

Economic Development and Transport Summary report

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Ministry of **Transport**
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This report summarises the major findings of the Ministry of Transport's Economic Development and Transport project. Its purpose has been to contribute to the New Zealand Government's *Policy Direction for Transport*, which aims for a "transport system that supports the growth of our country's economy". The project's guiding question has therefore been: How can our transport system support New Zealand's economic development? This question has been explored in four reports. The first and second provide international literature reviews on theories of economic development and then on the specific contribution of transport. The third report constructs a Future Options for the New Zealand Economy (FONZE) model to analyse possible futures for New Zealand's economic development out to 2042. The final report offers an opening discussion on implications for the country's transport system.

This paper is presented not as policy, but with a view to inform and stimulate wider debate.

Executive summary

The New Zealand Government's broad objective for transport policy is "an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country's economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders". This project has therefore explored how the transport system can support New Zealand's economic development.

The study has adopted the approach to economic development advocated by Nobel Laureate Amartya Sen in his 1989 book *Development as Freedom*. Sen argues that development involves "the expansion of the 'capabilities' of persons to lead the kinds of lives they value – and have reason to value", which is consistent with the objective for transport cited above.

The foundations of modern economic theories of economic growth were laid in two scientific articles published in 1956, giving rise to the neoclassical growth model. This model suggests that two factors determine economic growth: (1) the rate of population growth; and (2) the rate of labour productivity growth (or, equivalently, the rate of technological progress).

Subsequent models, known as "endogenous growth models", have sought to explain what determines growth in labour productivity. The key concept is that technological progress results from intentional activity by specialised workers who use existing knowledge to produce new knowledge. New knowledge has considerable potential to contribute to economic development because it has the property of being "non-rival in consumption"; that is, if a piece of knowledge is being used by one person, this does not prevent another person from using that same piece of knowledge at the same time.

Endogenous growth models demonstrate that the proportion of the workforce devoted to producing new knowledge is important for economic development, as are practices and policies that successfully reduce the proportion of wasted research effort.

Within the general framework of the neoclassical and endogenous growth models, some specific systematic approaches have been proposed for promoting economic development in practice. This project explored seven examples that have had specific applications to New Zealand:

- ▶ Krugman's theory of agglomeration economics
- ▶ Heterogeneous regional development models
- ▶ Evolutionary economics and path-dependency
- ▶ Porter's theory of competitive advantage
- ▶ Skilling's theory of small country strategies
- ▶ Resource-based economic development
- ▶ Florida's theory of the creative class

All of these models are relevant to investment in transport infrastructure, but there is some tension between the first two in particular that is the subject of considerable debate in the literature. Some analysts argue that opportunities for agglomeration should be accelerated to deliver greater national growth, which suggests transport investment should focus on major cities and their connections to other parts of the country and to global markets. Other analysts argue that national growth requires all regions in a country to develop their particular strengths, which suggests a greater emphasis on investment in

intraregional transport infrastructure that is tailored to each region's opportunities. Striking the right balance between these two approaches is an important element in a nation's strategic approach to transport planning.

More generally, innovation in transport has been vitally important in New Zealand's economic history. It has increased people's economic opportunities allowing them to leave the lives they value. Sound investment in transport infrastructure enhances the ability of people to move themselves and their produce from place to place, increasing opportunities for travel and trade.

The literature cautions against using transport infrastructure investment as a stabiliser of economic activity at the national level or in slow-growing regions. Instead, the focus should be on investments that enhance underlying competitiveness and productivity. The Eddington Transport Study prepared for the United Kingdom Government in 2006, for example, identified seven interconnected "micro driver mechanisms" for transport impacts on the economy, which have obvious connections with the systematic approaches presented in the above list.

There are sound reasons for government involvement in planning transport infrastructure, although this does not preclude partnerships with the private sector in provision, maintenance or ownership. The literature is clear that it is not the *quantity* of investment in transport infrastructure that is necessarily beneficial for economic development; the *quality* of that investment is crucial.

Decision-makers need to be cognisant that investments can affect the location and type of economic activity in different parts of the country. The literature emphasises that investments in transport infrastructure must be *integrated* with a region's development of its human capital and its opportunities for innovation, taking into account key linkages with other regions and the global marketplace.

The AERU constructed the Future Options for the New Zealand Economy (FONZE) model to analyse plausible futures for the New Zealand economy. FONZE relies on the neoclassical growth model result that growth in economic production depends on population growth, and the rate of increase in the workforce's labour productivity. Statistics New Zealand input-output tables and population projections were used with the Treasury's projection of labour productivity growth to model New Zealand's spatial-industry structure in 2042 under a baseline analysis and under seven plausible economic futures.

One observation stands out in this modelling, which is the growth in the importance of the Auckland region. In the baseline analysis, Auckland grows from 33.6 percent of national gross domestic product in 2007 to 41.3 percent in 2042. The basic cause of this growth is the Statistics New Zealand projection that the population of Auckland will grow at a much faster rate than any other region in the country. Different futures in the FONZE model mute or reinforce that effect, but it is clear that Auckland can be expected to increase its population and level of economic activity more quickly than the rest of New Zealand.

