. However, overall asset condition is assessed as good.

Distribution Assets have a broad age range, and condition is generally good. The average reliability of the distribution industry overall has improved, as reported by the Commerce Commission (Electricity distributors' performance from 2008 to 2013), but it varies widely between distributors. Some distributors had a significantly larger number of outages, and a significantly longer duration of outages than others. Each EDB is dealing with significant regional variations in topography, population density and resilience of the communities they are delivering to.



Note: Q1 represents the 25th percentile, Q3 represents the 75th percentile.
Source: Electricity distributors ' compliance statements and information disclosures.

Delivered power quality is becoming an increasing issue with reducing tolerance of appliances and customers able to monitor power quality. Generally, distribution networks rely on 1970/80's technology, which will struggle to transition to much more active networks with distributed generation, smart meters, electric vehicles and other changes. Generally voltage is the issue rather than frequency.

In transmission, Transpower's Asset Management Plans and Strategies were the subject of independent review in 2010 resulting in a range of recommendations, primarily related to achieving compliance with PAS55 standards. Transpower is in the process of addressing these.

Under Part 4 of the Commerce Act 1986, the Commerce Commission sets information disclosure requirements for the 29 electricity distribution businesses (EDB's) and Transpower, as well as price-quality paths for 17 of the EDB's and Transpower. Disclosures include condition, quality, capacity and asset management plan information, and can be found on the Commerce Commissions website.

Gas

The "New Zealand Gas Story" issued by the GIC in February 2013 (available on their website) notes: "overall processing facilities' operational reliability record is strong".

In gas transmission, assets are generally well maintained, reaching international standards under health and safety regulations. These regulations include requirements for management plans to address pipeline risks, including those created by challenging geologies along North Island transmission routes. Transmission from Taranaki is dominantly via the Maui pipeline and otherwise via Vector's pipeline network. The Maui Gas Outage of 2011 has highlighted vulnerabilities for a pipeline that has had high levels of reliability for over 30 years.

Applying to the total gas sector there are a large number of acts, regulations, standards, codes of practice and guidelines governing the quality of gas sector installations as well as the quality of the natural gas being distributed and used. Health and safety is an important element of these. Foremost among these is the Gas Act 1992 and the amendments of 2004 together with the Gas Regulations 1993. The sector therefore meets relatively stringent delivered gas quality requirements and networks are designed and operated to high standards.

Commerce Commission information disclosure requirements, which are similar to those for EDB's, provide information on gas pipeline reliability.

Oil

The oil sector must meet stringent and comprehensive fuel quality standards in particular to meet international standards as required by vehicle and aircraft manufacturers. In order to achieve this, the sector has a range of operational, monitoring, testing and reporting procedures in place. Under the Consumer Guarantees Act, goods that are normally bought for personal use must be of an acceptable quality, "fit for purpose", free of minor defects and safe. These guarantees apply to fuel. Under the Fair Trading Act, companies can't misrepresent the qualities of a product they sell, so all fuel must be correctly labelled such as "Unleaded 91".

Regulations governing important properties of petrol and diesel, for protecting consumers and the environment, are the Engine Fuel Specifications Regulations 2008 (Regulations). These regulations describe the most important performance properties of fuel, such as the octane number, and they specify limits for components that could harm you, your vehicle or the environment. These components include aromatics, lead and sulphur.

Under the national fuel quality monitoring scheme, Trading Standards (part of the Ministry of Business, Innovation and Employment), organises testing of petrol and diesel samples to ensure oil companies are complying with the regulations. Testing under the scheme concentrates on the fuel's most critical properties, such as octane number, benzene level, contaminants, aromatics, water in diesel, and sulphur content. Motorists fund the fuel quality monitoring scheme through the petroleum fuels monitoring levy (PFML).

The delivered quality of oil is therefore very high and the oil delivery system including operation and maintenance must be to high standards particularly for health and safety reasons.

What Capacity is it at?

Considering energy in general, the small size of the New Zealand market leads to relatively dynamic supply and demand balances with susceptibility to step-changes in demand. The contribution one company can make is material. As the service sector contribution to GDP increases, the correlation of energy demand growth to GDP growth appears to be declining.

Electricity

A significant portion of NZ's thermal electricity generation fleet currently only has committed fuel supply to the end of 2014. Assuming extended thermal fuel supply contracts are secured, electricity generation appears to have appropriate headroom capacity available, with a range of options to meet changing demand over time and "N-1 contingency" to accommodate short term unplanned plant outages (N-1 refers to the system at all times being able to manage should the biggest single risk occur).

However, the generation mix may not be appropriate in the future, particularly with large thermal generation units needing long start up times and increasingly being called upon for ramp up, ramp down operation with deleterious effects on asset lifetimes. Thermal generation plays a key role by providing support at times of low hydro inflows, low wind generation and supporting seasonal demand profiles (e.g. high demand in the winter when hydro inflows are low). This role is also contingent on securing flexibility in gas supply contracts to accommodate such variations in demand, an issue which is partially addressed by the Ahuroa gas storage facility, but is implicitly at odds with gas producers' desires for constant production.

Electricity transmission and distribution capacity is under active management, with a need to be prepared for additions to urban areas, either due to densification or urban spread. In addition to Commerce Commission requirements on EDB's, the Electricity Authority is an independent Crown entity responsible for the efficient operation of the electricity market with oversight of the system from generation through to customer service. Transpower publishes an Annual Planning Report which details the status of all projects that Transpower considers possible over the next 15 years. The latest is 2013, and the report ensures a transparent and comprehensive understanding including generation assumptions and distribution network assumptions, and more particularly provides assurance at a national and regional level of sufficient capacity.

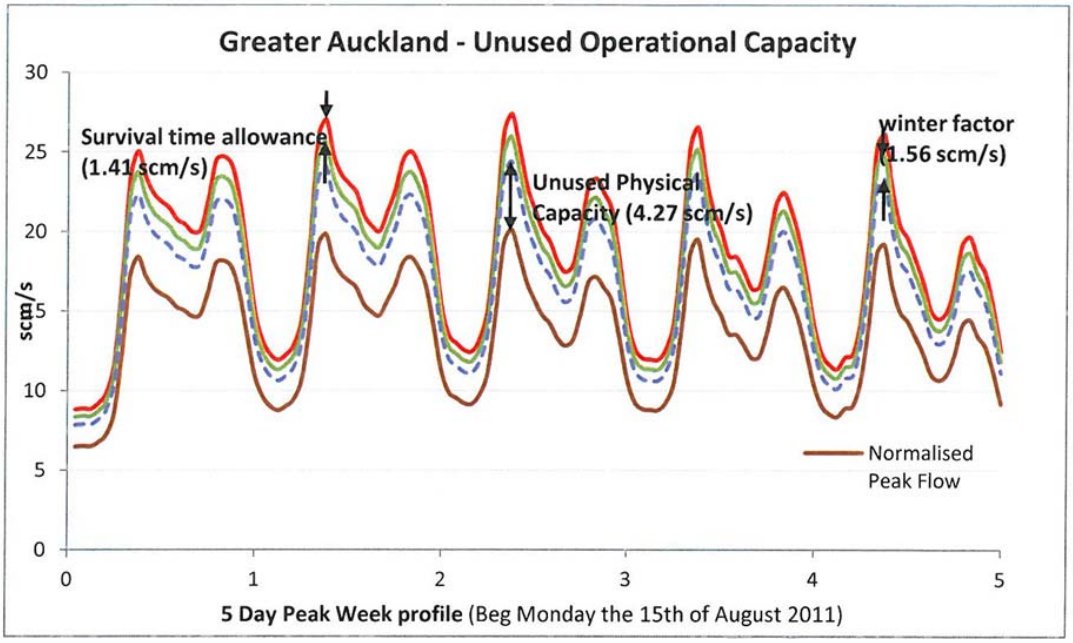
An issue that needs to be considered is the gap between peak and trough demand. An increasing gap may lead to increasing price differentials on a daily basis, and the sector will need to consider opportunities to better manage peaks in order to delay capacity investment and gain better use of existing assets. The recent upgrade of the High Voltage Direct Current transmission line from Benmore in the South Island to Haywards in the North Island has acted to mitigate this effect, with improved ability to manage daily demand movements.

Capacity can in part be addressed by demand-side management. Transpower is currently assuming this role by default at the national level and various EDB and others initiatives are contributing at the regional and local level. A demand-side market is emerging but a number of technical, market and contractual barriers exist.

Gas

There is some confidence in on-going gas supply, with the presence of Methanex in the market being a good indicator of the overall situation (currently operating its three production trains). The number of gas fields operating means gas supply capacity is now more certain than it was 10 years ago, but the nature of the market means escalating levels of uncertainty beyond the next three to five year window.

Gas transmission pipelines have confirmed capacity to handle peak demand for at least another year, the primary pressure point being the Vector pipeline to Auckland. The Gas Industry Company (GIC) is active in advancing this matter. Vector have published a revised methodology for determining the capacity available for reservation (commercially available firm capacity) and, with changing demand, a significant amount of capacity has been freed up. The graph below is on Vector's website and shows the unused "operational" capacity (i.e. that which could be contracted on a firm basis).



Source: Vector

Work is underway through the Gas Transmission Investment Programme to address long-term transmission capacity and pricing issues.

Gas demand other than for Methanex is generally flat or declining, in line with other developed countries, such as the UK, where gas demand is understood to have dropped 20%. Efforts are being applied to improve oil and gas reserves data to alleviate uncertainty in future supplies and encourage access to these supplies. Should substantial reserves of gas be accessed above current demand levels, there are a number of options available, including the possibilities of CNG (Compressed Natural Gas) for use in the transport fleet, LNG (Liquefied Natural Gas) for export, and additional Methanol production. It is difficult to assess how valuable increased reserves data will be in making infrastructure investment decisions as they are most often contingent on formal contractual arrangements.

Oil

Oil production and processing have no known capacity issues within New Zealand. Private sector incentives and investments are aligned to optimise capacity supply and access economically recoverable resources. However, with refiners closing in Australia, crude production is having to be shipped further afield, increasing pressure to enable larger export tankers to operate, which would require infrastructure upgrades at Port Taranaki.

For supply, almost all oil is imported either as crude or product and delivered through ports throughout New Zealand. Storage facilities exist at various points in the supply chain. Within New Zealand, the distribution comprises some aged assets which are being de-mobilised, and opportunities exist to improve efficiency and supply chains. Refining NZ is a publicly listed company covering all New Zealand's refining capacity and also distribution capacity via the Refinery to Auckland pipeline (RAP), and annual shareholder reporting provides a good measure of capacity and performance. The refinery will generally maximise production to its capacity, with the balance provided by international markets.

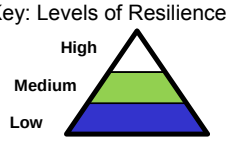
Petrol consumption continues to drop (42% to 41% of total demand in 2012) with diesel continuing to rise (42% to 44% of total demand in 2012). This follows trends in other developed countries and leads to caution with respect to possible over-investment and the likelihood that new investment will largely be along new roads and in high growth areas such as Auckland.

EVIDENCE BASE: ENERGY SECTOR

How resilient is it?

When considering the resilience of energy supplies, it is necessary to consider a range of attributes of resilience including: service delivery; adaptation; the community or users; responsibility; interdependencies; financial strength; continuity; and organisational performance. This encourages deliberations with users and greater transparency on the ability of energy systems to meet current and future needs in a comprehensive fashion, in order to achieve efficient and effective outcomes. Increased resilience is not necessarily achieved by greater investment and is often achieved by operational improvements.

Key: Levels of Resilience



Electricity

With New Zealand's largely renewable electricity generation system and relatively limited hydro storage capacity, mainly in South Island catchments, there is vulnerability to low rainfall periods and a necessity to ensure sufficient generation capacity at all times. When hydro storage is being conserved, electricity flow will tend to reverse and be from the North to the South Island, and the (HVDC) transmission line from Benmore in the South Island to Haywards in the North Island is therefore a vital link.

Electricity	Resilience Expectations	Assessed Resilience	Desired Movement
Generation			
Individual Generator <300MW			–
Individual Generator >300MW			–
River Chain >300MW			–
Transmission			
66kV			↑
110kV			↑
220kV & >			↑
HVDC			–
Distribution			
Embedded generation			–
Distribution <			–
Distribution 11kV			–
Distribution general			↑
Retail			
Retail functionality			–
Customer Interface			↑

Growth in electricity demand is predominantly around Auckland so over recent years transmission reinforcement from the south has been vital to ensure security of supply. Northland, being another net importer of electricity and having major industrial consumers such as the refinery, has been concerned for many years about supply risk. This is being partially alleviated by the same transmission upgrades.

As demonstrated by recent storm events in Wellington and Canterbury, in the eletricity market risks to the distribution system and resilience are key considerations to reduce consequential economic and social losses associated with outages. The vulnerability of the "last kilometre" in parts of the system, the economic consequences of outage, and the duration of outage probably need increased attention. Largely for commercial reasons at this stage, some distribution companies are starting to deploy Remote Area Power Supplies (RAPS).

Gas

In-built redundancy within critical supply chain elements and the industry's contingency management processes mean that unplanned interruptions of various durations, as occur from time to time, are usually rectified quickly and pass unnoticed by most other industry participants and consumers. Threats to the supply chain are well known, with the main hazards in respect of pipeline routing and facilities operation subject to statutory oversight/certification, regular monitoring, maintenance and/or mitigation works. MBIE is currently reviewing gas supply security and a consultant's report will be released for feedback in early 2014.

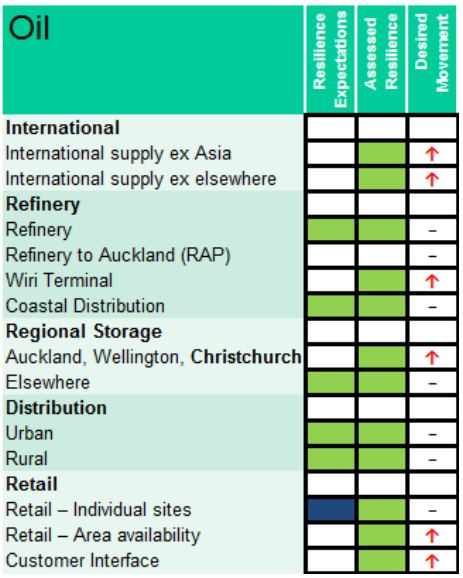
This gas supply security assessment contributes to improving understanding of levels of resilience across the energy sector as mapped out in the following assessment made at a national level. As further evidence is developed, this tabulation will be refined and will be used to assist in prioritising efforts.

Gas	Resilience Expectations	Assessed Resilience	Desired Movement
Sources			
Gas Fields < X TJ/day			–
Gas Fields > X TJ/day			–
Imported LPG			–
Transmission			
Maui			–
Vector – to Huntly			–
Vector – Huntly to Auckland			↑
Vector – National			–
Large Commercial			↑
Distribution			
Residential/small commercial			–
Large commercial			–
LPG Bottled			–
LPG Networked			–
Retail			
Retail functionality			–
Customer Interface			↑

EVIDENCE BASE: ENERGY SECTOR

Oil

New Zealand will remain highly vulnerable to international oil supply disruption and price. Through New Zealand's membership of the International Energy Agency (IEA), New Zealand is required to hold 90 days of stock effectively held through storage onshore and international arrangements where stock is held offshore. There are considerable Lifelines concerns about the inability of service stations to supply fuel during electricity outages and other emergency situations.



Oil	Resilience Expectations	Assessed Resilience	Desired Movement
International			
International supply ex Asia			↑
International supply ex elsewhere			↑
Refinery			
Refinery			–
Refinery to Auckland (RAP)			–
Wiri Terminal			↑
Coastal Distribution			–
Regional Storage			
Auckland, Wellington, **Christchurch**			↑
Elsewhere			–
Distribution			
Urban			–
Rural			–
Retail			
Retail – Individual sites			–
Retail – Area availability			↑
Customer Interface			↑

What are we investing?

The energy sector has significant on-going investment both to maintain existing facities and to invest in new.

In electricity there has been significant investment into the national grid which is now reducing as capacity margins are restored. Investment in new generation, largely in wind and geothermal, has declined recently with the flattening in demand increase. Retirement of aging thermal plant is a feature requiring active attention and some demobilisation costs. All electricity distribution businesses continue to invest in asset renewals.

Gas investments are largely driven by petroleum and gas exploration investments. Exploration activities have increased substantially over recent years and investments in new gas finds have supported Methanex refurbishment and electricity generation.

The oil refinery is making significant investments in improving efficiency and capacity. In oil distribution there is on going maintenance investment and some investment in new storage facilities.

A more complete assessment across the energy sector is yet to be made but current investment levels are considered reasonable and appropriate for the sector.

How productive is it?

The following is adapted from the document "Energy in New Zealand 2013" published by the Ministry of Business, Innovation and Employment. This document presents a range of energy sector performance indicators including energy intensity, emissions intensity, energy self-sufficiency and household energy affordability indicators. With respect to productivity energy intensity is the most significant measure.

Energy Intensity

Energy intensity is a measure of the energy used (in MJ) per unit of gross domestic product (GDP, in real 95/96 New Zealand dollars). It is influenced by both the composition of industry within the economy and improvements in energy efficiency. For a more detailed analysis of the drivers of energy use in New Zealand, readers are encouraged to read the report: *Changes in Energy Use – New Zealand, 1990–2012.*

EVIDENCE BASE: ENERGY SECTOR

Energy Intensity by Industry

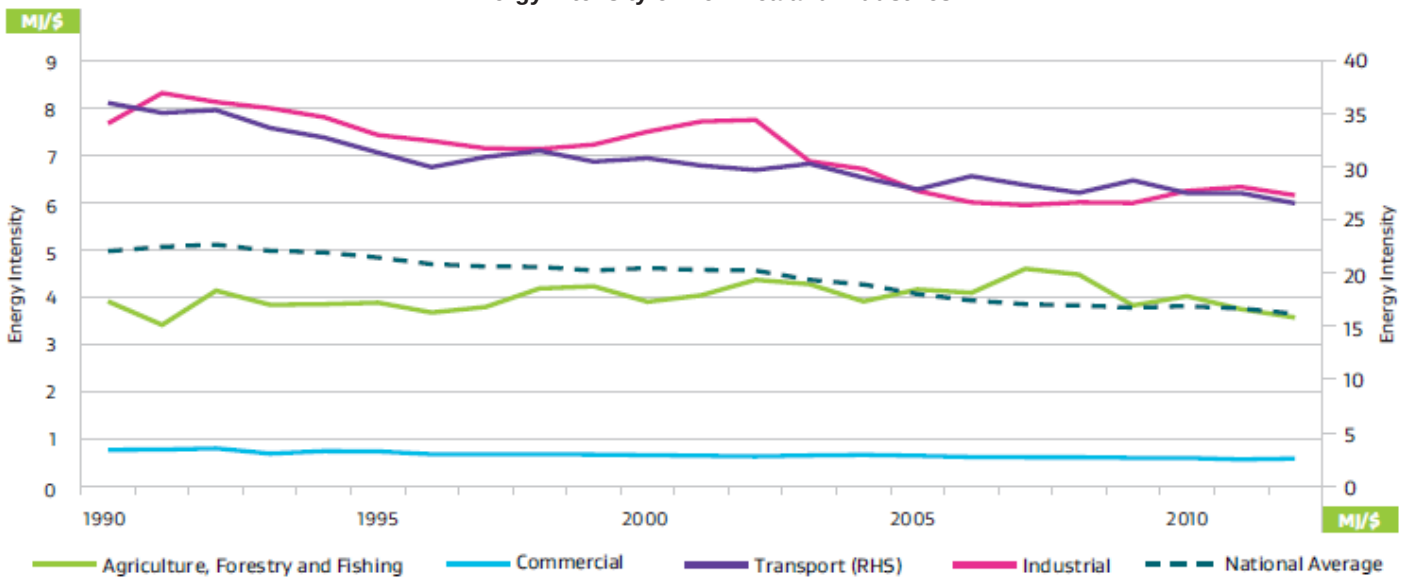
Since 1990, the overall energy intensity of the economy has improved in real terms by an average rate of 1.4% per annum to 3.6 MJ per (95/96) dollar in 2012. The most significant factor in this almost 27% improvement in energy intensity has been the rapid growth of the commercial sector (low energy intensity) relative to the industrial sector (high energy intensity).

The figure below shows a time series of the energy intensity of industries within the New Zealand economy. In this chart, the dashed lines refer to individual industries, whereas the solid blue line is the average energy intensity of New Zealand. The individual industries within the New Zealand economy all showed improvements in energy intensity since 1990. The agriculture, forestry and fishing sector's energy intensity has been relatively flat, but quite variable since 1990. The variability of the energy intensity is largely related to agricultural production volatility. The commercial sector is the least energy intensive sector at 0.6 MJ per dollar in 2012; this has improved steadily at a rate of 1.2% per annum since 1990. The energy intensity of the industrial sector (including chemical and metals manufacturing) has improved at an average rate of 1.0% per annum since 1990. It was relatively flat until 2002, when Methanex NZ's Waitara Valley methanol production facility was mothballed. Industrial energy intensity increased in 2011, but has since fallen again in 2012. Factors affecting industrial energy use in 2012 included:

- Methanex NZ restarting a second methanol production train at their Motunui plant in mid-2012 after signing a 10-year gas supply agreement with Todd Energy
- Production of aluminium at the Tiwai Point aluminium smelter was lower in 2012 than in 2011
- Production dropped in the wood, pulp and paper manufacturing sector.

Transport is New Zealand's most energy intensive sector, at 27 MJ per dollar in 2012. The energy intensity of transport has improved by 1.4% per annum since 1990.

Energy Intensity of New Zealand Industries



Source: Energy in New Zealand 2013 published by Ministry of Business, Innovation & Employment

How well are we managing it?

In general, there is a high level of information disclosure and oversight from MBIE, the Energy Efficiency and Conservation Authority (EECA), and Statistics New Zealand. Reporting obligations on many sector participants also contribute to high levels of transparency. MBIE has live energy information available on its website and regularly publishes the Energy in New Zealand (previously Energy Data File) and Energy Outlook: http://www.med.govt.nz/sectors-industries/energy/energy-modelling/publications/energy-in-new-zealand-2013

Electricity

Effective sector management is in place, but it is recognised that on-going monitoring of arrangements is necessary to ensure that it is relevant and appropriate. Competition appears healthy in both the generation and retail markets. Electricity transmission and distribution is a monopoly market.

Dominant in sector oversight are the Ministry of Business Innovation and Employment (MBIE) Infrastructure & Resource Markets; the Electricity Authority; the Commerce Commission for information disclosure and price-quality paths; and Transpower as system operator.

The Electricity Authority (Authority) is an independent Crown entity responsible for the efficient operation of the New Zealand electricity market. Although independent, the Authority is required to have regard to Government Policy Statements and must pursue the statutory objective set for it in the Electricity Industry Act 2010 (Act) to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers.

Gas

Again, competition appears relatively healthy in this market and governance arrangements with a co-regulatory body are proving effective. There will always be tensions in gas supply due to the discrete nature of gas fields, their varying characteristics, the relatively small New Zealand demand and the lumpy investment decisions on both the demand and supply side.

The Gas Industry Company (GIC) is the gas industry body, responsible for developing downstream industry governance arrangements that ensure gas (including natural gas and LPG) is delivered safely, efficiently and reliably to new and existing customers. The GIC is a special-purpose industry-owned company and co-regulator. It works closely with other regulatory bodies whose responsibilities also include the gas industry: Worksafe NZ for energy safety; MBIE for oversight of the co-regulatory model and consumer protection; and the Commerce Commission for information disclosure and price-quality paths. It is required to meet objectives in Part 4A of the Gas Act 1992 and Government Policy Statements. Its strategy is to optimise gas's contribution to New Zealand.

For gas, as for electricity, technical, health and safety regulations are the responsibility of MBIE. MBIE is currently undertaking a review of gas sector supply risks.

The Gas Association (GANZ) represents companies and organisations in the gas sector involved in the transportation and trading of gas. GANZ represents interests across the major pipelines, networks, GMS, and below the meter to equipment suppliers and installation. GANZ's prime focus is on the safety and technical aspects of the natural gas industry.

Oil

Appropriate sector management is in place but it is recognised that on-going monitoring of arrangements is necessary. MBIE has primary sector oversight at the government policy level and has recently led work on assessing oil security. This has resulted in Cabinet decisions on Measures to Improve Domestic Oil Security and also confirmation of International Energy Agency (IEA) obligations for international security purposes. MCDEM oversees communication and coordination arrangements and readiness activities for oil supply during civil emergencies. International standard health, safety and environmental obligations lead to high quality operations and management. Liquid fuel prices are substantially determined by international pricing and increasing price volatility is expected.

The oil refinery is a tolling facility with users able to direct source product from offshore markets or process crude through the refinery. It must therefore be price competitive. There is active competition in oil distribution and retailing with indications of rising distribution and retail margins. The total delivered price of liquid fuels is dominated by the international oil price component.

There are four major oil companies operating in the NZ market with healthy competition evident in the retail market, for example the availability of discounting through associations with supermarket chains and other loyalty programs. There are continuing concerns around the reduction in the numbers of service stations.

What future trends and scenarios may impact energy infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand).

Each scenario has an associated set of projections of future infrastructure demand. The NIU has not produced any new models or forecasts in this regard. Rather, we rely upon existing sector forecasts where applicable and relevant. In the energy sector, our analysis primarily relies upon extensive modelling and forecasting completed by MBIE and Transpower.

The full results of our scenario modelling investigation have been published in a separate document available on the NIU website, but relevant extracts for the Energy sector are reproduced below.

Implications for energy infrastructure in the central scenario

The implications for our energy infrastructure in the central scenario are drawn primarily from modelling completed by MBIE (Energy Outlook: Reference Scenarios 2011, Energy Outlook: Insights 2013) and by Transpower (Transmission Tomorrow and Transmission Tomorrow: Enduring Grid).

The key pressures in the central scenario are related to trends in peak load and base load (and the ratio between the two), spatial distribution of future demand and the mix of installed generation types.

Based on the assumptions for the central scenario, the modelling completed by MBIE and Transpower suggests the following implications for our energy infrastructure:

- Electricity demand will grow on average by 1.1% per annum through 2040
- Increased irrigation and the use of heat pumps will continue to boost summer energy demand. Irrigation, in particular, will increase the utilisation of the grid on the east coast of the South Island
- There is an ongoing need for the backbone grid from Roxburgh to Otahuhu and its capacity will need to increase over time
- Additional capacity for the regional connections to the backbone grid is less certain with more variation between scenarios. For the regional connections, newer technology options for better utilising the grid, such as extracting more capacity from the existing lines or the use of demand-side management, have added value
- There is likely to be significant investment required in geothermal plants (with their share of electricity generation projected to grow from 14% in 2012 to between 21% and 29% in 2040)
- Demand for wind power will increase modestly, although its relative cost in comparison to other electricity sources will continue to constrain its growth
- Geothermal and wind power can make only a minimal contribution to meeting peak demand. As such, future investment will be necessary to establish flexible peaking capacity, demand management initiatives and/or energy storage options
- Demand for gas is expected to remain relatively steady and will continue to come from price sensitive users such as petrochemical manufacturing facilities and power generators, as well as from other industrial, commercial and residential users. A sufficient level of exploration is expected to ensure supply is available to meet demand

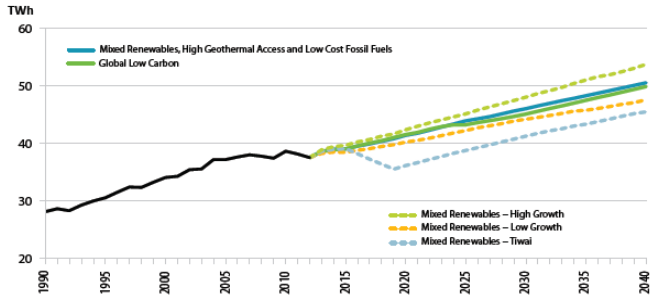
EVIDENCE BASE: ENERGY SECTOR

- Both the extraction and export of oil from Taranaki and the import of oil are expected to continue along current trends; and
- The central scenario incorporates high uncertainty (and relatively low impacts) from new technologies such as electric vehicles and household photovoltaic panels due to their cost differentials in comparison to other options

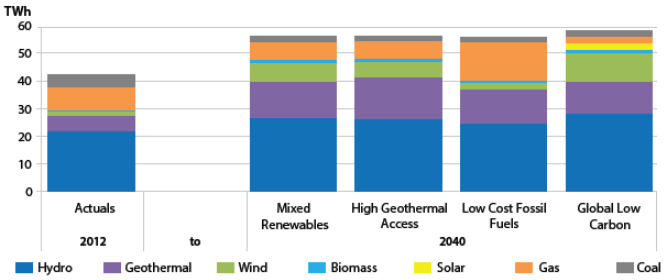
Further, Transpower's analysis found that the type, location, size and timing of generation development are the greatest sources of uncertainty. Generation development will occur in response to demand as well as the type of fuels that are available. With a substantial amount of energy generation resources potentially available in New Zealand, it is difficult to predict where and when this development might occur.

On balance, MBIE estimate that $14 billion in new generation investment will be needed by 2030. Estimates for electricity demand and generation are reproduced below:

Grid level electricity demand by scenario



Electricity generation by scenario



Source: Ministry of Business, Innovation & Employment (2013)

Heavy industry in New Zealand

With a relatively small population by global standards, demand on our infrastructure can be heavily influenced by industrial activities such as forestry, and steel and aluminium processing. In New Zealand, these industries are concentrated in a small number of locations and in a small number of firms that are exposed to global markets. Forestry is concentrated in the north of the North Island, steel processing south-east of Auckland and aluminium processing in Southland. Accordingly, fluctuation in demand has the potential to occur at point sources and in discontinuous steps rather than gradual trends.

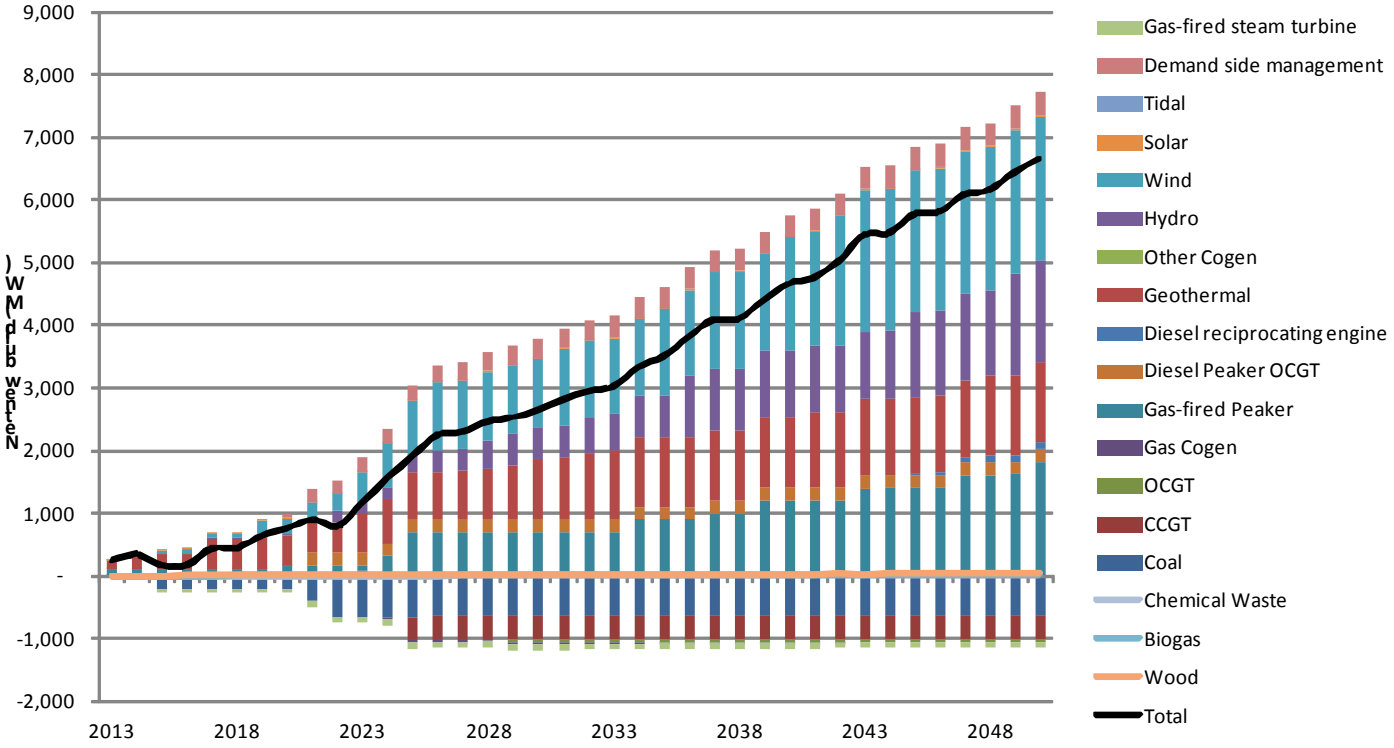
For example, since 2004, the wood processing industry's energy demand has declined rapidly by over 30% from its peak (MBIE, 2013). More recently, the future of aluminium production in New Zealand has been called into question. With about 15% of the country's electricity supply used by the Tiwai Point aluminium smelter, the potential impact on infrastructure is considerable.

Overall, we assume a gradual decline of heavy industry in New Zealand in the central scenario. The upside scenario assumes a return to peak demand, while the downside scenario assumes an accelerated decline of heavy industry. However, we do not speculate on the future of specific heavy industries. Nonetheless, careful infrastructure planning is required to ensure we are prepared for step changes in demand created by heavy industry – on the upside or the downside.

Implications for energy infrastructure in the upside scenario

Modelling by MBIE (discussed in detail in the central scenario section) considers the impact of high energy demand driven by higher than expected population and economic growth. Based on MBIE's projections in the high demand scenario, the net new build for electricity generation is shown by fuel type in the graph below.

New build by fuel type in the high demand (upside) scenario

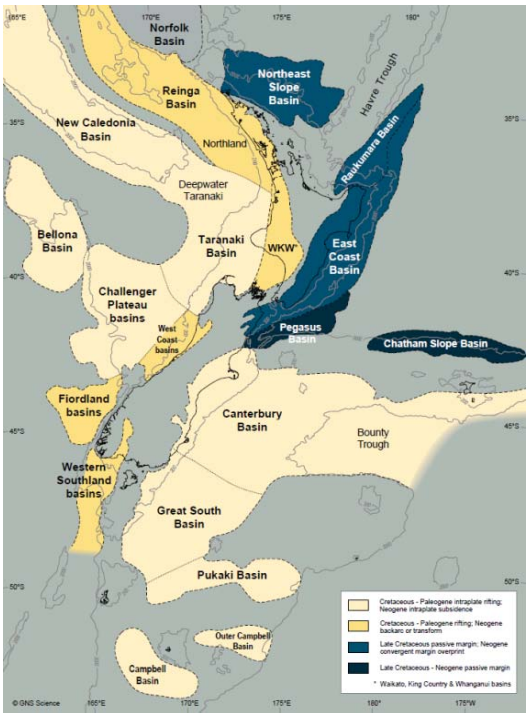


Source: Ministry of Business, Innovation & Employment, Treasury analysis

Source: NZ Petroleum & Minerals

Our upside scenario also considers the possible impacts emanating from the extensive oil and gas exploration that is underway in New Zealand. At present, New Zealand's gas production is located within the Taranaki region. Although Taranaki is comparatively well-placed to support new oil and gas discoveries (of a certain magnitude), a non-Taranaki discovery has the potential to create high demand for new pipelines and supporting infrastructure – especially if the new find is developed for the domestic market, rather than for offshore processing and distribution.

Similarly, a large, new discovery in Taranaki would increase the pressure on existing infrastructure in the region, some of which is already nearing capacity. Deep water discoveries may also change the type of infrastructure that is required (e.g. to service floating liquefied natural gas operations rather than onshore processing).



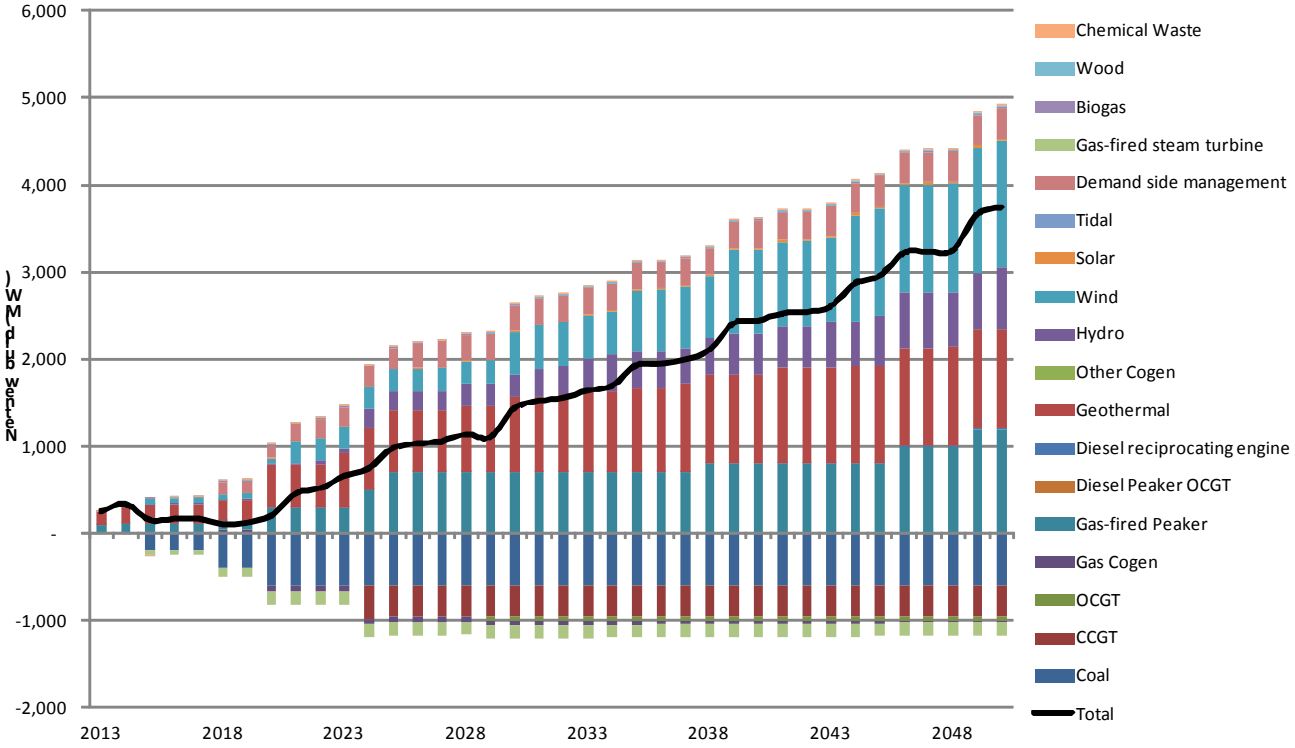
It is difficult to predict the location, timing and likelihood of a significant discovery. However, given the extent of New Zealand's petroleum basins, the probably of such an event occurring cannot be entirely discounted – especially with the current upswing in exploration activity.

Should a major oil or gas discovery occur, new or upgraded transport links, water infrastructure and social infrastructure will also be required to support the development – a clear example that demonstrates the interdependence of our infrastructure networks.

Implications for energy infrastructure in the downside scenario

Modelling by MBIE (discussed in detail in the central scenario section) considers the impact of low energy demand driven by lower than expected population and economic growth. Based on MBIE's projections in the low demand scenario, the net new build for electricity generation is shown by fuel type in the graph below.

New build by fuel type in the low demand (downside) scenario



Source: Ministry of Business, Innovation & Employment, Treasury analysis

As with most of the other sectors in the low demand scenario, the implications for our electricity infrastructure generally translate to a delay and reduction in size of new investment and underutilised or oversized assets.

In the oil and gas sectors, the downside scenario assumes few or no new discoveries (and/or policy changes that negatively impact exploration in New Zealand). In this case, production is expected to decline, which could lead to a gap between gas supply and demand, as well as underutilised oil export assets. At the same time, new infrastructure may be required to import energy to address the gap in gas supply and demand.

Sources

Gas Information Disclosures. The Commerce Commission has published information disclosure requirements for gas pipeline services under Part 4 of the Commerce Act 1986. http://www.comcom.govt.nz/regulated-industries/gas-pipelines/

Electricity Information Disclosures. Suppliers of electricity lines services are subject to information disclosure regulations under Part 4 of the Commerce Act 1986. http://www.comcom.govt.nz/regulated-industries/electricity/

Vector Rotowaro-North Capacity Determination (2012) http://www.vector.co.nz/sites/vector.co.nz/files/Rotowaro-North%20Capacity%20Determination%2028%20November_0.pdf

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INFRASTRUCTURE EVIDENCE BASE

Urban Water

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

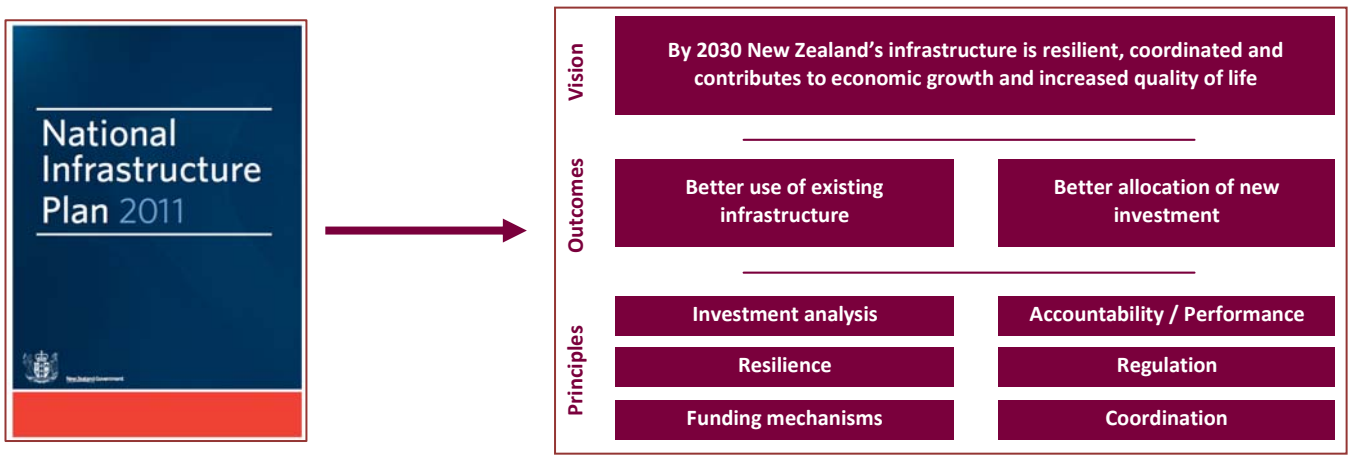
EVIDENCE BASE

Urban Water

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for the Urban Water sector, which the NIU defines as the 3-Waters: drinking water, wastewater and storm water. Key assets within this sector include pipelines, water treatment plants, wastewater treatment plants, tanks and reservoirs, and pumping stations. It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend analysis, and resilience assessment.

This narrative does not include flood protection. The NIU recognises the importance of flood protection systems for much of our other infrastructure sectors and urban environments and the significant cost of these to regional councils. In collating this first Evidence Base, the focus has been on the 3-Waters. We expect that future iterations will include flood water protection.

Where data has been provided, this is publically available information, and has been provided with permission of the information owner.

EVIDENCE BASE: URBAN WATER

Overview messages

The infrastructure for the 3-Waters is a key economic enabler: a precursor for any significant residential, industrial or commercial development and a key input for any agricultural, processing or manufacturing enterprise.

The 3-Waters has a large asset base, with approximately 66% of costs fixed[1] and significant levels of expenditure are planned over the next 10 years, including 1,016 projects (excluding those under $1m) totaling over $11 billion. Expenditure is driven by growth, renewals and requirements to meet new standards (Levels of Service).

Networks continue to operate without widespread service failures. There is some concern, however, that the now aging infrastructure and increasing levels of reported asset deterioration have the potential to influence future circumstances.

The sector is characterised by a large number of providers, managing a large number of network assets with a wide geographic spread, heavily influenced by topography and natural features (drinking water sources and discharge options). Two distinct patterns are emerging: one of larger urban areas with higher capacity, capability and rating base which are often growing; and one of smaller provincial areas with a static/declining population and rating base leading to lower capacity and capability.

There are varying levels of asset management maturity and understanding of asset condition across both larger and smaller areas, and no consistent national data framework or asset data standards, such as formats, definitions, analytics, or benchmarks. The International Infrastructure Management Manual provides detailed asset management guidance but application is variable.

The increasing focus on water, especially quality considerations, and the nature of the increasing demands imposed on the 3-Waters suggests the asset planning environment, including the analytics that support it, requires an increasing level of maturity that will test all Councils.

In addition, increasing consent requirements, particularly for wastewater and stormwater, are driving up costs and raising affordability questions for smaller/provincial local authorities.

Finally, the key future driver of demand for Urban Water infrastructure is population growth. Current trends suggest a group of Councils needing to optimize their 3-Waters networks to cater for growth, and a second group of Councils facing a static or reducing rate payer base and the challenge of meeting future renewals and levels of service from this.

Context

As originally explained in the 2010 National Infrastructure Plan, early settlers relied on wells, springs, streams and rainfall to supply their water needs. As towns grew, the local councils (or boards) and other entities initially assumed responsibility for providing a continuous supply, followed by a reticulated water supply direct to households and businesses. Over time, this has meant that local government now has the responsibility for supplying reticulated water to approximately 85% of people who are on such water systems.

Like drinking water, the disposal of wastewater in urban and built-up areas is primarily the responsibility of local authorities. Councils assumed this responsibility for similar public health, environmental and service delivery reasons. Management and asset planning considerations are also similar between the two types of networks, as are issues related to access to consistent information about the assets.

Water and water disposal systems represent key urban amenities that contribute to the health and wellbeing of the population in both rural and urban settings. In New Zealand, the regional variation in topography and water resource means that these systems are best managed at a local or regional level rather than centrally. Wastewater and many water systems are generally not interconnected across the country, although some areas may share treatment facilities. Each reticulated system has assets to collect untreated wastewater from customers and transport it to facilities for the treatment and disposal of wastewater effluent, which includes liquid, solids and gas.

[1] 2009 estimate of 3-Waters asset base, worth approximately $33 billion.

EVIDENCE BASE: URBAN WATER

Similarly, councils have responsibility for stormwater, drainage and flood protection systems, many of which started as individual systems under the control of separate boards or committees.

A significant driver of investment over recent times has been the requirement for water supplies, where practicable, to meet the requirements of the Drinking-water Standards for New Zealand and the requirements of the Health Act 1956 (as amended in 2007) and have approved Public Health Management Plans.

What do we have?

The total value of water, wastewater and stormwater assets under local government control is estimated to be approximately $33 billion (2009 figure).[2]

Estimated replacement costs		
Water	**Wastewater**	**Stormwater**
$11.4b	$12.7b	$8.9b

Source: Department of Internal Affairs

Is it where it needs to be?

The infrastructure for the 3-Waters is a precursor to significant residential, industrial or commercial development. The infrastructure is typically laid or built in the early stages of development. There are exceptions with some residential communities operating without reticulated networks, typically smaller and/or isolated communities, relying on rain tanks and/or on-site sewerage systems such as septic tanks.

The more notable issues with location are:

- Where populations have grown beyond the levels able to be supplied by the existing drinking water sources. In these cases further development may be restricted, there may be water restrictions regularly applied, or significant costs may be needed to increase supply.
- Where wider externalities and factors have changed over time and the current location or type of infrastructure provided is no longer suitable. In particular, for wastewater and changed discharge requirements.
- A number of economic pressures in regards to demands on potable water, particularly in the rural communities. Potable water supplies are coming under increasing pressure to meet the demands of other economic uses / users (e.g. farming, horticulture etc).

What quality is it?

The Ministry of Health 2013 Annual Report on Drinking-water Quality 2011-2012 reports on drinking-water quality for all registered community drinking-water supplies that served populations of more than 100 people from 1 July 2011 to 30 June 2012. This reports that only 76.7% of the reticulated population achieved full compliance with bacteriological, protozoal and chemical standards, although some non-compliance is technical in nature rather than having to do with water quality.

[2] Optimised Replacement Cost – from Department of Internal Affairs: Local Government Information Series 2009/19 – Information on local government water network infrastructure.

EVIDENCE BASE: URBAN WATER

	POPULATION COUNTS (000'S)					PERCENTAGE OF POPULATION				
	Large	Medium	Minor	Small	Total	Large	Medium	Minor	Small	Total
Total Population	2992	268	464	82	3807					
Bacteriological compliance	2947	237	409	56	3684	98	88	88	68	96
Protozoal compliance	2694	140	187	19	3039	90	52	40	23	80
Chemical compliance	2890	242	431	81	3645	97	90	93	99	96
Overall compliance	2611	116	176	17	2920	87	43	38	20	77

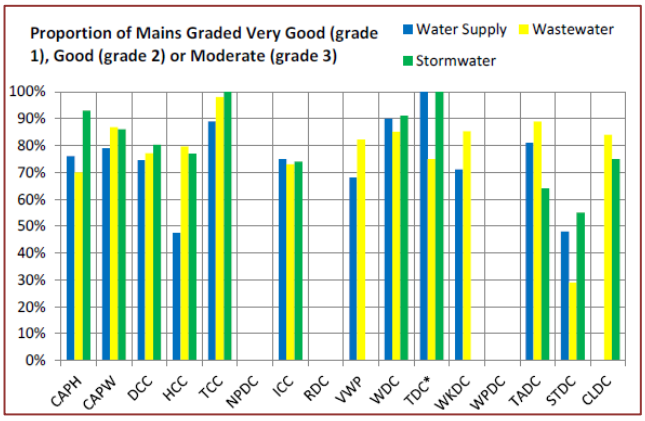
NB: Population figures are rounded to the nearest thousand. As a result of rounding, figures may not add up to totals shown.

In terms of asset condition, a significant portion of assets included in the available case studies and reports are assessed as "poor asset condition".

Water NZ reports 7 of 16 had at least 20% of water pipework rated as condition grade 4 (poor) and 5 (very poor) with a further 4 not collecting data. What is not clear from this data is the link to asset criticality.

The same report shows a similar story for wastewater with 6 of 16 having at least 20% of Wastewater mains rated as condition grade 4 (poor) and 5 (very poor) with a further 3 not collecting data.

SPM noted that reporting of asset condition was inconsistent through the asset management plans, meaning attempts at confident projections of the status of the asset stock would be of doubtful value.



AVERAGE REMAINING ASSET LIVES (YEARS)				
	Auckland	**Metropolitan**	**Provincial**	**Rural**
Water Supply	44	40	36	32
Waste Water	47	42	30	48
Stormwater	84	35	65	36

A surrogate measure of condition may be inferred from the valuation data. The ratio (Remaining Life / Expected Life) gives a high level view of the status of the total service group. On average the valuation judgement is that assets are in general less than half way through their expected lives. However, this needs to be interpreted with a note of caution as the quality and confidence in the underlying data on which the calculations are based is variable and generally low.

HIGH-LEVEL VIEW OF ASSET CONDITION % (RATION: REMAINING LIFE/EXPECTED LIFE)				
	Auckland	**Metropolitan**	**Provincial**	**Rural**
Average	66	61	58	49

Stormwater appears to be the least well understood – both the MWH and Water NZ report either a high number of non-assessments or a low confidence in the data. This may be a reflection of the younger stormwater network and a focus of Councils more recently on water and wastewater.

EVIDENCE BASE: URBAN WATER

What capacity is it at?

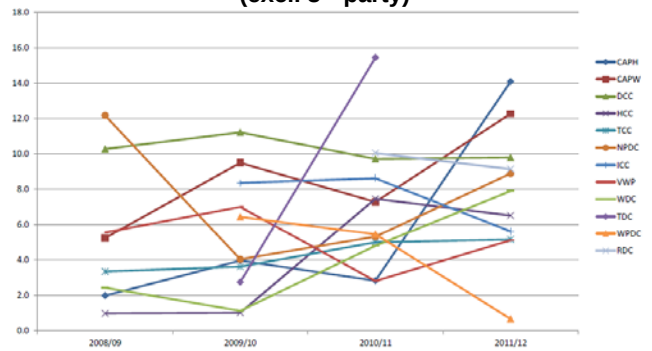
The estimated capacity of the surveyed water supply systems totals 668 million cubic metres per annum. The capacity utilisation rates range from 22% to 92% and average 56%. This is the average utilisation over the year. However, there are seasonal peaks for both water supply and water demand.[3]

Little information has been found on capacity on individual plants or schemes, although 100% adequacy of supply was reported by large, medium and minor zones. Water supplies to 96.3% (79,100 people) of the population in 95.4% (291) of the small supply zones reported adequacy of supply.

The 2012 WaterNZ report shows variable trends for unplanned interruptions with five providers increasing trend and six a decreasing trend.

There are encouraging signs from the PWC/GHD pilot of 2011/12 with eight of nine providers having sufficient KPIs to provide a general measure of performance (an 'amber' rating) - however, only four of the nine achieved a 'green' rating.

Unplanned interruptions per 1000 serviced properties (excl. 3rd party)



Source: Water NZ 2012 Annual Report

Achieving a 'green' rating required 8-25 KPIs and in general enabled an assessment of performance - at least 5 KPIs across: water leakage, water quality, sewer overflows, service interruptions, customer service, cost recovery.

The Water NZ report on Wastewater Treatment Plant Capacity currently utilised indicates sufficient headroom for the majority but 5 of 16 (31%) are at 80% capacity or over - New Plymouth District Council, Rotorua District Council, Waikato District Council, Taupo District Council, South Taranaki District Council. Noting that Plant capacity is only one part of the network and pipe capacity for example, is also a key determinant.

Resilience

A key point when considering resilience is the importance of overlaying the objective data with subjective intelligence due to the interdependencies with other infrastructure sectors and the particular geographic features of each locality or region eg. Christchurch with 160 wells is in a very different situation than Wellington City with one main pipeline into the City that crosses a major fault in several places.

In the table to the right resilience expectations from a national perspective are identified as low medium or high. When making these judgements a wide range of aspects require consideration. To demonstrate; under Urban Water "City mains" generally have a very high economic and social value associated with them. A high level of resilience expectation is therefore attributed to them. An assessed resilience of medium reflects the significant vulnerabilities of some of these routes both from limited options and ability to withstand hazards such as earthquakes. In contrast "Private laterals" have a low resilience expectation in part due to the relatively low economic value associated with them and also the relative ease of remediation. "Private laterals" are also a good example of level of resilience being

Water	Resilience Expectations	Assessed Resilience	Desired Movement
Urban Water			
Private laterals			–
Street			–
City mains			↑
Reservoirs			↑
Urban Wastewater			
Private laterals			–
Street			–
City mains			↑
Treatment facilities			↑
Urban Stormwater			
Private laterals			–
Street			–
City mains			↑
Discharge			↑

[3] 2004 Ministry of Economic Development Stocktake. Available at: http://www.med.govt.nz/templates/MultipageDocumentPage9031.aspx?&MSHiC=65001&L=0&W=water+infrastructure&Pre=%3cb%3e&Post=%3c%2fb%3e

dependent on your perspective; if your residence or building is dependent on a particular lateral you are likely to expect a high level of resilience and in many cases this probably exists.

In addition to the NIU assessment, PWC/GHD identified six metrics to assess for resilience, shown in the table below. Overall for the Resilience principle, 2 of the 9 providers rated green with the other 7 rated amber. Vulnerability assessments rated the lowest - 2 green, 5 amber, 2 red (recognising that high vulnerability in itself does not mean low resilience).

Water NZ reported on reservoir days of supply: the average across the 16 providers is 2.05 days with a median of 1.8 and a range of 0 - 5.1 days.

Table 7 Scores against each metric for the Resilience principle, for pilot study operators

Metrics for Resilience	Waikato	Hamilton	Waipa	Taupo	Watercare	New Plymouth	Hutt	Wellington	Dunedin
Overall score for principle									
Design & construction standards									
Natural hazard risk assessments									
Vulnerability assessments									
Key risks: understand & mitigation									
Network resilience consideration *									
Power outage contingency plan									

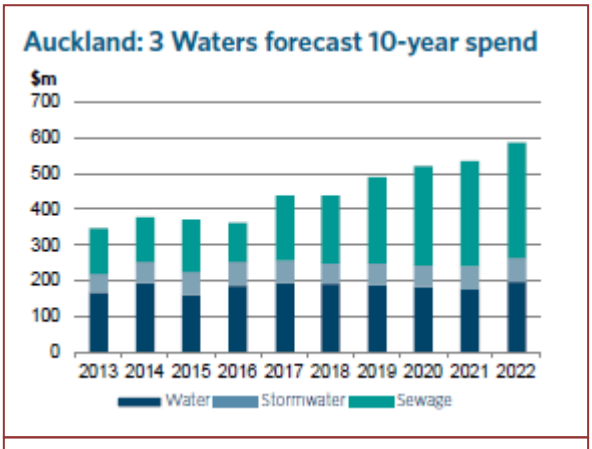
Note: (*) The score for this metric was derived from scores for sub-metrics. The scores for each sub-metric are shown in Appendix C.

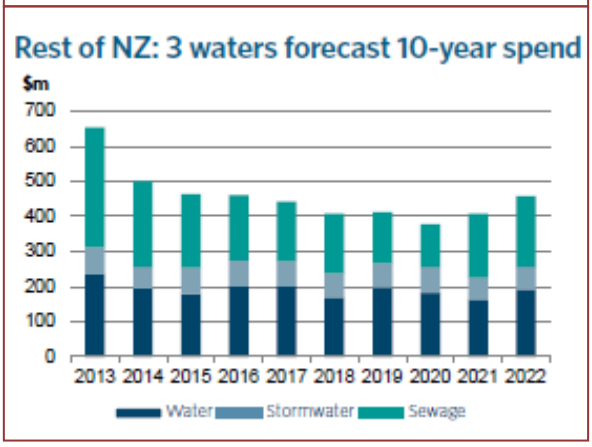
What are we spending?

Water

Real capital expenditure on water for councils in the rest of New Zealand is forecast to decrease over time. Renewals makes up 50% of projected spend, gradually increasing over time. Most change is due to decreasing expenditure on improvements to levels of service from 28% of annual expenditure in 2013, to 17% in 2022.

Capital expenditure on water in Auckland is uneven with most capital being spent on increased demand (40%) followed by renewals (35%). The amount spent on renewals increases from $41 million in 2013 to $77 million in 2022.





Source: DIA analysis of Council LTPs 2012 - 2022

Wastewater

For councils in the rest of New Zealand, there is a period of significant expenditure on sewage in the early years of the LTP, gradually decreasing before increasing again in 2021. As renewals remain stable (44% of the total), the increased expenditure in the early years is being driven by both improvements to levels of service, and to cater for increased demand.

In Auckland, capital expenditure on sewage will increase steadily and significantly over the next ten years, from $127 million in 2013 to $322 million in 2022. Increased demand makes up 43% of the total forecast spend with renewals next at 31%.

EVIDENCE BASE: URBAN WATER

Stormwater

Spend on stormwater assets comprises 4% of total capital expenditure for Auckland, and 5% for councils in the rest of New Zealand. Councils in the rest of New Zealand will gradually reduce their capital expenditure on stormwater. Most expenditure will be for improvements to levels of service (49%), suggesting councils may be addressing capacity issues with their existing stormwater systems. Sector feedback suggests that as stormwater networks tend to be younger the longer term picture will be for increasing capex as renewals are due.

Capital expenditure on stormwater in Auckland is set to peak in 2015 and 2016, and again in 2022. Over time the proportion of expenditure on improved levels of service will increase from 36% in 2013, to 44% in 2022.

There are significant levels of expenditure planned over the next 10 years: 1,016 projects (excluding those under $1m) totaling over $11 billion. The drivers for expenditure are very different, depending on whether the Local authorities are projected to grow or not.

	High growth (%)	Minimal growth (%)	Negative growth (%)
Renewals	48	59	71
Levels of Service	30	30	23
Demand	23	11	7

How productive is it?

The data to determine productivity is not immediately obvious or available. Some insight can be gleaned from looking at the costs.

The Water NZ report identifies a wide variation of unit cost of water delivery - range from $0.65 to $1.65 - Median of $0.89 and mean of $1.05.

Perhaps more significantly, the trend data over last four years shows little movement in price.

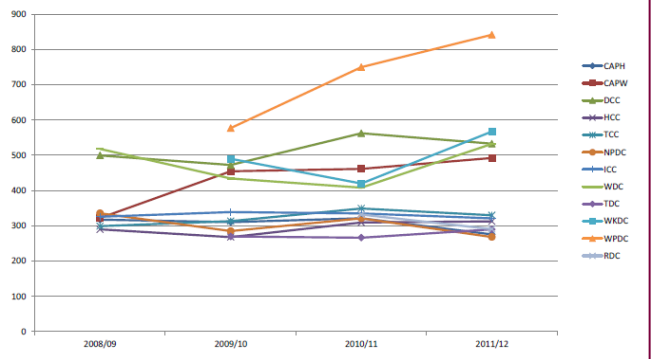
SPM reports the cost of production varies from $0.62 / m3 to $3.40 / m3 with an average range of $0.70 for rural to $1.25 for Auckland.

SPM also notes that a number of communities in New Zealand are blessed with aquifers that deliver high quality water into the supply networks without the need for treatment. Others require extensive headworks structures and treatment to meet demand and Drinking Water standards.

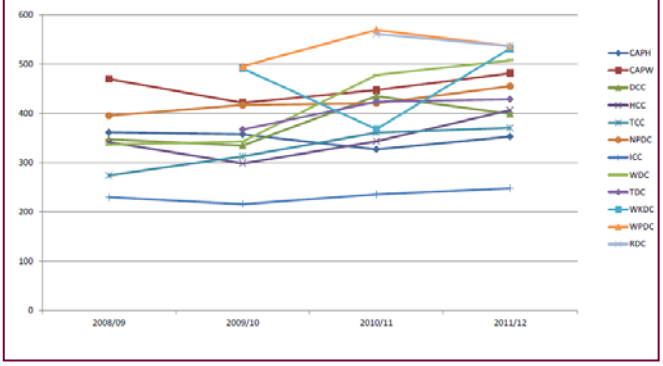
For wastewater, Water NZ reports an even wider variation of unit cost – a range from $0.51 to $3.67 - Median of $1.20 and mean of $1.55. Trend data over last four years shows increasing unit cost - likely to relate to widespread upgrade programme that has been underway.

The flipside is a look at **water loss** - 25% of the 16 providers meet suggested international benchmark[4]. Prima facie, this suggests significant wastage and loss of productivity.

Water Supply: Total Cost per Serviced Property ($pa)



Wastewater: Total Cost per Serviced Property ($pa)



[4] Infrastructure Leakage Index (ILI). Industry standard for water loss assessment is Benchloss, evaluating Current Annual Real Loss and comparing this with Unavoidable Annual Real Loss to provide ILI. Water NZ suggest international experience is that network losses are being effectively managed if ILI <2.

EVIDENCE BASE: URBAN WATER

COST OF PRODUCTION (WATER SUPPLY) $PER METER CUBED				
Sector	**Auckland**	**Metropolitan**	**Provincial**	**Rural**
Average	1.25	1.15	1.2	0.07

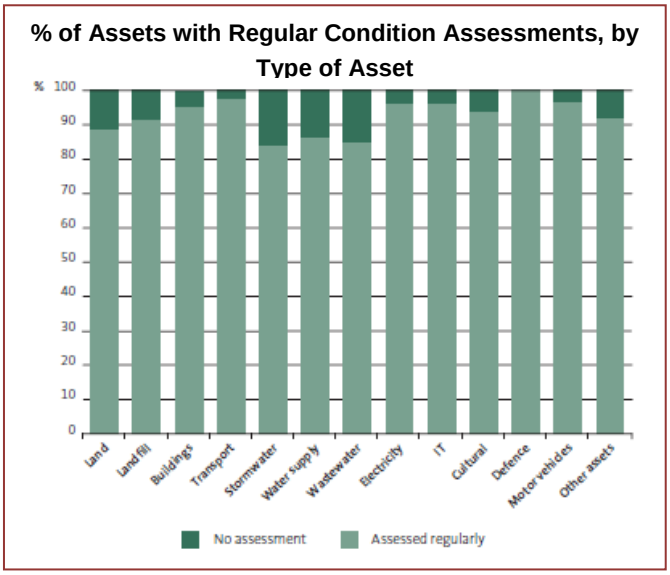
How well are we managing it?

Fundamental to managing long-life infrastructure assets is having mature asset management practices that reflect the scale and scope of each service provider. The reports reviewed show a number of providers not collecting data or having a low level of confidence in the data being collected on the assets.

The 2013 OAG report identified that stormwater, water supply and waste water assets were all assessed less than the overall average across public sector assets.

Only 4 of 9 providers participating in the PWC/GHD-led pilot rated a 'green' for condition assessments (the criteria for a 'green' rating is done at least 3 yearly, reflected in LTP for all critical assets and a sample of others).

Adding to this picture, OAG reports that "Based on the information we collected, maintenance and renewal plans are being followed for about 40% of assets, and those plans influenced the work carried out to some extent for a further 53%" (OAG 2013 4.5)



Source: OAG 2013

Further, there was a lack of regular reporting to governing bodies with less than 60 of local government decision makers receiving regular asset condition information (OAG 2013 5.10). The same pattern emerges when looking at investment analysis. The PWC/GHD pilot developed seven metrics to asses investment analysis. Results show room for improvement. Stronger areas were AMP revisions (6 of 9 rated green) and Basis of replacement decisions (7 of 9 rated green). Weakest areas were Ownership structure consideration (6 red, 3 amber), Demand forecasting process (8 amber, 1 green) and Cost & benefits included (3 green, 6 amber).

Table 6. Scores against each metric for the Investment Analysis principle, for pilot study operators

Metrics for Investment Analysis	Waikato	Hamilton	Waipa	Taupo	Watercare	New Plymouth	Hutt	Wellington	Dunedin
Overall score for principle									
Methodology									
AMP revisions									
Ownership structure consideration									
Demand forecasting process									
Time period for appraisal									
Cost & benefits included *									
Basis of replacement decisions									

Note: (*) The score for this metric was derived from scores for sub-metrics. The scores for each sub-metric are shown in Appendix C.

This was reinforced by the Better Local Government Infrastructure Efficiency Expert Advisory Group in their 2013 report with the IEEAG saying “On the part of councils, business case decisions need to be improved to ensure that appropriately scaled and targeted solutions are delivered. Better asset management can also help achieve efficiencies and therefore contain costs."

The underlying quality of available data is also a concern with regards to forecasting, and means little meaningful insight can be drawn at a national level. Consequently, we have focussed on other indicators such as whether forecasting is done, the quality of this and the inclusion of both supply and demand management (DM) strategies to meet forecast demand.

The data reviewed suggests significant room for improvement. Local authorities typically included population changes, may have considered demand management strategies but not quantified their potential impact, did not verify forecasts and overall, forecasting would be considered minimum - intermediate standard.

- OAG (2010) rated 5 of 8 providers forecasting as minimum standard with the other 3 at intermediate. They also noted the lack of verification.
- MWH identified the lack of quantification of the impact of other drivers of demand and that councils have not defined what they will do to implement demand management strategies.
- PWC/GHD rated only 1 of the 9 providers as 'green' – a 'green' rating requires detailed data, and forecasts internally consistent with assumptions.
- PWC/GHD also looked at more short term measure on the accuracy of actual v planned capex - with only 1 provider meeting the 'green' criteria – a 'green' rating = actual within 10% budget on average or in total over 3 years, and within 20% in each year.

Overall, the above paints a picture of a sector that can substantially improve asset management practices, the quality of information collected and reported to governing bodies, and the use that is made of this information.

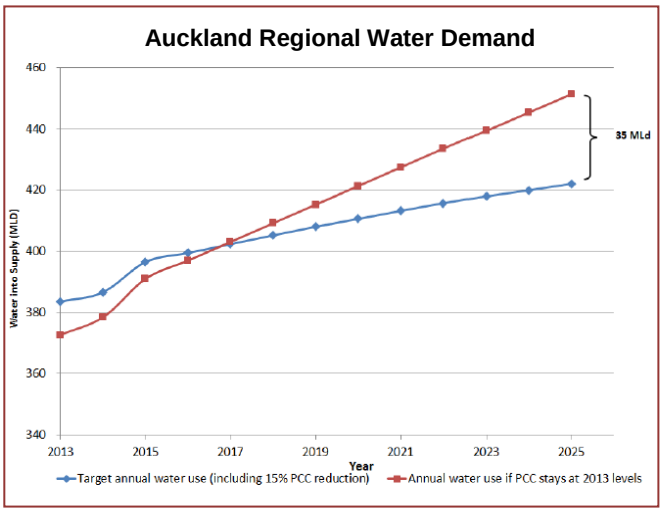
What future trends and scenarios may impact urban water infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand)[5]. The results of this investigation have been published in a separate document available on the NIU website, but relevant extracts for the Urban Water sector are reproduced below.

Implications for urban water infrastructure in the central scenario

At present, the availability of data, projections and modelling for our water infrastructure is inconsistent and fragmented[6]. Accordingly, it is difficult to develop an informed view of future infrastructure requirements at a regional and national level. Instead, we focus on readily available indicators of future demand such as demand for water in Auckland and Wellington.

With both high population growth and relatively modest water resource availability, Auckland makes a good case study for understanding the substantial investment in urban water infrastructure that may be required in the absence of other solutions. Watercare's most recent demand management plan (right) demonstrates the scale of the



Source: Watercare 2013

5 Each scenario has an associated set of projections of future infrastructure demand. The NIU has not produced any new models or forecasts in this regard. Rather, we rely upon existing sector data and forecasts where applicable and relevant.

6 Local authorities are taking steps toward improvement in this regard (e.g. LGNZ 3 Waters project and the establishment of a Centre of Excellence).

challenge. Across the country, both the level of demand and the ability to pay for the required investment will be dependent on population, which in this scenario suggests challenges for both rural and urban centres as population migrates from one to the other.

Apart from water demand, the urban water sector also faces pressure to ensure water quality meets acceptable standards – both for potable supply and for the discharge of wastewater and stormwater to the receiving environment. For wastewater discharge quality, the

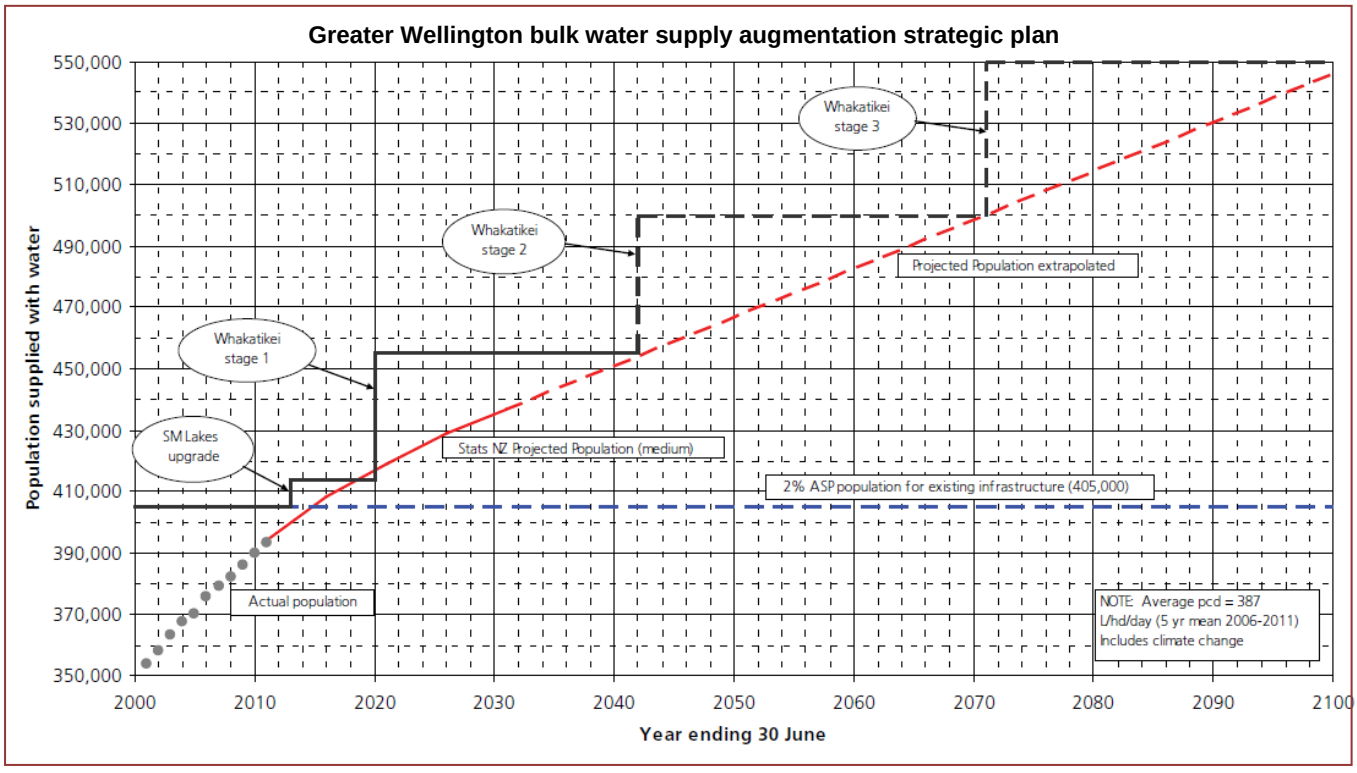
government is currently investigating a number of reforms related to fresh water management. The level of investment that may be required will be dependent, in part, on the level of standards to be met (and by the existing water quality outcomes being achieved).

Implications for urban water infrastructure in the upside scenario

The upside scenario assumes that climate change will occur more rapidly than IPCC projections. From a spatial perspective, this impacts coastal areas where our assets begin to deteriorate more rapidly and low-lying communities (and their infrastructure networks) are threatened. Moving inland, higher rainfall in the west of country brings both benefits and risks, while less rainfall in the east may magnify water scarcity in areas such as Canterbury.

Population growth will also create urban water infrastructure demand in the upside scenario. Taking Auckland as an example, the Stats NZ high population for the Auckland region by 2031 is nearly 8% above the medium projection. Although this may seem small at face value, the impact from a variation of this size cannot be underestimated – particularly when the development of new sources of supply (or incentivising lower per capita demand) can be years in the making.

For example, Greater Wellington Water's plan to ensure that sufficient capacity is available to meet demand is shown in the graph below. In the event that population growth shifts from the Stats NZ medium projection to the high projection instead, augmentation of the system may be required much earlier than planned.



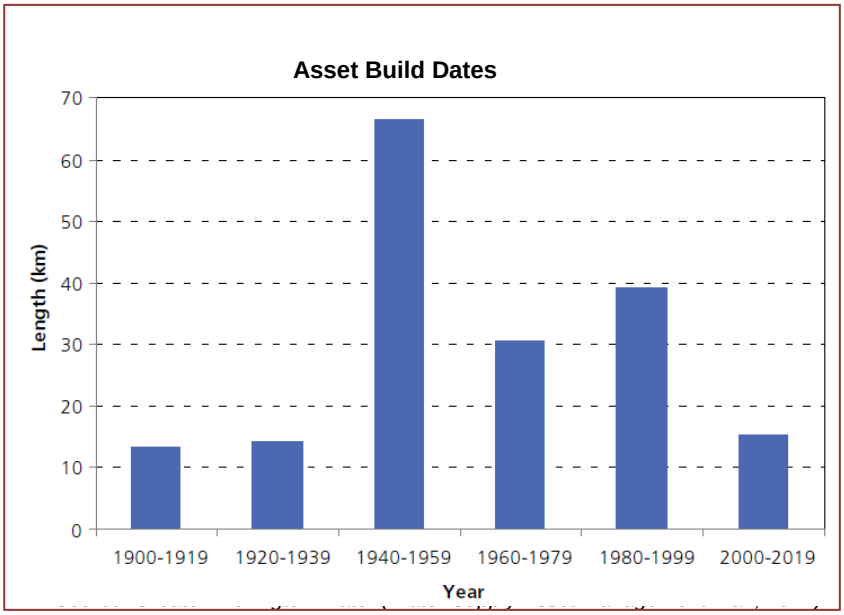
Source: Greater Wellington Water (Water Supply Asset Management Plan, 2012)

EVIDENCE BASE: URBAN WATER

Implications for urban water infrastructure in the downside scenario

As with the other scenarios, the effect of the downside scenario on our urban water sector is expected to be driven in large part by population. In this case, low population growth (and decline in some areas) will translate to lower requirements for new sources of supply and infrastructure upgrades. In rural areas that experience high population decline, the existing assets may in fact be significantly underutilised – with their operation and maintenance creating a burden on the remaining ratepayers.

In a similar vein, the downside scenario assumes that we have high public and private debt, lower incomes and a limited ability to pay. In the medium to long term, this type of funding constraint could be exacerbated by the looming renewal of a substantial cohort of assets built in the mid-20th century. Although the average age and expected useful life of urban water assets varies across the country, Greater Wellington Water (see right) again provides one example of the lumpy renewal liability faced by many councils over the next 30 to 50 years.



EVIDENCE BASE: URBAN WATER

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INFRASTRUCTURE EVIDENCE BASE

Productive Water

February 2014

NATIONAL INFRASTRUCTURE UNIT

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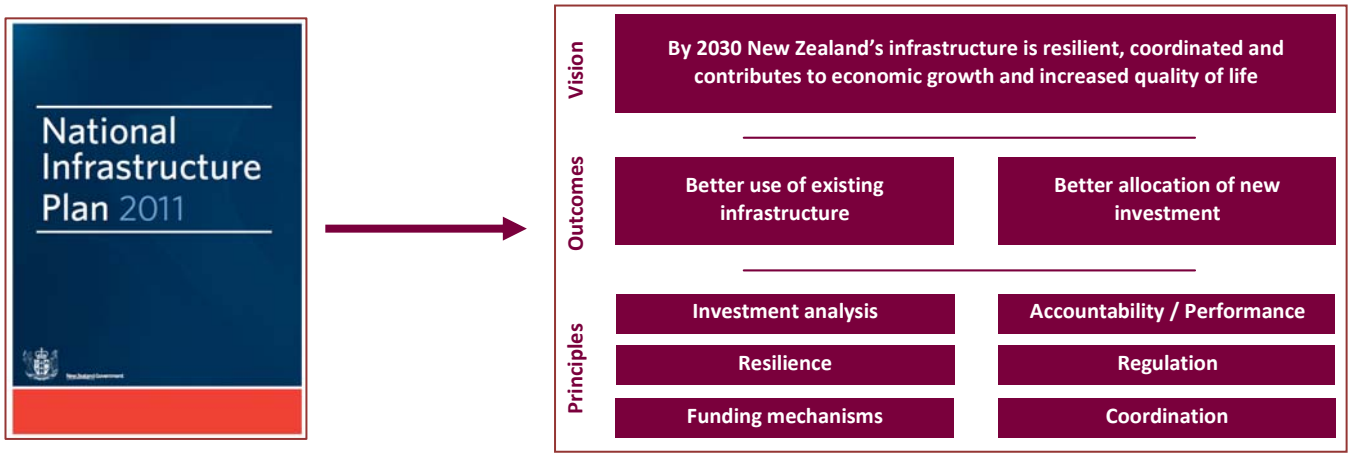
EVIDENCE BASE

Productive Water

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital that it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for the productive water sector, which the NIU defines as irrigation with a focus on the main irrigation schemes and some passing comment on water used for electricity generation. It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend analysis, and resilience assessment.

Where data has been provided, this is publically available information, and has been provided with permission of the information owner.

EVIDENCE BASE: PRODUCTIVE WATER

Overview messages

Irrigation can be found throughout New Zealand but is concentrated in a small number of regions, particularly Canterbury (62%) followed by Otago (13%). Irrigation schemes serve 245,000ha of the 721,700ha irrigated.

There is a large variation in asset condition, age and efficiency, which is reflected in the wide range of water cost – a factor of 10 between lowest and highest in one Canterbury analysis, and productivity varies across schemes.

There is also a wide range of asset management practices from immature through to comprehensive asset management programmes. Improvements are being made, driven by increasing liability, changing management structures, increasing regulatory reporting/monitoring, requirements to access Irrigation Acceleration Fund support and investor scrutiny where capital raising.

However, there is widespread investment uncertainty regarding future management expectations for contaminants, including nutrients, and therefore the ability to intensify land use alongside mitigation cost implications for existing and intensified land use.

Future irrigation development and its associated land use will have to perform to a higher environmental standard than has been previously required, raising short-term affordability issues. Water from new irrigation schemes or schemes undergoing modernisation will be expensive to deliver; it is widely recognised that 'the readily available water is gone'. Add to this the additional cost of environmental mitigations on farm and the initial capital investment has now considerably increased. This will require future consideration of the intergenerational nature of irrigation development, and a better understanding of where the costs and benefits sit.

Another risk for the sector is that sub-optimal infrastructure development may occur if inefficient processes are adopted to address the necessary iterative cycle of uptake, design, finance and consent considerations within business case risk management. Although, there is an opportunity to collaboratively build on the learnings of each scheme development and utilise existing capital infrastructure development processes, this is an area that should be considered further.

Resilience assessments within the sector could also be developed further.

Irrigation has significant interdependencies with the wider infrastructure network – increased pressure on the electricity lines network, synergies and conflicts with hydro-generation assets, changed requirements of the transport network, and an increased need for a modern telecommunications network (RBI) are all integral to operational efficiency for modern schemes and their shareholders enterprises. There are also indirect links to increased need for social infrastructure as irrigated farms employ more FTE's per hectare.

Context

Large-scale irrigation in New Zealand began in the late 19th century, particularly in the Central Otago region. During the Great Depression of the 1930's, several large-scale irrigation projects such as the Rangitata Diversion Race were built using government funding. The majority of major schemes were constructed between 1960 and the mid 1980's in the Canterbury and Otago regions.

In 1988, central government began to transfer ownership of the Crown schemes to farmers. No schemes remain in Crown ownership.

In 1991, responsibility for approving scheme development was devolved to local government under the Resource Management Act 1991. Central government re-focused its interventions on funding science and technology development, and in later years on better facilitating the planning and proposal development process, through initiatives such as the Sustainable Farming Fund and the Community Irrigation Fund.

A limited number of schemes have been developed since devolution, including Opuha Dam (1998, 72,000,000m^3), Waimakariri (1999, 18,000ha), North Otago Stage 1 (2006, 10,000ha), and the Wai-iti Valley Augmentation Dam (2006, 800,000m^3). Each of these projects had significant backing from territorial authorities. More recently, Barrhill Chertsey (2010, 10,000ha) and Acton Farmers Irrigation Cooperative (2011, 6600ha) are operating, Rangitata South is constructed and Central Plains Water (60,000ha) begins stage 1 construction in February 2014.

As captured in the Business Growth Agenda, the Government is committed to improving both the urban and productive water sectors and delivering a sustainable approach to water infrastructure management

into the future. This recognises that water resources are critical for the primary production sectors and water is New Zealand's competitive advantage for our export industries. Recent initiatives include:

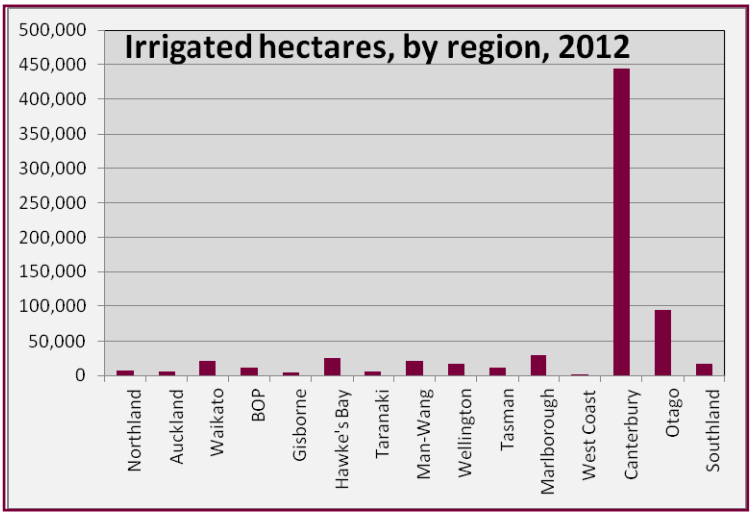
- The Irrigation Acceleration Fund. Now into its second year of operation, it has allocated $18.3 million – supporting 11 projects across Hawkes Bay, Wairarapa, Canterbury and Otago. The primary focus of the fund is to support the development of rural water infrastructure proposals to the investment-ready prospectus stage.
- The establishment of Crown Irrigation Investments Ltd. The company will act as a bridging investor for regional water infrastructure projects, helping kick-start projects that are commercially viable in the longer term and manage the initial uptake risk period. The Government has set aside $80 million in Budget 2013 for this purpose.

What do we have?