The Ministry of Transport has completed an initial assessment of the transport implications of the baseline and seven futures analysed in the FONZE model. This assessment does not suggest any major shocks to the transport system, except in some parts of the network that are already heavily utilised or subject to future growth pressures, where investment may be needed to mitigate localised congestion at peak times and at specific pinch-points in the overall system.

Most of the national state highway network appears to have sufficient capacity to handle substantially increased freight. There would be instances where some projects would be required (for example, additional passing lanes) or more substantive projects moved forward (bridge replacements, four-laning). There are also significant pinch-points on the network where additional truck movements could create adverse effects, notably additional congestion. This is mainly within major urban areas.

KiwiRail has spare capacity on almost all its network, and would benefit financially from increased freight. The KiwiRail turnaround plan has seen substantial investment in its infrastructure, which has improved its capacity and the reliability of journey times.

All New Zealand airports with scheduled flights have spare capacity. The airport most affected under all the scenarios in this study is Auckland. Rapid or accelerated growth in Auckland may bring forward the date when a second runway is needed; the airport company already has the land and planning permission for that option and some preliminary construction work has already been undertaken. Some provincial airports would not be able to accommodate regular jet services without runway lengthening and/or strengthening, but increased turboprop frequency would be the best response to increased demand.

Some of New Zealand's major ports are increasing their capacity while others have spare capacity or the potential to add capacity. Some have constraints that would need to be overcome in the medium term to support the economic development of their regions. Potential future demand at particular ports will be affected not only by the scenarios in this study but also by the advent of larger container ships.

In conclusion, increased transport demands implied by the scenarios examined in this study are not expected to create major capacity problems in most of the transport network, but may bring forward the dates for routine capacity enhancements such as additional road lanes and rail passing loops.

Increased demands may add to existing difficulties with certain pinch-points in the road network: the most notable cases under all scenarios are in Auckland. There are potential investments to address the main freight-related problems, while broader policies will be needed for general urban traffic.

Introduction

This report concerns one of three projects commissioned by the Ministry of Transport in 2014 to inform, challenge and stretch the Ministry's strategic thinking. The three projects have looked at: future travel demand; transport and economic development; and future funding of the transport system. This report summarises the second of these projects.

This project took place in the context of the New Zealand Government's broad objective for its transport policy, which seeks "an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country's economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders".¹ Therefore, the purpose of the project has been to explore how the country's transport system can support New Zealand's economic development.

The project proceeded in four stages, each of which produced a substantial report containing more details beyond the précis in this summary report. The titles of the four reports are listed below; the first and third reports were prepared by the AERU at Lincoln University, the second report was prepared by Ian Wallis Associates Ltd, and the fourth report was prepared by the Ministry of Transport.

1. *Economic Development: A Review of Key Themes in the International Literature.*
2. *Contribution of Transport to Economic Development – International Literature Review.*
3. *Future Options for the New Zealand Economy: Model, Data and Futures.*
4. *Transport Implications of Future Options for the New Zealand Economy: An Opening Discussion*

The remainder of this report summarises the key findings from the project. Four major sections correspond to the project's four stages, and a final section concludes with a short discussion of the project's overall key messages.

1. Theories of economic development

The study has adopted the approach to economic development advocated by Nobel Laureate Amartya Sen in his 1989 book *Development as Freedom*. Sen argues that development involves "the expansion of the 'capabilities' of persons to lead the kinds of lives they value – and have reason to value".² This is consistent with the objective for transport cited above, which aims to support economic growth *in order to* deliver greater prosperity, security and opportunities for all New Zealanders. Broadly speaking, the economics literature has focused on three items that can expand the capabilities of a population:

- ▶ investment in physical capital
- ▶ investment in human capital (education and health)
- ▶ investment in new knowledge creation and utilisation.

¹ New Zealand Government (2011) *Connecting New Zealand: A summary of the government's policy direction for transport* (p. 3). Wellington: Ministry of Transport.

² Sen, A. (1989) *Development as freedom* (p. 18). Oxford: Oxford University Press.

The neoclassical growth model

The foundations of modern economic theories of economic growth were laid in two scientific articles published in 1956 by Robert Solow and Trevor Swan.³ Solow's article has been particularly influential, giving rise to the neoclassical growth model.

The model assumes that the quantity of economic production in a society depends on four factors: (1) the amount of land (assumed fixed); (2) the size of the workforce (assumed to grow at the society's population growth rate); (3) the quantity of physical capital (such as buildings, roads, machinery and the like, assumed to grow as a result of new investment each year net of depreciation of the existing capital stock); and (4) the labour productivity of the workforce, which depends on the society's level of technological progress (which Solow assumed advanced at a fixed rate each year).

Solow demonstrated that in this model the economy settles on a long run equilibrium in which there is a constant ratio between the quantity of physical capital and the size of the workforce. This "capital-labour ratio" positively influences the population's material living standards (defined as the level of production divided by the population size) and is higher if the share of production devoted to investment is higher, if the rate of physical capital depreciation is lower, or if population growth is lower.

Solow's original model treated all workers as identical. An obvious extension, therefore, was to recognise the importance of the education and health of the society's workforce.⁴ Incorporating these factors (which are called "human capital" by economists because education and health, like physical capital, require investment to increase) also has a positive influence on the capital-labour ratio and material living standards, alongside the three influences identified in the previous paragraph.

Although each of the above factors influence production per person in the neoclassical growth model, Solow demonstrated that only two factors influence the rate of *growth* of production: (1) the rate of population growth; and (2) the rate of labour productivity growth (or, equivalently in the model, the rate of technological progress). This very important result is still much used in growth accounting (see Section 3 below). It also stimulated further research on what determines a society's rate of technological progress, leading to what have become known as "endogenous growth models".

Endogenous growth models

Solow assumed that the rate of technological progress was exogenous; that is, determined outside of his economic model. Later economists beginning with Paul Romer developed "endogenous growth models" in which this key parameter is explained within the model itself.⁵ The key concept is that technological progress results from intentional activity by specialised workers who use existing knowledge to produce new knowledge. These specialists are often labelled in the literature as "scientists" but this term is intended to cover a range of people involved in research, development and commercialisation.

³ Solow, R. M. (1956) A Contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70 (1), 65–94. Swan, T. W. (1956) Economic growth and capital accumulation. *Economic Record*, 32, 334–361.

⁴ Mankiw, N. G., Romer, D. & Weil, D. N. (1992) A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 10 (2), 407–437. Knowles, S. & Owen, P. D (1995) Health capital and cross-country variation in income per capita in the Mankiw-Romer-Weil Model. *Economics Letters*, 48(1), 99–106.

⁵ Romer, P. M. (1986) Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002–1037.

Knowledge has two properties that justify public policy attention to its production. First, if a piece of knowledge is being used by one person, this does not prevent another person from using that same piece of knowledge at the same time. The knowledge needed to fly an airplane can be used by a pilot travelling from Auckland to Singapore at exactly the same time that another pilot is using the same knowledge to travel from London to Los Angeles (whereas the two trips require two planes and two pilots).

Economists say that knowledge has the property of being “non-rival in consumption”. This property makes new knowledge extremely powerful for economic development and improved wellbeing — the new knowledge can be used by everyone simultaneously.

The second property is that knowledge is generally non-excludable; that is, without special laws it would not be generally possible to exclude people from using new knowledge if they do not pay for the costs of producing that knowledge. This second property severely weakens the incentives for the production of new knowledge. It might cost large sums of money to undertake research and to develop a new idea into a commercial product, but these costs will not be recouped if others are permitted to simply copy the idea and sell the same commercial product to consumers at a cheaper price.

Taken together, these properties mean that new knowledge is potentially valuable to society but not profitable for anyone to produce. To address this conundrum, laws have been developed for defining and protecting “intellectual property” in the form of copyright and patents. These allow researchers to place on public record new knowledge in return for the legal right for a fixed period to be able to exclude others from using that new knowledge except on terms set by the producer.

Returning to endogenous growth models, a country’s workforce can be divided into two groups: production workers and knowledge workers. Only the output of production workers affects material living standards, but the productivity of these workers depends on the accumulated knowledge created by the second group. The productivity of the knowledge workers is influenced by items such as: the extent to which a greater number of researchers leads to wasteful duplication of effort; the extent to which it becomes harder to create new knowledge as the current stock of knowledge expands; and the extent to which the effectiveness of research diminishes as the number of new products increases.⁶

Endogenous growth models demonstrate that the proportion of the workforce devoted to producing new knowledge is important for economic development, as are practices and policies that successfully reduce the proportion of research effort that is wasted. Some models show that these factors influence a society’s *level* of production per capita, while others show that they influence its long-run rate of economic *growth*.

⁶ Two good articles that compare and contrast different assumptions are: Ha, J. & Howitt, P. (2007). Accounting for trends in productivity and R&D: A Schumpeterian critique of semi-endogenous growth theory. *Journal of Money, Credit and Banking*, 39(4), 733-744; and Ang, J. & Madsen, J. (2011). Can second-generation endogenous growth models explain the productivity trends and knowledge production in the Asian miracle economies? *Review of Economics and Statistics*, 93(4) 1360-1373.

Systematic approaches to economic development

Within the general framework of the neoclassical and endogenous growth models, some specific systematic approaches have been proposed for promoting economic development in practice. This project explored seven examples that have specific applications to New Zealand.