Statistics New Zealand data shows that in 2012, there was a total of 721,700 hectares of irrigated land. The majority of this is in Canterbury (444,800 hectares or 62%) with Otago the second largest region (93,900 hectares or 13%). The largest North Island region was Hawkes Bay with 26,000 hectares or 4%.

The 721,700 hectares in 2012 is an increase of 16% over 2007 (619,300 hectares). The majority of this growth was in Canterbury with a further 59,500 hectares, Manawatu-Wanganui with 10,000 hectares and Waikato with 4,400 hectares.

Most of the following data and commentary relate to irrigation schemes. This reflects the availability of data, despite irrigation schemes only making up 34% of total irrigated hectares.



Source: Statistics NZ

Key features from Irrigation NZ irrigation scheme data show:

- Irrigation schemes currently account for 245,000ha of the national irrigated area. There is approximately another 250,000ha at varying stages of development.
- The wide range of scheme size in NZ. Whilst the median scheme irrigated area is 4,400ha, the largest (schemes supplied by the Rangitata Diversion Race) currently irrigates 66,000ha, whereas there are also a number of irrigation schemes irrigating under 1,000ha (Maungatapere in Northland for example).
- The average number of shareholders per scheme is 118 with the range from under 10 to over 350. Shareholders are typically irrigators operating within a cooperative company structure.
- The vast majority of schemes are run of river with few currently having any significant storage (excluding buffer ponds and tanks serving operational purposes) and consequently subject to water supply reductions that may compromise reliable water application. Opuha is an exception with 72million m^3 of storage servicing 16,0000ha of irrigation, but it still has a risk of supply shortfalls in dry summers.
- The irrigation schemes have extensive distribution networks, the largest having over 100km of piping or 200km of open channels.
- The 10 largest schemes' water takes on average equate to 0.62 l/s/ha but range between 0.45 and 0.85 l/s/ha. Their combined take allows the extraction of 130 m^3/s.

EVIDENCE BASE: PRODUCTIVE WATER

Alongside irrigation, water is fundamental to the generation of New Zealand's electricity supply with over 75% of New Zealand's electricity coming from power stations that are dependent upon freshwater – 60% from hydro stations, and 17% from freshwater-cooled thermal stations.[1]

Is it where it needs to be?

The location of irrigation schemes is driven by the need for irrigation to enable a range of land uses where rainfall is insufficient and/or unreliable. Factors include: climate, soil water characteristics, the availability of irrigable land (plains and gently sloping land), and the practicality of conveying a reliable water supply to it. As a result the vast majority of irrigation is located upon the plains and foothills of New Zealand's East Coast (approx 87% of irrigated hectares), particularly where rivers provide a ready source of water as they flow from New Zealand's mountain ranges to the sea.

Where the natural climate and soils are able to underpin a range of land uses, there is less value in developing irrigation. However recent drought events have demonstrated the value of irrigation for risk management in these areas, particularly for high value crops.

Unlike other infrastructure sectors, irrigation directly increases the production base. It therefore requires a comparable increase in the level of service from other infrastructure sectors, both directly, particularly energy and transport, and indirectly, where irrigation results in greater employment and thus an increased need for social infrastructure associated with supporting growing populations. 80% of irrigated hectares are in regions that are serviced by New Zealand 5 largest export ports (by value).

Alongside transport a key infrastructure dependency associated with irrigation is the need for a secure electricity supply. The growth in irrigation has changed the electricity demand profile with the summer demand from irrigation now higher in some areas than the traditionally higher winter demand (driven by space heating). For example, Electricity Ashburton report summer demand as more than double the winter period demand. Network capacity has grown at 10% compounded for the last ten years and maintenance/capital upgrades requiring equipment outages must be scheduled around peak irrigation periods.

Energy generation can be either synergistic or competitive with irrigation for water supply, depending on the specific situation; for example, the Waitaki storage system enables high reliability of irrigation water to some schemes but competes for water with others. There are opportunities to develop infrastructure in future which can be operated to better utilise capital and water for both purposes. 80% of irrigation is located in or next to regions that generate significant amounts of New Zealand's electricity (Southland, Otago, Canterbury and Waikato).

An understated but now emerging role for irrigation infrastructure is to provide for recreational and environmental wants of the community which are themselves undersupplied by the more variable climate. Opuha Dam was an early result of the recognition that lack of rainfall was affecting fishing and recreational values in the Opihi River as well as irrigation reliability. Many more instances of realising multiple benefits are likely to emerge throughout NZ as communities become involved in collaborative approaches to optimising outcomes from water.

What quality is it?

Reliability of supply has been identified as essential to enable efficient application of water which is required to minimise nutrient loss and avoid over-build of infrastructure. Many schemes were built when water allocation favoured minimising production losses in droughts over in-stream and high value productive uses, exemplified by the low number of schemes with storage. Irrigation NZ data shows reliability typically ranging from 70 – 95% with a number of smaller 'run of river' schemes being as low as 50%.

[1] Information prepared for the Land and Water Forum, 2010

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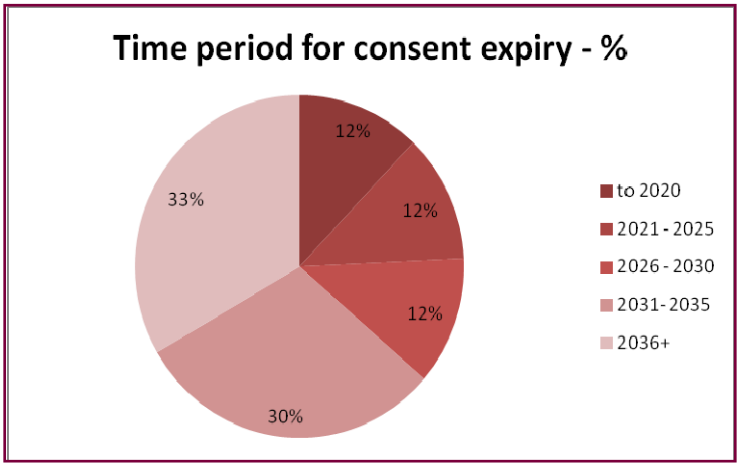
A number of schemes are investigating options to increase reliability through the addition of storage. The universal expectation is that reliability needs to increase above 90% to encourage on-farm water efficiency and broaden the range of potential uses.

Understanding the amount of allocable resource and having hydrologically and environmentally sensible limits could help reliability whereas use beyond a limit (or no limit) could decrease reliability for all users (spread too thinly).

A further area of focus for irrigators is the duration of Resource Consents, particularly considering the large upfront capital costs required. Consents for the majority of the significant schemes run through to at least 2031 with many issued for the maximum of 35 years.



Source: NIU analysis of Irrigation NZ data

What capacity is it at?

The capacity of water infrastructure has two components – the ability to supply peak flows to farms during in the hottest weeks (peak), and the ability to deliver sufficient water to the desired reliability during the season (volume). As a general rule, most irrigation schemes are running at or just below their current peak flow capacity i.e. all of the water allocated from rivers above environmental flows under consent requirements is committed to scheme shareholders. Most do not have sufficient storage for reliable supply in drier years (volume).

However through on-going efficiency gains at both the scheme and farm scale, better co-ordination of peak water takes at the catchment scale, and the development of strategic storage for volume reliability, there is much capacity for irrigation expansion from within existing water take allocations. This is reflected by the number of existing schemes with plans for modernisation and subsequent expansion without taking any more water, particularly in Canterbury and Otago.

Truly 'greenfield' irrigation scheme developments are mainly in areas such as the Wairarapa and Hawke's Bay where scheme development was not previously considered.

How resilient is it?

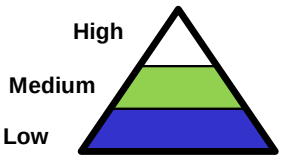
Required levels of resilience will vary depending on perspective. This assessment is made at a national level and for productive water is yet to be developed with robust supporting evidence. NIU defines the resilience of infrastructure to include not just the physical or hard assets but also other aspects such as how infrastructure organisations function, capacity and capability to fund, and community awareness.

To provide an assessment of resilience, the water sector (urban and productive) has been disaggregated and qualitative methods applied to compare resilience expectations (from a national perspective) with the assessed level of resilience to identify desired improvements. These tabulations have been publicly available and presented in various forums through 2012 and 2013 and continue to evolve as new information comes available.

EVIDENCE BASE: PRODUCTIVE WATER

At this stage the resilience assessment for the water sector has largely been in the urban water component including some exercises looking at specific district water services. Ideally similar work would be undertaken in future for specific irrigation schemes.

Key: Levels of Resilience



Water	Resilience Expectations	Assessed Resilience	Desired Movement
Natural			
Lakes			–
Rivers			–
Rural Water			
Irrigation			–
Reticulation			↑

In the table to the right productive water is largely encompassed under "Rural Water – Irrigation". The rationale for a low rating (blue) for resilience expectation is that from a national perspective there are numerous schemes with considerable diversity across catchments and across production types. Clearly from a local perspective a medium or high level of resilience would be desirable.

As noted earlier there are significant interdependencies of productive water, both being dependent on other elements of infrastructure to function and being a major contributor to demand on other sectors. This is probably the most important aspect going forward to improve resilience.

How productive is it?

Analysis undertaken by New Zealand Institute of Economic Research (NZIER) in 2010 for the Ministry of Agriculture and Forestry (MAF, now the Ministry for Primary Industries (MPI)), concluded that the net impact of irrigating an additional 347,000 hectares would be $2.43 billion in added farm gate production, an increase of approximately $7,000 per irrigated hectare.[2]

Inefficiencies exist with the large scale use of open races/channels to carry water. For example, Ashburton Lyndhurst Irrigation Company calculated water losses from open channels were in excess of 15%. An $8 million piping development enabled a further 550 hectares to be irrigated by the 15% efficiency gain.[3]

A survey undertaken in 2012 for Ashburton Electricity Ltd shows the effective price of water supplied by the schemes, once the data set was normalised, ranged from approximately $130-1,250/ha/year or $0.02-0.23/$m^3$. The mean cost of water supplied by the schemes was calculated as approximately $830/ha/year or $0.15/$m^3$ (Aqualinc 2012).

How well are we managing it?

Nationally, making any statement about overall asset management is difficult due to the lack of a consistent set of data across all irrigation schemes that is easily aggregated.

Anecdotally, asset management practices have been historically immature; there has not been a formalised annual process for accountability and performance. In part due to the age of many of the schemes, the capital costs have been paid. This is gradually changing, driven by a number of factors including:

- increasing liability – the significant investment that efficient irrigation and its resulting land uses requires has created an increased level of shareholder debt which the irrigation scheme water supply performance underpins
- changing management structures – the majority of large schemes have recently employed skilled general managers with specific responsibilities for the operation of the scheme, this has inevitably resulted in the gradual introduction of more formal asset management systems

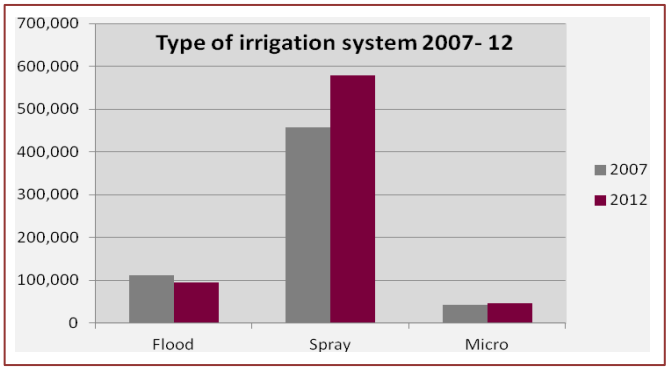
2 NZIER 2010, p13.
3 Irrigation NZ article – John Van Polanen, ALIL Chairman.

- increasing focus on regulatory factors with water use under increased scrutiny due to scarcity in some catchment areas and also new dam safety requirements (larger races are also captured by the same legislation)
- a number of newer schemes and proposed schemes that need to raise capital requiring greater discipline, and
- the standards and requirements needing to be met to access the Irrigation Acceleration Fund etc.

Other factors have also worked to limit the incentives to improve technical, allocative and dynamic efficiencies – most obvious of these is that many schemes charges have not covered the full operational, maintenance and particularly depreciation costs, and are levied on a per hectare basis rather than a peak supply or volume used basis. All of these signals can and are being improved via current and new infrastructure.

Due to the water measurement and reporting regulations 2010 the overall understanding of national water use and consent data is rapidly developing and has been a key focus of the freshwater reforms. The 2010 Aqualinc analysis concluded that actual water use assessments showed that the percentage of water use compared to the consented allocation varies between regions from below 30% to nearly 200%.

The 2012 data also shows a trend towards more effective irrigation methods. Between 2007 and 2012, flood systems have decreased from 18% to 13%, conversely, more efficient spray and drip-micro systems have increased.



Source: Statistics NZ

What future trends and scenarios may impact productive water infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand).[4] The results of this investigation have been published in a separate document available on the NIU website, but relevant extracts for the Productive Water sector are reproduced below.

Implications for productive water infrastructure in the central scenario

In the central scenario, global demand for commodities is assumed to increase as the world population grows, incomes rise and consumer preferences change. Developing countries are driving a structural shift in commodity demand. A recent Reserve Bank report (Sullivan & Aldridge, 2011) describes this phenomenon:

> *Growth in food demand is fastest in the early stages of a country's development. As countries become wealthier, consumer preferences switch from merely more food, to higher nutrient food. So in the initial stages of development a country may consume higher quantities of rice, but as wealth continues to grow, other grains, such as wheat, become more popular, and then dairy and meat become larger parts of the national diet. Eventually food demand becomes dictated more by population growth than income growth.*

[4] Each scenario has an associated set of projections of future infrastructure demand. The NIU has not produced any new models or forecasts in this regard. Rather, we rely upon existing sector data and forecasts where applicable and relevant.

EVIDENCE BASE: PRODUCTIVE WATER

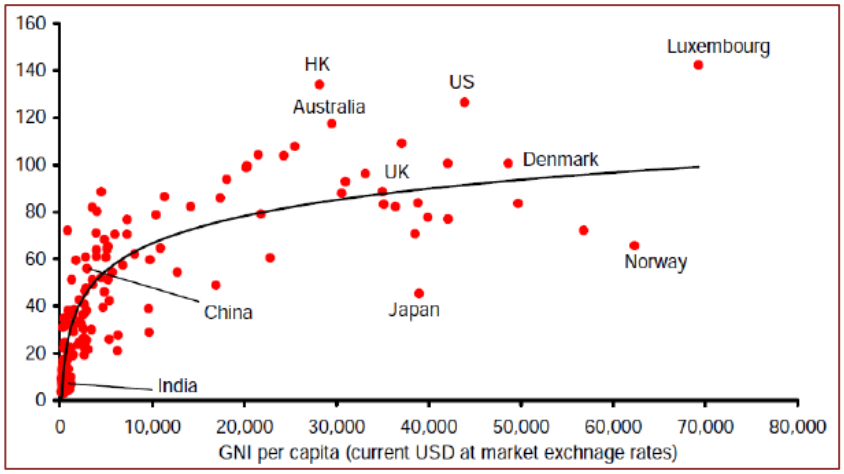
This trend is especially evident in Asia where it appears that incomes still have much room to rise. Sullivan & Aldridge (2011) cite a comparison of China with Taiwan to illustrate this point (data collated by Nomura Global Economics):

Average per capita annual food consumption (kilograms)

Period	GNI per capita (USD)	Grain	Vegetables	Meat	Milk	Fruit
Taiwan						
1975	979	162	110	27	15	55
1980	2,394	134	130	43	25	70
1985	3,368	110	103	56	32	112
1990	8,325	102	93	63	43	132
1995	13,103	100	102	73	59	137
China						
2000	934	265	132	39	3	46
2005	1,734	376	168	48	11	62
2008	3,427	444	171	42	15	65

Source: Taiwan Council of Agriculture, China Statistical Yearbook and Nomura Global Economics (cited in Sullivan & Aldridge, 2011)

Similarly, Sullivan & Aldridge note that annual per capita meat consumption correlates closely with per capita income around the world (graph data from FAO, World Bank and Nomura Global Economics).

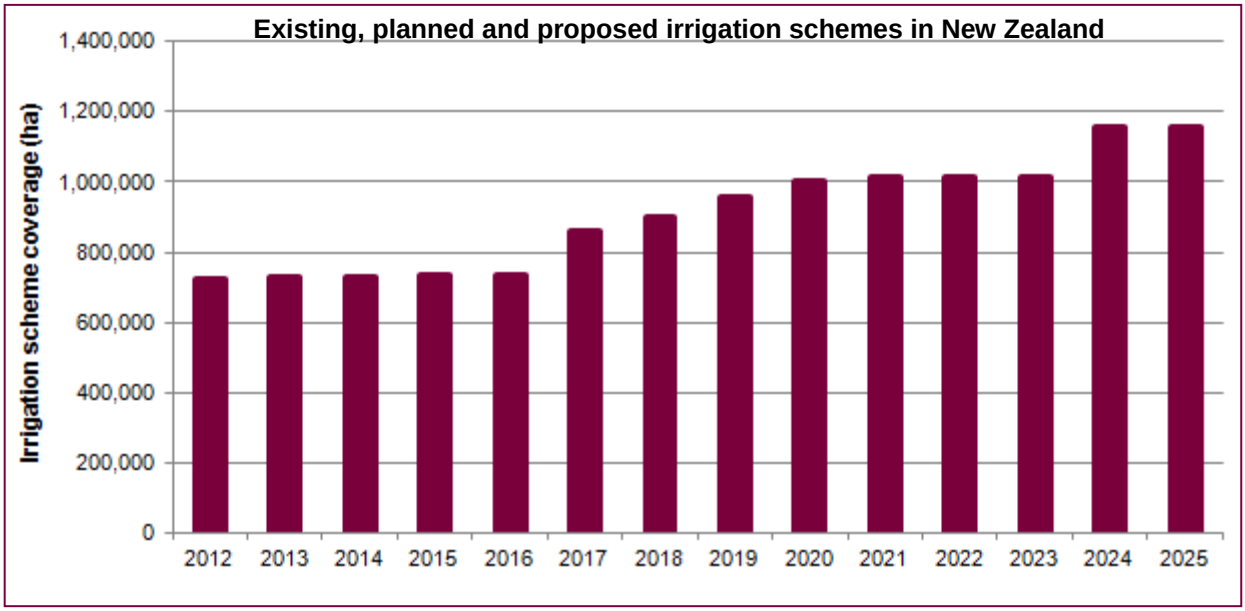


Based on this data, the central scenario assumes that global economic growth, and Asian growth in particular, will bolster demand for proteins from New Zealand. This trend will be facilitated by both our geographic proximity to Asia and our relative abundance of water which gives us a comparative advantage in agricultural commodities markets.

Along with commodity-based water demand in the central scenario comes a gradual increase in demand for recreational and environmental benefits. Combined with climate change predictions, this will drive the need for reliable infrastructure to store and distribute alpine-sourced water to take the pressure off groundwater and coastal rain-fed rivers along the east coast of both islands.

The following graph estimates our total area of irrigated land over the next 10 years based on existing proposals. Whether these proposals proceed, or are supplemented by even more schemes, depends on the continued strength of global agricultural commodity demand and the availability of water sources.

EVIDENCE BASE: PRODUCTIVE WATER



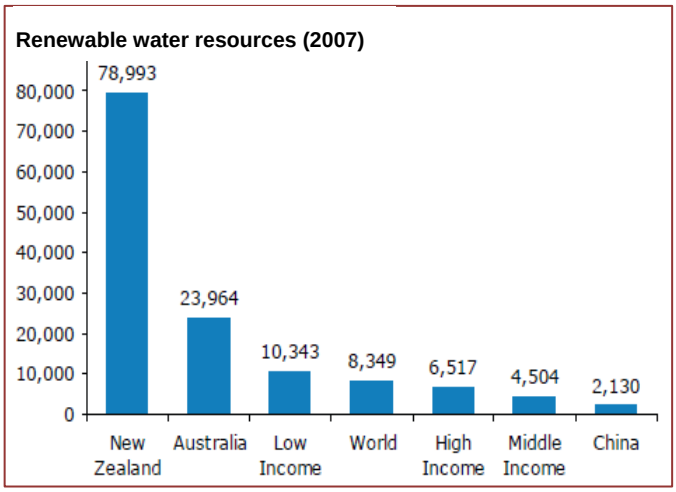
Source: ANZ, MPI, Irrigation NZ and Treasury analysis (2013)

Finally, at the same time that we face high demand for our commodities (especially animal proteins), the intensification of grazed animal land uses in New Zealand will keep the spotlight on water quality in the coming years. The convergence of environmental, social, cultural and economic interests will likely drive the need for new infrastructure, technology and management practices to maintain or improve the health of our waterways. The government is currently investigating a number of reforms to ensure the quality and quantity of our fresh water meets the needs of stakeholders.

Implications for productive water infrastructure in the upside scenario

In the productive water sector, climate change, with projected impacts on rainfall and hydrology, will have a major impact on irrigation schemes. There will be regional differences in changes in rainfall, presenting localised challenges for those designing and managing irrigation schemes (Office of the Prime Minister's Chief Science Advisor, 2013). The same report also highlighted that changes in seasonal river flows and snow melt are likely.

The extent to which storage is available (or needed) for our irrigation schemes will be a key factor in the infrastructure response to climate change. Although climate change will stress our local resources to some extent, our relatively bountiful water resources in other regions may be a strategic advantage from a macro perspective.[5] Irrigation infrastructure can be used to collect allocated water from one catchment and apply it in another. In the right circumstances, this can alleviate allocation pressure in catchments with scarcity and provide water for environmental flows and recreational pursuits.



Source: ANZ, United Nations ESCAP

[5] An increase in population and higher incomes for New Zealanders may further increase the domestic demand for water (including environmental awareness and recreational uses). This will increase our requirements for water infrastructure and highlights the need for robust systems that allocate and manage water quantity and quality across the various sectors of our society (e.g. urban water, productive water, environmental flows).

EVIDENCE BASE: PRODUCTIVE WATER

Implications for productive water infrastructure in the downside scenario

Although climate change will be less concerning in the downside scenario, demand for productive water infrastructure will also be relatively low due to weak demand for our agricultural products.

Also, a proliferation of new technology, coupled with better information links through programs such as the Rural Broadband Initiative, will drive innovation and productivity in the agricultural sector. Low cost sensors for water, crops, livestock, weather and geospatial data may reduce or defer the need for capital upgrades. On the other hand, technology may in fact drive additional infrastructure investment – if, for example, better assets and more storage is required to ensure the water supply is reliable enough to make the technology investment worthwhile.

EVIDENCE BASE: PRODUCTIVE WATER

Sources

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INFRASTRUCTURE EVIDENCE BASE

Social Sector

February 2014

NATIONAL INFRASTRUCTURE UNIT

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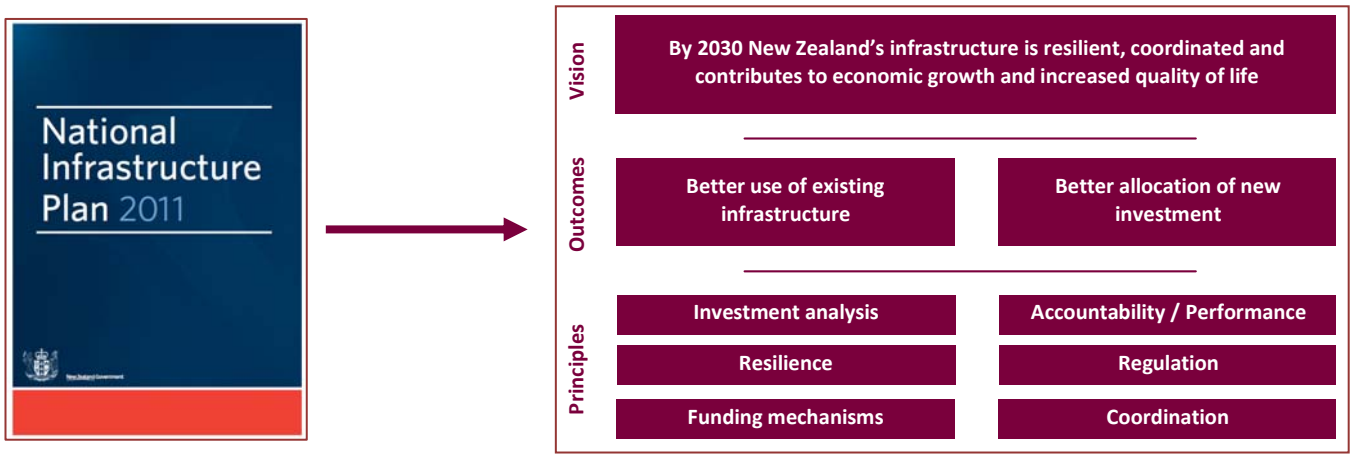
EVIDENCE BASE

Social Sector

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for the social sector, defined by NIU as the assets needed to deliver social services to the public. These social services include social housing, health, education, justice (including police, courts, and corrections), and elements of defence infrastructure. It follows from the overview document, which can be found on the NIU's website.

NIU has not produced a full evidence base for the social sector as the Treasury has been undertaking a separate exercise to develop the *2014 Investment Statement*.[1] For the first time, the Investment Statement will have a focus on property, plant and equipment and

[1] Under section 26NA of the Public Finance Act, Treasury is required to develop an Investment Statement before the end of 2017 and then at intervals not exceeding four years. The overall purpose of the 2014 Investment Statement is to provide Ministers, Members of Parliament, taxpayers, journalists, investors, lenders, government agency staff, and rating agencies an overview of the state of the Crown's assets and liabilities, and frameworks for considering performance and key risks in a single document. The first Investment Statement was produced in 2010 followed by a supplement in 2011, both are available on the Treasury website.

include a detailed analysis on the performance of social assets on the Crown's balance sheet. NIU has been involved in the production of the Investment Statement and as a result has not duplicated the work here. Instead, this document provides an overview of the social sector, drawing upon the work of the Investment Statement and several other key studies. The Investment Statement is expected to be published shortly and will be available from the Treasury website. It also provides information drawn from the resilience assessment and scenario and trend analysis completed by NIU.

Where data has been provided, this is publically available information, and has been provided with permission of the information owner.

Overview messages

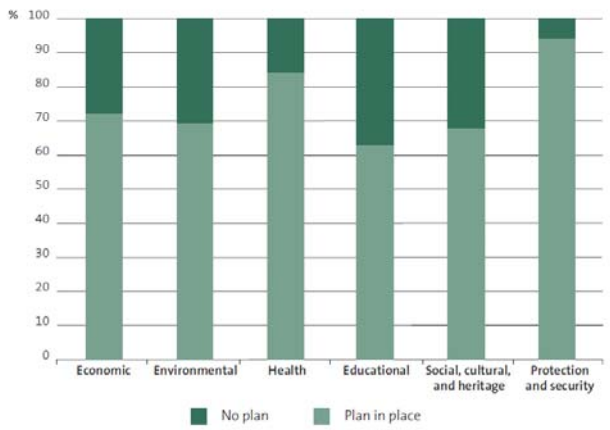
The social sector has made substantial progress in recent years, especially in areas of asset management, capital planning, procurement, and the allocation of capital. The Government's Better Business Case (BBC) process continues to develop, and an external review conducted in July 2013 found widespread user endorsement of, and support for, BBC method and guidance. Equally there has been some positive movement in procurement with new Government Procurement Rules coming into effect in 2013 and the two pathfinder Public Private Partnerships close to completion – the PPPs focus on innovation has demonstrably changed agencies thinking on delivering outcomes. Further PPPs are being developed, including the first transport PPP, Transmission Gully.

There is a growing awareness that capital asset management is important, and capital-intensive agencies are expected to demonstrate a level of asset management practice and performance that is appropriate to the scale of assets under their management and the criticality of those assets to the delivery of key public services.

However, there are still significant improvements that can be made. Asset management has traditionally been underdeveloped. An independent report on asset management maturity was commissioned from GHD Ltd in 2011/12, which provided useful baseline data across 13 of the capital intensive agencies that together manage over $66 billion worth of physical assets and software. The report showed that all but one agency had a gap between current and target levels of asset management maturity. The chart on the following page highlights the 17 attributes of asset management that span the asset life cycle, demonstrating the wide variety in maturity around them. Some of the largest gaps are in planning and asset information systems, which are key to enabling a more mature practice.

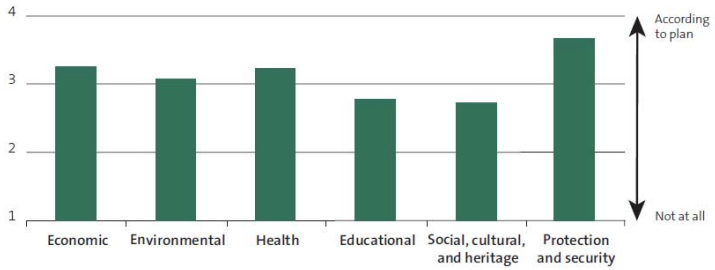
Equally, in June 2013 the Office of the Auditor-General published the *Managing Public Assets* report and showed that although most public entities understand the importance of planning for assets (with plans in place for about 75% of assets), most assets across all service groups varied in the extent to which they were being managed, including some where the plans were not being followed at all. It was also found that asset condition information is not being regularly reported to decision-makers.

Maintenance and renewal profiles, by service group



Source: The Office of the Auditor-General

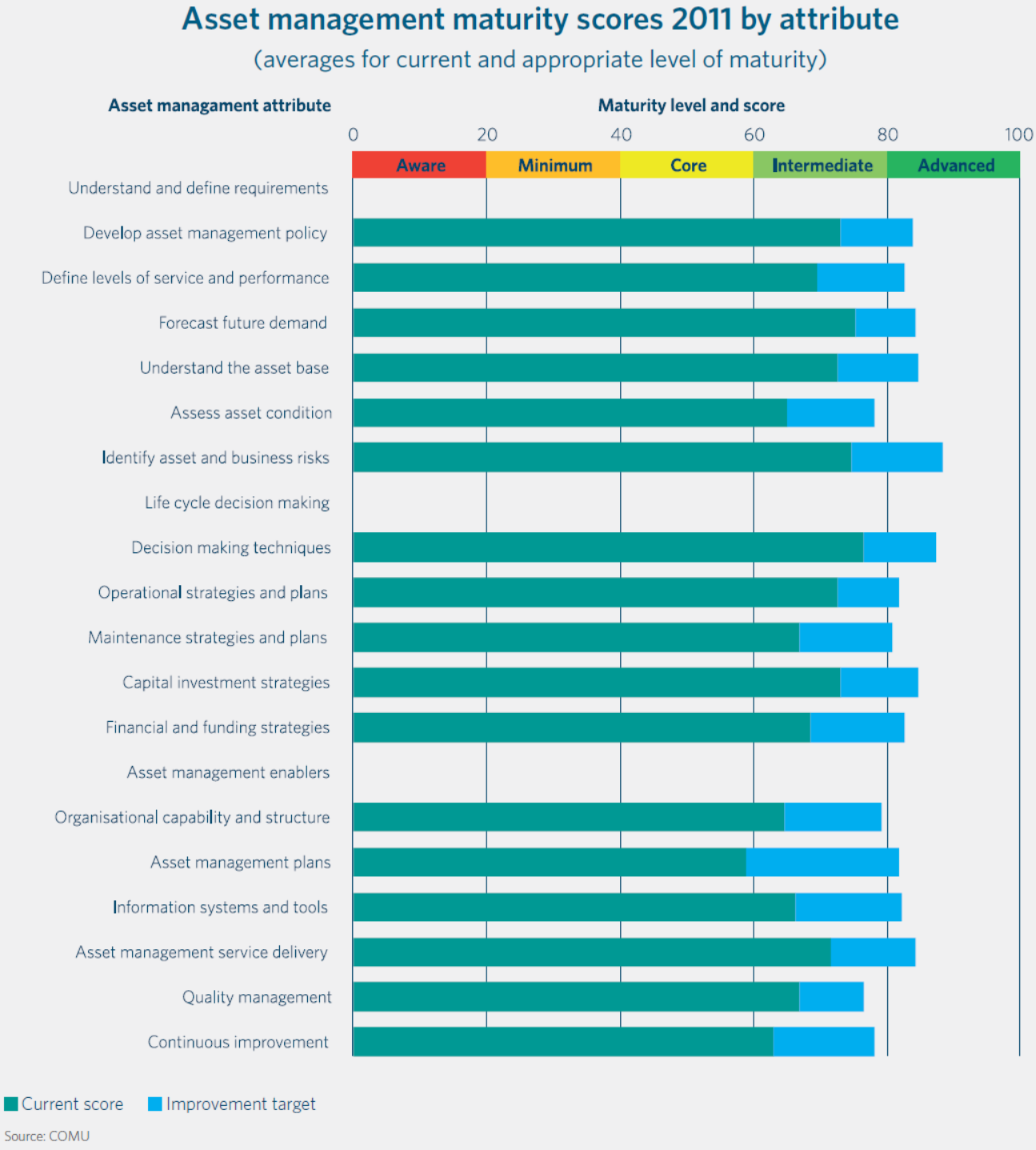
How well maintenance & renewal plans are followed, by service group



Note: These averages were calculated based on the responses on a scale of 1-4, with 1 specified as "not at all" and 4 specified as "according to plan". Grades 2 and 3 were not specified.

Source: The Office of the Auditor-General

EVIDENCE BASE: SOCIAL SECTOR



In addition, there are challenges the sectors need to address in the future. Reflecting the detail contained in the upcoming 2014 Investment Statement and the view of the NIU, some of the broad themes that emerge for social infrastructure are highlighted below:

- Demographic changes will have a significant impact on future service needs. Increased urbanisation has led to asset over- and under-utilisation of assets, and changes in the proportion of the population within different age groups will also affect the demand for different social sector services. Resources could be more effectively used if the asset base is rationalised and aligned with demand expectations.

EVIDENCE BASE: SOCIAL SECTOR

- The age of social assets means that there is a specific need for a step change in asset management over the next 10-20 years. The large number of older assets means decisions will need to be made on whether to replace or maintain them to meet future service needs. This provides an opportunity for new thinking on how infrastructure supports service delivery and exploring demand as well as supply-side options.
- There is a lack of coordination across the social sector as a whole when developing individual capital asset plans, whilst coordination within specific sectors varies.
- Crown assets can be utilised more effectively to avoid unnecessary additional expenditure which results in poor value-for-money for the taxpayer. This can be achieved through a reprioritisation of the estate and the policies that dictate asset use. Again, there are opportunities here to explore demand-side options and innovation in service delivery.
- The availability, quality, comparability, and consistency of data on social asset performance varies across different sectors. There is a need to develop a similarly high standard of information on the state of assets and their performance within the social sector, and to integrate this understanding into making better capital decisions.
- Technological advances continue to play a significant role in determining the size and type of asset base required to deliver social services. The rapidity of technological progression will demand a more flexible approach to infrastructure investment, which will ensure that infrastructure remains adaptable to the ever-changing means of delivering social services.

Context

As at 30 June 2013, the total value of the Crown's social assets was $124.3 billion. Almost half of the Crown's social asset portfolio is held in three areas – state highways, state housing, and primary and secondary schools. Based upon the 2013 Budget forecasts, social assets are expected to grow from $124.3 billion in 2013 to $131.0 billion in 2017, an increase of 5.1%.

As noted earlier, NIU has not produced a full evidence base for the social sector as the Treasury has been separately developing the *2014 Investment Statement*, which includes a detailed analysis on the performance of social assets on the Crown's balance sheet. NIU has been involved in the production of the Investment Statement and as a result has not duplicated the work here. As this chapter instead provides an overview of the social sector (based on the Investment Statement and other key studies), some of the subsections present in the other sector specific narratives are not reproduced here.

EVIDENCE BASE: SOCIAL SECTOR

Resilience

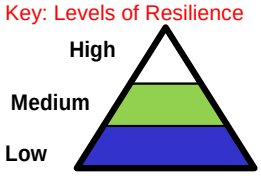
Required levels of resilience will vary depending on perspective. This assessment is made at a national level and is yet to be developed with robust supporting evidence. It does however assist in prioritising efforts.

NIU defines the resilience of infrastructure to include not just the physical or hard assets but also other aspects such as how infrastructure organisations function, capacity and capability to fund, and community awareness. To provide an assessment of resilience, the social sector has been disaggregated and qualitative methods applied to compare resilience expectations with assessed level of resilience to identify desired improvements in resilience. These tabulations have been publicly available and presented in various forums through 2012 and 2013 and continue to evolve as new information comes available.

At this stage the resilience assessment for the social sector is least developed but it is noted that it is probably the sector most vulnerable to interdependency issues being very dependent on all other sectors and being a primary interface with communities.

In the table resilience expectations from a national perspective are identified as low medium or high. When making these judgements a wide range of aspects require consideration. Particularly for social assets, very specialised facilities tend to warrant high levels of resilience whereas if the functions can be relatively easily undertaken elsewhere then a low resilience expectation is appropriate. To demonstrate; under "Courts" the functions undertaken can be undertaken in alternate facilities (low "Resilience Expectation") but "Regional hospitals" provide specialised facilities and associated services (high "Resilience Expectation"). Under this assessment police, health laboratories and regional hospitals deserve specific attention but a more robust assessment may indicate alternate priorities.

Key: Levels of Resilience



Social	Resilience Expectations	Assessed Resilience	Desired Movement
Education			
Pre-school			–
Primary School			–
Secondary school			–
University/Post Secondary			–
Justice			
Police			↑
Corrections			–
Courts			–
Health			
Laboratories			↑
Medical Centres			–
Local/specialised hospitals			–
Regional hospitals			↑
Housing			
Individual houses			–
Housing blocks			–
Suburbs			–
Defence			
Airforce assets			–
Navy assets			–
Army assets			–

What future trends and scenarios may impact social infrastructure?

As part of the development of the Evidence Base for New Zealand's infrastructure, the NIU has undertaken an investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios: a central scenario (best estimate of future infrastructure demand), an upside scenario (high infrastructure demand) and a downside scenario (low infrastructure demand).[2] The results of this investigation have been published in a separate document available on the NIU website, but relevant extracts for the Social infrastructure sector are reproduced below.

Implications for social infrastructure in the central scenario

Social infrastructure is most directly impacted by demographic change, which forms the main part of this discussion. The increased use of technology, although it shows promise for better utilising social assets, is expected to become only gradually more integrated over time in the central scenario – causing relatively minor overall impacts.

[2] Each scenario has an associated set of projections of future infrastructure demand. The NIU has not produced any new models or forecasts in this regard. Rather, we rely upon existing sector data and forecasts where applicable and relevant.

EVIDENCE BASE: SOCIAL SECTOR

Education

Demand for education infrastructure is influenced by fertility rates, migration levels and retention rates. In this analysis, we rely upon Ministry of Education school roll forecasts for primary and secondary schools (National School Roll Projections: 2011 Update). The medium scenario in the school roll projections aligns with the medium population growth assumed in our central scenario.

Figure 1: Primary school roll projections to 2030

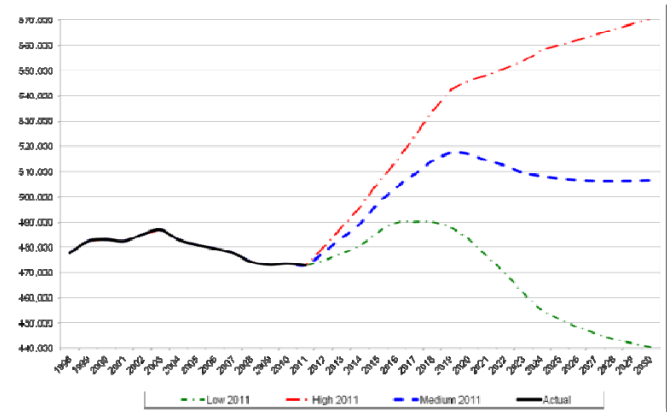
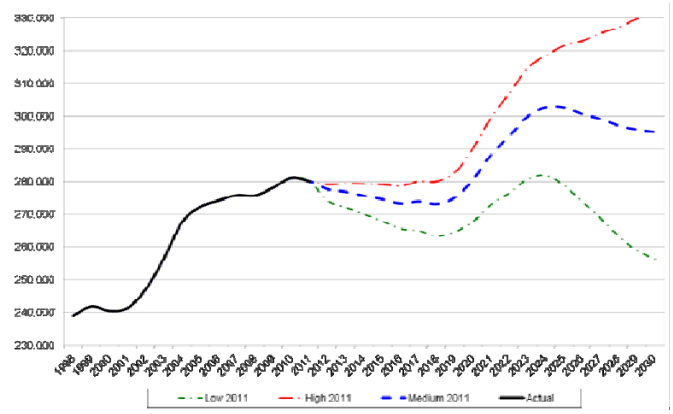


Figure 2: Secondary school roll projections to 2030



Source: Ministry of Education (2011)

In the central scenario, the total school roll is projected to peak in 2024 at approximately 810,000 full-time equivalents (from 755,000 in 2012). After 2024, the school roll is expected to diminish which is consistent with the general trend of an ageing population.

However, considering the school roll projections at a national level masks the substantial variation that is expected to occur at a regional and local level. For example, based on Stats NZ medium projections from 2011 to 2031, the population aged 0 to 14 in the Ruapehu district will decline by 36% while in the Selwyn district it will increase by 30%. Overall, 50 of 67 territorial authorities will have fewer children in 2031 than they had in 2011. These changes will have direct implications as to whether new schools are required and whether existing schools need to be upgraded or rationalised.

Justice

As with education infrastructure, assets in the justice system are closely linked to population. The Ministry of Justice reports that the most influential factors affecting justice forecasts are (Justice Sector Forecasts 2012-2022):

- Number entering the courts system (the single most significant variable)
- Proportion of people remanded in custody
- Average time spent on custodial remand, and
- Proportion of imposed sentence served in custody (excluding remand).