1. Krugman's theory of agglomeration economics

In 1991, Paul Krugman demonstrated how the property of increasing returns to scale in manufacturing can result in a spatial equilibrium where manufacturing production agglomerates in cities where incomes are high relative to places outside major population centres.⁷ Increasing returns to scale means that doubling inputs in a production process results in more than a doubling of outputs. One of the factors that gives rise to this phenomenon is the production and utilisation of new knowledge (because knowledge is non-rival in consumption). This theory has been used to argue for policies that support the growth of a country's major cities, although Philip McCann has warned in a New Zealand context that all of the world's most productive cities are at least twice the size of Auckland.⁸

2. Heterogeneous regional development models

A significant strand of the literature, including studies by the Organisation for Economic Cooperation and Development (OECD), has argued that a focus on agglomeration economics can miss important contributions to national development. A recent report concludes, for example, that "while policy makers should ensure the few regions with the strongest contribution to aggregate growth continue to be competitive and maintain their levels of income, improving the performance of periphery and even lagging regions should not be neglected because their cumulated contribution is dominant".⁹ Thus every region needs to support local leadership to mobilise local resources to take advantage of the region's particular strengths and opportunities.

3. Evolutionary economic and path dependency

Evolutionary economics departs from the equilibrium methodology of the neoclassical growth model and argues that economies evolve over time through learning processes of imperfect adaptation and error-ridden discoveries.¹⁰ The development of regions and nations is therefore strongly path-dependent, with future opportunities constrained or assisted by history. There is universal recognition that New Zealand's economic prosperity was founded on primary sector exports, for example, but opinions differ as to whether the country should build on those foundations or make a conscious decision to develop more diverse, high-tech capabilities.¹¹

⁷ Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99(3) 483-499.

⁸ McCann, P. (2009). Economic geography, globalisation and New Zealand's productivity paradox. *New Zealand Economic Papers*, 43(3), 279-314.

⁹ Garcilazo, E. & Oliveira Martins, J. (2013). *The contribution of regions to aggregate growth in the OECD*. OECD Regional Development Working Papers (p. 14). 2013/28. Paris: OECD Publishing, A New Zealand example in this tradition is the collection of the papers edited by J. E. Rowe (2005) *Economic Development in New Zealand*. Aldershot: Ashgate.

¹⁰ Nelson, R. R. & Winter, S. G. (1982) *An evolutionary theory of economic change*. Cambridge MA: Belknap Press.

¹¹ Contrast Webb, C. J. & Grant, C. (2003) *Economic transformation: An implementation framework*. Tertiary Education Commission Research Paper. Wellington: Tertiary Education Commission; and Hendy, S. & Callaghan, P. (2013). *Get off the grass: Kickstarting New Zealand's innovation economy*. Auckland: Auckland University Press.

4. Porter's theory of competitive advantage

Michael Porter constructed a theory from numerous country studies indicating that nations can construct competitive advantage through a strategic approach to economic development.¹² A key idea is that the competitive industries in a nation are not generally distributed across the economy, but tend to cluster geographically because of advantages from the exchange and flow of information among buyers, suppliers and related industries. It is now standard for economic development agencies in New Zealand to identify and foster industry clusters in their region.

5. Skilling's theory of small country strategies

David Skilling has observed that small countries typically performed better than large countries over the last two decades, with higher per capita income growth rates of about half a percentage point on average.¹³ New Zealand is an exception to this observation, which Skilling suggests is because it has not fully engaged with the global economy and has not built a clear perspective on how the country might develop areas of competitive strength.

6. Resource-based economic development

A stylised fact in economics is the so-called “curse of natural resources” — countries rich in natural resources tend to perform badly, especially when the resource runs out. New Zealand has escaped this curse, due at least in part to its sound government, political, business and civil institutions.¹⁴

7. Florida's theory of the creative class

Richard Florida has argued that economic prosperity depends on what he calls “the creative class”, comprising people who use their creativity as a key factor in their work in business, education, health care, law or other professions.¹⁵ His argument suggests that nations and regions need to pay attention to building “a good people climate” by investing in lifestyle amenities that attract creative people.

¹² Porter, M. E. (1998) *The competitive advantage of nations* (2nd ed.). New York: The Free Press. Crocombe, G. T., Enright, M. J. & Porter, M. E. (1991) *Upgrading New Zealand's competitive advantage*. Auckland: Oxford University Press.

¹³ Skilling, D. (2012) *In uncertain seas: Positioning small countries to succeed in a changing world*. Landfall Strategy Group Working Paper, available at www.landfallstrategy.com. Skilling, D. (2012) “There Is no such thing as domestic policy,” presentation to the New Zealand Treasury, 15 May 2012.

¹⁴ Torvik, R. (2009) Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy*, 25(2), 241-256.

¹⁵ Florida, R. (2002) *The rise of the creative class: And how it's transforming work, leisure, community and everyday life*. New York: Perseus Book Group. Sir Paul Callaghan advocated policies to make New Zealand “a place where talent wants to live”; see his article, Sustainable Economic Growth for New Zealand: An Optimistic, Myth-busting Perspective, *TalentNZ*, 1 (2013), pp. 99-100.

2. Transport and economic development

Innovation in transport has been vitally important in New Zealand's economic history. The development of ocean-faring craft and navigational skills led to the initial settlement by Māori in the 13th century and by Europeans in the 18th century. Overseas borrowing by Sir Julius Vogel in the 1870s to construct a national railways network opened up large parts of the country for development. The first refrigerated shipment of meat to the United Kingdom in 1882 produced a stepwise increase in the country's economic prosperity. The construction of the Auckland Harbour Bridge in 1959 opened up the North Shore for commercial and residential development. The introduction of wide-body airliners in the 1970s made international tourism affordable to greater numbers of people.

Each of these examples illustrates how transport can contribute to increasing people's economic opportunities, enabling them to lead the lives they value. Sound investment in transport infrastructure enhances the ability of people to move themselves and their produce from place to place, increasing opportunities for travel and trade.

Transport and productivity growth

Investment in transport infrastructure has been used in many countries as a tool to stimulate economic activity when the economy is in a recession or is forecast to experience lower economic growth. The challenge with using such investment as a macroeconomic stabiliser is getting the timing right. Large infrastructure projects take a long time to plan and obtain the necessary planning consents; consequently there is a risk that construction begins just as the economy is already recovering. Under these circumstances, an increase in transport infrastructure investment can create inflationary pressures rather than acting to stabilise the economy.

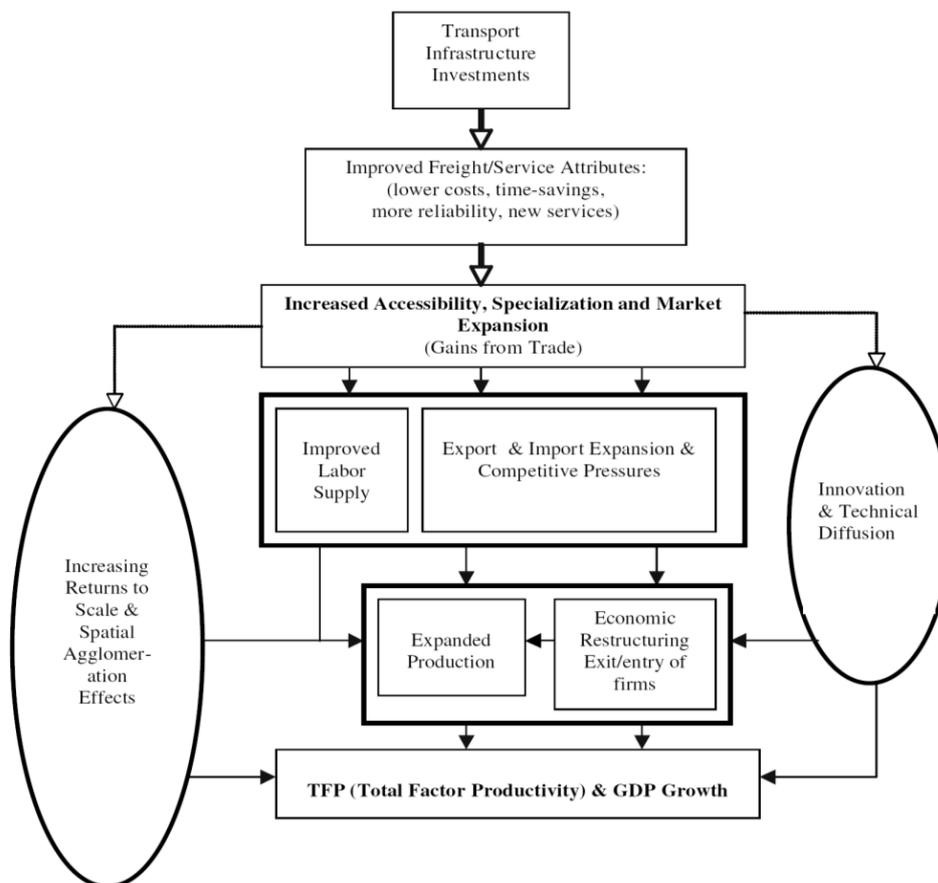
Consequently, greater attention has been paid to the contribution transport investment can make to the underlying competitiveness and productivity of the economy in good times and in bad. It is generally recognised that overinvestment in transport infrastructure can be a drain on the economy (by raising the costs of doing business, including paying taxes), but inadequate investment means that poor transport links can inhibit economic performance. Sir Rod Eddington, for example, was commissioned by the United Kingdom Government to examine long-term links between transport and productivity, resulting in the Eddington Transport Study published in 2006 in four volumes.¹⁶ The study identified seven "micro driver mechanisms" for transport impacts on the economy:

- ▶ increasing business efficiency, through time savings and improved reliability for business travellers, freight and logistic operations
- ▶ increasing business investment and innovation by supporting economies of scale or new ways of working
- ▶ supporting clusters and agglomerations of economic activity
- ▶ improving the efficient functioning of labour markets, increasing labour market flexibility and the accessibility of jobs

¹⁶Eddington, R. (2006). Transport's role in sustaining UK's productivity and competitiveness: The case for action. London: Department for Transport.