These variables are not explicitly included in our central scenario assumptions. However, the Ministry of Justice forecast is based on the Stats NZ medium population projection, which is consistent with the central scenario we have developed. Graphs from the Ministry of Justice study are reproduced below:

Figure 3: Prison population forecast to 2022

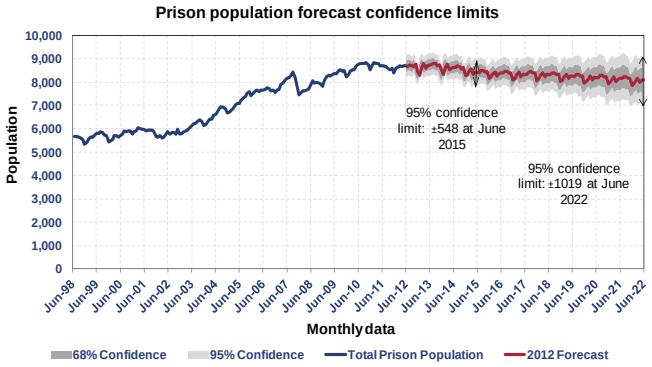
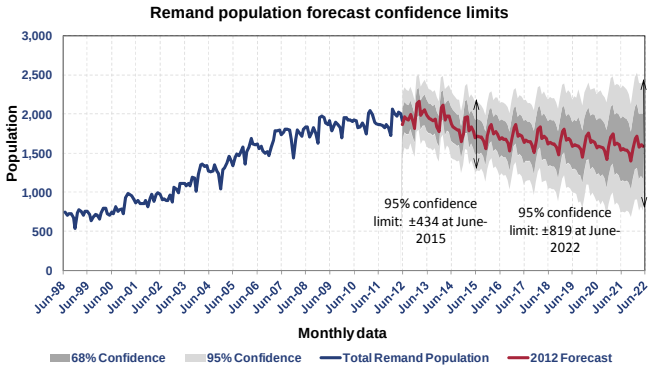


Figure 4: Total remand population to 2022



Source: Ministry of Justice (2012)

In general, the national trend is for decreased demand in our justice system. However, this is likely to vary by region. Although the trend may be downward overall, no further analysis has been conducted for this exercise and it is possible that urban areas experiencing high growth will see an increase in demand for justice-related infrastructure – against the national trend.

Health

Demand in the health sector is related to demographics (population growth, age cohorts), income effects and health sector productivity. The central scenario assumes a business as usual trend with respect to income and productivity, with the most tangible link to health infrastructure demand being demographic change.

As with all social infrastructure, future demand will be subject to significant regional variation in the central scenario with urban centres (especially Auckland) experiencing high population growth which will place pressure on health infrastructure. Similarly, our maturing population will place high demand on aged care facilities and assessment, treatment and rehabilitation (AT&R) services.

Implications for social infrastructure in the upside and downside scenarios

Social infrastructure is primarily impacted by higher or lower levels of population growth (and the location in which these changes occur).

In the education sector, the combined primary and secondary school roll is projected to reach between 700,000 and 900,000 students by 2030. Although Ministry of Education projections do not specifically note where these students will be located, the associated Stats NZ population projections show the most substantial variation in the upper North Island (and to a lesser extent, other major urban centres).

Similarly, the prison population is expected to range between 7,000 people in the downside scenario to 9,000 people in the upside scenario. Again, the spatial distribution of the impact is unknown but is expected to be primarily urban in line with population projections.

Finally, in the upside scenario, the ageing of our population is slower than expected with high inward migration and high fertility rates. When compared to the central scenario, this is expected to increase the burden on maternity services and early childhood care – but will reduce the burden (in relative terms) on aged care facilities. In the downside scenario, the situation is reversed –decreasing the burden on maternity services and early childhood care, but increasing the burden on aged care facilities.

EVIDENCE BASE: SOCIAL SECTOR

Sources

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INFRASTRUCTURE EVIDENCE BASE

Scenario/Trends Analysis

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

SCENARIO/TRENDS ANALYSIS

A Discussion Document by National Infrastructure Unit

February 2014

The government committed to a number of actions to give effect to the vision and guiding principles that underpin the 2011 National Infrastructure Plan. A core group of these actions relate to building an evidence base to better understand:

- the **pressures** that place future demand on our infrastructure (scenario modelling workstream)
- the current **state** of our infrastructure (performance indicators, resilience and capital intentions), and
- the **response** to changes in the state and pressures on our infrastructure (an upcoming suite of initiatives).

This publication supports the first action (above) by summarising the outcomes of the investigation into future pressures placing demand on our infrastructure for a range of plausible scenarios.

Objective

The purpose of the scenario modelling workstream is to answer the following key questions regarding infrastructure:

- What are the future drivers of demand?
- Based on these drivers, what are the plausible alternative scenarios for future demand?
- What are the implications from a cross-sector, whole of New Zealand viewpoint?

Methodology

The scenario modelling workstream commenced in May 2013, with the National Infrastructure Unit (NIU) identifying major trends already noted by infrastructure sectors. Workshops were held with stakeholders to discuss these trends and to consider what scenarios would be of most value for the NIU to develop.

Further consideration has led to NIU using the following methodology to undertake the scenario modelling exercise:

1. Conduct a preliminary desktop review to gather existing trend data from infrastructure sectors
2. Hold a series of workshops across New Zealand to solicit input on key trends and possible scenarios for consideration
3. Conduct an in-depth review of trend data for key drivers of demand
4. Using the key drivers of demand that have been identified, create three cross-sector, whole of NZ scenarios that represent alternate views of future demand
5. For each scenario (central, upside and downside), analyse the future implications for NZ infrastructure using existing sector data
6. Consult with stakeholders to test the scenarios and outcomes of the analysis – and revise accordingly
7. Produce a clear and concise report summarising the scenario modelling outcomes as part of the evidence base

N.B. NIU is not producing any modelling itself, but using sector data and scenarios.

Scenario modelling in the context of supply and demand

New Zealand's demand for infrastructure is constantly changing. In this publication, we develop three alternative scenarios of the future and then rely on existing modelling (by each sector) to translate these scenarios into expected infrastructure demand.

The supply-side response to future demand is outside the scope of this publication. Instead, the way in which we respond to future pressures is addressed through other NIU workstreams (e.g. demand management, capital intentions plan) and will be a key focus of our work over the coming year.

SCENARIO/TRENDS ANALYSIS

Scenarios, forecasting and the strategic planning process

Gazing into the crystal ball of New Zealand's infrastructure is an inherently hazy endeavour. We cannot, with absolute clarity, predict the location and timing of our infrastructure investment needs over the next 50 years. We can, however, ensure that we have the correct processes and systems in place to effectively inform our decision making.

In that context, strategic planning relies (in part) on two related, but distinct, processes for understanding our future requirements – namely, scenario planning and forecasting. The New Zealand Transport Agency (NZTA) defines these techniques in the following way:

- **Scenarios** – an alternative set of possible futures. Scenarios say what might happen given a set of observed mega-trends. Scenarios do not predict the future; rather they help to guide our decisions using a qualitative view of what may lie ahead.
- **Forecasts** – a quantitative view of the future (either singular or alternative). Forecasting relies on trends and other input variables to predict a best estimate of what lies ahead.

The trends and scenario modelling described in this document represents somewhat of a hybrid approach. First, we build a set of scenarios that describe alternative views of the future (a central scenario, an upside scenario and a downside scenario). Then, to the extent that data is available, we make use of forecasts and projections that align with our scenarios in order to develop the evidence base that provides a quantitative range of future infrastructure demand.

Box 1. Scenario modelling in New Zealand

There are several government agencies in New Zealand that use scenario modelling as a planning tool. In this investigation, the NIU draws upon existing scenario data published by these agencies rather than producing new modelling. Accordingly, the NIU acknowledges the scenario modelling work completed by the following agencies:

- **NZTA** – NZTA have a well-established programme to analyse mega-trends and construct scenarios to inform their strategic planning process. NZTA's scenario planning is a continuously evolving process.
- **MoT** – the Ministry of Transport also uses scenario modelling and has been working with NZTA (in collaboration with NZIER) to develop a long term transport demand model. In addition, a Future Freight Scenarios study is underway and should be published in early 2014: http://www.transport.govt.nz/research/nationalfreightdemandsstudy/
- **MBIE** – The MBIE energy modelling team periodically updates a range of scenarios regarding energy demand, supply and generation: http://www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling
- We are also grateful for the input and comments received from a wide range of stakeholders – including numerous government agencies, private sector entities and academic institutions.

Other notable scenario modelling initiatives

Scenario modelling is used by numerous companies, governments and institutes around the world. Two notable initiatives (of many) are referenced below to provide a broader, international perspective:

- **Shell** – An early adopter of scenario planning. An extensive set of Shell's scenario publications and guidance can be found here: http://www.shell.com/global/future-energy/scenarios.html
- **International Energy Agency** – IEA use scenarios to investigate and model various alternative futures regarding energy and technology: http://www.iea.org/publications/scenariosandprojections/

Infrastructure and the driving forces of change

We have grouped the major trends affecting infrastructure demand into four categories: population, economy, technology and resources. The table below shows the variables with potential to exert the greatest influence on our infrastructure requirements based on NIU's analysis:

Table 1: Key drivers of change

1) Population	2) Economy	3) Technology	4) Resources
Total population Age profile Regional distribution	Demand for commodities Service sector growth Heavy industry decline Funding constraints	Intelligent networks Technology-driven behaviour change	Water quantity and quality Carbon price & emission limits Climate change impacts Oil / gas discovery & price movements

Source: NZTA mega-trends study (2012), Treasury analysis

The influence of any one driver of change (e.g. technology) cannot be entirely isolated from another (e.g. economy). Nor can these drivers of change be neatly separated into domestic and international components. Rather, a frequently reoccurring theme in this study is one of interdependence – between New Zealand and the global economy, between the key drivers of change and between our infrastructure sectors.

The relationship between infrastructure and each of the key drivers of change – population, economy, technology and resources – is discussed in more detail below.

1. Population

The number, age profile and spatial distribution of our population correlates strongly with the assets and networks that underpin our society – from schools and hospitals to water services, transport links and energy supply. Whether the population grows or declines, gets older or younger – and in which locations these changes occur – can have a widespread impact on future infrastructure investment requirements.

Whereas aggregate demand is important for some sectors (e.g. electricity, which has a national grid), local population is important for other sectors (e.g. water, where networks tend to be more localised).

Population trends: the central scenario (business as usual)

A summary of recent population projections by Statistics New Zealand (national, regional and age profile) is shown below:

Figure 1: Total population

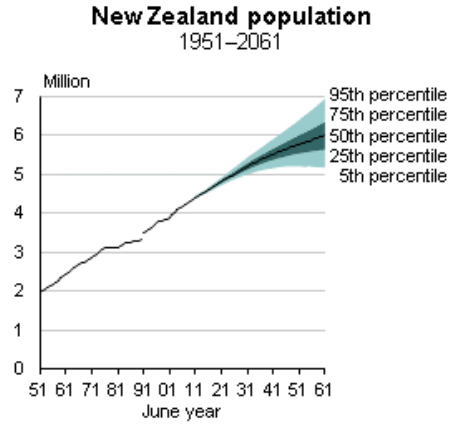


Figure 2: Age distribution

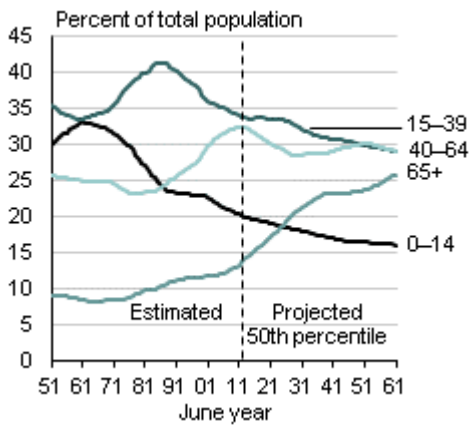
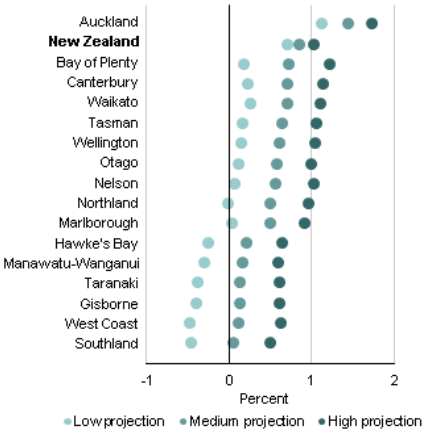


Figure 3: Regional growth



Source: Statistics New Zealand (2012)

SCENARIO/TRENDS ANALYSIS

By 2061, the population is estimated to increase from 4.5 million (2013) to 6.0 million based on the medium projection (i.e. the 50th percentile probability).

In the medium projection, the proportion of population aged 65+ (14% in 2012) is estimated to be 26% in 2061. Consequently, the rate of growth is projected to slow as our population ages.

Statistics New Zealand projects that 50 territorial authority areas will have fewer children in 2031 than in 2011 and 17 territorial authority areas will have less people outright by 2031 (although all regions are expected to grow over this time).

Urbanisation of our population is projected to continue, with the highest growth occurring in Auckland (reaching almost 2 million inhabitants by 2031 in the medium projection).

Key uncertainties: upside and downside factors

Key population uncertainties that may affect our infrastructure requirements include:

- **Total population** – ranging from 5.2 million in 2061 (low estimate) to 7.0 million (high estimate)
- **Ageing** – all projections show an increase in age. However, some uncertainty exists in the fertility rate and migration levels, and
- **Regional shifts** – the degree to which population consolidates in urban centres (especially the upper half of the North Island) will affect the size and location of some infrastructure.

Scenario development

Taking into account the business as usual estimates and key uncertainties, the potential future scenarios (as they relate to population) are summarised below:

Table 2: Population variables for each scenario

Driver of change	Central Scenario	Upside Scenario	Downside Scenario
Total population	6.0 million by 2061	7.0 million by 2061	5.2 million by 2061 (decline after 2051)
Age profile	Steady ageing	Slower ageing (high fertility & migration)	Accelerated ageing (low fertility & migration)
Regional distribution	Steady urban growth at rural expense	High urban growth and rural decline	Urban growth is constrained, rural growth static to declining

Source: Treasury analysis

2. Economy

The changing landscape of the New Zealand economy – and its interaction with the global economy – influences the type, location and amount of infrastructure that is required to enable our prosperity. In return, resilient, efficient and coordinated infrastructure networks are vital to a well-running economy.

As a small nation with an open market, trade is an essential component of New Zealand's economy through the export of goods and services and the import of raw materials and capital equipment. Maintaining a stable and transparent regulatory environment is also a key factor in encouraging both foreign and domestic investment in our country.

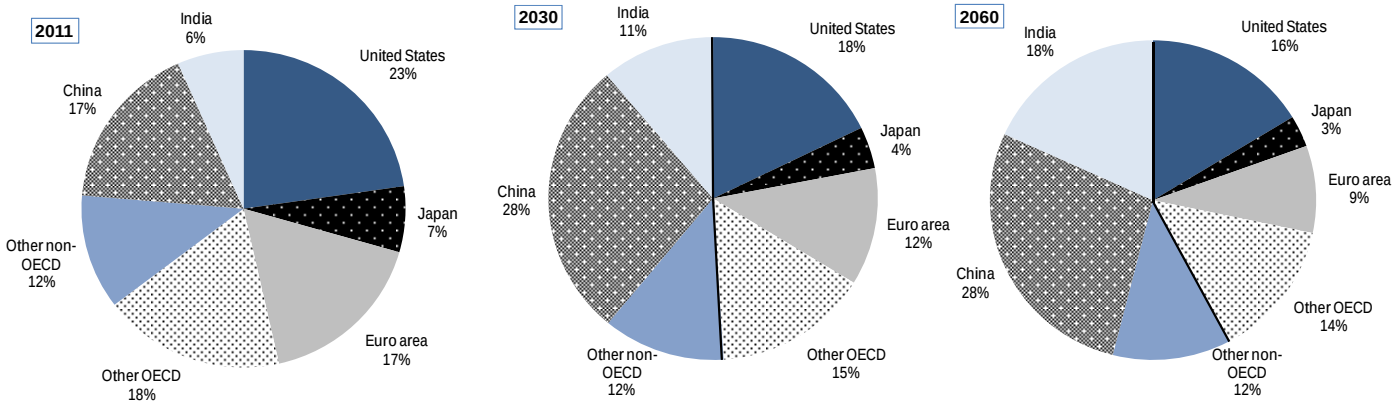
Our reliance on trade makes clear the critical role that our ports and airports play in linking New Zealand to the world. Similarly, our telecommunications infrastructure plays a supporting role in connecting us, socially and economically, to our neighbours in the Pacific and around the world.

SCENARIO/TRENDS ANALYSIS

Domestically, we depend on road and rail networks for the movement of goods and people. We also depend on reliable supplies of water, energy and social infrastructure to support our residents, communities and businesses. In addition, the efficiency with which these services are provided indirectly affects our global competitiveness.

Key economic trends

Taking a broad view of recent trends, the geographic context of the world economy is changing with the advent of the 'Asian century'. For example, China and India are projected to double their combined share of global GDP in the next 50 years, from 23% in 2011 to 46% in 2060 (OECD, 2012).



Source: OECD (2012)

The influence of China, in particular, on New Zealand's economy has grown in recent years. In 2008, China overtook the United States to become New Zealand's second largest trading partner after Australia (New Zealand Treasury, 2013). The projected rise in wealth, living standards and changing dietary tastes in China has implications for New Zealand in terms of our export commodities (e.g. dairy, meat, forestry) and our export services (e.g. tourism, education). A sustained increase in commodity demand will likely create a need for investment in our productive water infrastructure, freight networks and supporting infrastructure.

More immediately, the world economy continues to be plagued by uncertainty in the aftermath of the global financial crisis. The recovery has been uneven, with little to no growth in Europe, a moderate recovery in the United States and mixed results in the other advanced economies – with persistent upside and downside uncertainties projected to remain (OECD, 2013).

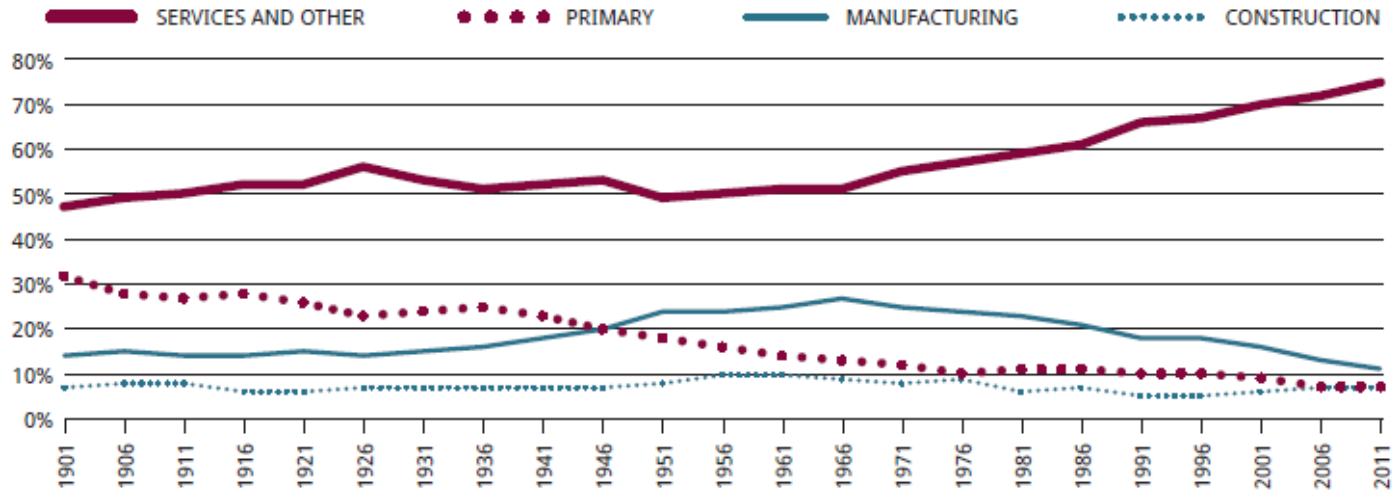
Turning toward the domestic economy, regional data paints a highly segmented picture. The Regional Economic Activity report (Ministry of Business, Innovation & Employment, 2013) shows:

- A divergence between overall economic activity (dominated by urban areas, especially Auckland) and export activity (dominated by the primary sector in rural areas), and
- Distinct regional activities, impacted by different trends and with different implications for infrastructure. Key statistics from the MBIE Regional Economic Activity report include:
  - Half of New Zealand's professional services workers live in Auckland and another 20% live in Wellington
  - The majority of our forestry industry is located north of Taupo
  - Over half of our petrol is processed at Marsden Point in Northland
  - Waikato (in particular) and increasingly Canterbury and Southland are key dairying regions
  - Sheep and beef farming is concentrated in the Manawatu-Wanganui, Canterbury and Otago regions, and
  - Mining is concentrated in the areas of the West Coast and the Coromandel.

SCENARIO/TRENDS ANALYSIS

The trend toward urbanisation of our population is mirrored by the trend of an increasing share of employment in the service sector:

Figure 4: Employment shares by industry (1901 to 2011)



Source: MBIE Regional Economic Activity Report 2013 (based on Stats NZ and NZIER data)

Key uncertainties: upside and downside factors

Key economic uncertainties that may affect our infrastructure requirements include:

- **Demand for commodities** –the increasing income and wealth of emerging economies has led to an increased demand for commodities. The degree to which the appetite for agricultural commodities is sustained will have a significant impact on New Zealand.
- **Service sector expansion** – the service sector as a share of New Zealand's employment has been increasing since the 1960s. The extent to which this trend continues (or regresses) is linked with the urbanisation of our population.
- **Heavy industry growth** – The future of heavy industry (e.g. wood processing, aluminium smelting) is uncertain – demand (or lack thereof) from these sectors can have a major impact on electricity demand (among other sectors).
- **Funding constraints** – events which lead to rising public debt levels may constrain our ability to build and maintain infrastructure. Low incomes and/or high infrastructure expenditure may similarly constrain consumer ability to pay.

Scenario development

Taking into account the business as usual estimates and key uncertainties, the potential future scenarios (as they relate to the economy) are summarised below:

Table 3: Economic variables for each scenario

Driver of change	Central Scenario*	Upside Scenario	Downside Scenario
Demand for commodities	Export volume growth at long-term trend rate	Rapid increase and sustained long-term demand for dairy, wool, meat, seafood	Decline in commodity export volumes and/or prices
Service sector expansion	Continued steady increase (esp. Auckland)	Rapid growth (Auckland-centric)	Decline or slow growth in services
Heavy industry (e.g. aluminium, wood processing)	Continued slow decline of most heavy industries	Return to peak demands	Rapid decline of heavy industry – individually or collectively
Funding constraints	Manageable public and private debt, consumer ability to pay	Low public and private debt, high incomes / consumer ability to pay	High public and private debt, low incomes / consumer ability to pay

Source: Treasury analysis. Note: The Central Scenario assumes national GDP growth in line with the Treasury's 2013 Statement on the Long Term Fiscal Position.

3. Technology

Innovation and technology drive productivity improvement and are the key enablers of long-run economic growth in New Zealand[1]. Although forecasting productivity improvement is fraught with difficulty, the last two decades have seen a proliferation of technology and innovation worldwide. How these new technologies are integrated into our industries, our behaviours and – indeed – into our infrastructure, may play a large part in determining future infrastructure needs.

Changes in technology may impact our future infrastructure requirements by:

- Creating demand for technology infrastructure itself (e.g. Ultra Fast Broadband)
- Altering demand and/or investment requirements by: influencing behaviours (e.g. smart meters), increasing asset performance and utilisation (e.g. intelligent networks), or adopting current design and operation methodologies when renewing century-old infrastructure, and
- Changing the structure and location of our industries (e.g. teleworking, online retail).

Most notably, through the Ultra Fast Broadband (UFB) initiative, the government has committed to installing a fibre network that will be available to 75% of New Zealanders by 2020 – a multi-billion dollar investment in new infrastructure. Combined with the Rural Broadband Initiative (RBI), the government estimates that 97.8% of New Zealand's population will have access to these schemes.

The UFB network and increased speed of mobile networks (i.e. 4G) may also enable an increase in teleworking. The resulting decrease in demand on our transport networks (during peak commuting hours) would create infrastructure savings, although it is difficult to ascertain the extent to which better, faster communication links will catalyse this behaviour.

[1] In telecommunications, the bulk of technology innovation takes place outside of New Zealand with the result that sector profitability is key to accessing those innovations for use in NZ.

Finally, the age of technology has the potential to change the entire structure of some industries – for example, forcing shopping centres and CBD retail precincts to focus on service-related activities rather than trading in products. This becomes relevant in an infrastructure sense when considering the impact on our transport networks. Although overall demand may not change, the altered patterns and timing of vehicle movements may have new, location-specific implications.

Box 2. Intelligent networks – making better use of existing infrastructure

Intelligent networks combine information and communication technology with hard assets (e.g. roads or power assets).

What is an intelligent network?

An intelligent network is one that:

- Can monitor performance, remotely sense asset condition, assess availability of the network, monitor utilisation and communicate this information to both users and managers of the network
- Can be embedded with new infrastructure or installed retroactively
- Is site-specific or system-wide

In essence, an intelligent network transforms 'dumb' assets into 'smart' assets and drives networks to work harder and perform better. The potential value offered by intelligent networks can be categorised in four ways:

- **Exploit existing capacity** by creating networks that can actively manage peak demands (defer the need for upgrades) or by removing the need to design assets for worst case scenarios (reduce the size of future upgrades)
- **Extend asset lives** through targeted, cost-effective condition monitoring and performance reporting
- **Reduce operating costs** – for example by deploying leak detection technologies combined with predictive analytics that reduce leakage, reactive maintenance and energy usage in water networks, and
- **Mitigate the risk of failure** by harnessing real-time data that enables informed decision making in both the short and long term.

Despite the potential benefits offered by intelligent networks, this is an emerging field with outcomes in some areas that are still uncertain. As with all infrastructure, the benefits must therefore be weighed against the costs of deployment.

One noteworthy initiative in the realm of intelligent networks is the Ministry of Transport's Intelligent Transport Systems action plan. Currently under consultation, this plan aims to capitalise on technological opportunities available in the transport sector (http://www.transport.govt.nz/ourwork/intelligenttransportsystems/).

Key uncertainties: upside and downside factors

Key technology demand uncertainties that may affect our infrastructure requirements include:

- **Emergence of intelligent networks** – integration of sensors, communication links, data analytics and control mechanisms with our infrastructure assets could greatly improve efficiency and utilisation. However, the timeframe for these developments is uncertain and the effectiveness – on a large scale – is still to be proven.
- **Technology-driven behaviour change** – technology has the potential to empower residents to control their timing and quantity of infrastructure consumption (e.g. smart energy meters, increase in telecommuting).
- **Adoption rates** – the rate at which New Zealand residents and businesses adopt the applications and services enabled by new technologies is one determinant in the timing of technology-based societal shifts.

Scenario development

Taking into account the business as usual estimates and key uncertainties, the potential future scenarios (as they relate to technology) are summarised below:

Table 4: Technology variables for each scenario

Driver of change	Central Scenario	Upside Scenario*	Downside Scenario*
Emergence of intelligent networks	Gradual integration of technology with assets	Slow integration of technology with assets	Rapid integration of technology with assets
Technology-driven behaviour change	As projected UFB take-up and 4G / 5G mobile demand	Slow adoption of UFB and low 4G / 5G mobile network usage	Rapid adoption of UFB and high 4G / 5G mobile network usage

Source: Treasury analysis. Note: The upside scenario relates to high infrastructure demand (viewed as low technology usage) – and the reverse for the downside scenario. Demand for technology infrastructure itself is taken as a by-product of these changes.

4. Resources

Resource availability can be both a constraint and an enabler for our economy. For example, 47% of the world population is projected to live in areas of high water stress by 2030 (OECD, 2008). If this trend continues, New Zealand will be well placed to leverage our relatively bountiful water resources to produce water-intensive agricultural commodities for export to drier and less fertile parts of the world. Nonetheless, domestic demand for fresh water may arise from multiple sources – agricultural, urban, recreational, environmental and cultural – driving a need for mutually beneficial solutions where localised water scarcity emerges in New Zealand.

Sitting alongside water quantity as a key driver of change is the water quality in our lakes and rivers. Changes in market or societal expectations in managing water quality may emerge through pathways such as consumer preferences based on environmental accreditations, regulations or environmental limits. At the same time, demand for our agricultural commodities (especially from grazed animals[2]) may focus more attention on ways to achieve good water quality outcomes for all sectors of society.

Constraints in other resources, such as emissions limits and carbon pricing, may present both risks and opportunities for New Zealand. Similarly, a changing climate – whether more frequent floods and droughts, increasing temperatures, higher sea levels or changing patterns and locations of rainfall – presents us with risks (domestically) and opportunities (if we are less severely affected at the margins than other regions of the world).

Apart from water and climate, oil and gas are also important resources that can drive a change in infrastructure demand. Almost 40% of our consumer energy is used for transport – and oil accounts for approximately 98% of our transport fuel.

Separate to fuel for the transport system (which is mainly imported), the discovery of new oil and gas reserves within New Zealand may create high demand for infrastructure.

[2] It is expected that agricultural land will be used to generate the highest and best value over time. At present, the trend is toward producing animal proteins – which can increase contaminant loading in waterways in the absence of appropriate management techniques (whether infrastructure-based or non-infrastructure solutions). However, it should be noted that intensified land use may in fact shift over time to activities that do not place as much pressure on water quality as does animal grazing (aided by irrigation infrastructure which improves water supply reliability and enables a wider range of land use including annual crop-based uses).

Box 3. Climate change impacts in New Zealand

The Ministry for the Environment (MfE) projects the likely climate change impacts in New Zealand to be:

- higher temperatures, more in the North Island than the South, (but still likely to be less than the global average)
- rising sea levels
- more frequent extreme weather events such as droughts (especially in the east of New Zealand) and floods
- a change in rainfall patterns - higher rainfall in the west and less in the east.

The MfE lists the following potential positive and negative effects from the changing climate:

- agricultural productivity is expected to increase in some areas but there is the risk of drought and spreading pests and diseases. It is likely that there would be costs associated with changing land-use activities to suit a new climate
- people are likely to enjoy the benefits of warmer winters with fewer frosts, but hotter summers will bring increased risks of heat stress and subtropical diseases
- forests and vegetation may grow faster, but native ecosystems could be invaded by exotic species
- drier conditions in some areas are likely to be coupled with the risk of more frequent extreme events such as floods, droughts and storms
- rising sea levels will increase the risk of erosion and saltwater intrusion, increasing the need for coastal protection
- snowlines and glaciers are expected to retreat and change water flows in major South Island rivers.

Source: Ministry for the Environment (http://www.mfe.govt.nz/issues/climate/about/impacts.html)

Key uncertainties: upside and downside factors

Key uncertainties regarding resources that may affect our infrastructure requirements include:

- **Carbon price and emissions limits** – a high carbon price – if it eventuates – is likely to reduce energy usage.
- **Climate change impacts** – the rate at which the sea level rises will have varying impacts on our low-lying, coastal infrastructure, and an increasing prevalence of droughts will threaten the productivity of our agricultural sector.
- **Water quantity and quality** – global water scarcity may be beneficial given our relatively high availability of renewable water resources (although domestic water scarcity is likely to exist in some areas). Increasing demand and expectations for both water quantity and water quality may lead to competition between agricultural, environmental, recreational and cultural sectors for both abstraction and discharge rights.
- **Oil / gas discovery** – much of our oil and gas infrastructure is based in Taranaki. A major discovery elsewhere (if it requires onshore processing) may create significant demand for new infrastructure. Similarly, a major new discovery in Taranaki would increase the pressure on infrastructure that is already in high demand. On the other hand, declining domestic gas production may shift the focus to infrastructure required for increased energy importation.

SCENARIO/TRENDS ANALYSIS

Scenario development

Taking into account the business as usual estimates and key uncertainties, the potential future scenarios (as they relate to resources) are summarised below:

Table 5: Resources variables for each scenario

Driver of change	Central Scenario	Upside Scenario	Downside Scenario
Carbon price & emission limits	$25/tonne carbon price (from MBIE scenarios)	$0/tonne carbon price (from MBIE scenarios)	$100/tonne carbon price (from MBIE scenarios)
Climate change impacts	Climate change as per Intergovernmental Panel on Climate Change projections	Rapid sea rise, increase in rainfall variability and extreme events	Low sea level rise, small change in frequency of events (drought / flood)
Water quantity and quality	Gradual increase in water scarcity and market or societal expectations for water quality	Rapid increase in water scarcity and market or societal expectations for water quality	Static or decreasing scarcity and low market or societal expectations for water quality
Oil / gas discovery	Business as usual oil / gas discovery	Significant oil / gas discovery (especially, but not limited to, regions other than Taranaki)	Little to no discovery of new, commercially viable oil / gas reserves in NZ

Source: Treasury analysis

Infrastructure and interdependency – current and future trends

With a collective value well in excess of $100 billion, New Zealand's infrastructure networks are vast and complex. Although frequently viewed as isolated sectors, our infrastructure is increasingly comprised of a series of interconnected systems.

For example, the energy sector relies upon process water for heating and cooling (or directly, for hydro generation). On the other hand, energy is an essential input enabling the distribution of potable water and treatment of wastewater. Taking another view, the geographic proximity of infrastructure networks often creates an intrinsic linkage (e.g. water pipelines installed underneath roads).

The trend of increasing interdependency is a double-edged sword. The integration of information and communication technology with hard infrastructure shows great promise in increasing the efficiency and effectiveness of service provision. However, interconnectedness can elevate risk exposure – where failure in one network can quickly propagate through other infrastructure networks.

In terms of scenario modelling, it is important to understand the current and future trends that link our infrastructure networks. The need is particularly acute in the context of:

- A trend toward convergence of our networks (particularly with information and communication technology being used in other sectors), and
- Long lives of many assets that create infrequent opportunities for change (i.e. to leverage the positive forces of interdependence – or to mitigate the risks).

The following diagram shows current interdependencies and future opportunities and trends in the connectedness of our infrastructure.

Infrastructure Interdependencies

Legend
Current interdependencies
Future interdependencies

Relies Upon Other Sectors For...

Provides Outputs To...

TRANSPORT	• Transport is highly reliant on hydrocarbons from energy sector • (Some) public transport relies on electricity to operate *• Electricity is required for electric vehicle charging* *• New fuel sources (or a changing mix) may create new dependencies*	• Stormwater management provides flood protection for transport assets	• Communication systems enable transport networks ops & planning • Smart transport systems reliant on advanced communication capability *• Congestion charging & dynamic prices rely on communications links* *• Self-driving cars require a dedicated spectrum*	
• Transport sector imports and distributes fuels • Transport and energy assets are frequently co-located	**ENERGY**	• Process water (e.g. cooling) required for some energy generation • Hydro power is reliant on the availability of water resources *• Wastewater as an energy resource* *• Energy recovery in water distribution (e.g. mini-hydro)*	• Control and communication systems for energy infrastructure *• Networked energy systems have increasing cyber security needs*	• Social assets consume - and pay for - electricity
• Transport provides the means to move waste by-products • Roads and water pipelines are frequently co-located • Transport moves goods and services critical to the productive water sector	• A significant amount of electricity is required to distribute and treat water • 30% of household energy use is for water heating • Energy by-products have potential to contaminate groundwater	**WATER**	• Communication systems assist the operation & planning of water systems • Civil defence systems (e.g. tsunami warning) rely on telemetry & comms *• Smart water meters and intelligent networks rely on communication links*	• Social assets consume - and pay for - water services
• Transport and telecommunication networks are frequently co-located	• National grid and telecommunications infrastructure are frequently co-located • Electricity is required to maintain operable communication networks	• Stormwater management provides flood protection for telecom assets	**TELECOMMUNICATIONS**	• Social assets consume - and pay for - telecommunication services
• Transport links provide access to social infrastructure	• Energy provision is an essential need for health care, schools, etc	• Water provision is an essential need for health care, schools, etc	• Control and communication systems for buildings • Emergency communications networks link hospitals / ambulances to people	**SOCIAL INFRASTRUCTURE**

SCENARIO/TRENDS ANALYSIS

Central Scenario: Implications for our infrastructure

The central scenario reflects the current trends and best estimates for key drivers of change that will affect future infrastructure investment requirements. This does not mean that the central scenario should be viewed as destiny, nor is it the NIU's expectation of what will happen. Rather, the purpose of scenario modelling is to contemplate alternate futures during strategic planning. To that end, the three scenarios (central, upside and downside) should be considered as a body of evidence, rather than as separable components.

Key drivers of change in the central scenario

Population

- Sustained population growth - reaching 6 million people by 2061
- An ageing population, with 24% aged 65+ (up from 14% in 2012)
- Increasing urbanisation results in a continued shift to main centres

Economy

- Commodity export volume growth continues at long-term trend rates
- Continued steady increase in urban-based service sectors; slow decline of most heavy industries
- Prudent and manageable debt levels

Technology

- Gradual integration of technology with assets
- UFB take-up occurs in line with projections
- 4G (and, in the future, 5G) mobile demand is in line with best estimates

Resources

- Medium carbon price ($25 / tonne)
- Climate change as per IPCC projections, increasing water scarcity and pressure on water quality
- 'Business as usual' oil / gas discovery in New Zealand

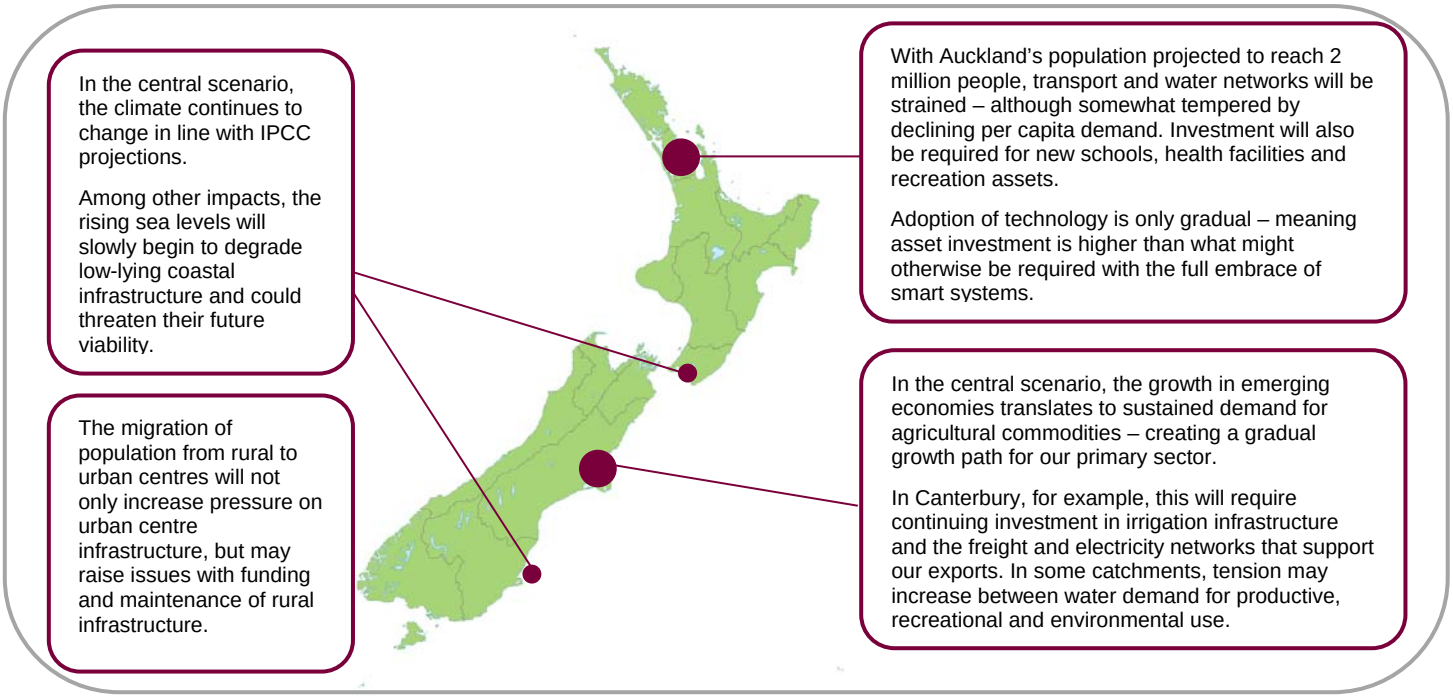
A description of the central scenario

The central scenario is characterised by a continuing trend of population movement to urban centres, especially in the upper North Island. Conversely, targeted growth in rural areas is provided by demand for agricultural and other primary sector products.

This translates, in infrastructure terms, to increasing demand on transport, water, telecommunications and social infrastructure in major urban centres and regional investment requirements in freight networks and productive water infrastructure. In the central scenario, the aggregate demand for energy and telecommunications infrastructure also continues to increase in line with GDP projections.

SCENARIO/TRENDS ANALYSIS

The key spatial implications for our infrastructure are shown in the diagram below (note: the diagram is not exhaustive and focuses only on selected major trends):



Interdependencies in the central scenario

Key changes in the interdependence of our infrastructure sectors include:

- Continued gradual convergence of our networks, and
- Regional interdependencies will strengthen – induced by the increasing segmentation of the economy between the primarily urban-based service sector and the rural primary sector.

The central scenario assumes gradual adoption of most technology rather than rapid uptake, although increased demand for services such as mobile will be aligned with increasing population in urban centres. In this case, ICT infrastructure will likewise only gradually continue its integration into water, transport, energy and social assets.

Box 4. Taking a cross-sector, whole of New Zealand perspective

Our infrastructure networks are both national and local. The degree to which a network is affected by national trends versus local impacts determines how the drivers of change (population, economy, technology, resources) manifest themselves as future infrastructure demand.

In general, our electricity network has a nationwide reach and is influenced by national trends in the aggregate. In contrast, our water networks and social infrastructure tend to be more localised and are highly affected by regional trends. Our transport and telecommunications networks are somewhere in between – with significant local influences, but flowing through a nationally connected system.

In reviewing the existing projections and scenario planning, two sectors stand out for the work they have already undertaken to understand future demands: the energy sector and the transport sector, both of whom have completed extensive investigations and modelling. Also, although much of the data is privately held, we believe the telecommunications sector has a firm understanding of future pressures.

Although demand forecasts do exist in the water and social sectors, it is more difficult to find comprehensive and consistent projections bridging the local and national levels. The modelling in these sectors also does not always consider scenarios created from the entire suite of fundamental drivers (population, economy, technology, resources).

Sector-by-sector discussion

Energy

Our energy infrastructure is spread across three separate, but interconnected segments: electricity, oil and gas. The electricity network consists of more than 100 generation sources, many of which are located in remote areas and connected to urban centres via the national grid. Both natural gas and oil are extracted from the Taranaki region, with the oil mainly exported while gas is used domestically. Crude oil, on the other hand, is imported and processed at Marsden Point Refinery – which supplies all of the country's aviation fuel, 80% of our diesel and about 50% of our petrol (among other products).

The implication for our energy infrastructure in the central scenario draws primarily upon modelling completed by MBIE (ref: Energy Outlook: Reference Scenarios (2011), Energy Outlook: Insights (2013)) and by Transpower (ref: Transmission Tomorrow (2011) and Transmission Tomorrow: Enduring Grid (2011)).