- ▶ increasing competition by opening up access to new markets
- ▶ increasing domestic and international trade by reducing the costs of trading
- ▶ attracting globally mobile activity by providing an attractive business environment and good quality of life.

There are obvious connections between these mechanisms and the theories of economic development described in the previous section. Further, the mechanisms are inter-connected, as has been depicted in a figure published by T. R. Lakshmanan and reproduced here as Figure 1.¹⁷



Source: Lakshmanan (2011, *op. cit.*, Figure 8, p. 9).

Figure 1: Transport infrastructure and economy-wide benefits

Government investment in transport infrastructure

The reasons why governments are involved in the planning of transport infrastructure are sound, although this involvement does not preclude partnerships with the private sector in provision, maintenance or ownership. In the terminology of economists, transport networks typically: have the characteristics of public goods; give rise to natural monopolies; and may create externalities that offer benefits or impose costs on people not involved directly in the transport market. These features all suggest that the private sector would underinvest in transport infrastructure, creating an opportunity for the public sector to improve aggregate welfare with quality investment decisions.

¹⁷ Lakshmanan, T. R. (2011). The broader consequences of transport infrastructure investments. *Journal of Transport Geography*, 19(1), 1–12.

Quality investment in transport infrastructure

The literature is clear that it is not the *quantity* of investment in transport infrastructure that is necessarily beneficial for economic development; the *quality* of that investment is crucial. The Eddington Transport Study, for example, made the following observation:

For developed economies, the debate should be focused on the capacity and performance of the existing network: productivity benefits from transport may be more closely related to the efficiency of infrastructure use, rather than simply the absolute amount of investment, particularly where capacity is stretched, as demonstrated, for instance, through congestion or unreliability. The relationship between transport and growth in a mature economy is therefore likely to be an incremental one. (Volume 1, p. 13)

Cost benefit analysis (CBA) remains the primary tool for assessing socio-economic benefits of any proposal for investment in transport infrastructure, although this tool does not necessarily indicate whether a project will support economic growth *per se* (the benefits might be primarily improved safety, for example, where any impact on economic growth would be indirect). This tool allows analysts to measure conventional benefits such as time and cost savings, reliability, quality/comfort, safety and environmental impacts. However, wider indirect benefits may also be included (for example, employment, productivity/output, competition, prices/wages and investment). Arthur Grimes has further emphasised that infrastructure investment creates 'options' that must be taken into account.¹⁸

Place-based versus people-based investment in transport infrastructure

Investments in transport infrastructure are, by their nature, 'place-based'. Consequently, investment decisions can affect the location and type of economic activity in different parts of the country. This means that policy advisors and decision-makers should be cognisant that transport investment infrastructure does not simply *respond* to the needs arising from economic activity; decisions also influence the types of activity that will flourish and the location of that activity. An obvious historical example in New Zealand was the decision to build the Auckland Harbour Bridge in 1959. In the present day, a decision to reduce investment in Auckland city's transport infrastructure might incentivise some businesses to move out of that city to satellite towns around Auckland.

Therefore, numerous episodes in different countries have occurred where transport infrastructure projects have been initiated in an attempt to help 'lagging' regions. There is a substantial body of evidence that such attempts are misguided and may be counter-productive, especially if they hinder the internal migration of people to urban centres where they would be most productive.¹⁹ Short-term opportunities for employment may be created during the construction phase, but in the medium term, it may create an economic millstone around the local authority's neck as it is required to maintain the new asset. Consequently, there has recently been greater emphasis on 'people-based' policies that focus on

¹⁸ Grimes, A. (2010) *The economics of infrastructure investment: Beyond simple cost benefit analysis*. Motu Working Paper 10-05. Wellington: Motu Economic and Public Policy Research.

¹⁹ World Bank (2009) *Reshaping economic geography: Economic development report 2009*. Washington DC: World Bank. Glaeser, E. L. & Gottlieb, J. D. (2008) The economics of place-making policies. *Brookings Papers on Economic Activity, Spring, 1*, 155–239; Crescenzi, R. & Rodríguez-Pose, A. (2012). Infrastructure and regional growth in the European Union. *Papers in Regional Science, 91*(3), 487-513; Daley, J. & Lancy, A. (2011). *Investing in regions: Making a difference*. Melbourne: Grattan Institute.

raising educational achievements and matching skills development with the requirements of expanding industries.

This does not mean that 'place-based' policies have been abandoned; indeed the OECD and others argue a paradigm shift in the vision for regional policy has brought innovation to the core of the regional development agenda.²⁰ The major conclusion is that investment in transport infrastructure will not on its own create economic growth in a region that is growing slowly (or is in decline). Indeed, economic growth is not necessarily dependent on increasing vehicle kilometres travelled (VKT); other forms of access can support the increase in economic activity.

Instead, transport infrastructure investment decisions must be *integrated* with a region's development of its human capital and its opportunities for innovation, taking into account the importance of inter-regional linkages. Addressing bottlenecks that are hindering growth should be a priority, especially since the quality of transport links can make a region more competitive for attracting and retaining businesses compared to regions with poor quality links.