The key pressures in the central scenario are related to:

- Trends in peak load and base load (and the ratio between the two)
- Spatial distribution of future demand, and
- The mix of installed generation types.

The Energy 'Reference Scenario' (2011) and Electricity 'Mixed Renewables' (2013) scenario developed by MBIE are roughly equivalent to the central scenario defined here. In general, these scenarios assume:

- GDP growth by sector will occur according to NZIER mid-level forecasts (at a national level this equates to approximately 2% per annum growth to 2030)[3]

[3] Although the NIU prefers to use Treasury GDP projections, we make use of existing scenario modelling for this publication – which, in the case of the energy sector, is based (in part) on NZIER GDP projections. The NZIER data estimates that New Zealand's real GDP will be about 50% higher in 2030 than in 2011. In contrast, the Treasury's 2013 Long Term Fiscal Model estimates a real GDP increase of 57% between 2011 and 2030. For the purpose of scenario modelling, we consider this to be within the bounds of uncertainty in the context of future infrastructure requirements.

SCENARIO/TRENDS ANALYSIS

- Population will grow according to the Stats NZ medium projection (in line with our central scenario assumption)
- An emissions price of $25 per tonne of carbon dioxide (in line with our central scenario assumption)
- Gas discovery occurs according to the Oil and Gas simulation model ('business as usual' in our central scenario). International oil prices increase according to NYMEX futures and IEA projections, and
- No significant changes in electricity demand from heavy industries.

In the Transmission Tomorrow publication, Transpower analysed nine different scenarios. Four of these were developed specifically by Transpower to test various parameters relating to the national grid. The remaining five are taken from scenarios set out in the Electricity Commission's 2008 Statement of Opportunities. In our central scenario discussion that follows, we draw upon the most likely trends that emerge collectively from the nine Transpower scenarios.

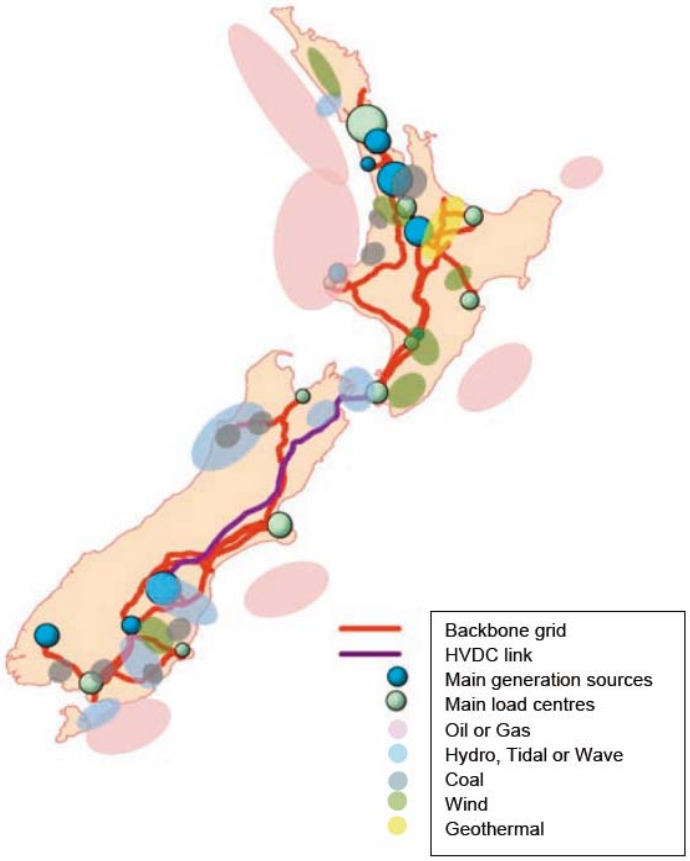
Based on the assumptions for the central scenario, the modelling completed by MBIE and Transpower suggests the following implications for our energy infrastructure:

- Electricity demand will grow on average by 1.1% per annum through 2040
- Increased irrigation and the use of heat pumps will continue to boost summer energy demand. Irrigation, in particular, will increase the utilisation of the grid on the east coast of the South Island[4]
- There is an ongoing need for the backbone grid from Roxburgh to Otahuhu and its capacity will need to increase over time
- Additional capacity for the regional connections to the backbone grid is less certain with more variation between scenarios. For the regional connections, newer technology options for better utilising the grid, such as extracting more capacity from the existing lines or the use of demand-side management, have added value
- There is likely to be significant investment required in geothermal plants (with its share of electricity generation projected to grow from 14% in 2012 to between 21% and 29% in 2040)
- Demand for wind power will increase modestly, although its relative cost in comparison to other electricity sources will continue to constrain its growth
- Geothermal and wind power can make only a minimal contribution to meeting peak demand. As such, future investment will be necessary to establish flexible peaking capacity, demand management initiatives and/or energy storage options
- Demand for gas is expected to remain relatively steady and will continue to come from price sensitive users such as petrochemical manufacturing facilities and power generators, as well as from other industrial, commercial and residential users. A sufficient level of exploration is expected to ensure supply is available to meet demand
- Both the extraction and export of oil from Taranaki and the import of oil are expected to continue along current trends, and
- The central scenario incorporates high uncertainty (and relatively low impacts) from new technologies such as electric vehicles and household photovoltaic panels due to their cost differentials in comparison to other options.

Further, Transpower's analysis found that the type, location, size and timing of generation development are the greatest sources of uncertainty. Generation development will occur in response to demand as well as the type of fuels that are available. With a substantial amount of energy generation resources potentially available in New Zealand, it is difficult to predict where and when this development might occur.

[4] Where new irrigation systems are gravity fed, potential exists for a decrease in energy use if they replace groundwater pumping solutions.

Figure 5: Location of potential future energy generation resources



Source: Transmission Tomorrow: Enduring Grid (Transpower, 2011)

On balance, MBIE estimate that $14 billion in new generation investment will be needed by 2030. Estimates for electricity demand and generation are reproduced below:

Figure 6: Grid level electricity demand by scenario

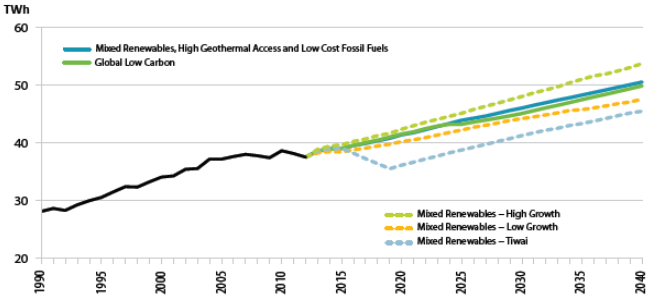
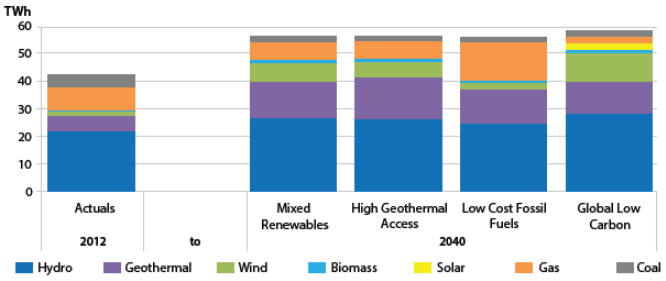


Figure 7: Electricity generation by scenario



Source: Ministry of Business, Innovation & Employment (2013)

Transport

The demands placed on our transport infrastructure in the central scenario can be separated into freight movements (export and domestic) and household travel (including tourism). In this analysis, we draw upon information from the National Freight Demands Study[5] (2008), published outputs from the land transport demand model[6] (Stephenson & Zheng, 2013) and supporting data from NZTA and the Ministry of Transport.

The National Freight Demands study relies upon population projections, GDP forecasts and individual commodity forecasts. Population projections are based on Stats NZ medium projections and are in alignment with our central scenario assumptions. National GDP forecasts are based on an average of 2% per year GDP growth. Although this does not align exactly with current Treasury projections, we consider it to be within an acceptable range for the purpose of modelling the central scenario. Finally, our central scenario does not include specific forecasts for individual commodities. However, the National Freight Demands Study uses trends and best estimates in this regard which, although based on pre-GFC optimism, we consider to be in the general spirit of the central scenario.

Key implications for our transport infrastructure as reported in the National Freight Demands Study include:

- From 2006 to 2031, the number of freight tonnes lifted (and tonne-kms transported) is expected to increase by 70% to 75%. Freight growth will be in both basic commodities (typically transported short distances) and sophisticated products (longer distances)
- Rail freight demand is projected to increase by 70% between 2006 and 2031 – with its modal share remaining approximately the same over that period
- Coastal shipping is projected to reach 8.5 to 9.0 million tonnes by 2031 – approximately double the level in 2006 (this is driven in part by planned expansion of the Marsden Point refinery)
- Substantial growth in traffic generation is forecast for Waikato with an increase in forestry and dairy traffic as well as increased movement of aggregates to serve both Waikato and Auckland. Canterbury is also forecast to experience high growth in traffic generation due to an increase in dairy production
- Auckland is projected to have the highest growth in terms of traffic that is attracted to the region – reflecting the movement of primary products from Northland and Waikato.

At the household level, transport demand is affected by demographic shifts, economic changes and fuel prices (among other factors). The land transport demand model developed by NZIER contains an extensive range of inputs that allow various scenarios to be modelled. The base case modelled by NZIER relies upon the following assumptions:

- **Macroeconomic** – generally based on long-run historical averages and best estimates (e.g. an oil price of $300 in 30 years, roughly aligned with the IEA's World Energy Outlook projection published in 2012)
- **Industry** – industry GDP is a function of total GDP, but with shares modelled using a VAR
- **Technology** – gradual improvements in fuel economy (0.2% per annum) and various assumptions on the share of alternative fuels used by vehicles
- **Price and income responsiveness** – base case assumptions linking travel behaviour to changes income or the cost of travel

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[5] The Ministry of Transport commissioned Deloitte to carry out an update of the National Freight Demand study and to undertake a Future Freight Scenarios study. Each of these studies may provide an improved outlook on future transport demands. The reader is referred to the Ministry of Transport website (http://www.transport.govt.nz/research/nationalfreightdemandsstudy/), where these reports will be published upon their completion (expected to be in 2014).

[6] Several agencies are working with NZIER to undertake further demand modelling across the transport modes (completion date unknown).

- **Regional dimensions** – GDP and industries are included by region, as are other variables such as household incomes, freight demand, etc, and
- **Tax rates** – assumed to grow in line with inflation.

From the NZIER report produced for NZTA, the key implications for our infrastructure in the base case include:

- Household travel demand is projected to grow nationally by 1.0% per annum over the next 30 years, although the kilometres travelled per vehicle is projected to decline
- Two-thirds of travel demand growth is due to population growth. Regionally, this translates to increased pressure on transport networks in our urban centres, and
- Public transport demand is projected to grow by 0.95% per annum over the next 30 years. The public transport share of travel is projected to gradually decline over time (as incomes grow, enabling private vehicle use).

Graphs of selected results are shown below:

Figure 8: Growth in travel demand (passenger-kilometres)

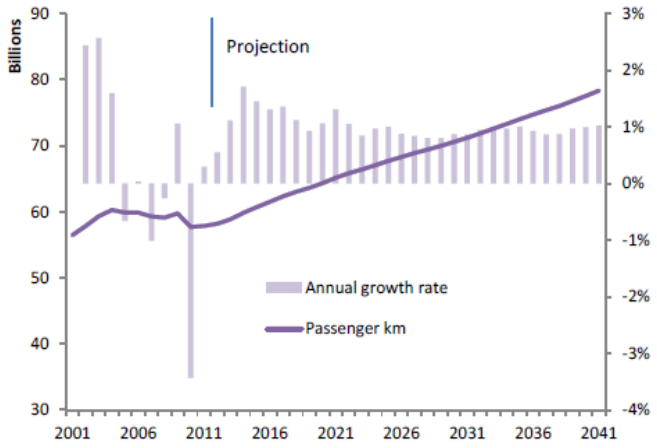
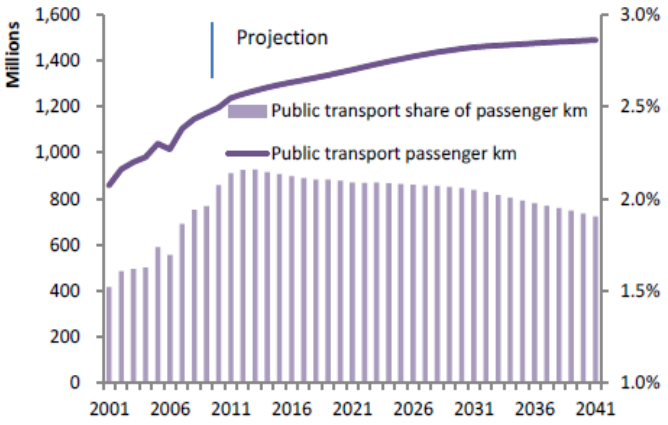


Figure 9: Growth in public transport demand (passenger-kms)



Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)[7]

Water

Although water, as a resource, is governed by a natural and interconnected cycle, we generally consider our water infrastructure in two separate categories: urban water and productive water. At present, the availability of data, projections and modelling for our water infrastructure is inconsistent and fragmented[8]. Accordingly, it is difficult to develop an informed view of future infrastructure requirements at a regional and national level[9]. Instead, we focus on readily available indicators of future demand such as irrigation projections (for productive water) and demand for water in Auckland and Wellington (for urban water).

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7 The information provided by NZIER information provides an indication of structural trends and underlying demand pressures only, and deliberately exclude policy/supply-side initiatives.

8 Local authorities are taking steps toward improvement in this regard (e.g. LGNZ 3 Waters project and the establishment of a Centre of Excellence).

9 In part, this also reflects the localised nature of water infrastructure, where a national picture may not show the nuanced requirements of individual Councils and communities.

Productive Water

In the central scenario, global demand for commodities is assumed to increase as the world population grows, incomes rise and consumer preferences change. Developing countries are driving a structural shift in commodity demand. A recent Reserve Bank report (Sullivan & Aldridge, 2011) describes this phenomenon:

> *Growth in food demand is fastest in the early stages of a country's development. As countries become wealthier, consumer preferences switch from merely more food, to higher nutrient food. So in the initial stages of development a country may consume higher quantities of rice, but as wealth continues to grow, other grains, such as wheat, become more popular, and then dairy and meat become larger parts of the national diet. Eventually food demand becomes dictated more by population growth than income growth.*

This trend is especially evident in Asia where it appears that incomes still have much room to rise. Sullivan & Aldridge (2011) cite a comparison of China with Taiwan to illustrate this point (data collated by Nomura Global Economics):

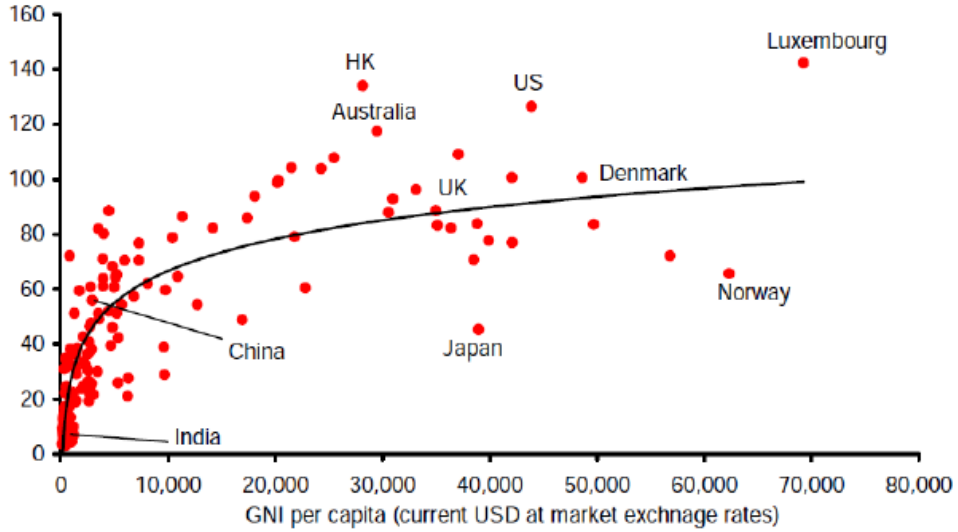
Table 6: Average per capita annual food consumption (kilograms)

Period	GNI per capita (USD)	Grain	Vegetables	Meat	Milk	Fruit
Taiwan						
1975	979	162	110	27	15	55
1980	2,394	134	130	43	25	70
1985	3,368	110	103	56	32	112
1990	8,325	102	93	63	43	132
1995	13,103	100	102	73	59	137
China						
2000	934	265	132	39	3	46
2005	1,734	376	168	48	11	62
2008	3,427	444	171	42	15	65

Source: Taiwan Council of Agriculture, China Statistical Yearbook and Nomura Global Economics (cited in Sullivan & Aldridge, 2011)

Similarly, per capita meat consumption correlates closely with per capita income around the world:

Figure 10: Per capita livestock meat consumption (kg / year)



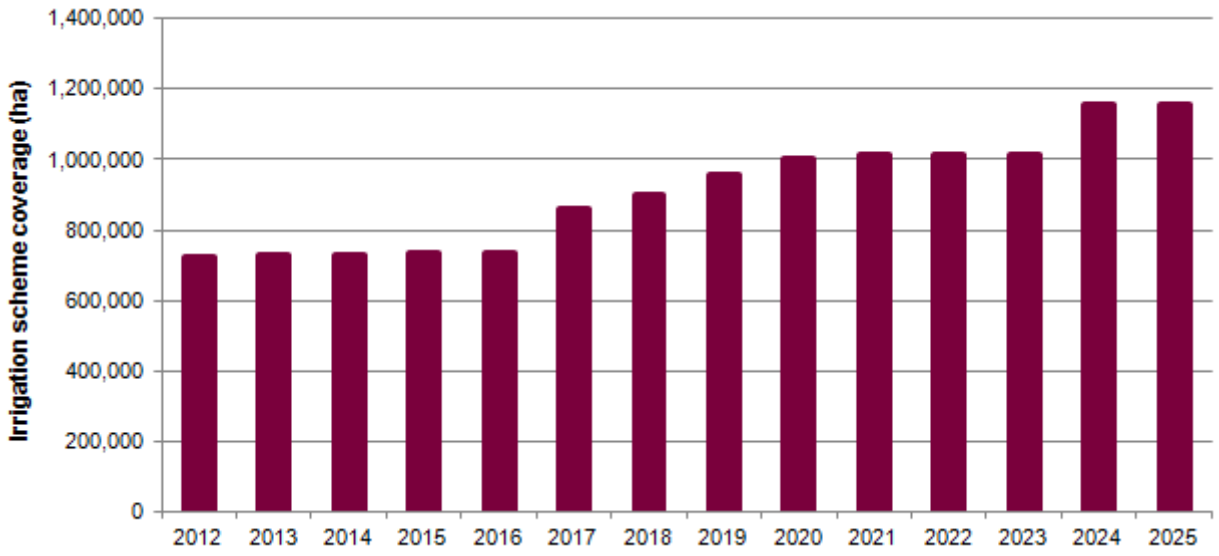
Source: FAO, World Bank and Nomura Global Economics (cited in Sullivan & Aldridge, 2011)

Based on this data, the central scenario assumes that global economic growth, and Asian growth in particular, will bolster demand for proteins from New Zealand. This trend will be facilitated by both our geographic proximity to Asia and our relative abundance of water which gives us a comparative advantage in agricultural commodities markets. Although rapid growth in prices and demand is unlikely to continue unabated, the medium term outlook is expected to be strong.

Along with commodity-based water demand in the central scenario comes a gradual increase in demand for recreational and environmental benefits. Combined with climate change predictions, this will drive the need for reliable infrastructure to store and distribute alpine-sourced water to take the pressure off groundwater and coastal rain-fed rivers along the east coast of both islands.

The following graph estimates our total area of irrigated land over the next 10 years based on existing proposals. Whether these proposals proceed, or are supplemented by even more schemes, depends on the continued strength of global agricultural commodity demand and the availability of water sources.

Figure 11: Existing, planned and proposed irrigation schemes in New Zealand



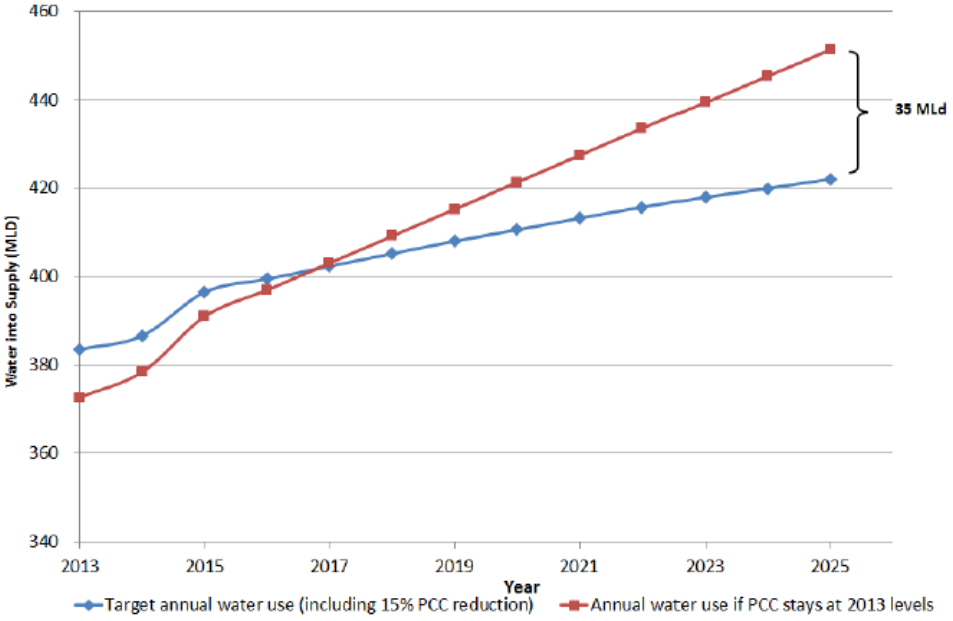
Source: ANZ, MPI, Irrigation NZ and Treasury analysis (2013)

Finally, at the same time that we face high demand for our commodities (especially animal proteins), the intensification of grazed animal land uses in New Zealand will keep the spotlight on water quality in the coming years. The convergence of environmental, social, cultural and economic interests will likely drive the need for new infrastructure, technology and management practices to maintain or improve the health of our waterways. The government is currently investigating a number of reforms to ensure the quality and quantity of our fresh water meets the needs of stakeholders.

Urban Water

As with the productive water sector, our urban water sector is similarly expected to face substantial demand pressure in the future. With both high population growth and relatively modest water resource availability, Auckland makes a good case study for understanding the substantial investment that may be required in the absence of other solutions. Watercare's most recent demand management plan demonstrates the scale of the challenge:

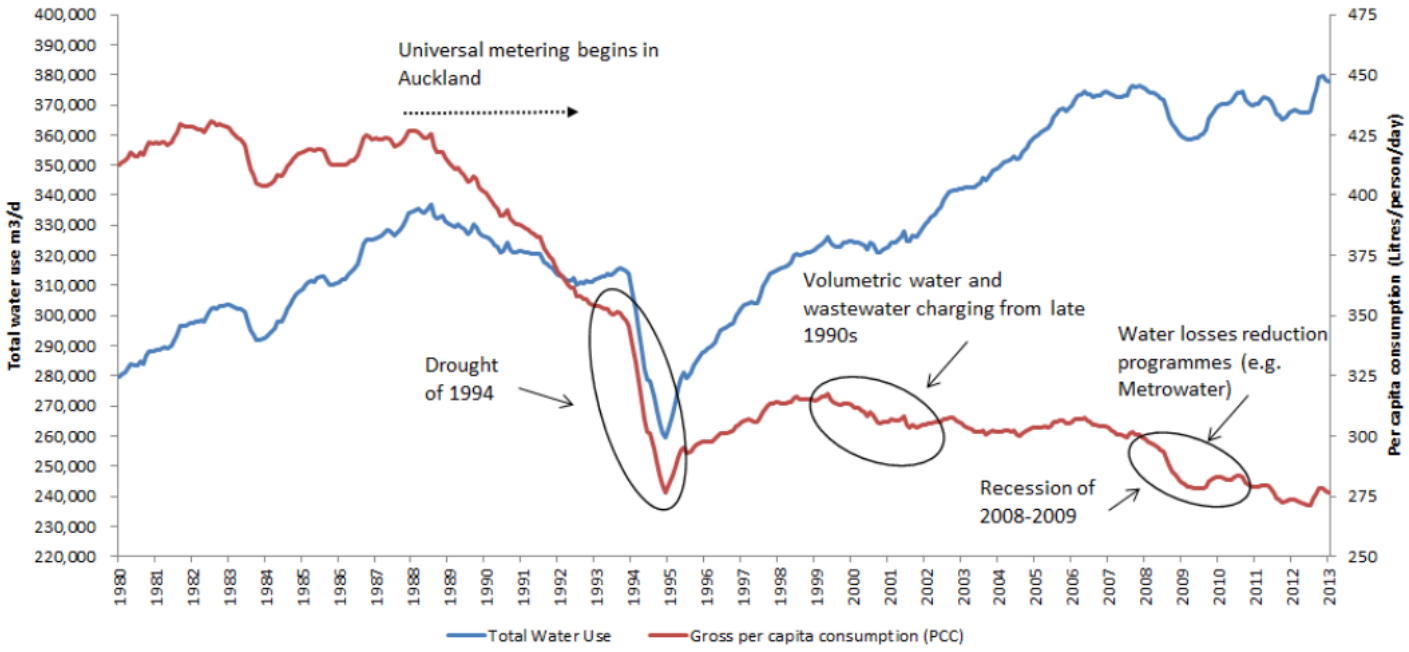
Figure 12: Demand for water in Auckland



Source: Auckland Regional Water Demand Management Plan (Watercare, 2013)

Although demand management and/or supply-side responses are outside the remit of this publication, it is interesting to note the encouraging path that Auckland's water sector has taken over the last three decades. Despite an 85% growth in population from 1980 to 2013, Auckland's water demand grew by only 35% during this period – thanks in large part to per capita consumption dropping from over 400 litres / person / day to approximately 275 litres / person / day.

Figure 13: Historical water use in Auckland



Source: Auckland Regional Water Demand Management Plan (Watercare, 2013)

Apart from water demand, the urban water sector also faces pressure to ensure water quality meets acceptable standards – both for potable supply and for the discharge of wastewater and stormwater to the receiving environment. For the smaller potable water suppliers, compliance deadlines to meet obligations in the Health (Drinking Water) Amendment Act 2007 are staggered from 2013 to 2016. For wastewater discharge quality, the government is currently investigating a number of reforms for fresh water management. The level of investment that may be required in the urban water sector is dependent, in part, on the level of standards to be met and also by the existing standard of water quality that is being achieved.

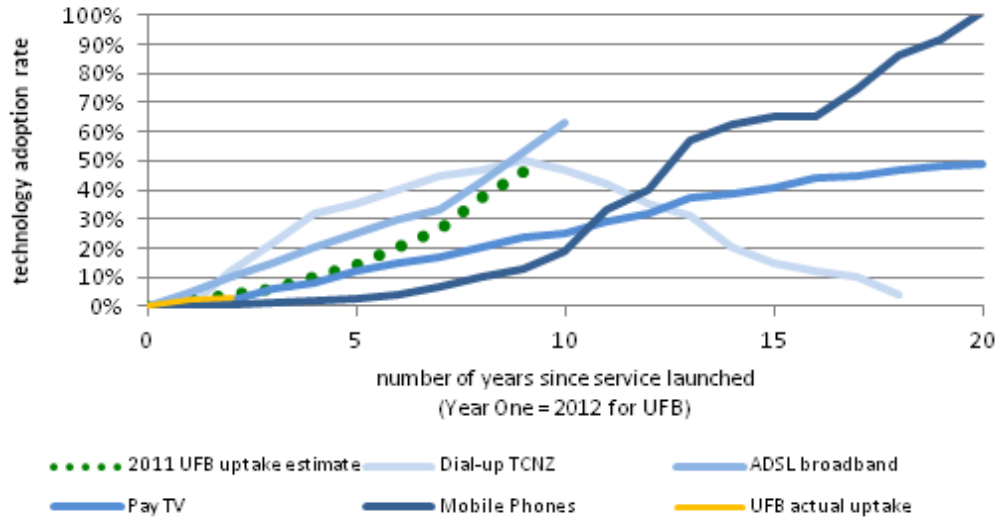
Both level of demand and ability to meet the investment required will be dependent on population, which in this scenario suggests divesting difficulties between rural and urban centres as population migrates from one to the other.

Telecommunications

The key driver of telecommunications infrastructure is data demand. Rather than being linked directly to supply side technology or network change, data demand is most immediately driven by customers adopting and using new services and applications – such as for e-commerce, online entertainment, and digital methods of providing education or health services.

In the central scenario, the UFB network (in tandem with the RBI) will be progressively developed by 2020, with nearly 98% of our population having access to faster broadband by this time. UFB uptake will also begin to change consumer patterns with concomitant impact on our physical infrastructure requirements. To provide some context for the UFB initiative, a recent graph produced by MBIE shows adoption rates in New Zealand for various technologies:

Figure 14: Technology uptake rates in New Zealand



Source: Ministry for Business, Innovation & Employment (2013)

Along with the UFB initiative, the recent 700 MHz 4G spectrum auction in New Zealand is a key step in the roll-out of fourth generation networks by telecommunications providers. The auction conditions were designed to make 4G coverage available to 90% of our population within 5 years. While it is difficult to project the demand in New Zealand, Cisco estimates that global mobile data traffic will increase 13-fold between 2012 and 2017 (Cisco, 2013). The same report projects that 4G connections will comprise 10% of total mobile connections and account for 45% of total traffic.

Demand in the telecommunications sector is expected to have both an urban and rural strand. The increasing urbanisation of our population will drive the need for new or upgraded towers in Auckland (for example) to cater for mobile voice and data demand. At the same time, demand for broadband in rural areas is expected to strengthen as 3G and 4G / LTE wireless options become available.

As the UFB network is developed and as mobile data traffic increases, the central scenario assumes that the burden placed on the copper network will reduce. The central scenario assumes that technology, in general, will enable future infrastructure demand. In that context, demand for telecommunications infrastructure occurs primarily through the adoption by consumers of content and applications supported by the UFB network and 4G mobile networks.

Social infrastructure

Social infrastructure is most directly impacted by demographic change, which forms the main part of this discussion. The increased use of technology, although it shows promise for better utilising social assets, is expected to become only gradually more integrated over time in the central scenario – causing relatively minor overall impacts.

Education

Demand for education infrastructure is influenced by fertility rates, migration levels and retention rates. In this analysis, we rely upon Ministry of Education school roll forecasts for primary and secondary schools (National School Roll Projections: 2011 Update). The medium scenario in the school roll projections aligns with the medium population growth assumed in our central scenario.

Figure 15: Primary school roll projections to 2030

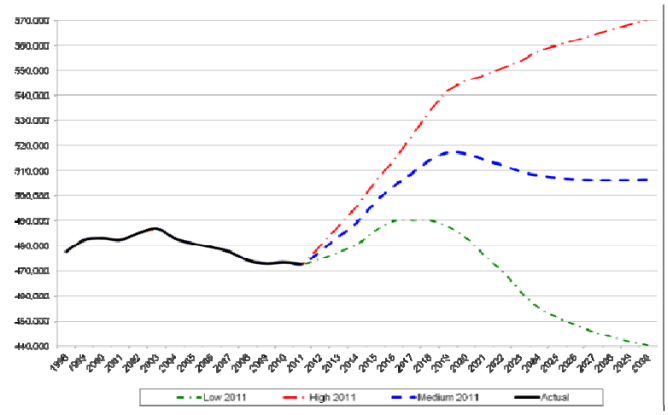
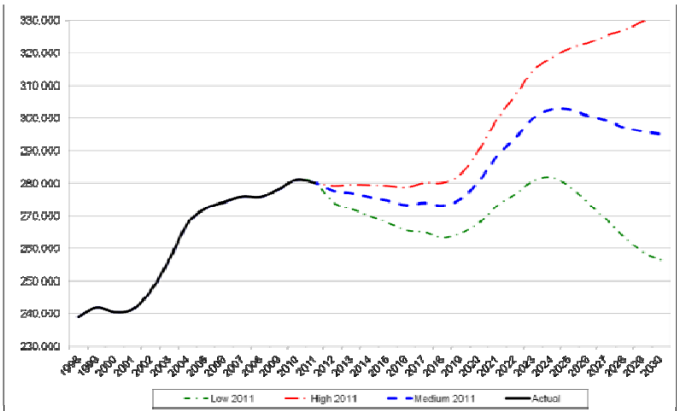


Figure 16: Secondary school roll projections to 2030



Source: Ministry of Education (2011)

In the central scenario, the total school roll is projected to peak in 2024 at approximately 810,000 full-time equivalents (from 755,000 in 2012). After 2024, the school roll is expected to diminish which is consistent with the general trend of an ageing population.

However, considering the school roll projections at a national level masks the substantial variation that is expected to occur at a regional and local level. For example, based on Stats NZ medium projections from 2011 to 2031, the population aged 0 to 14 in the Ruapehu district will decline by 36% while in the Selwyn district it will increase by 30%. Overall, 50 of 67 territorial authorities will have fewer children in 2031 than they had in 2011. These changes will have direct implications as to whether new schools are required and whether existing schools need to be upgraded or rationalised.

Justice

As with education infrastructure, assets in the justice system are closely linked to population. The Ministry of Justice reports that the most influential factors affecting justice forecasts are (Justice Sector Forecasts 2012-2022):

- Number entering the courts system (the single most significant variable)
- Proportion of people remanded in custody
- Average time spent on custodial remand, and
- Proportion of imposed sentence served in custody (excluding remand).

These variables are not explicitly included in our central scenario assumptions. However, the Ministry of Justice forecast is based on the Stats NZ medium population projection, which is consistent with the central scenario we have developed. Graphs from the Ministry of Justice study are reproduced below:

Figure 17: Prison population forecast to 2022

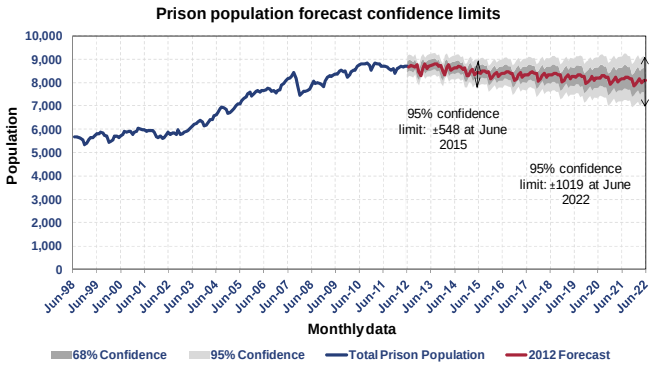
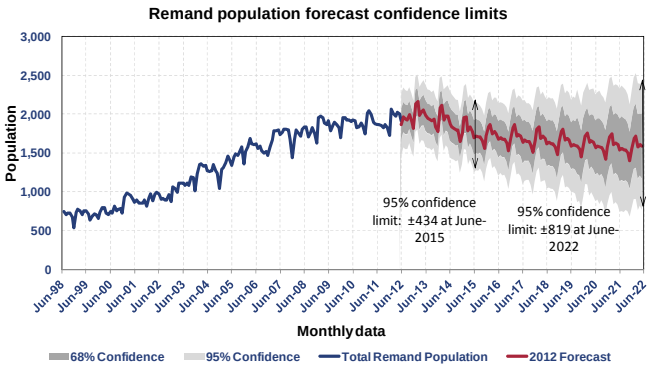


Figure 18: Total remand population to 2022



Source: Ministry of Justice (2012)

In general, the national trend is for decreased demand in our justice system. However, this is likely to vary by region. Although the trend may be downward overall, no further analysis has been conducted for this exercise and it is possible that urban areas experiencing high growth will see an increase in demand for justice-related infrastructure – against the national trend.

Health

Demand in the health sector is related to demographics (population growth, age cohorts), income effects and health sector productivity. The central scenario assumes a business as usual trend with respect to income and productivity, with the most tangible link to health infrastructure demand being demographic change.

As with all social infrastructure, future demand will be subject to significant regional variation in the central scenario with urban centres (especially Auckland) experiencing high population growth which will place pressure on health infrastructure. Similarly, our maturing population will place high demand on aged care facilities and assessment, treatment and rehabilitation (AT&R) services.

Upside Scenario: Implications for our infrastructure

The upside scenario reflects trends in key drivers of change that result in high investment requirements for New Zealand's infrastructure. Where projections or modelling results are available, we consider the implications for our infrastructure in the upside scenario by discussing specific deviations relative to the central scenario for each sector.

As with the other scenarios, the upside scenario does not represent the NIU's expectation of the future and we do not provide comment on the likelihood of all of the high demand factors (listed below) coinciding. Instead, this scenario should be viewed as a possible upper bound for infrastructure demand.

Key drivers of change in the upside scenario

Population

- High population growth - reaching 7 million people by 2061
- Slower than projected ageing (high fertility & high inward migration)
- Higher than projected urban growth, and accelerated rural decline

Economy

- Rapid increase and sustained demand for dairy, wool, meat, etc
- Rapid growth in service sector (Auckland-centric); return to peak heavy industry demand
- Low debt levels, high incomes

Technology

- Slow integration of technology with assets
- UFB take-up is slower than currently projected
- 4G (and, in the future, 5G) mobile demand is lower than estimated

Resources

- Low / no carbon price ($0 / tonne)
- Rapid sea level rise, sharp increase in extreme climate events, substantial pressure on water quantity & quality
- Significant oil / gas discovery in New Zealand

A description of the upside scenario

The upside scenario is based on the highest level of population growth, accompanied by consolidation of population in our urban centres. Many of the rural areas decline in population as the trend toward a service-oriented economy continues. However, the upside scenario also assumes both a return to peak heavy industry demand (e.g. processing of wood and metals) and an emerging economy-fuelled boom in our agricultural exports.

This translates, in infrastructure terms, to soaring demand for transport, water and social infrastructure in major urban centres, and similarly high demands placed on water resources, productive water infrastructure and all transport modes used for distribution and export. Although demand related to primary sector growth is high in rural areas, population decline in the rural centres results in underutilised or 'stranded' assets that are no longer needed.

In the upside scenario, the high aggregate demand for energy brings forward the need for investment in new sources of generation and increases the need to augment our energy distribution infrastructure – especially in areas where heavy industry is located.

Finally, the upside scenario assumes that climate change will occur more rapidly than IPCC projections. From a spatial perspective, this has implications for our coastal areas where our land erodes more quickly, assets begin to deteriorate more rapidly and low-lying communities (and their infrastructure networks) are threatened.

Moving inland, higher rainfall in the west of country brings both benefits and risks, while less rainfall may reduce water supply reliability in areas such as Canterbury (rain on the west will provide more water into large rivers, but supply will be more variable).

Interdependencies in the upside scenario

The upside scenario is characterised by a slow or limited trend in the convergence of our networks. The low adoption rate of new technology in this scenario means that infrastructure productivity gains are not realised to the extent that they could be.

Sector-by-sector discussion

Transport

A limited set of stochastic results from the long term demand model have been published by NZTA and NZIER. Of the results that have been published, demand uncertainty is due mainly to price and income variations. Graphs that show a possible range of demand for vehicle travel and public transport usage are reproduced below:

Figure 19: Public transport demand (stochastic estimate)

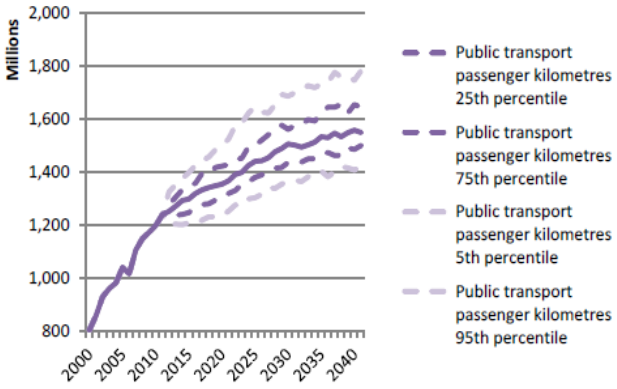
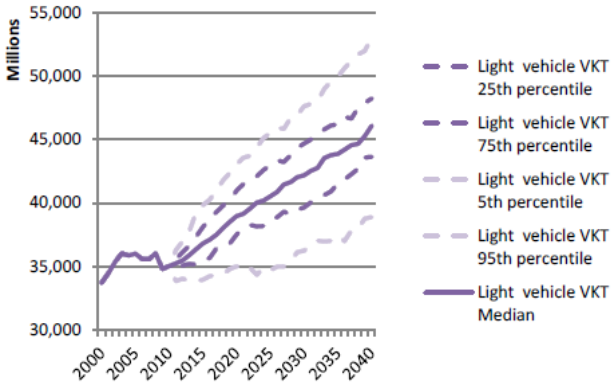


Figure 20: Vehicle kilometres travelled (stochastic estimate)



Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)

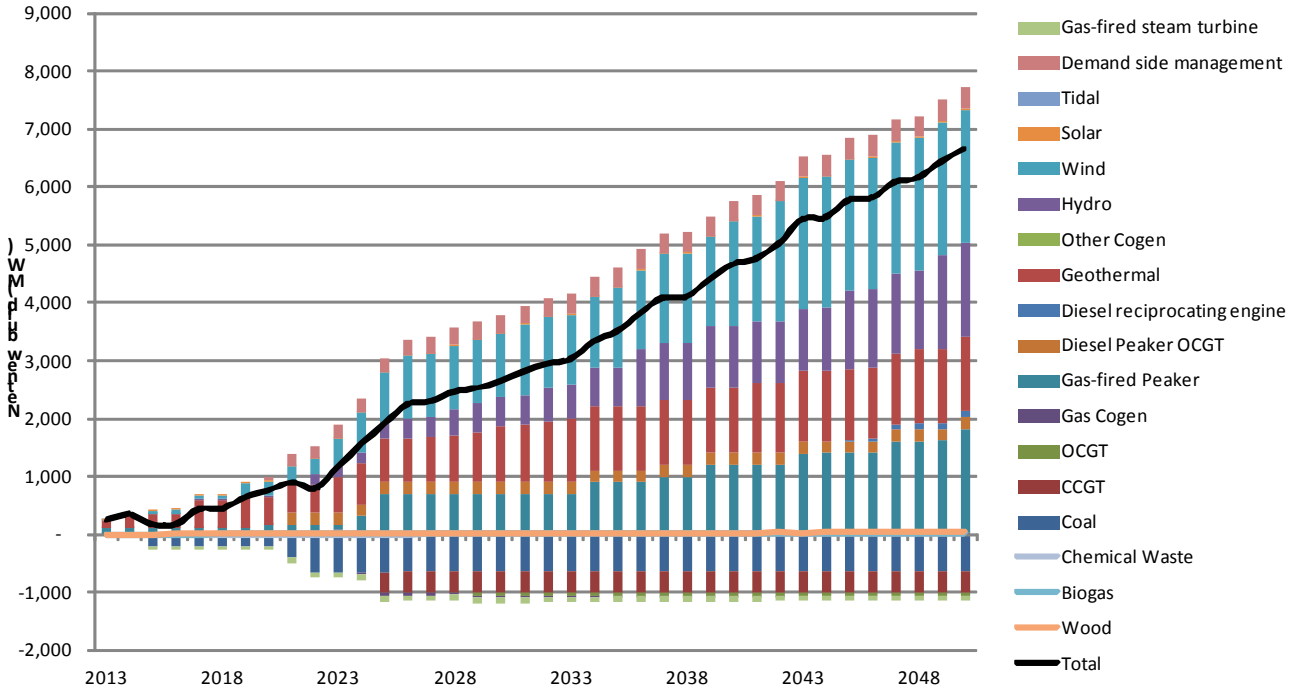
When compared to the central scenario (50th percentile), the modelled equivalent to the upside scenario (95th percentile) shows an approximately 15% increase in both public transport demand and light vehicle kilometres travelled. This translates into a need to construct new roads, upgrade existing roads and develop new public transport options in line with demand estimates. However, the need for new assets will be highly regionalised and is likely to be concentrated in urban centres.