²⁰ OECD (2009). *How regions grow: Trends and analysis*. Paris: OECD Publishing; OECD (2011). *Regions and innovation policy*. OECD Reviews of Regional Innovation. Paris: OECD Publishing; Tomaney, J. (2010). *Place-based approaches to regional development: Global trends and Australian implications*. Sydney: Australian Business Foundation; Barca, F., McCann, P. & Rodríguez-Pose, A. (2012). The case for regional development intervention: Place-based versus place-neutral approaches. *Journal of Regional Science*, 52(1), 134-152.

3. Future Options for the New Zealand Economy (FONZE)

The AERU was commissioned by the Ministry of Transport to prepare a model to analyse plausible futures for the New Zealand economy. The main purpose was to obtain a better understanding of where economic activities might be located in New Zealand, which would offer insights into how transport infrastructure decisions might support economic growth. This resulted in the Future Options for the New Zealand Economy (FONZE) model, which is based on the neoclassical growth model described in Section 1 of this report. In particular, FONZE relies on Solow's conclusion that growth in economic production depends on population growth and the rate of increase in the workforce's labour productivity.

The latest available national input-output tables provided by Statistics New Zealand are for the year ending March 2007. David Butcher (a private sector consultant based in Christchurch) has used these data to generate input-output tables for New Zealand's Regional Councils (reduced to 16 after the small regions of Nelson and Tasman are combined). FONZE uses these regional tables to define the spatial-industry structure of the New Zealand economy in 2007, showing the value of production from each of 19 sectors in each of the 16 regions. Employment in each sector in each region is incorporated from Census data. Assumptions about population growth and labour productivity growth then allow the FONZE model to project the spatial-industry structure in 2042.

The FONZE baseline

The baseline analysis is constructed using official Statistics New Zealand population projections and the long-run estimate of labour productivity growth projected by Treasury in the 2014 Budget.²¹ The latter figure (based on the number of employed and self-employed people) is 0.9 per cent per annum; that is, the baseline analysis assumes that the productivity of all employed and self-employed people in every sector in every region grows at 0.9 per cent each year.

Subnational population projections are provided by Statistics New Zealand in three scenarios: low growth, medium growth and high growth. There are significant differences in the growth rates of different regions, and between the low and high growth scenarios in each region. These differences are major drivers in the FONZE model and so are reproduced here in Table 1. Notice in particular that the Auckland region is projected to grow in the medium growth scenario at more than twice the rate of any other region and that the populations of six regions are projected to decline in the low growth scenario.

²¹ Statistics New Zealand (2012) *Subnational population projections: 2006 (base)-2031*, October 2012 update. Wellington: Statistics New Zealand; Treasury (2014) *Budget economic and fiscal update 2014 additional information*. Wellington: New Zealand Treasury.

Table 1: Statistics New Zealand subnational population projections (percent per annum)

Region	Low Growth	Medium Growth	High Growth
Auckland	1.1%	1.5%	1.8%
Bay of Plenty	0.2%	0.7%	1.2%
Canterbury	0.2%	0.7%	1.2%
Gisborne	-0.5%	0.1%	0.6%
Hawke's Bay	-0.2%	0.2%	0.7%
Manawatu-Wanganui	-0.3%	0.2%	0.6%
Marlborough	0.0%	0.5%	1.0%
Nelson	0.1%	0.6%	1.0%
Northland	0.1%	0.5%	0.9%
Otago	0.2%	0.6%	1.1%
Southland	-0.4%	0.1%	0.5%
Taranaki	-0.4%	0.2%	0.6%
Tasman	0.2%	0.7%	1.1%
Waikato	0.3%	0.7%	1.1%
Wellington	0.1%	0.6%	1.0%
West Coast	-0.4%	0.2%	0.6%

Source: Statistics New Zealand (2012, *op. cit.*).

Medium growth projections were used for each region in the baseline analysis. The employment-population ratio in each region was assumed to be constant, so that population growth equalled employment growth. Since the Auckland region's population is projected to grow faster than the rest of the country, its share of the national population rises from 33.0 percent in 2007 to 40.7 percent in 2042 (see Figure 2) and industry sectors over-represented in Auckland increase their share (see Table 2).