Although quantitative modelling of freight demand is not available for the upside scenario, we estimate that the pressures placed on road, rail, port and airport infrastructure will increase in line with economic growth. Latent capacity in these networks will be absorbed (to varying degrees) and existing pinch points will intensify.

Energy

Modelling by MBIE (discussed in detail in the central scenario section) considers the impact of high energy demand driven by higher than expected population and economic growth. Based on MBIE's projections in the high demand scenario, the net new build for electricity generation is shown by fuel type in the graph below.

Figure 21: New build by fuel type in the high demand (upside) scenario



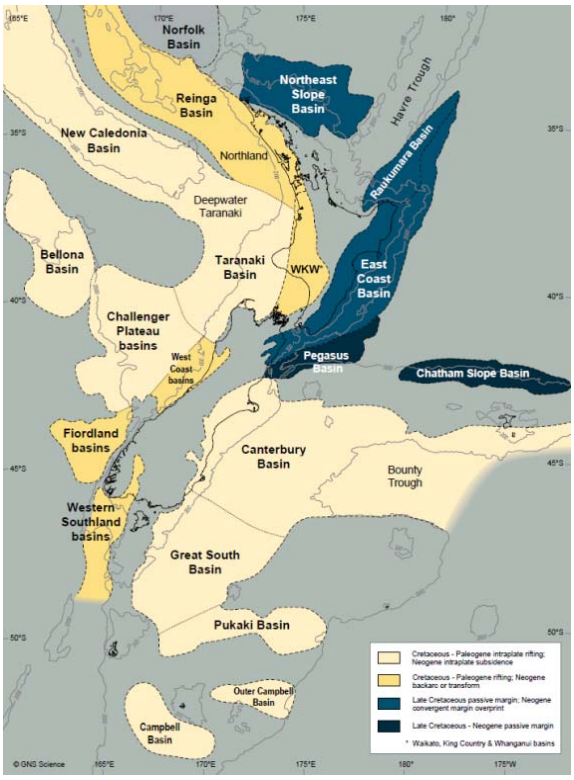
Source: Ministry of Business, Innovation & Employment, Treasury analysis

Our upside scenario also considers the possible impacts emanating from the extensive oil and gas exploration that is underway in New Zealand. At present, New Zealand's gas production is located within the Taranaki region. Although Taranaki is comparatively well-placed to support new oil and gas discoveries (of a certain magnitude), a non-Taranaki discovery has the potential to create high demand for new pipelines and supporting infrastructure – especially if the new find is developed for the domestic market, rather than for offshore processing and distribution.

Similarly, a large, new discovery in Taranaki would increase the pressure on existing infrastructure in the region, some of which is already nearing capacity. Deep water discoveries may also change the type of infrastructure that is required (e.g. to service floating liquefied natural gas operations rather than onshore processing).

It is difficult to predict the location, timing and likelihood of a significant discovery. However, given the extent of New Zealand's petroleum basins, the probably of such an event occurring cannot be entirely discounted – especially with the current upswing in exploration activity.

Should a major oil or gas discovery occur, new or upgraded transport links, water infrastructure and social infrastructure will also be required to support the development – a clear example that demonstrates the interdependence of our infrastructure networks.



Source: NZ Petroleum & Minerals

Box 5. Heavy industry in New Zealand

With a relatively small population by global standards, demand on our infrastructure can be heavily influenced by industrial activities such as forestry, steel and aluminium processing. In New Zealand, these industries are concentrated in a small number of locations and in a small number of firms that are exposed to global markets. Forestry is concentrated in the north of the North Island, steel processing south-east of Auckland and aluminium processing in Southland. Accordingly, fluctuation in demand has the potential to occur at point sources and in discontinuous steps rather than gradual trends.

For example, since 2004, the wood processing industry's energy demand has declined rapidly by over 30% from its peak (MBIE, 2013). More recently, the future of aluminium production in New Zealand has been called into question. With about 15% of the country's electricity supply used by the Tiwai Point aluminium smelter, the potential impact on infrastructure is considerable.

Overall, we assume a gradual decline of heavy industry in New Zealand in the central scenario. The upside scenario assumes a return to peak demand, while the downside scenario assumes an accelerated decline of heavy industry. However, we do not speculate on the future of specific heavy industries. Nonetheless, careful infrastructure planning is required to ensure we are prepared for step changes in demand created by heavy industry – on the upside or the downside.

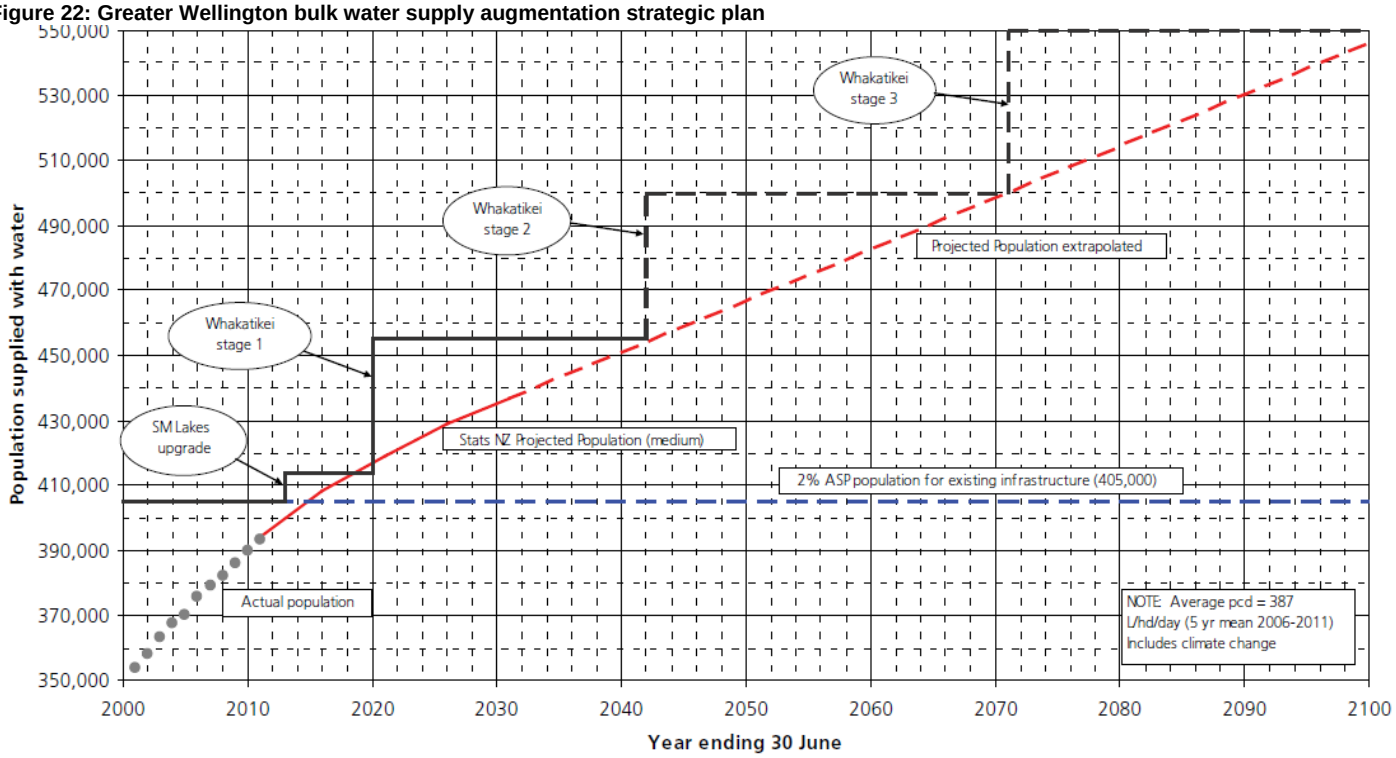
Water

Urban Water

The effect of the upside scenario on our urban water sector is expected to be driven in part by population. Taking Auckland as an example, the Stats NZ high population for the Auckland region by 2031 is nearly 8% above the medium projection. Although this may seem small at face value, the impact from a variation of this size cannot be underestimated – particularly when developing new sources of supply (or incentivising lower per capita demand) can be years in the making.

For example, Greater Wellington Water's plan to ensure that sufficient capacity is available to meet demand is shown in the graph below (Greater Wellington Regional Council, 2012). In the event that population growth shifts from the Stats NZ medium projection to the high projection instead, augmentation of the system may be required much earlier than planned.

Figure 22: Greater Wellington bulk water supply augmentation strategic plan



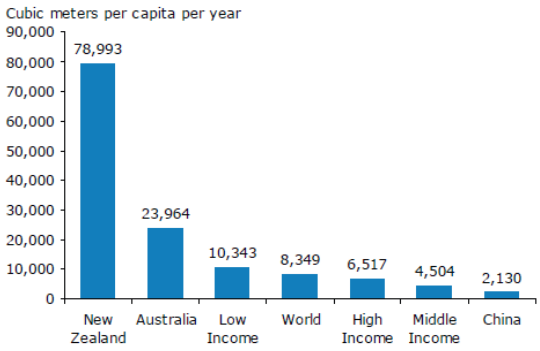
Source: Greater Wellington Water (Water Supply Asset Management Plan, 2012)

Productive Water

In the productive water sector, climate change, with projected impacts on rainfall and hydrology, will have a major impact on irrigation schemes. There will be regional differences in changes in rainfall, presenting localised challenges for those designing and managing irrigation schemes (Office of the Prime Minister's Chief Science Advisor, 2013). The same report also highlighted that changes in seasonal river flows and snow melt are likely.

The extent to which storage is available (or needed) for our irrigation schemes will be a key factor in the infrastructure response to climate change.

Figure 23: Global renewable water resources (2007)



Sources: ANZ, United Nations ESCAP

However, although climate change will stress our local resources to some extent, our relatively bountiful water resources in other regions may be a strategic advantage from a macro perspective[10]. Irrigation infrastructure can be used to collect allocated water from one catchment and apply it in another or several others. In the right circumstances, this can alleviate allocation pressure in catchments with scarcity and provide water for environmental flows and recreational pursuits.

[10] An increase in NZ population and higher incomes for New Zealanders may further increase the domestic demand for water (including environmental awareness and recreational uses). This will increase our requirements for water infrastructure and highlights the need for robust systems that allocate and manage water quantity and quality across the various sectors of our society (e.g. urban water, productive water, environmental flows).

Telecommunications

In the upside scenario, we assume that the UFB network (in tandem with the RBI) will continue to be progressively developed by 2020, but with adoption rates lower than expected. In general, the upside scenario assumes low demand for new technology, which is reflected in relatively higher demand for other assets (which have not leveraged productivity-enhancing technology improvements). However, this scenario does note the increased demand for services such as mobile which are aligned to population growth and migration, and expects increased demand in urban centres in particular.

With limited data and modelling publicly available, it is difficult to forecast the specific local, regional or national implications for our copper, mobile, fibre and other telecommunications assets in the upside scenario.

Social Infrastructure

Social infrastructure in the upside scenario is affected by high levels of population growth (in the urban centres) and decline (in rural centres). Key implications for each sector are noted below.

Education

Nationally, the combined primary and secondary school roll is projected by the Ministry of Education to be approximately 900,000 in 2030 under this scenario (where it is about 800,000 in the central scenario). Although the projections do not specifically note where these additional 100,000 students will be located, the associated Stats NZ population projections show a substantial increase in the upper North Island (and to a lesser extent, other major urban centres).

Justice

As with education infrastructure, the justice system will also be more heavily burdened in the upside scenario when compared to the central scenario. The forecast produced by the Ministry of Justice suggests the prison population may reach about 9,000 people in a high-demand environment (compared with 8,000 in the medium projection). This is essentially a flat prison population from the present day, rather than a declining population in the central scenario. Again, the spatial distribution of the impact is unknown but is expected to be primarily urban.

Health

In the upside scenario, the ageing of our population is slower than expected with high inward migration and high fertility rates. When compared to the central scenario, this is expected to increase the burden on maternity services and early childhood care – but will reduce the burden (in relative terms) on aged care facilities.

Downside Scenario: Implications for our infrastructure

The downside scenario reflects trends in key drivers of change that result in low investment requirements for New Zealand's infrastructure. Where projections or modelling results are available, we consider the implications for our infrastructure in the downside scenario by discussing specific deviations relative to the central scenario for each sector.

As with the other scenarios, the downside scenario does not represent the NIU's expectation of the future and we do not provide comment on the likelihood of all of the low demand factors (listed below) coinciding. Instead, this scenario should be viewed as a possible lower bound for infrastructure demand.

Key drivers of change in the downside scenario

Population

- Population reaches 5.2 million people by 2061 (declining after 2051 though)
- Higher than projected ageing of the population (low fertility & migration)
- Urban growth is constrained and rural centres are static or declining

Economy

- Decline in commodity export volumes and/or prices
- Decline or slow growth in services; rapid decline of heavy industry
- High public and private debt; low incomes / consumer ability to pay

Technology

- Rapid integration of technology with assets
- UFB take-up is much more rapid than current projections
- 4G (and, in the future, 5G) mobile demand exceeds best estimates

Resources

- High carbon price ($100 / tonne)
- Low sea level rise, little change in extreme event frequency, little to no pressure on water quantity & quality
- Limited discovery of commercially viable oil / gas reserves in NZ

A description of the downside scenario

The downside scenario is based on the lowest population projection and assumes a soft or declining world economy (particularly in developing countries). Urban growth is constrained and the population in rural centres is static or declining.

This translates, in infrastructure terms, to lower demand for transport, water and social infrastructure in major urban centres, and comparatively low demands placed on water resources, productive water infrastructure and freight transport modes. Rural infrastructure is underutilised due to both static or declining population and weak demand for goods produced by the primary sector.

In the downside scenario, the low aggregate demand for energy reduces the need for investment in new sources of generation and decreases the need to augment our energy distribution infrastructure – especially in areas where heavy industry is located.

Finally, the downside scenario assumes that climate change will occur more slowly than IPCC projections. From a spatial perspective, this extends the life of coastal assets – more than would be the case in the central scenario. In a similar vein, the regional effects of drought and flooding are also reduced.

Interdependencies in the downside scenario

In contrast to the other scenarios, the downside scenario assumes a warm embrace of new technology by our residents and rapid integration of information and communication systems in our infrastructure networks. In this scenario, the trend toward convergence of our infrastructure sectors accelerates and the potential for productivity gains are maximised.

The increase in interdependency manifests itself through better utilisation of existing assets and altered behaviours of our residents due to an increase in teleworking, e-commerce and consumer-centric demand management options.

Sector-by-sector discussion

Transport

As with the upside scenario, the same limited set of stochastic results from the long term demand model have been published by NZTA and NZIER. Graphs that show a possible range of demand for vehicle travel and public transport usage are again reproduced below:

Figure 24: Public transport demand (stochastic estimate)

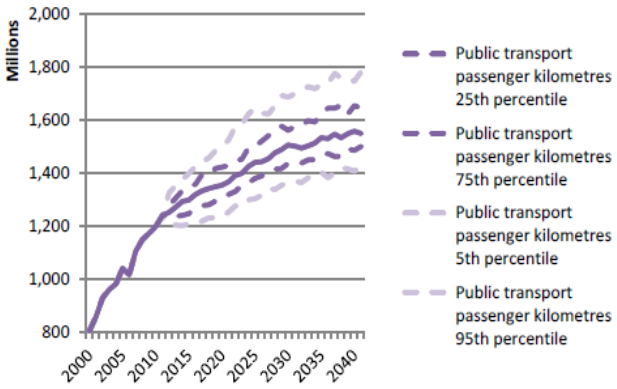
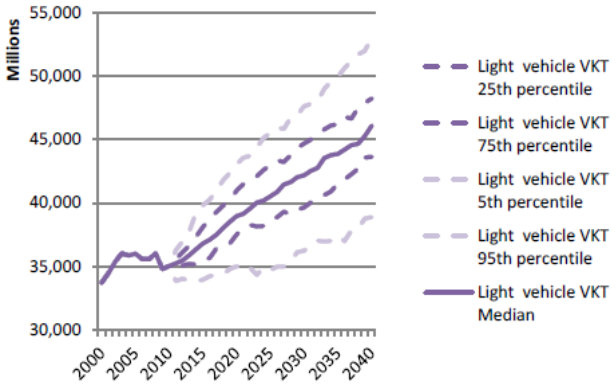


Figure 25: Vehicle kilometres travelled (stochastic estimate)

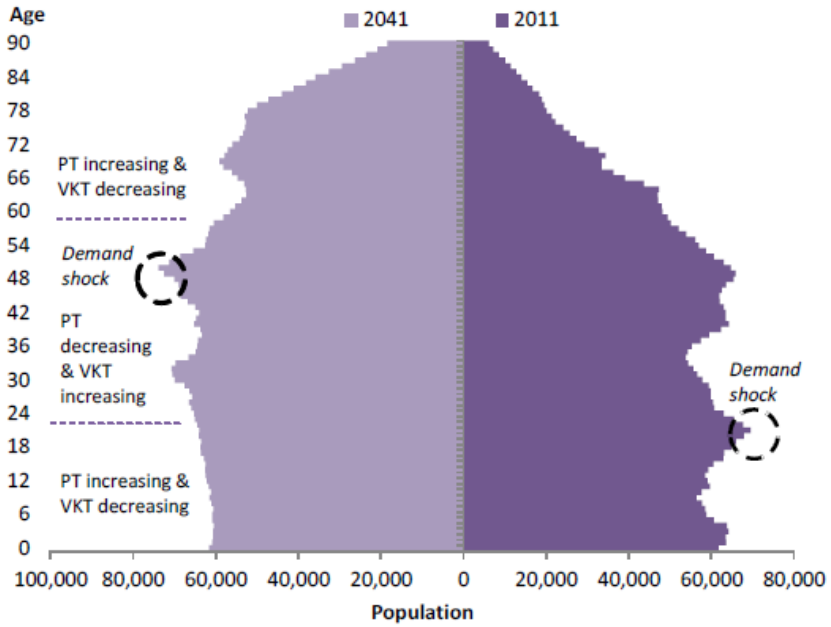


Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)

When compared to the central scenario (50th percentile), the modelled equivalent to the downside scenario (25th percentile) shows an approximately 10% reduction in public transport demand and 15% reduction in light vehicle kilometres travelled. The need to construct new roads, upgrade existing roads and develop new public transport options is accordingly diminished in this scenario.

As our population ages in the downside scenario, it is interesting to note an expected increase in public transport demand by the elderly (and an increase in private vehicle usage for those who are 'middle-aged' – driven by relatively high income growth in this scenario). The following graph demonstrates this concept:

Figure 26: Demand impacts by age distribution

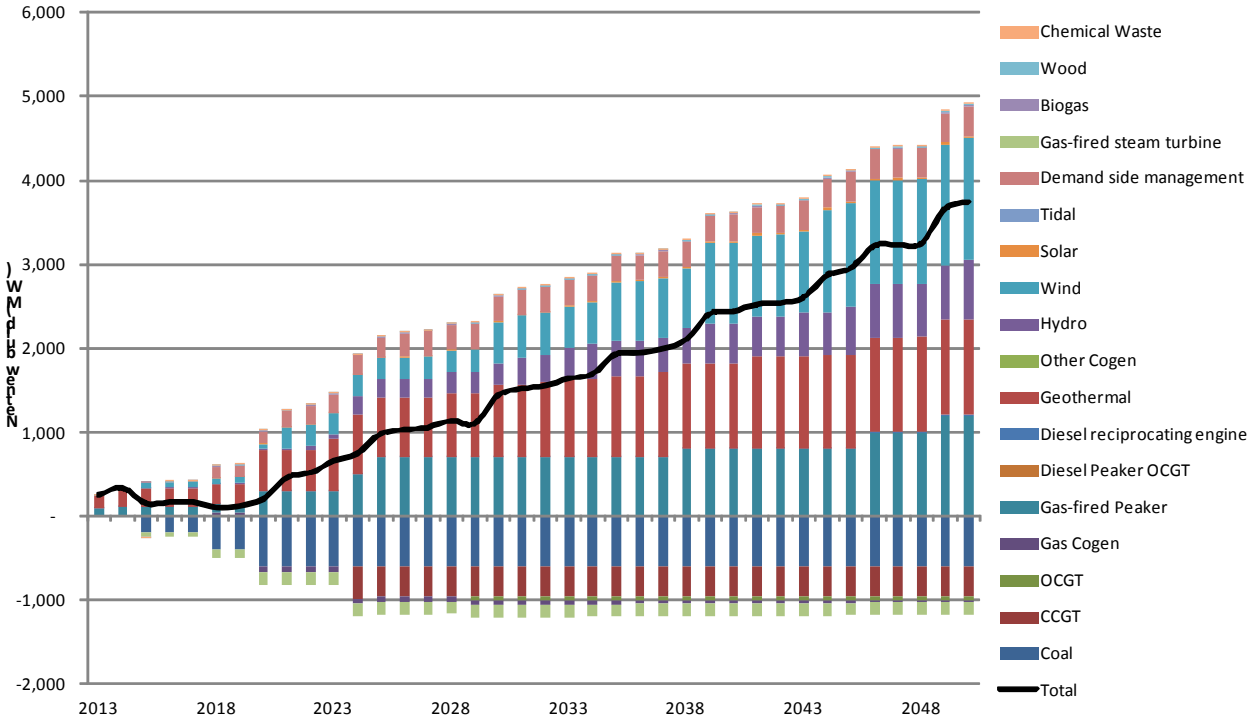


Source: National Long-Term Land Transport Demand Model, NZIER and NZTA (2013)

Energy

Modelling by MBIE (discussed in detail in the central scenario section) considers the impact of low energy demand driven by lower than expected population and economic growth. Based on MBIE's projections in the low demand scenario, the net new build for electricity generation is shown by fuel type in the graph below.

Figure 27: New build by fuel type in the low demand (downside) scenario



Source: Ministry of Business, Innovation & Employment, Treasury analysis

As with most of the other sectors in the low demand scenario, the implications for our electricity infrastructure generally translate to a delay and reduction in size of new investment and underutilised or oversized assets.

In the oil and gas sectors, the downside scenario assumes little to no new discoveries (and/or policy changes that negatively impact exploration in New Zealand). In this case, production is expected to decline which could lead to a gap between gas supply and demand, as well as underutilised oil export assets. At the same time, new infrastructure may be required to import energy to address the gap in gas supply and demand.

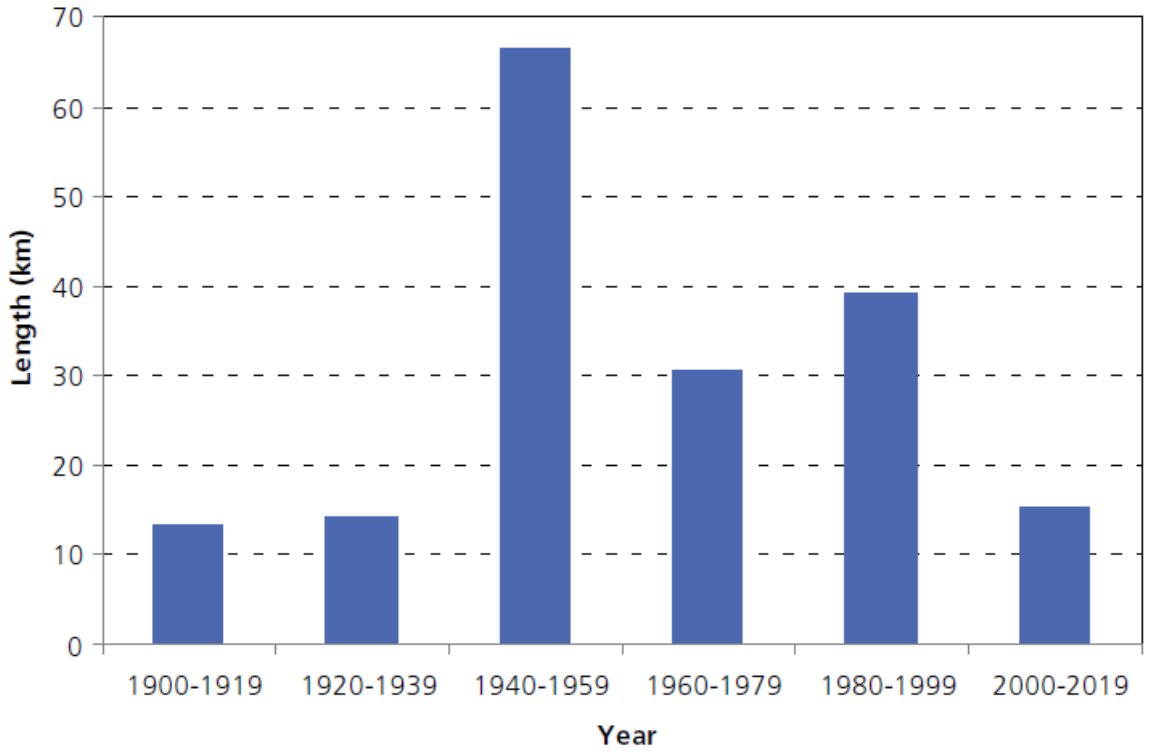
Water

Urban Water

As with the other scenarios, the effect of the downside scenario on our urban water sector is expected to be driven in large part by population. In this case, low population growth (and decline in some areas) will translate to lower requirements for new sources of supply and infrastructure upgrades. In rural areas that experience high population decline, the existing assets may in fact be significantly underutilised – with their operation and maintenance creating a burden on the remaining ratepayers.

In a similar vein, the downside scenario assumes that we have high public and private debt, lower incomes and a limited ability to pay by our ratepayers. In the medium to long term, this type of funding constraint could be exacerbated by the looming renewal of a substantial cohort of assets built in the mid-20th century. Although the average age and expected useful life of urban water assets varies across the country, Greater Wellington Water provides one example of the lumpy renewal liability faced by many councils in the next 30 to 50 years:

Figure 28: Length of distribution pipelines by year of construction (Greater Wellington Water)



Source: Greater Wellington Water (Water Supply Asset Management Plan, 2012)

Productive Water

Although climate change will be relatively 'kind' in the downside scenario, demand for productive water infrastructure will also be relatively low due to weak demand for our agricultural products.

Also, a proliferation of new technology, coupled with better information links through programs such as the Rural Broadband Initiative, will drive innovation and productivity in the agricultural sector. Low cost sensors for water, crops, livestock, weather and geospatial data will enable more efficient water use and better infrastructure management. Taken at face value, leveraging technology in the productive water sector would reduce or defer the need for capital upgrades. However, it should be noted that technology may in fact drive additional infrastructure investment – if, for example, better assets and more storage is required to ensure the water supply is reliable enough to make the technology investment worthwhile.

A recent report by CSIRO in Australia provided some insight into emerging technologies in the agricultural sector (Griffith, Heydon, Lefort, Taylor, Trotter, & Wark, 2013). These include:

- Integration of sensor data and related digital services into vertical supply chains to create efficiencies and innovation in processing, distribution and marketing
- The increasing focus by agribusiness companies on using digital services to optimise supply chains and complement their traditional focus on physical products and processes
- Biosecurity and food safety initiatives that will increasingly use agricultural sensor data for early detection and monitoring of incidents
- Growing consumer demand for information about food provenance that can be used to add value to food and provide more customer choice
- The development of tools and methodologies for biomass and carbon accounting that can be used for farm operations as well as emerging carbon markets
- Addressing the unmet demand from rural communities for better access to education, health and other social and communication services.

Source: CSIRO, Smart Farming: Leveraging the impact of broadband and the digital economy (2013)

Telecommunications

In the downside scenario, we assume that the UFB network (in tandem with the RBI) will continue to be progressively developed by 2020, but with adoption rates much higher than expected. In general, the downside scenario assumes high demand for new technology, which is reflected in relatively lower demand on other assets (where productivity-enhancing technologies have been leveraged). Although it also notes lower demand for services such as mobile which are aligned to population growth and mobility.

With limited data and modelling publicly available, it is difficult to forecast the specific local, regional or national implications for our copper, mobile, fibre and other telecommunications assets in the downside scenario. However, we assume that the aggregate demand will be relatively high for fibre and mobile in line with global trends.

It should also be noted that what we currently consider to be 'ultra fast' broadband will one day be ordinary by international standards. Although the timing of such a scenario is uncertain, the end result would be a need to upgrade our fibre networks to achieve faster speeds (or to invest in other technologies, whatever they may be).

Social Infrastructure

Social infrastructure in the downside scenario is affected by low projections for population growth (in the urban centres) and gradual decline (in rural centres). Key implications for each sector are noted below.

Education

Nationally, the combined primary and secondary school roll is projected by the Ministry of Education to be approximately 700,000 in 2030 under this scenario (where it is about 800,000 in the central scenario). The projections do not specifically note where this decline will occur.

Justice

As with education infrastructure, the justice system will also be less utilised in the downside scenario when compared to the central scenario. The forecast produced by the Ministry of Justice suggests the prison population may reach about 7,000 people in a low-demand environment (compared with 8,000 in the medium projection) – an acceleration of the trend toward a declining prison population. Again, the spatial distribution of the impact is unknown.

Health

In the downside scenario, the ageing of our population is higher than expected with low inward migration and low fertility rates. When compared to the central scenario, this is expected to decrease the burden on maternity services and early childhood care – but will substantially increase the burden on aged care facilities.

Summary

Concluding remarks

Pressure is placed on our infrastructure networks by four fundamental drivers of change: population, economy, technology and resources. While it is common to forecast a best estimate of demand, the future is inherently difficult to predict. The purpose of this publication, therefore, is to create a profile of future demand that encompasses a range of plausible upside and downside scenarios.

During our investigations, it became clear that the energy and transport sectors have both undertaken significant work in the area of scenario planning and demand modelling – based on the fundamental drivers of change, incorporating both spatial and temporal effects and considering the interdependencies between infrastructure sectors. Although the demands placed on energy and transport infrastructure are no less daunting, it is encouraging that systems appear to be in place to enable proactive management of these networks.

Although demand modelling has been undertaken within the water and social infrastructure sectors, it is more difficult to find published evidence that allows us to paint a joined-up picture at a local, regional and national level that includes both upside and downside scenarios. The same is true for telecommunications, where the sector is privatised and has not published forecasts or trend analysis.

Regardless of the sector, the future implications for our infrastructure are profound. In the upside scenario, population growth creates high demand on all aspects of our urban infrastructure and economic growth exacerbates this demand. Regional infrastructure requirements are commodity-driven in the main, creating demand for productive water infrastructure and transport links for distribution or export. Failure to manage these high levels of demand will inhibit the growth of our economy and restrain living standards from reaching a level they might otherwise have achieved.

On the contrary, the downside scenario creates, on balance, a low demand trajectory for our infrastructure. Although technology uptake is high (creating demand in the telecommunications sector), the other sectors are relatively unburdened due to low population growth, limited urbanisation and anaemic economic growth. In this case, continuing to augment our infrastructure networks in the long run may lead to an expensive mistake – resulting in early investment or, in the worst case, a network of stranded, underutilised and oversized assets that are costly to build and maintain.

Whether our future follows a low-demand path, a high-demand path or somewhere in between is unclear. But, the lesson to be learned is more obvious: it is essential that we have, both within and between our infrastructure sectors, a robust system in place that helps us to anticipate shifting patterns of demand and to respond appropriately.

Next steps

Having developed an evidence base that covers performance, trends and scenarios, resilience and capital intentions, our next step is to investigate the most appropriate ‘response’. In doing so, the NIU’s first action is to consult widely with each sector on the evidence base and what, if any, actions might be needed to address issues highlighted by it.

This initial scenario modelling investigation helps to provide an illuminating perspective on the nature of the response and conveys two clear messages – namely, that the response should seek to:

- Leverage the positive drivers of change (e.g. embrace cost-effective new technologies) and mitigate the negative drivers of change (e.g. develop and implement climate change adaptation plans), and
- Exploit the opportunities presented by interdependence (e.g. intelligent networks that improve asset utilisation), whilst simultaneously managing the risks of interdependence (e.g. resilience planning to protect against failure propagation).

Finally, the infrastructure response is not expected to be a static plan. Instead, the response must continuously evolve to address new evidence and shifting trends – whether global or domestic.

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INFRASTRUCTURE EVIDENCE BASE

Resilience

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

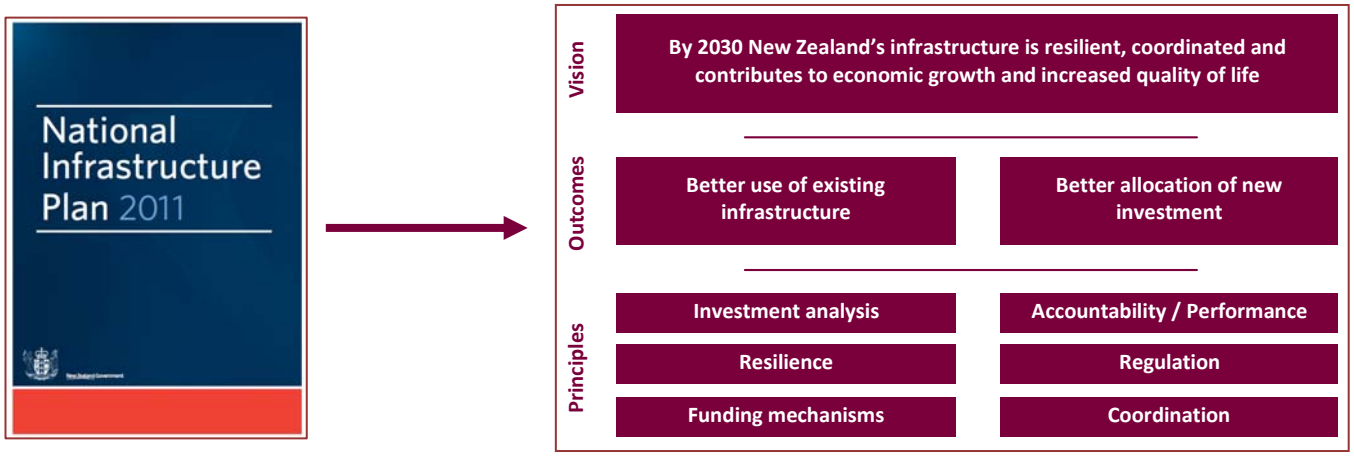
EVIDENCE BASE

Resilience

February 2014

Introduction

Infrastructure is a crucial part of the New Zealand economy. It supports the day to day activities of New Zealanders, helps to improve living standards for all, and can be a driver for economic growth. As such, it is vital it is managed as well as possible. The National Infrastructure Plan 2011 sets out a long term vision for New Zealand's infrastructure and seeks to provide a common direction for how we plan, fund, build and use all economic and social infrastructure.



A significant constraint identified in the National Infrastructure Plan 2011 was the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment. A key part of the National Infrastructure Unit's (NIU) work programme over the past two years has been to develop a more robust Evidence Base to address this constraint. In particular, publishing the Evidence Base enables a discussion identifying the significant issues for New Zealand infrastructure and options to respond to these. Discussion of these will underpin the NIU's work programme over 2014, through to the release of the next National Infrastructure Plan in 2015.

The Evidence Base draws together work on performance indicators (the current state of the infrastructure), scenario and trend analysis (the future pressures or drivers of demand), the national resilience picture, and the first 10-year Capital Intentions Plan (what is known about indicative future spend).

This document forms the substantive component of the Evidence Base for infrastructure resilience covering key sectors (transport, energy, telecommunications, water, social and interdependencies). It focuses on the New Zealand context for national infrastructure resilience, a common understanding of what resilience refers to, and progress being made assessing adequacy of resilience levels within sectors and between sectors. This is a work in progress requiring continuing re-calibration. It follows from the overview document, which can be found on the NIU's website. It draws information from the performance indicators, scenario and trend

Resilience involves infrastructure organisations, funders, insurers, business and communities working together for the benefit of New Zealand.

EVIDENCE BASE: RESILIENCE

Overview messages

- Infrastructure resilience enables economic and community resilience. In this context resilience attributes include; delivery of (infrastructure) service, community preparedness, consideration of interdependencies, financial strength and organisational performance. Risk mitigation, adaptability and the will to act in advance are key ingredients.
- New Zealand is a relatively hazardous country. Infrastructure fails.
- Resilience deals with emergent as well as shock events and improved resilience necessitates co-ordination of multiple interests to deliver improved economic outcomes.
- Resilience addresses black swan (rare, unprecedented) events and complex system risks with dynamic interdependencies.
- All infrastructure sectors have weakest link vulnerabilities including for example global supply chains for equipment or highly skilled expertise.
- Not all elements of infrastructure require high levels of resilience from a national perspective. Preliminary assessments have identified areas requiring priority attention based on resilience expectations and current assessed levels of resilience. Some of these are being addressed as specific workstreams; national oil security, gas security of supply, international telecommunications cables, investment in KiwiRail, and investment by Transpower.
- Interdependencies of infrastructure sectors presents increasingly complex issues potentially decreasing overall resilience. The activities of regional lifelines groups are being actively supported to reveal interdependency issues and increase community awareness of vulnerabilities. Various research projects are underway to examine more sophisticated means of assessing resilience aspects of interdependencies.
- There are particularly high infrastructure vulnerabilities where limited alternatives exist such as in trans oceanic communication cables and international oil supplies.

Context

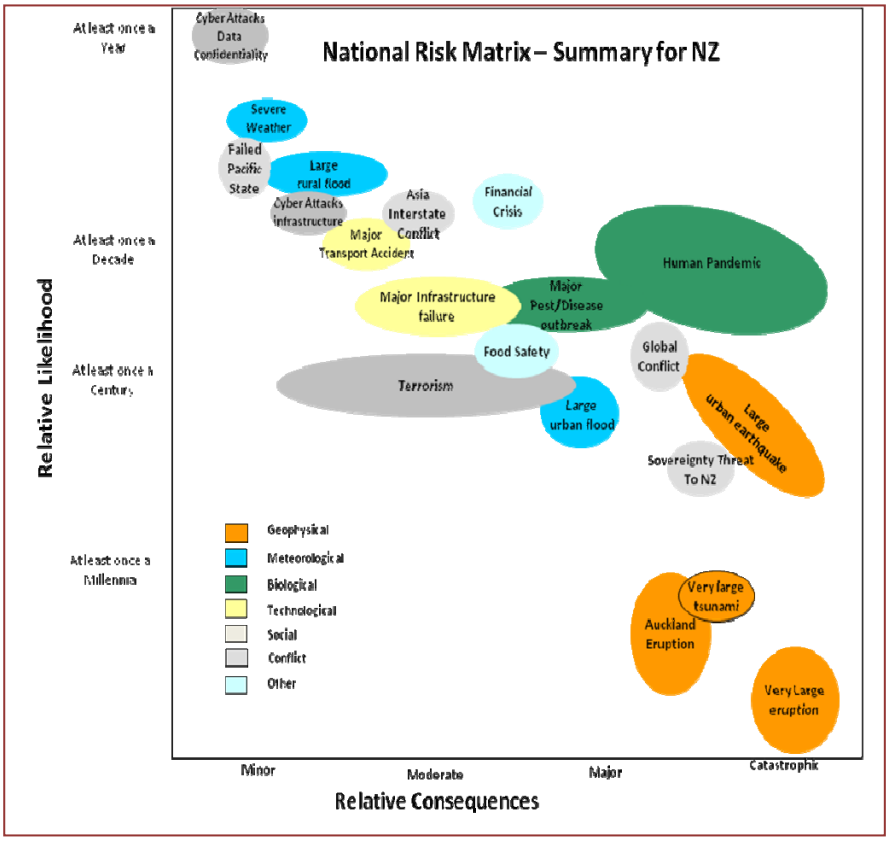
Modern communities are reliant on the dependable functioning of infrastructure, including buildings, telecommunications, electricity, water and transportation networks. This infrastructure forms a highly complex system with many points of connection. There is increasing international awareness of the need for communities to be resilient in the face of change and challenge.

The Kiwi way of life is vulnerable to damage to infrastructure, both long slow damage from corrosion and neglect, as well as short sharp damage from unexpected disasters, especially in a country like New Zealand which has active threats from seismic and volcanic hazards, as well as severe weather events.

The National Infrastructure Plan identifies resilience as one of the 6 guiding principles and has as a goal *"By 2030 New Zealand's infrastructure is resilient and coordinated and contributes to economic growth and increased quality of life."*

In New Zealand the context for advancing infrastructure resilience has substantially developed over recent years in part driven by events in Canterbury but also a broader understanding of the necessity for coordinated action. "New Zealand's National Security System" (May 2011) recognises many of the key risks including Auckland volcanic eruptions, very large tsunami, large earthquake, large urban flood, severe weather, major infrastructure failure, and major transport accident. Increased resilience will reduce the risk of interruption from these hazards and other threats such as terrorism.

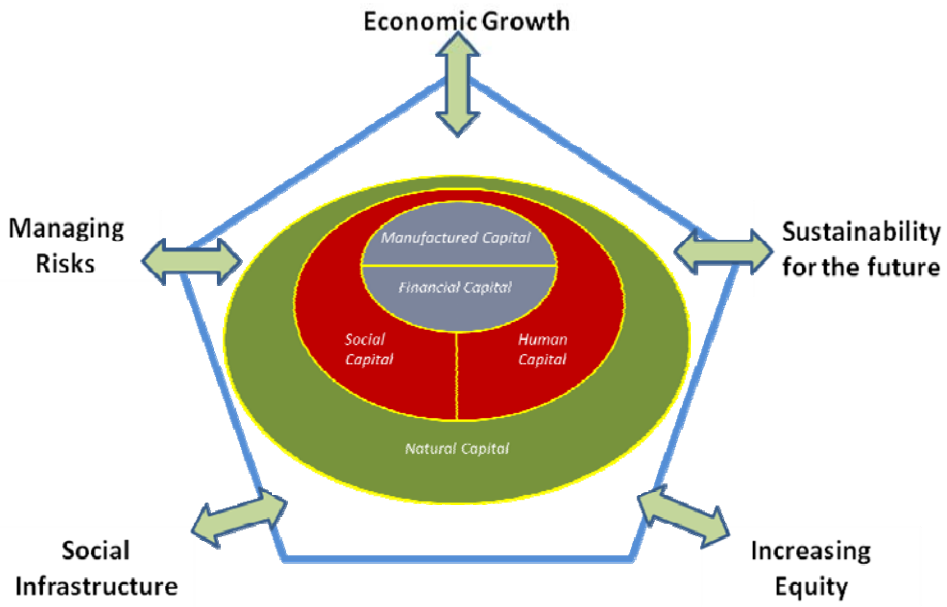
EVIDENCE BASE: RESILIENCE



Infrastructure failure features as a specific item in this National Risk Matrix. Infrastructure would be both affected by and significantly contribute to New Zealand's ability to manage most of the other risks identified.

The National Science Challenge has Resilience to Nature's Challenges as a priority and the Ministry of Business, Innovation and Employment has through the Natural Hazards Research Platform and other research activities been connecting research with practice supporting activities such as "The Economics of Resilient Infrastructure" and low damage design of bridges and buildings. Many of our universities, consulting companies, GNS Science and NIWA are active in this area.

The Government is working towards higher living standards for New Zealanders and is cognisant of the need for both wise investment and balanced management of financial risks. The Treasury's living standards framework provides a basis for the "... increased quality of life" in the National Infrastructure Plan goal referred to earlier. The capitals (natural, human, social, financial & manufactured) and the perspectives applied to them in generating advice are presented visually in the following schema:



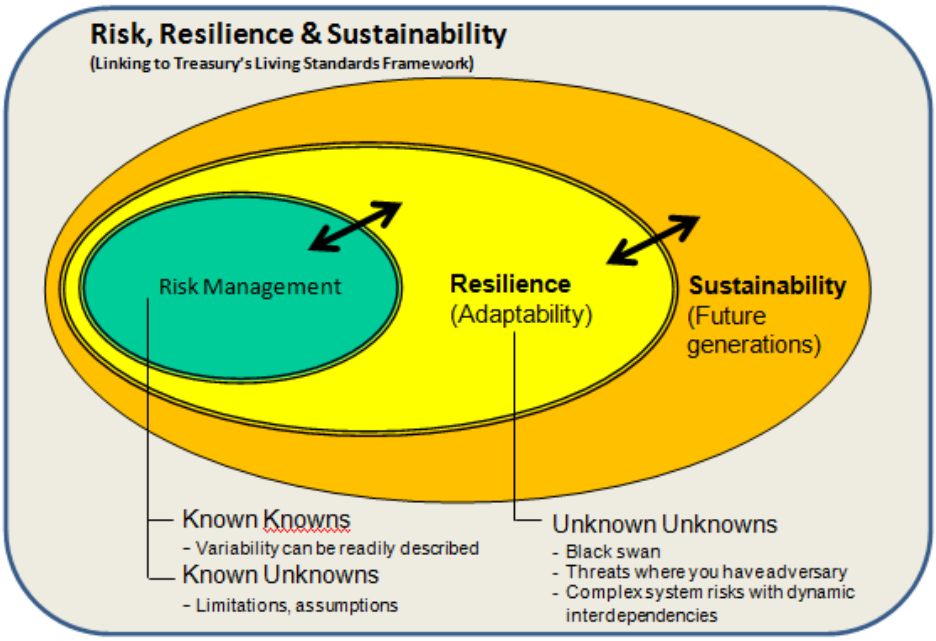
Resilience is the capacity of each of the capitals to adjust to changing conditions caused by sudden shocks, gradual stresses and cumulative change, without loss of form or function.

As expressed in this quote from Hamel & Välikangas, 2003: "Strategic resilience is not about responding to a onetime crisis. It's not about rebounding from a setback. It's about continuously

anticipating and adjusting to deep, secular trends that can permanently impair the earning power of a core business. It's about having the capacity to change before the case for change becomes desperately obvious."

Resilience is not just about responding to adverse events. It is also about preparing for the future and being able to respond to opportunities as well as risks. Climate change adaptation and changing New Zealand demographics are good examples.

The following diagram demonstrates how the concept of resilience is related to both risk and sustainability:



In the overall management of complex risks, investment in the enhancement of resilience can be more cost-effective than direct investment in mitigating specific hazards or threats. The pursuit of increased levels of resilience should lead to economic costs being materially reduced, as well as relieving long term pressures on local and central government budgets. Communities including businesses, families and individuals benefit from increased understanding of vulnerabilities and can make more informed decisions on their level of preparedness.

At a fundamental level **"Resilient is something you are not something you do"** and recognises that we dealing with a constantly changing situation. The reality is that infrastructure fails for many reasons and New Zealand is reasonably hazardous. Infrastructure resilience supports resilient economies and communities.

EVIDENCE BASE: RESILIENCE

What do we have

To ensure that resilience is considered in its broader context from a national perspective the National Infrastructure Unit has developed a series of attributes which should collectively form part of any resilience assessment:

Resilience attributes

Service Delivery
Focus on national, business and community needs in the immediate and longer term

Adaptation
National infrastructure has capacity to withstand disruption, absorb disturbance, act effectively in a crisis, and recognises changing conditions over time

Community Preparedness
Infrastructure providers and users understand the infrastructure outage risks they face and take steps to mitigate these. Aspects of timing, duration, regularity, intensity, and impact tolerance differ over time and between communities

Responsibility
Individual and collaborative responsibilities are clear between owners, operators, users, policy-makers and regulators. Responsibility gaps are addressed

Interdependencies
A systems approach applies to identification and management of risk (including consideration of interdependencies, supply chain and weakest link vulnerabilities)

Financial Strength
Financial capacity to deal with investment, significant disruption and changing circumstances

Continuous
On-going resilience activities provide assurance and draws attention to emerging issues, recognising that infrastructure resilience will always be a work in progress

Organisational Performance
Leadership and culture are conducive to resilience, including: Leadership & Culture, Networks and Change Ready. Future skills requirements are being addressed

Applying these attributes is a significant challenge and one we must continue to address. To demonstrate the importance of applying all attributes collectively; an infrastructure provider may have a robust physical network delivering a service but be found wanting with respect to customer service or levels of insurance or assumed fuel supplies following a shock event. Users of infrastructure may expect continuous supply whereas the providers' contractual arrangements may not commit to that or perverse business imperatives may emerge that do not necessarily act in the best interests of society. In these and other stuations users may not be well informed of the potential vulnerabilities or do not make their own decisions over mitigation options. Organisations, their leadership and culture, are strong determinants of levels of resilience across all the attributes.

Assessment of resilience across all these attributes encourages deliberations with users and greater transparency on the ability of infrastructure systems to meet current and future needs in a comprehensive fashion to achieve efficient and effective outcomes. Increased resilience is not necessarily achieved by greater investment and is often achieved by operational improvements.

EVIDENCE BASE: RESILIENCE

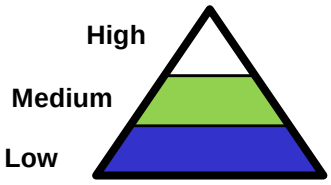
Levels of Resilience

Not all elements of infrastructure require high levels of resilience and in some cases high levels of resilience may not be achieveable due to external factors, a case in point being New Zealand's exposure to international oil supplies.

Required levels of resilience will vary depending on perspective. To develop the Evidence Base for national infrastructure Resilience the National Infrastructure Unit considered that progress would be best achieved by putting forward a view to be challenged and developed further by others. This view has been socialised for around 18 to 24 months and various editions and modifications made based on feedback received. In some cases government agencies responsible for sectors have progressed the next levels of evidence base in support of these views (eg. Ministry of Transport) and in some cases endeavours have progressed specific areas identified as priorities (eg. MBIE oil sector security and international telecommunications cables).

In the tables that follow resilience expectations from a national perspective are identified as low medium or high. When making these judgements a wide range of aspects require consideration. The below tables and commentary show this by sector.

Key: Levels of Resilience



Transport

Under Local Roads "Strategic freight routes" are those routes generally to and from airports and ports, generally with a very high economic value associated with them and generally carrying freight of a time critical nature. A high level of "Resilience Expectation" is therefore attributed to them. An "Assessed Resilience" of medium reflects the significant vulnerabilities of some of these routes both from limited alternate options and urban pressures for example. In contrast "Suburban roads" have a low "Resilience Expectation" in part due to the relatively low economic value associated with them and also the generally large number of alternate access options.

"Suburban roads" are also a good example of level of resilience being dependent on your perspective; if you reside in a particular suburban road you a likely to expect a high level of resilience and in many cases this probably exists.

In rail, the low rating for the National Rail Centre reflects the fact there is only one for the country. An example of the risk this poses is the case of an electricity outage in Wellington stopping rail services in Auckland, as happened a couple of years ago. The medium ratings shown in both suburban and national rail is reflective of the lack of investment over recent years, and the "catch up" mode we are currently in.

Transport	Resilience Expectations	Assessed Resilience	Desired Movement
Local Roads			
Suburban			–
Main arterial with alternate			–
Main arterial – no alternate			–
Strategic freight routes			↑
National Roads			
National with alternate			–
National – no alternate			↑
Road/Rail Link Span			
Cook Straight ferries & terminals			–
Rail			
Suburban (incl rolling stock)			↑
National (incl rolling stock)			↑
National Train Control Centre			↑
Ports			
Individual Ports			–
Ports with specialist facilities			↑
Ports Network			↑
Airports			
Regional airports			–
Airways NZ			–

Ports have been the subject of specific attention recognising their critical importance to New Zealand's productive economy. The University of Auckland and others have been undertaking research considering tsunami vulnerabilities to port network operations and structures. The Port of Lyttelton, and the strategic freight routes servicing it is a particular case in point as it looks to recover from damage sustained during the earthquake events.

The assessment included here has been created by the National Infrastructure Unit, taking a national level perspective, and thus may differ from other perspectives. Further work is needed to develop this with robust supporting evidence; however, this does provide a starting point for prioritising efforts. Based on this assessment, key areas of attention are; Strategic freight routes, National Roads with no reasonable alternate routes, Rail and Ports.

EVIDENCE BASE: RESILIENCE

Telecommunications

The sector has indicated in discussions that it considers resiliency to be suitable for New Zealand, with diverse technology in the backhaul providing a good basis. Empirical evidence from the recent Christchurch earthquakes also appears to support this view, with mobile services operating within 24 hours of the earthquake.

The sector has raised a query regarding the resilience of 111 calls, which have a single point of failure as all calls must go through the PSTN, although only about 20% originate on it.

With regard to the NIU assessment, included in the table to the right, "International Cables" have been attributed a high level of "Resilience expectation" as a result of the very high economic value associated with them and the fact they generally carry time critical data. An "Assessed Resilience" of medium reflects the significant vulnerability related to limited alternate options and the geographic proximity of landing points in New Zealand. While additional international cables will increase resilience, the quantum is hard to define.

In contrast "Landline – voice" is being superseded by new technologies and a medium "Resilience Expectation" reflects its transitionary state, its relatively low economic value and availability of alternatives. "Landline – voice" is also a good example of level of resilience being dependent on your perspective; if your residence has this means of communication you could expect a high level of resilience and in many cases this probably exists.

Telecommunications	Resilience Expectations	Assessed Resilience	Desired Movement
International			
Cables			↑
Satellite			↑
Backhaul (Main Trunk lines)			
National			↑
Regional			↑
Local exchanges			↑
Access (to local exchanges)			
Landline – voice			–
Landline – data (incl Broadband)			–
Mobile			–
Radio Telephony			–
111			↑
6 Telecon Core Exchanges			↑
2 Telecom ICAP Exchanges			↑
2 Telecom ICAP Exchanges			↑
Television			
Regional			–
National			–
Radio			
2 Telecom ICAP Exchanges			–
2 Telecom ICAP Exchanges			–
Retail			
Customer Interface			↑

Energy

Electricity

With New Zealand's largely renewable electricity generation system and relatively limited hydro storage capacity, mainly in South Island catchments, there is vulnerability to low rainfall periods and a necessity to ensure sufficient generation capacity at all times. When hydro storage is being conserved, electricity flow will tend to reverse and be from the North to the South Island, and the (HVDC) transmission line from Benmore in the South Island to Haywards in the North Island is therefore a vital link.

Growth in electricity demand is predominantly around Auckland so over recent years transmission reinforcement from the south has been vital to ensure security of supply. Northland, being another net importer of electricity and having major industrial consumers such as the refinery, has been concerned for many years about supply risk. This is being partially alleviated by the same transmission upgrades.

As demonstrated by recent storm events in Wellington and Canterbury, in the eletricity market risks to the distribution system and resilience are key considerations to reduce consequential economic and social losses associated with outages. The vulnerability of the "last kilometre" in parts of the system, the economic consequences of outage, and the duration of outage probably need increased attention. Largely for commercial reasons at this stage, some distribution companies are starting to deploy Remote Area Power Supplies (RAPS).

Electricity	Resilience Expectations	Assessed Resilience	Desired Movement
Generation			
Individual Generator <300MW			–
Individual Generator >300MW			–
River Chain >300MW			–
Transmission			
66kV			↑
110kV			↑
220kV & >			↑
HVDC			–
Distribution			
Embedded generation			–
Distribution <			–
Distribution 11kV			–
Distribution general			↑
Retail			
Retail functionality			–
Customer Interface			↑

EVIDENCE BASE: RESILIENCE

Gas

In-built redundancy within critical supply chain elements and the industry's contingency management processes mean that unplanned interruptions of various durations, as occur from time to time, are usually rectified quickly and pass unnoticed by most other industry participants and consumers. Threats to the supply chain are well known, with the main hazards in respect of pipeline routing and facilities operation subject to statutory oversight/certification, regular monitoring, maintenance and/or mitigation works. MBIE is currently reviewing gas supply security and a consultant's report will be released for feedback in early 2014.

This gas supply security assessment contributes to improving understanding of levels of resilience across the energy sector as mapped out in the following assessment made at a national level. As further evidence is developed, this tabulation will be refined and will be used to assist in prioritising efforts.

Gas	Resilience Expectations	Assessed Resilience	Desired Movement
Sources			
Gas Fields < X TJ/day			–
Gas Fields > X TJ/day			–
Imported LPG			–
Transmission			
Maui			–
Vector – to Huntly			–
Vector – Huntly to Auckland			↑
Vector – National			–
Large Commercial			↑
Distribution			
Residential/small commercial			–
Large commercial			–
LPG Bottled			–
LPG Networked			–
Retail			
Retail functionality			–
Customer Interface			↑

Oil

New Zealand will remain highly vulnerable to international oil supply disruption and price. Through New Zealand's membership of the International Energy Agency (IEA), New Zealand is required to hold 90 days of stock effectively held through storage onshore and international arrangements where stock is held offshore. There are considerable Lifelines concerns about the inability of service stations to supply fuel during electricity outages and other emergency situations.

Oil	Resilience Expectations	Assessed Resilience	Desired Movement
International			
International supply ex Asia			↑
International supply ex elsewhere			↑
Refinery			
Refinery			–
Refinery to Auckland (RAP)			–
Wiri Terminal			↑
Coastal Distribution			–
Regional Storage			
Auckland, Wellington, **Christchurch**			↑
Elsewhere			–
Distribution			
Urban			–
Rural			–
Retail			
Retail – Individual sites			–
Retail – Area availability			↑
Customer Interface			↑

EVIDENCE BASE: RESILIENCE

Water

To provide an assessment of resilience, the water sector (urban and productive) has been disaggregated and qualitative methods applied to compare resilience expectations (from a national perspective) with the assessed level of resilience to identify desired improvements. These tabulations have been publicly available and presented in various forums through 2012 and 2013 and continue to evolve as new information comes available.

At this stage the resilience assessment for the water sector has largely been in the urban water component including some exercises looking at specific district water services. Ideally similar work would be undertaken in future for specific irrigation schemes.

In Urban Water "City mains" generally have a very high economic and social value associated with them. A high level of resilience expectation is therefore attributed to them. An assessed resilience of medium reflects the significant vulnerabilities of some of these routes both from limited options and ability to withstand hazards such as earthquakes. In contrast "Private laterals" have a low resilience expectation in part due to the relatively low economic value associated with them and also the relative ease of remediation. "Private laterals" are also a good example of level of resilience being dependent on your perspective; if your residence or building is dependent on a particular lateral you are likely to expect a high level of resilience and in many cases this probably exists.

Water	Resilience Expectations	Assessed Resilience	Desired Movement
Natural			
Lakes			–
Rivers			–
Rural Water			
Irrigation			–
Reticulation			↑
Urban Water			
Private laterals			–
Street			–
City mains			↑
Reservoirs			↑
Urban Wastewater			
Private laterals			–
Street			–
City mains			↑
Treatment facilities			↑
Urban Stormwater			
Private laterals			–
Street			–
City mains			↑
Discharge			↑

In addition to the NIU assessment, PWC/GHD identified six metrics to assess for resilience, shown in the sector specific narrative on urban water.

Productive water is largely encompassed under "Rural Water – Irrigation". The rationale for a low rating (blue) for resilience expectation is that from a national perspective there are numerous schemes with considerable diversity across catchments and across production types. Clearly from a local perspective a medium or high level of resilience would be desirable.

There are significant interdependencies of productive water, both being dependent on other elements of infrastructure to function and being a major contributor to demand on other sectors. This is probably the most important aspect going forward to improve resilience.

Social Sector

As with the water sector, the social sector has been disaggregated and qualitative methods applied to compare resilience expectations with assessed level of resilience to identify desired improvements in resilience. These tabulations have been publicly available and presented in various forums through 2012 and 2013 and continue to evolve as new information comes available.

At this stage the resilience assessment for the social sector is least developed but it is noted that it is probably the sector most vulnerable to interdependency issues being very dependent on all other sectors and being a primary interface with communities.

When making the judgements shown in the table on the right, a wide range of aspects have been considered, including the particularly need in the social sector for some heavily specialised assets. Very specialised facilities tend to warrant high levels of resilience whereas if the functions can be relatively easily undertaken

Social	Resilience Expectations	Assessed Resilience	Desired Movement
Education			
Pre-school			–
Primary School			–
Secondary school			–
University/Post Secondary			–
Justice			
Police			↑
Corrections			–
Courts			–
Health			
Laboratories			↑
Medical Centres			–
Local/specialised hospitals			–
Regional hospitals			↑
Housing			
Individual houses			–
Housing blocks			–
Suburbs			–
Defence			
Airforce assets			–
Navy assets			–
Army assets			–

elsewhere then a low resilience expectation is appropriate. To demonstrate; under “Courts” the functions undertaken can be undertaken in alternate facilities (low “Resilience Expectation”) but “Regional hospitals” provide specialised facilities and associated services (high “Resilience Expectation”).

Under this assessment police, health laboratories and regional hospitals deserve specific attention but a more robust assessment may indicate alternate priorities.

Interdependencies

In addition to assessing the sectors individually, NIU has undertaken a brief assessment of the interdependencies between sectors.

Interdependencies assessment increases in complexity quickly and to a large degree qualified judgements will be the best available. To date these have mostly been advanced by regional civil defence and Lifelines groups assembling representatives of all sectors and stress testing assumptions and dependencies. To demonstrate resulting assessments and the table; Transport is highly dependent on Energy as a fuel source and therefore a high “Resilience Expectation” whereas Transport is not as dependent on Water (eg. flooding, pumping of tunnels, cleaning) which therefore warrants a low “Resilience Expectation”. In the case of Transports dependence on Energy the “Assessed Resilience” is medium, to a large degree reflecting supply chain vulnerabilities of liquid fuel supplies.

Most sectors are increasingly dependent on the Telecommunications sector for improving operations and effectiveness. This interdependency unless well managed, can lead to reduced resilience and increased vulnerability.

Cyber security has not yet been represented in these tabulations but it is critical for operation of infrastructure systems and an example of where a sector may be assessed as meeting expectations but in most cases will have critical vulnerabilities.

Interdependencies	Resilience Expectations	Assessed Resilience	Desired Movement
Transport dependency on:			
Telco			–
Energy			↑
Water			–
Social			–
Telco dependency on:			
Transport			↑
Energy			↑
Water			–
Social			–
Energy dependency on:			
Transport			–
Telco			↑
Energy			–
Social			–
Water dependency on:			
Transport			–
Telco			↑
Energy			↑
Water			↑
Social dependency on:			
Transport			–
Telco			↑
Energy			↑

“Pinchpoints” and “Hotspots”

In addition to these sector assessments and the sector interdependency assessment there are specific sector vulnerabilities or “Pinchpoints” and geographic areas where the presence of multiple elements of infrastructure lead to interdependency vulnerabilities or “Hotspots”. The terminology of “Pinchpoints” and “Hotspots” largely derives from activities of local authority emergency management and Lifelines Groups who are the main source of the following lists. It is important to note that the identification of a Pinchpoint or Hotspot does not necessarily imply that there is a weakness or vulnerability but that these areas deserve particular attention in terms of on-going operations and future investments.

EVIDENCE BASE: RESILIENCE

As examples of source material:

- Auckland information is sourced from; “Assessment of infrastructure Hotspots in the Auckland region”, Auckland Engineering Lifelines Group, 2007. Infrastructure hotspots were identified based on the number of utilities within the immediate area as well as the overall services impact the area would have if hotspot were to suffer extensive utility failure. Those considered to be of national significance have been selected from a more extensive regionally significant list. The principal contact is Lisa Roberts, of Auckland Engineering Lifelines Group (AELG).
- Wellington information is sourced from; “Wellington Lifelines Group Update of Critical Areas 21 May 2010”. Those considered to be of national significance have been selected from a more extensive regionally significant list. The principal contact is Richard Mowll, of Wellington Engineering Lifelines (WELG).

In both cases the information from the source documents has been updated and revised in consultation with the principal contacts. The balance of the lists has been developed in consultation with a range of parties.

EVIDENCE BASE: RESILIENCE

Pinchpoints – Nationally Significant

Northland
- New Zealand Refining Company (NZRC)
- Refinery to Auckland Pipeline (RAP)

Auckland

Transport
- Ports of Auckland
- Auckland International Airport
- RNZAF Whenuapai
- Northcote Traffic Management Center

Fuel
- Refinery to Auckland Pipeline (RAP)
- Wiri Oil Depot

Telecommunications
- Radio New Zealand House, Hobson Street

Water supply & wastewater
- To be advised

Electricity
- Otahuhu-Henderson 220kV
- Vector Grid Exit Points (GXP's)

Gas
- Westfield Gate Station
- Papakura Gate Station

Bay of Plenty
- Mount Maunganui Fuel Terminal

Hawkes Bay
- Napier Fuel Terminal

Taranaki
- New Plymouth Fuel Terminal

Wellington
- Te Marua Lakes (& associated pipework)
- Radio New Zealand House, The Terrace
- Avalon Tower, Lower Hutt - RCCNZ/MOC
- Wilton Substation
- Central Park Substation

Nelson
- Nelson Fuel Terminal

Canterbury
- Christchurch Wastewater Treatment plant
- Air traffic control radars
- Tekapo Gates / SH 79
- Pukaki Dam / SH 79
- SH80 - Pukaki to Mt Cook
- SH1 - coastal North and South of Kaikoura
- SH1 - road bridges
- Rail to West Coast –coal exports
- Lyttelton Fuel Terminal
- Mobil – pump, pipeline, storage (Woolston)
- Liquigas – pump, pipeline, storage
- Timaru Fuel Terminal
- Transpower Grid Exit Points (GXP's)
- Twizel Control Centre & Switchyard
- Christchurch Central Exchange
- Timaru Exchange
- Kordia Transmission - Sugar Loaf

Otago Southland
- Dunedin Fuel terminal
- Bluff Fuel Terminal

Marine
- Inter Island Ferries - KiwiRail
- Inter Island Ferries – Others

Rail
- Auckland to Hamilton
- NIMT vicinity of Marton (Dairy freight)
- National Train Control Centre

Hotspots – Nationally Significant

	Notes
Auckland	
Auckland Harbour Bridge	Roads, Electricity, Gas, Telecoms, Water, Waste Water
Upper Queen Street	Roads, Electricity, Gas, Telecoms, Water
Church Street East	Roads, Electricity, Gas, Telecoms, Water, Waste Water, Rail
Panmure Bridge	Roads, Electricity, Gas, Telecoms, Water, Waste Water
Sylvia Park	Roads, Electricity, Gas, Telecoms, Water, Waste Water
Greenlane Roundabout	Roads, Electricity, Gas, Telecoms, Water
Great North Road	Roads, Electricity, Gas, Telecoms, Water, Waste Water
Makora Road	Roads, Electricity, Gas, Telecoms, Water
Newmarket Viaduct	Roads, Electricity, Gas, Telecoms, Water
St Marks Road	Roads, Electricity, Gas, Telecoms, Water, Rail
Triangle Road	Roads, Electricity, Gas, Telecoms, Water
Mt. Wellington Highway	Roads, Electricity, Gas, Telecoms, Water
Wiri Station Road	Roads, Electricity, Gas, Telecoms, Water
Bairds Road	Roads, Electricity, Gas, Telecoms, Water
Upper Harbour Drive	Roads, Electricity, Gas, Telecoms, Water
Grafton/ The Strand / Tamaki Drive	Port, Rail, Roads, Electricity, Gas, Telecoms, Water
Wellington	
Thorndon	Water, Sewerage, Telecoms, Electricity, Gas, Fuel, Road, Rail, Port
Petone Foreshore	Water, Sewerage, Gas
Haywards	Water, Sewerage, Telecoms, Electricity, Road
Seaview Wharf/Point Howard	Sewerage, Telecoms, Electricity, Gas, Fuel, Road, Port
Paekakariki/Pukerua Bay	Stormwater, Telecoms, Road, Rail
Main port area/Container terminal	Port, Freight
Ngauranga to Petone, incl Petone overbridge	Water, Road, Rail Gas
Ngauranga Gorge	Water, Telecoms, Electricity, Road, Rail
Canterbury	
Ferrymead Bridge	Water, Sewerage, Telecoms, Electricity, Transport
Lyttelton Tunnel & control centre	Transport (road & rail), Fuels, Water, Telecoms
Lyttelton Port & tank farm	Port, Fuel (oil, gas), Freight (coal)
Timaru Port & tank farm	Port, Fuel (oil)
Water supplies to Lyttelton & Timaru tank farms	Water, Fuel
Christchurch International Airport incl Air Traffic Control	Transport (air), Freight
Otago	
In progress - Otago Emergency Management Workshops March 2014	

Specific activities

The evidence base across sectors, pinchpoints and hotspots is being further developed in a number of current activities.

Government agencies with sector responsibilities are taking steps to provide the next layer of evidence base to support the overall sector assessments. The Ministry of Transport in close association with the New Zealand Transport Agency (NZTA) has completed a very initial pass through the Transport sector. The Ministry of Business, Innovation and Employment (MBIE) are to assess the Energy and Telecommunications sectors.

A number of the priority areas identified have had specific work underway:

Oil

MBIE undertook the Oil Security Review 2012 with a discussion paper supported by three documents:

- RAP Contingency options
- New Zealand Oil Security Assessment Update
- Information for NZIER Report on Oil Security

The proposals to improve New Zealand's domestic oil security focussed on minimising the economic cost of supply shortfalls from domestic infrastructure disruptions. The review found that:

- the fuel supply network in New Zealand is already reasonably robust
- the oil supply industry is adept at responding to most supply disruptions
- government already has processes in place to manage severe disruption events
- significant capital expenditure by government in the oil supply network is not required.

The review found that there are a number of non-regulatory measures that would improve domestic oil security. Following public consultation, Cabinet has agreed to a series of measures which MBIE will be working with other government departments, the oil industry, and consumer groups, to progress.

Gas Security

Secure gas supplies rely on a number of features including; having enough gas production to meet demand; an effective transmission and distribution system; an effective regulatory regime; a positive gas supply outlook and a system to ensure safe and secure gas supplies.

A number of actors and agencies contribute to these aims. Following a major failure of the Maui gas pipeline in 2011 the government undertook a review of the outage to ensure that the lessons learned are captured and that appropriate steps are being taken to strengthen the gas system. This resulted in the report "Review of the Maui Pipeline Outage of October 2011" and further work is underway on gas security of supply.

International cables

For telecommunications New Zealand is highly reliant on international communications linkages. MBIE is co-coordinating various workstreams related to the resilience of our international connections.

EVIDENCE BASE: RESILIENCE

Research

A research project entitled “Economics of Resilient Infrastructure” has received significant government funding and is one year into a four year project. Parties involved include GNS Science, Resilient Organisations, and Market Economics.

The NZTA has supported a project entitled “Measuring the Resilience of Transport Infrastructure”, due for publication early in 2014. This work is ground breaking and the next steps would be to put the resulting tools into practice to progressively refine them.

The Natural Hazards Research Platform supports a number of resilience related projects including projects related to water services, interdependencies of infrastructure and societal resilience.

Next steps

The National Infrastructure Unit has an active work programme under the broad headings of Coordination, Economic/financial, Indicators, Regional/Community, Research and Outreach. All contribute to confirming and building the evidence base for infrastructure resilience.

The resilience evidence base is a work in progress to continually recalibrate the information, and more importantly develop common structure and frameworks for resilience assessment.

The next steps include:

- Government agencies with sector responsibilities work with the private sector and others to develop the next layers of evidence in support of overall sector assessments similar to those presented in this document.
- Ensure integration of infrastructure resilience with consideration of national resilience, the National Security System and Treasury’s living standards framework.
- Advance the efforts of Resilient Organisations with respect to infrastructure providers and seek to identify possible organisational measures able to be applied in the evidence base.
- Work with local authority emergency management offices and Lifelines groups to achieve a nationally consistent perspective on regional vulnerabilities including pinchpoints and hotspots.
- Develop a toolkit and / or resource kit to enable infrastructure resilience assessments on a consistent basis.

INFRASTRUCTURE EVIDENCE BASE

Ten-Year Capital Intentions Plan 2013/14

February 2014

NATIONAL INFRASTRUCTURE UNIT

For more information visit: **www.infrastructure.govt.nz**

CAPITAL INTENTIONS PLAN

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CAPITAL INTENTIONS PLAN

INTRODUCTION

The National infrastructure Unit (NIU) working with key Government agencies, is publishing the first ten-year Capital Intentions Plan – a longer term view of government spending on infrastructure.

Longer-term planning and management of capital spending is a relatively new and evolving process across government. Publication of this report reflects the substantial progress that has been made by agencies over the past four years and their efforts to better understand the assets they have, their performance, and the long term management and investment required.

This report does not sit in isolation. It is only one aspect of a much wider work programme across government focussing on delivering better public services within tight fiscal constraints, responsibly managing the government's finances, and building a more productive and competitive economy. It compliments other recently published reports – including the National Construction Pipeline (New Zealand Building and Construction Productivity Partnership) and the 2014 Investment statement: Managing the Crown's Balance Sheet (Treasury).

As this is the first report, it is very much testing the waters and a first step. As agencies continue to develop and strengthen their asset management maturity, we expect future reports will be more detailed and comprehensive. Considering this, we would welcome your feedback on this report and your suggestions for how future reports could be more valuable or useful to you.

A separate section on methodology has been included. Overall, the primary focus has been on central and local government projects, and in particular those from the large capital intensive government agencies. Some information has also been included from the private sector to provide a more comprehensive picture.

To reflect the uncertainties of long term spending, both the dollar value of the projects and the start/end dates are being published as bands rather than raw numbers. However, the raw numbers have been used for the analysis and commentary.

The projects listed in this report and the analysis provided come with a number of caveats and parameters, reflecting the uncertainty inherent in longer terms plans, the financial rules for how government funding is allocated, the processes and sign-offs required for major capital expenditure and the reality that infrastructure only exists to enable the delivery of services – infrastructure requirements and projects can change as the mix of services to be delivered change. **Most significantly, inclusion of a project does not mean that it has been funded or approved, will proceed, or that if it does proceed, it will be the scale and timeframe indicated in this report. It is however, the best available picture at this particular point in time.**

Infrastructure and capital spending

In preparing this report, we have used the definition of infrastructure as included in the 2011 National Infrastructure Plan *"Infrastructure refers to the fixed, long-lived structures that facilitate the production of goods and services and underpin many aspects of quality of life. Infrastructure is made up of physical networks, principally transport, water, energy, communications and social assets."* For this report, it means that we have principally focussed on buildings and large assets and excluded a large number of projects that are less durable or fixed (for example, ICT projects).

CONTEXT

The Government has set out four priorities to deliver a stronger and more prosperous New Zealand:

- Delivering better public services within tight fiscal constraints
- Responsibly managing the government's finances
- Building a more productive and competitive economy
- Supporting the rebuilding of Christchurch

A large number of different but related work programmes are in progress to deliver on these priorities, including the 2011 National Infrastructure Plan (the Plan) and the work of the National Infrastructure Unit, the Business Growth Agenda, Better Public Services and the 10 key results area, and the Building and Construction Productivity Partnership.

Infrastructure is a crucial part of all of these priorities because of the services it provides. It supports our day to day activities, underpinning the quality of life and living standards within our communities and enabling growth by providing the supporting networks to move people, goods and information around our country and the world. We own a lot of infrastructure, it lasts a long time (sometimes over 100 years), and is costly to build and maintain – all money that could be spent elsewhere and on other things that New Zealanders care about.

Achieving these priorities and making the most of our resources and funding requires New Zealand to be managing our infrastructure well. We need to understand what assets we have, how well they are performing and we need to be working together on how best we plan, fund, build and use our infrastructure into the future.

The Plan encapsulates this in the vision that "By 2030 New Zealand's infrastructure is resilient and coordinated and contributes to economic growth and increased quality of life". To progress towards this vision, the Government committed to eight specific actions in the Plan including the production of this report - a ten-year Capital Intentions Plan.

Through the Plan, the government is seeking two outcomes:

Better use of existing assets

... getting more from the current stock of infrastructure is about looking at how assets are used, identifying opportunities for improved management, finding better ways of managing demand and ensuring users' expectations are understood

Better allocation of new investment

New Zealand needs to be smarter about investing in new infrastructure. The Government will prioritise investment where there are adequate returns and these are underpinned by robust analysis through a well understood and transparent process.

Across all the infrastructure sectors, the social sector is the sector that has the most direct government funding and provision and where a focus on these two outcomes can deliver substantial benefits. Accordingly, the social sector is a particular focus of this report and forms the majority of the central government projects on the list. It is also arguably the infrastructure sector where the most challenges and opportunities lie.

In the 2013 National State of Infrastructure Report, the National Infrastructure Unit highlighted that the social infrastructure sector has come a long way, especially in areas of asset management, capital planning, procurement and the allocation of capital while also identifying the opportunity for the pace and scale of improvement to be stepped up. The opportunities identified included:

- Developing a more sophisticated understanding on overall investment approach and why we own the assets we own and the risks involved.
- Greater use of private sector expertise in the development and management of new assets.
- Variability across agencies on maturity of capital asset management – including performance, planning and asset utilisation.
- Moving beyond individual agencies to a sector approach to planning and prioritising capital investment, including sharing asset management expertise across the sector.

Similar themes are emerging from the work Treasury is leading on developing the next Investment Statement, due to be published shortly, where for the first time, a particular focus was on social assets (Property, Plant and Equipment).

> *"… aside from the Budget process, there is no over-arching framework to assist Ministers to take well-informed decisions on cross-sector or cross-government investment proposals and to know whether current assets are performing.*
>
> *Does this matter? Yes. Without an overarching view it is hard to ensure aggregate decisions are optimal for New Zealanders and investments will achieve objectives and future demands. Helping at risk children will require investment in schools, in health facilities and in social services delivery, and perhaps in housing. The same is true for many other complex policy areas. These decisions require co-ordination.*
>
> *Without co-ordinated longer tem decision making and a balance sheet management framework that allows the Crown balance sheet to be flexible and nimble to changing needs we will continue to see misalignments in resources available compared to resource needs. Capital and assets are not free, so unnecessary holdings result in unnecessary costs being incurred.*
>
> *The size of the balance sheet and social asset portfolio mean that minor efficiency improvements can lead to large dollar savings, better investment allocation, and better social outcomes."*
>
> *(Draft Investment Statement, Treasury, 2014)*

In addition to the above, there are three other recent reports/documents that provide valuable context for the first ten-year Capital Intentions Plan. These are:

- National Construction Pipeline - New Zealand Building and Construction Productivity Partnership (2013). A joint report from the Productivity Partnership, BRANZ and Pacifecon, the National Construction Pipeline forecasts national construction demand for the next 6 years ending March 2019. Released on 10 December, the report forecasts the nature and timing of future building and construction work by type and region, complemented by information on known non-residential building and construction intentions.

- Office of the Auditor General – Managing Public Assets (2013).
  Provides an overview of the assets used to deliver services to the public. Its purpose is to provide a high-level view of the management of public assets, their condition and value, maintenance and renewals, and

what information is reported to decision-makers about these matters. The OAG hoped to initiate discussion by provoking relevant questions about the management of public assets rather than provide a technical assessment of asset management practices.

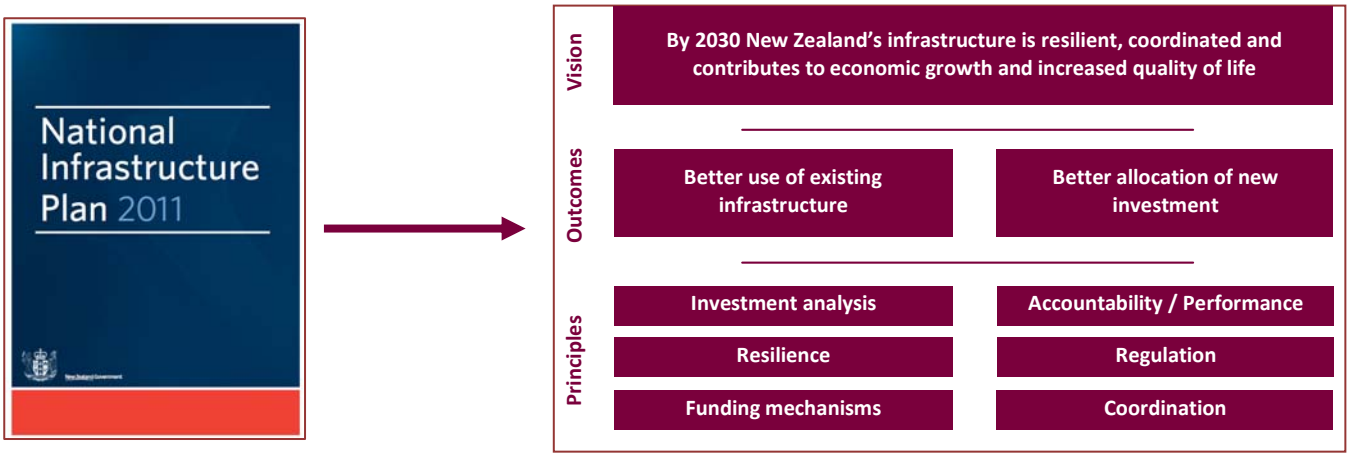
- Report of the Local Government Infrastructure Efficiency Expert Advisory Group (2013)
  The Local Government Infrastructure Efficiency Expert Advisory Group (EAG) focussed on how to deliver in the most cost-effective manner good quality local government infrastructure to support a growing economy. The EAG considered opportunities and barriers in terms of infrastructure costs, relevant legislation, and decision-making processes. The report notes that expenditure on infrastructure over the period 2013-2022 is projected to be $111.1 billion ($30 billion in capital expenditure and $81.1 billion in operational expenditure), a large proportion of which will be in Auckland.

PURPOSE

The first ten-year Capital Intentions Plan is one of eight specific actions committed to in the Plan. It is a practical means of responding to elements of the challenges and opportunities identified for social infrastructure and a means to facilitate the continued improvement of capital asset management, planning and allocation – primarily by providing a much greater level of transparency and visibility to the forward looking infrastructure investment programme.

It recognises that a key focus of the Plan is providing businesses with greater certainty and confidence about current and future infrastructure provision.

This report is being released as part of a suite of documents that together make up the National infrastructure evidence base, work the National Infrastructure Unit has been leading to overcome a key constraint identified in the Plan – the lack of information about asset condition and performance to allow more informed decisions and efficient and effective investment.



DATA REALITIES AND CAVEATS

The realities of publishing a report like this is that it is out of date before it is published and that it is guaranteed to be inaccurate. There are a number of reasons for this, none of which diminish the reason for undertaking the exercise and publishing the report.

Firstly, the focus is on the long term. Current projects that are in the market or shortly to come to market are well known to have a higher level of certainty. This certainty decreases the further into the future you look, but this is where the value can be the greatest and where the market has identified a key information gap.

Secondly, infrastructure only exists to provide a service. Thinking is constantly evolving on exactly what services need to be delivered and how best these are provided. This thinking will not stop and will mean that some of the future infrastructure projects listed will be superseded by new or changed thinking about what services need to be provided, what infrastructure best supports the delivery of these services, and how or who provides the infrastructure. Four examples of this include:

- How central government services to the public are delivered and the property requirements needed to deliver these has changed substantially with the learnings and experiences from the Christchurch earthquakes.
- Managing school property has undergone a major review in the last two years and along with evolving thinking about what is needed from property to create 21st century learning environments will mean different patterns and type of education spending patterns from what we expect today.
- Advances in technology and changing demographics mean different and changing future requirements for the type and location of health buildings.
- The capital cost of meeting the government's defence policy objectives, as set out in the Defence White Paper 2010, were recently confirmed as part of the Defence Mid-point Rebalancing Review (DMRR). The funding intentions taken by Cabinet in November in relation to the DMRR are not reflected in this plan, but will be part of future plans.

Thirdly, the Government financial system means that funding is appropriated to agencies on an annual basis through the Budget process. While appropriations can be for more than one year, the checks and balances that protect our system mean that a future Parliament may direct funds to different purposes or change the amounts of funds available.

Fourth, related to the above point, any large capital project has a process to go through, including indicative and detailed business cases (the BBC methodology). These often require Cabinet approval. Many of the medium/long-term projects included on this list have yet to undertake this process and therefore, do not have committed funding or a finalised scope and scale.

The projects included in this report are based on agencies best view of future spending at this particular point in time.

CAPITAL INTENTIONS PLAN

To reflect the uncertainties of long term spending, both the dollar value of the projects and the start/end dates are being published as bands rather than raw numbers. However, the raw numbers have been used for the analysis and commentary.

Inclusion of a project does not mean that it has been funded or approved, will proceed, or that if it does proceed, it will be the scale and timeframe indicated in this report. It is however, the best available picture at this particular point in time.

ANALYSIS: SUMMARY

OVERALL SUMMARY ANALYSIS AND FIGURES

The majority of the analysis has been undertaken on the central government intentions, reflected the primary purpose of the report. More limited analysis has been included (but without commentary) for the local government and private sectors.

The first iteration of the Capital intentions Plan includes a total of 3,153 infrastructure related projects across the central and local government and private sectors. The total spend identified is $92,012M NZD.

The breakdown by sector is as follows:

Central Government

Sector	Number of Projects	$ Value (M)
Social	195	30,117
Transport	65	16,454
Total	**260**	**46,572**

Local Government

Sector	Number of Projects	$ Value (M)
Energy	1	4.5
Environment	155	1,553
Land	8	98
Social	720	6,024.5
Transport	938	15,599
Water	1011	11,345
Total	**2833**	**34,624**

Private Sector

Sector	Number of Projects	$ Value (M)
Energy	31	5,852
Social	2	303
Transport	27	4,661
Total	**60**	**10,816**

ANALYSIS: CENTRAL GOVERNMENT

CENTRAL GOVERNMENT

260 projects have been included from central government agencies totalling over $46B NZD.

Central Government

Sector	Number of Projects	$ Value (M)
Social	195	30,117
Transport	65	16,454
Total	**260**	**46,572**

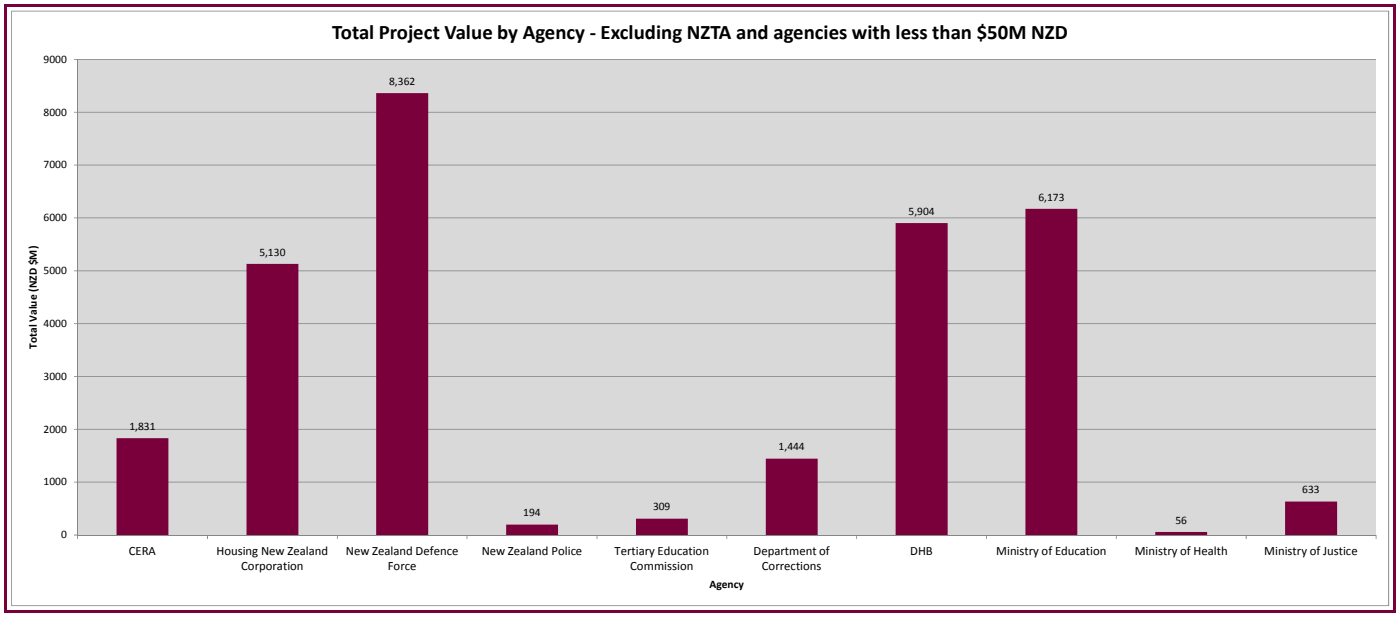
Analysis undertaken by NIU, based on 2013 HYEFU[1], suggests this totals approximately 83% of total spend over the next ten years.

The remainder of the spend is likely to have been excluded by the parameters of the data used for this report. Two examples of these parameters include the exclusion of all projects under $1M NZD and the general exclusion of non-infrastructure projects (although some Defence projects, not-typically thought of as infrastructure, have been included due to long life of assets and value). Exclusion of non-infrastructure projects means that for example, up to a possible $20M NZD of ICT projects are not captured (although different methodologies mean this figure is not directly comparable to the $46M and 83%).

By agency and region

Projects are captured from 20 agencies with the largest contributors by number being DHBs (69), NZTA (64), New Zealand Defence Force (23), Housing NZ (21) and NZ Police (19)

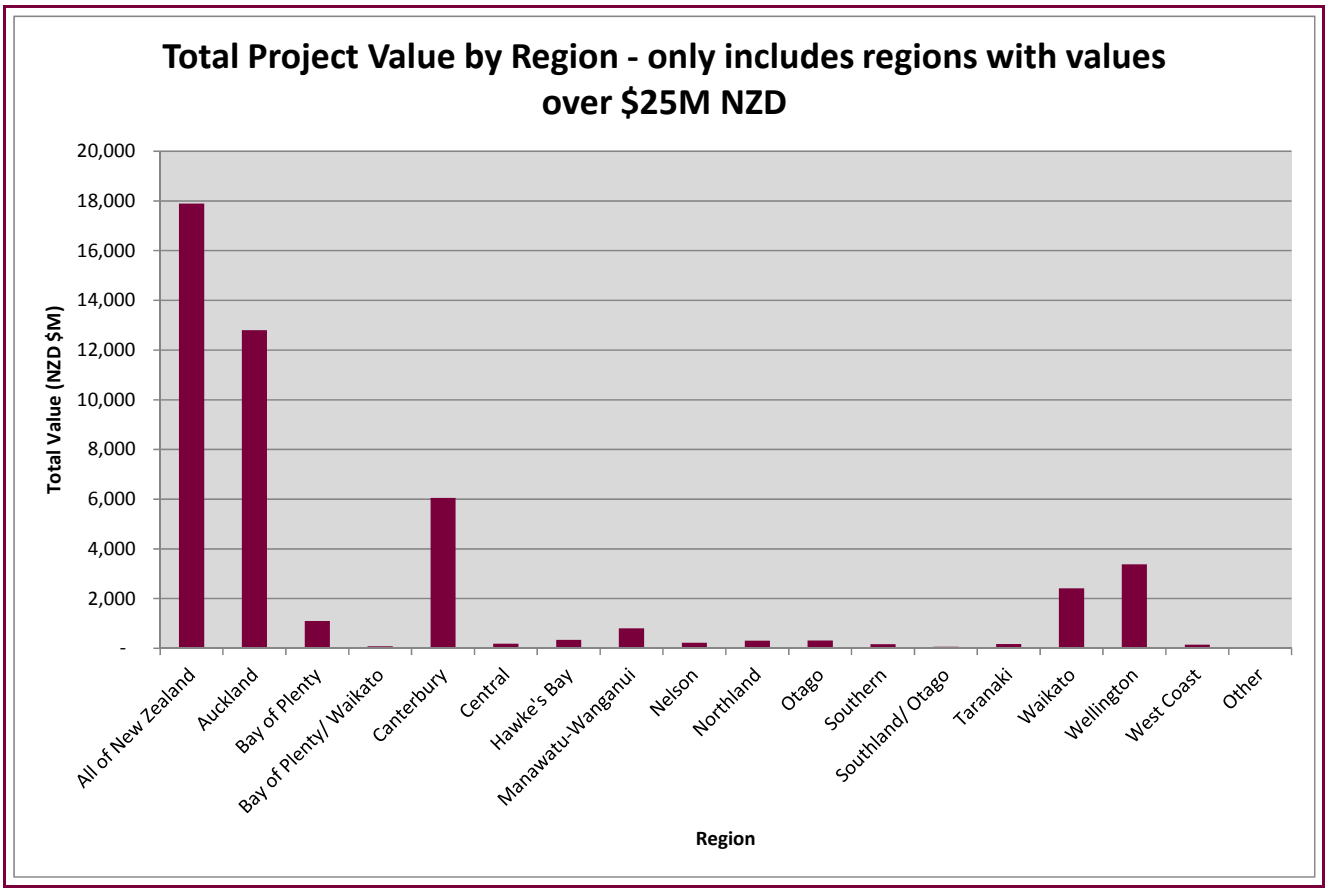
By total value of projects, NZTA are significantly the highest at just over $16B NZD, followed by NZ Defence, DHBs and Housing NZ. The middle range, by value, is shown in the chart below – excluding NZTA and the agencies with under $50M NZD total value.



[1] HEYFU is the Half Year Economic and Fiscal Update 2013, published by The Treasury on 17 December 2013 and available on the Treasury website. HYEFU includes forecast expenditure on PPE for five years, the fifth year has been extrapolated out a further five years to give an estimated figure for the ten-year spend.

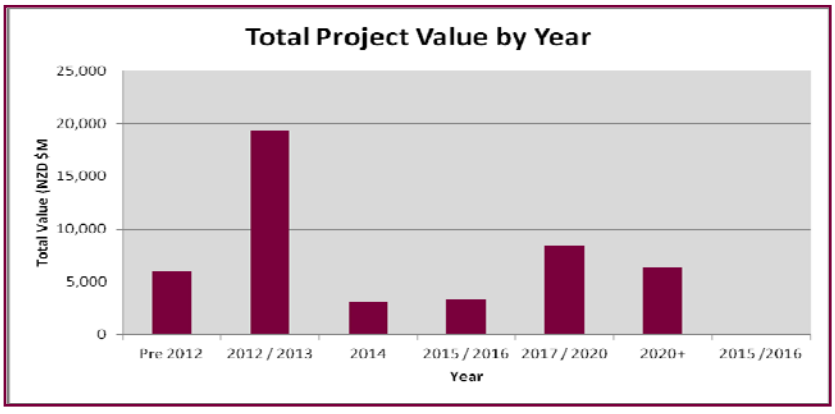
ANALYSIS: CENTRAL GOVERNMENT

At a regional level, the data is heavily influenced by a number of major programmes of work that cover New Zealand and are not further disaggregated. These are reflected in the over $17B NZD allocated to the "All of New Zealand" category. Selected examples of programmes of work in this category include: Housing New Zealand Corporation programmes to renew/refurbish assets, Department of Correction's prison core works programme, and the Ministry of Education's new schools and kura programme.



By Year

Project funding is based on the expected capital cost – not whole of life cost. As with the regional data above, the data is heavily influenced by a number of aggregated programmes of work. These have not been broken down into each year for this iteration of the report. As a result, the funding shown in the 2012/13 years is significantly higher than what will actually be spent.



General expectations of longer term funding intentions

Recognising the constraints on identifying specific projects over the longer-term, agencies have provided a general statement of where they expect to see longer-term funding allocated.

Education

The major focus of capital spend for Education over the next 10 years will be toward:

- providing increased capacity in the schooling network in areas of growth, particularly in Auckland;
- maintaining the condition, preserving the life and improving the functionality of existing school infrastructure; and
- supporting the Christchurch rebuild.

Improvements delivered through this investment will contribute to improving educational outcomes and maintaining the Crown's balance sheet.

Health

In the Health sector, capital prioritisation will need to be made in years 5-10 to balance the needs of the growing population in the Northern Region with the need for replacement of some South Island and Auckland Region facilities.

Police

Police will be looking to invest to deliver a more mobile, informed workforce that will ensure officers spend more time in their communities. It is anticipated that capital expenditure will focus on ICT investment, to facilitate mobility, rather than property and this will be confirmed through the continuation of the Policing Excellence programme.

Corrections

Key capital intentions for the Department of Corrections over the next four to five years include a new men's prison at Wiri as well as a major redevelopment at Auckland Prison and capital works at prison sites in Tongariro, Whanganui and Invercargill. The Department plans to deliver projects related to audio / video links connecting prison sites to courts, and asset lifecycle replacement in facilities at community corrections sites and prison sites. The Department will continue to upgrade its investment in electronic security assets and information technology systems. Investment in years 5 to 10 of the capital intentions plan is expected to be focussed on the planned asset lifecycle replacements at community corrections sites and prison sites and on electronic security and IT assets.

Defence

In accordance with the Defence White Paper (2010) and Defence Capability Plan (2011), the focus for NZ Defence remains on redistributing resources to front line defence capabilities. This entails the renewal of some aged infrastructure and the deliberate enhancement of some capabilities (military assets and infrastructure).

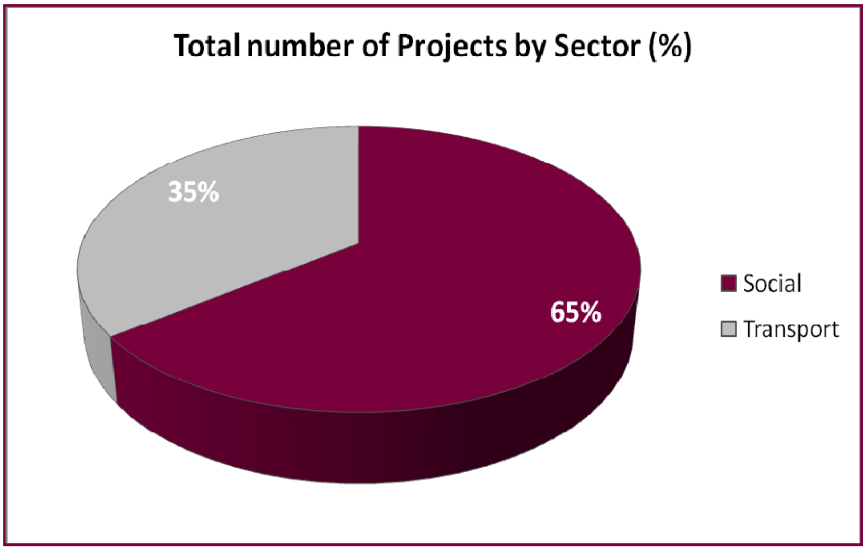
ANALYSIS: CENTRAL GOVERNMENT

By sector

The central government data has been broken into two sectors – social and transport.

The social sector category includes sub-sectors of health, housing, justice and security, earthquake etc.

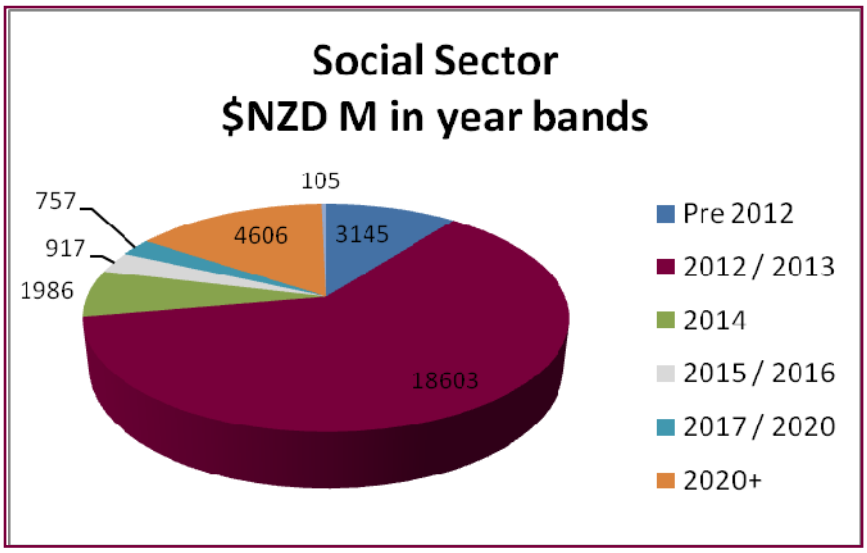
The transport sector category is mostly made up of roading projects, with one earthquake and one other transport related project included.



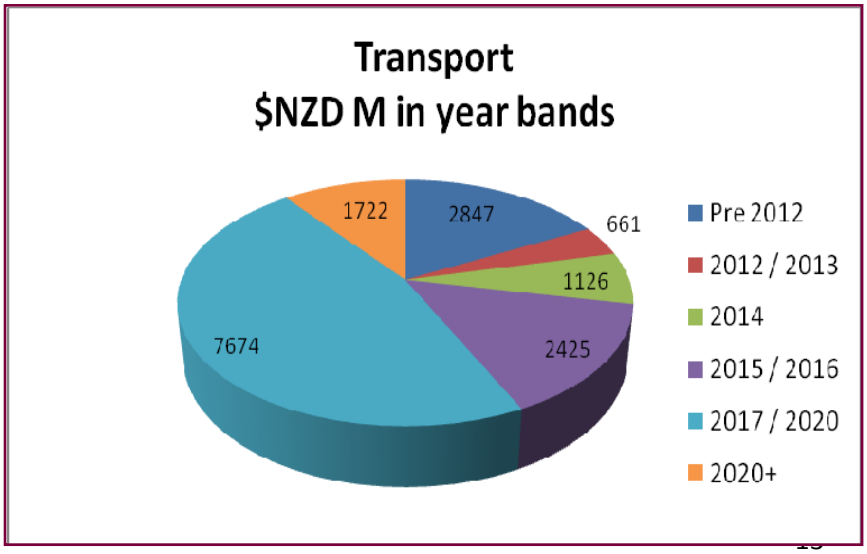
The majority of the social sector spending is captured in the pre-2012 and 2012/2013 years – reflecting the start year of large multi-year expenditure programmes. Examples include:

- Ministry of Education's Christchurch Education Renewal Programme
- Housing New Zealand Corporation programmes to renew/refurbish assets
- Department of Correction's Prison core works programme

These three multi-year programmes alone total over $5B NZD of funding.



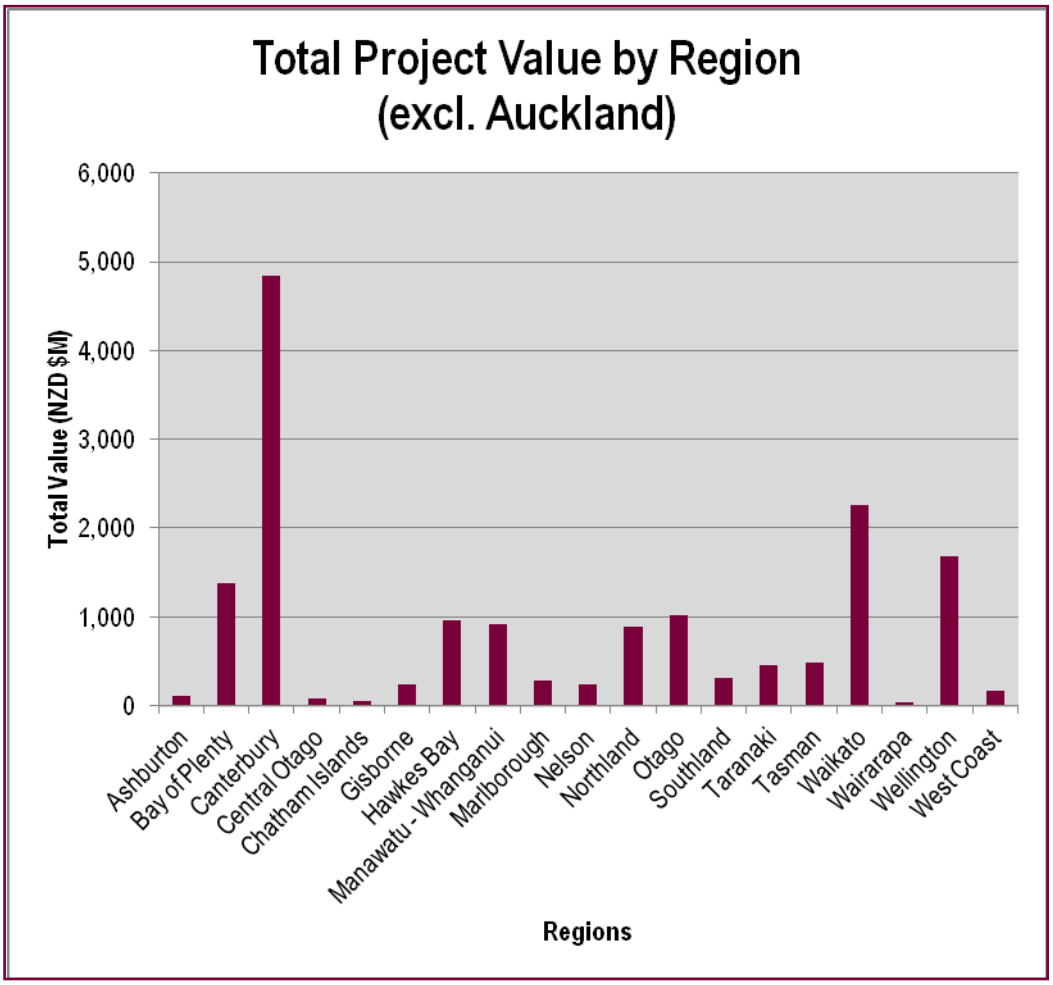
In contrast, almost 50% of the transport sector spending is forecast for post 2020, reflecting the scale of large transport investments expected, for example, the Waitemata Harbour Crossing.

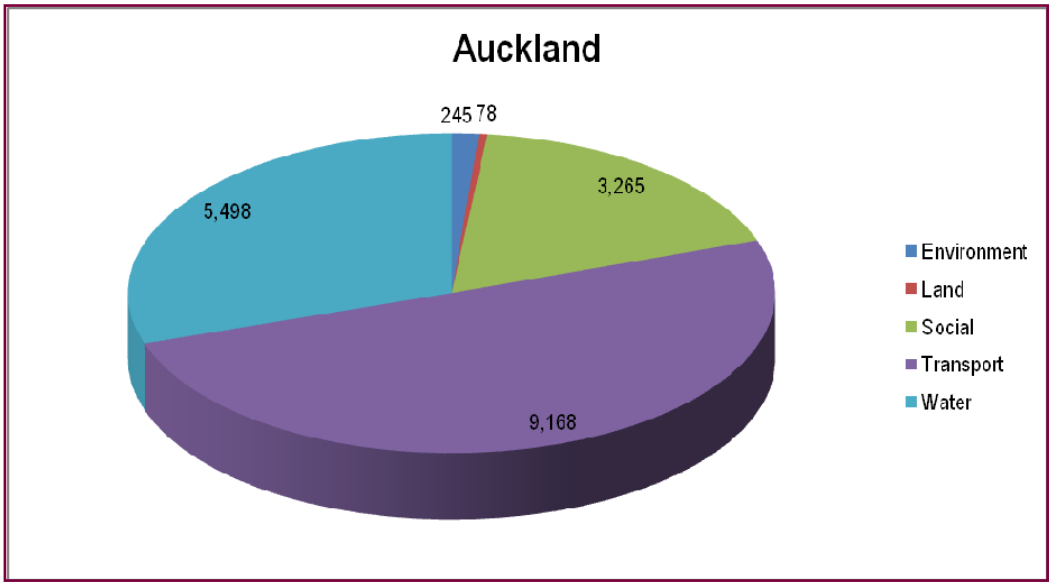


ANALYSIS: LOCAL GOVERNMENT

LOCAL GOVERNMENT

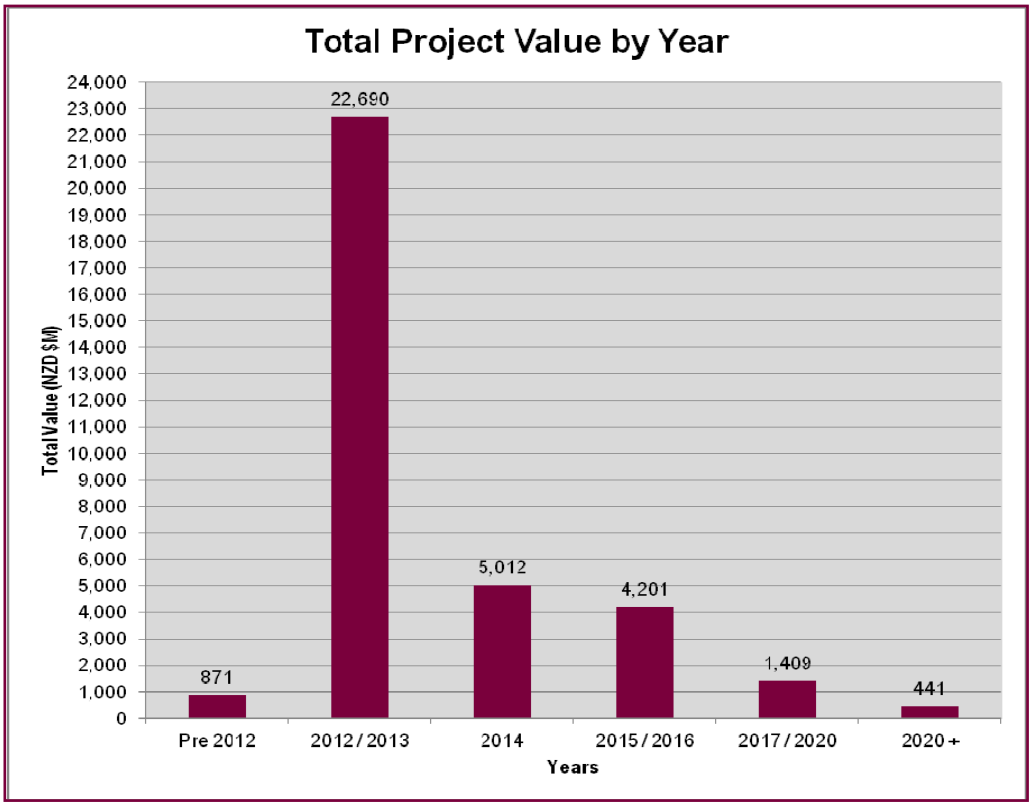
By region





ANALYSIS: LOCAL GOVERNMENT

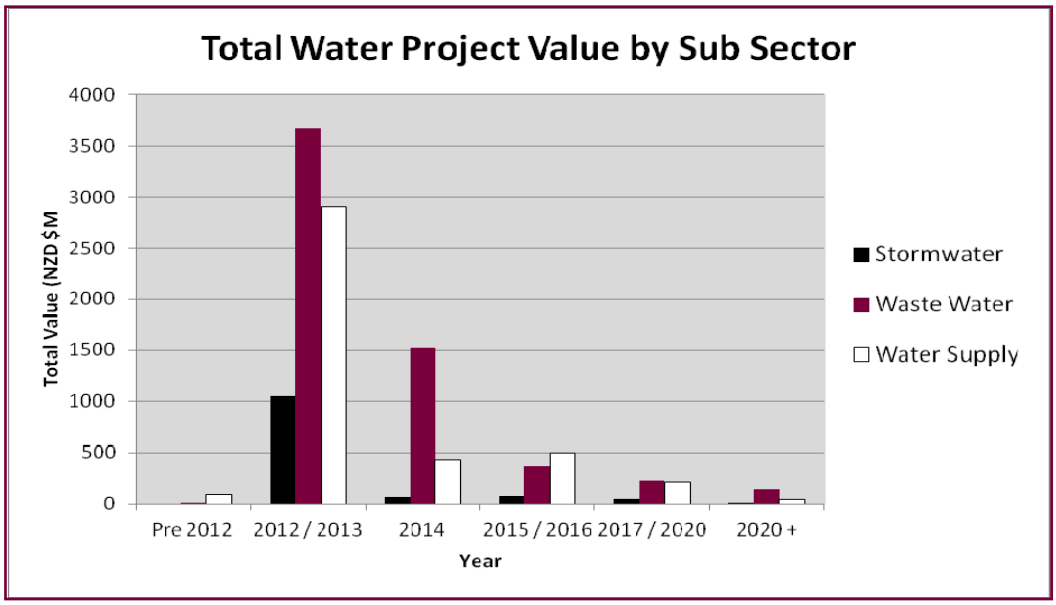
By year

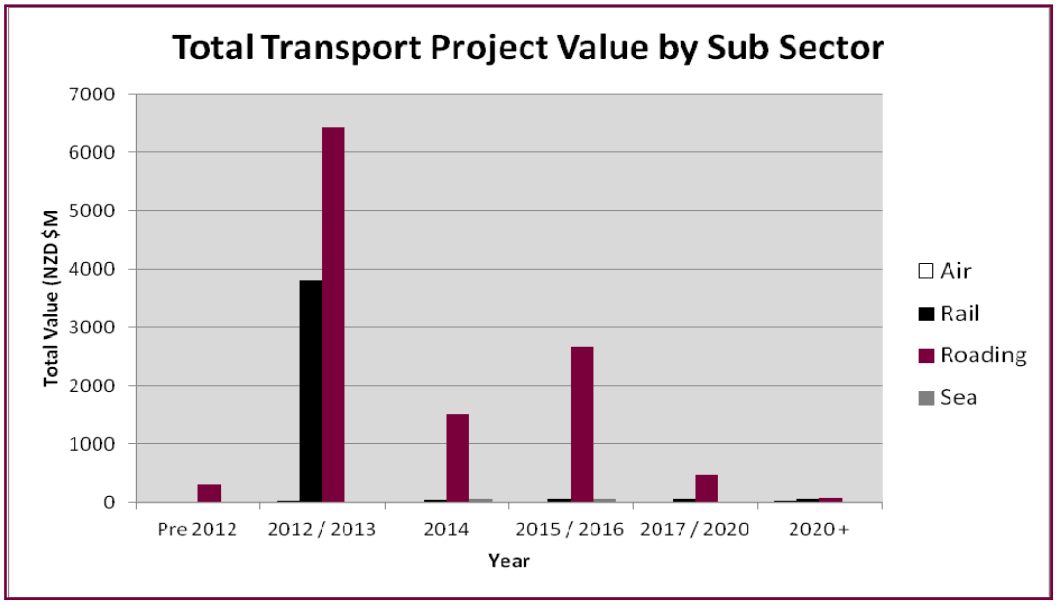


Total spend by sector and banded start date (NZD $M)						
	Pre-2012	2012/13	2014	2015/16	2017/20	2020+
Land		26	67	4	1	
Environment	387	581	441	119	12	15
Social	67	4,196	873	353	373	163
Transport	310	10,254	1,619	2,790	552	74
Water	108	7,628	2,012	936	471	190
Total	871	22,685	5,012	4,201	1,409	441

ANALYSIS: LOCAL GOVERNMENT

By sub-sector (water and transport)

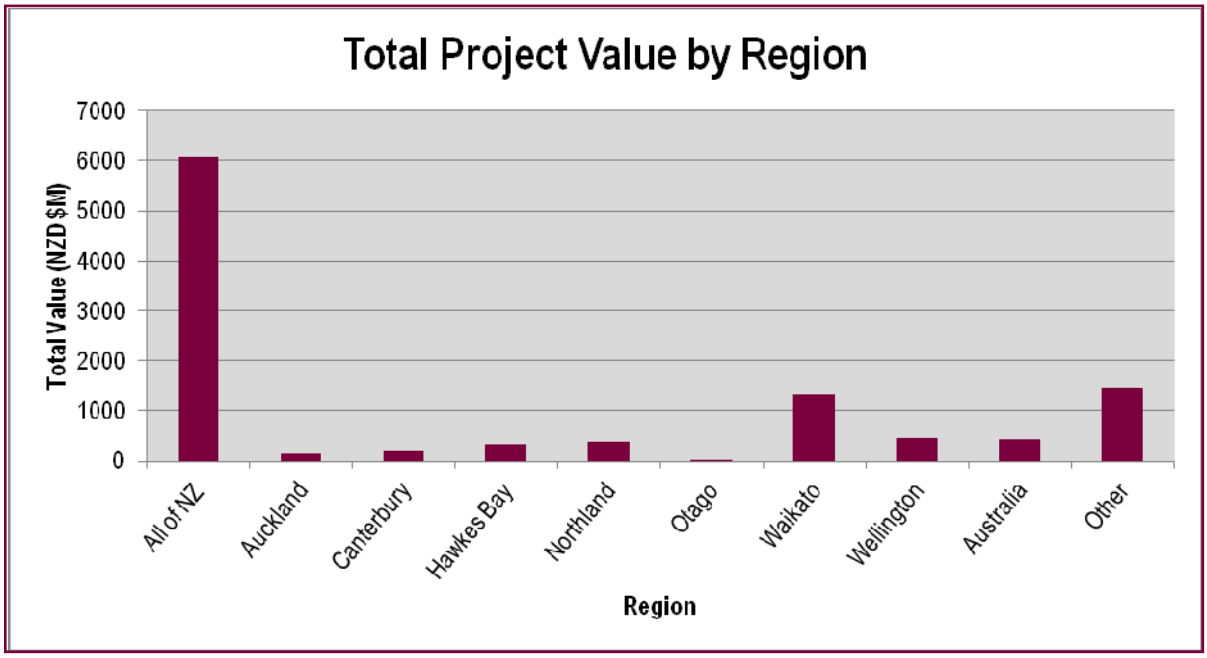




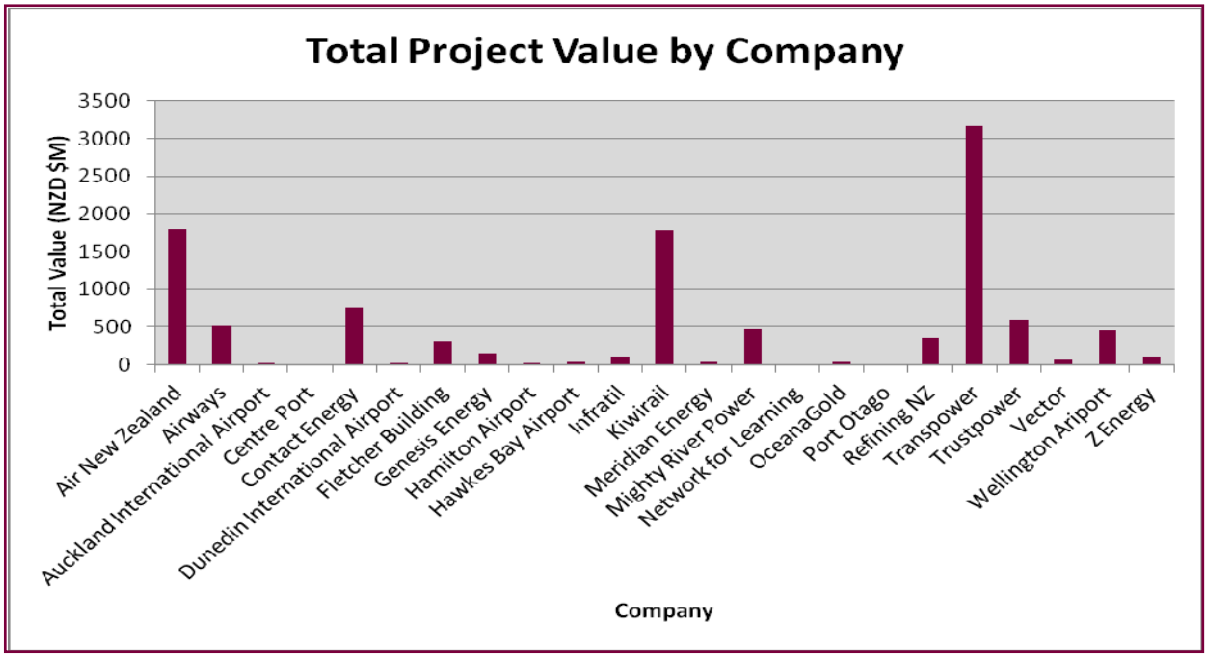
ANALYSIS: PRIVATE SECTOR

PRIVATE SECTOR

By region

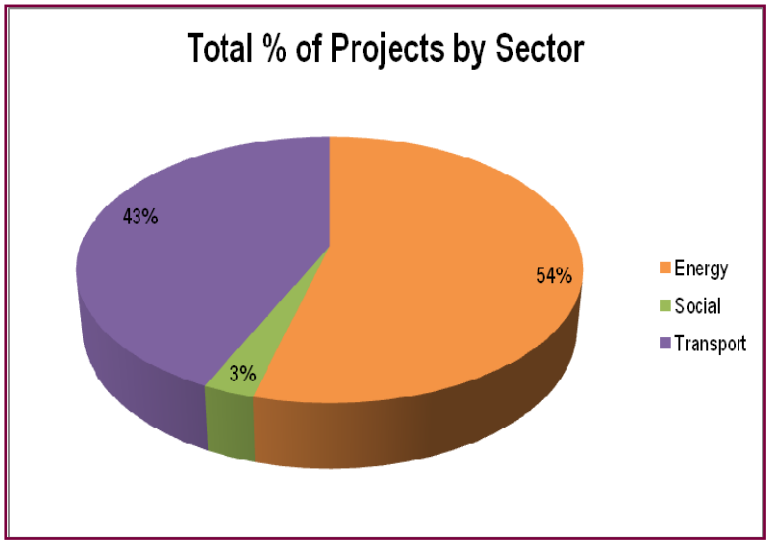


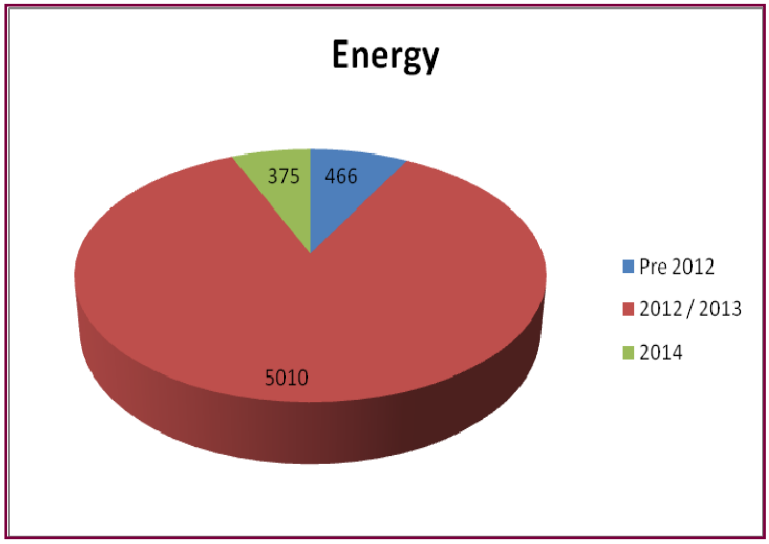
By company

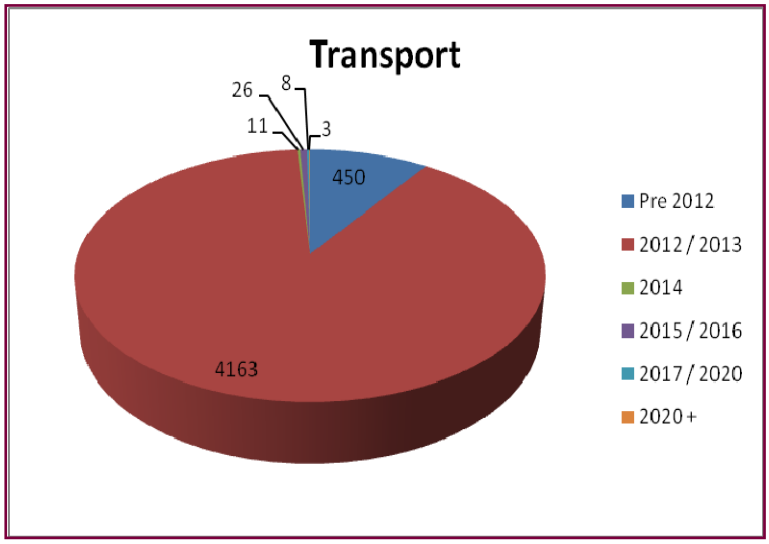


ANALYSIS: PRIVATE SECTOR

By sector







METHODOLOGY & ASSUMPTIONS

METHODOLOGY

Central Government

- Base data set used was the July collection from agencies and updated as relevant with later data collections.
- Minimum project cost of $1M NZD established.
- Projects extracted that weren't infrastructure or relevant including: Computer projects, Vessels, Motor vehicles, Furniture and fittings, some Military equipment (including aircraft and vessels where less than $25m capital investment), Aircraft, Commercial forests etc.
- Data sorted data into Sectors and Sub Sectors.
- Data sets circulated to Treasury analysts for review and master data set updated with changes.
- Data sorted into cost bands and start/end dates.
- Data sets recirculated to Treasury and agency analysts for review.
- Analysis undertaken and report drafted.

Local Government

- Infrastructure projects over $1M NZD extracted from Local Council Annual Plans and Long Term Plans
- Projects sorted into Sectors and Sub Sectors.
- List of projects sent to the District/City and Regional Councils for review, alteration & comment.
- Updated master list with Council feedback.
- Data sorted into cost bands and start/end dates.
- Analysis undertaken and report drafted.
    - Auckland region was extracted out of Total Project Value by Region as the total spend was the highest of all regions and value was gained by breaking it down further into the sectors.
    - Further breakdown of Transport and Water sectors into their sub sectors gained more value from the data.

Private Sector

- Infrastructure projects over $1M NZD extracted from Private sector companies websites.
- Discussions with Treasury COMU team about Agencies intentions.
- Data sorted into cost bands and start/end dates.
- Analysis undertaken and report drafted.

METHODOLOGY & ASSUMPTIONS

ASSUMPTIONS

General

- Only data over $1M NZD has been included in analysis.
- Where large programmes of work covering multiple years are included the full cost has been included in the first year.
- Projects typically excluded from data sets includes: Computer projects, Vessels, Motor vehicles, Furniture and fittings, some Military equipment (including aircraft and vessels where less than $25m capital investment), Aircraft, Commercial forests, Maintenance Programmes, Library Renewals / Books/ ITC projects, Land not for future infrastructure use etc.

Local Government

- Some Council's included projects which begin post 2022. These have not been included
- Some projects begin pre 2022 but extend past 2022. Only the value up to 2022 has been included. Total value included in comments field
- Councils confirmed projects which were outlined in Annual Plans and Long Term Plans but are now not proceeding. These have been removed from data set
- Some land projects have been included as future infrastructure use