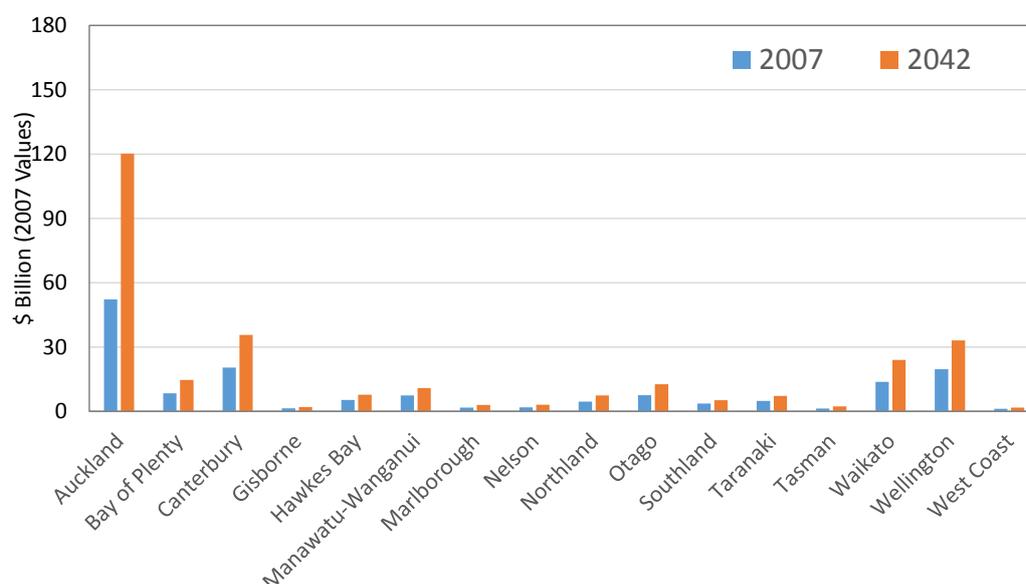


Figure 2: Projected real value added by region, baseline analysis, 2007 and 2042

Table 2: Projected real value added by sector, baseline analysis, 2007 and 2042

Sector in 2007 and 2042 (at 2007 prices)	2007		2042	
	\$b	%	\$b	%
Agriculture, Forestry and Fishing	8.5	5.5%	14.1	4.8%
Mining	1.9	1.2%	3.0	1.0%
Manufacturing	21.4	13.7%	39.7	13.6%
Electricity, Gas, Water and Waste Services	4.7	3.0%	8.7	3.0%
Construction	9.8	6.3%	18.1	6.2%
Wholesale Trade	8.5	5.5%	17.0	5.8%
Retail Trade	8.4	5.4%	15.5	5.3%
Accommodation and Food Services	3.5	2.3%	6.4	2.2%
Transport, Postal and Warehousing	7.1	4.6%	13.7	4.7%
Information Media and Telecommunications	5.5	3.5%	11.0	3.8%
Financial and Insurance Services	10.7	6.9%	20.7	7.1%
Rental, Hiring and Real Estate Services	21.3	13.7%	40.3	13.8%
Professional, Scientific and Technical Services	12.0	7.8%	23.5	8.1%
Administrative and Support Services	3.2	2.0%	6.1	2.1%
Public Administration and Safety	6.8	4.4%	12.3	4.2%
Education and Training	7.1	4.6%	13.3	4.6%
Health Care and Social Assistance	9.4	6.0%	17.2	5.9%
Arts and Recreation Services	2.4	1.5%	4.5	1.6%
Other Services	3.2	2.1%	6.0	2.1%
TOTAL	155.4	100%	291.2	100%

Seven futures in the FONZE model

The FONZE model can be used to analyse different futures by changing any of the assumptions in the baseline analysis. This project constructed seven different futures, grouped under three headings.

- ▶ **Primary Sector Expansion.** Futures 1 and 2 modelled the implications if there is a stepwise increase in primary sector production, either from agriculture due to more irrigable land, or from mining due to the discovery of significant oil and gas reserves off the Gisborne coast.
- ▶ **Catching up with Australia.** Futures 3 and 4 modelled the implications if the average productivity growth in New Zealand is sufficiently higher than currently projected by Treasury so that by 2042 the level of production per person in New Zealand might catch up with that in Australia. Future 3 assumed that higher rates of productivity growth are easier to achieve in sectors that are growing faster in world markets. Future 4 assumed that the higher productivity growth is achieved by increasing the skills of the workforce.
- ▶ **Location Choices.** Futures 5, 6 and 7 modelled the implications if the population growth rates in parts of the country are higher than in the baseline analysis. Future 5 assumed Auckland grows faster; Future 6 assumed the extra population occurs in the so-called three golden triangles of New Zealand at the expense of other parts of the country; and Future 7 assumed the higher population growth is in the country's market towns at the expense of growth in Auckland.²²

The details of this analysis can be found in the full AERU report. For this summary, however, one observation stands out. This is shown in Figure 3, which summarises the share of Auckland in the national economy in 2007 (33.6 percent), in 2042 in the baseline analysis (41.3 per cent) and in 2042 in each of the seven futures (between 37 and 44 percent). The basic driver of this growth is the projection that the population of Auckland will grow at a much faster rate than any other region the country.

Different futures in the FONZE model either mute or reinforce that effect, but in all cases it is clear that Auckland can be expected to increase its population and level of economic activity more quickly than the rest of New Zealand.

²² 'Market towns' is a term used here to refer to smaller population centres outside the main cities of Auckland, Hamilton, Wellington, Christchurch and Dunedin. The regional analysis is not necessarily well suited to this future, but it gave some insight into what might happen if a future pathway saw larger numbers of people choosing to live outside the main centres for lifestyle or other reasons.

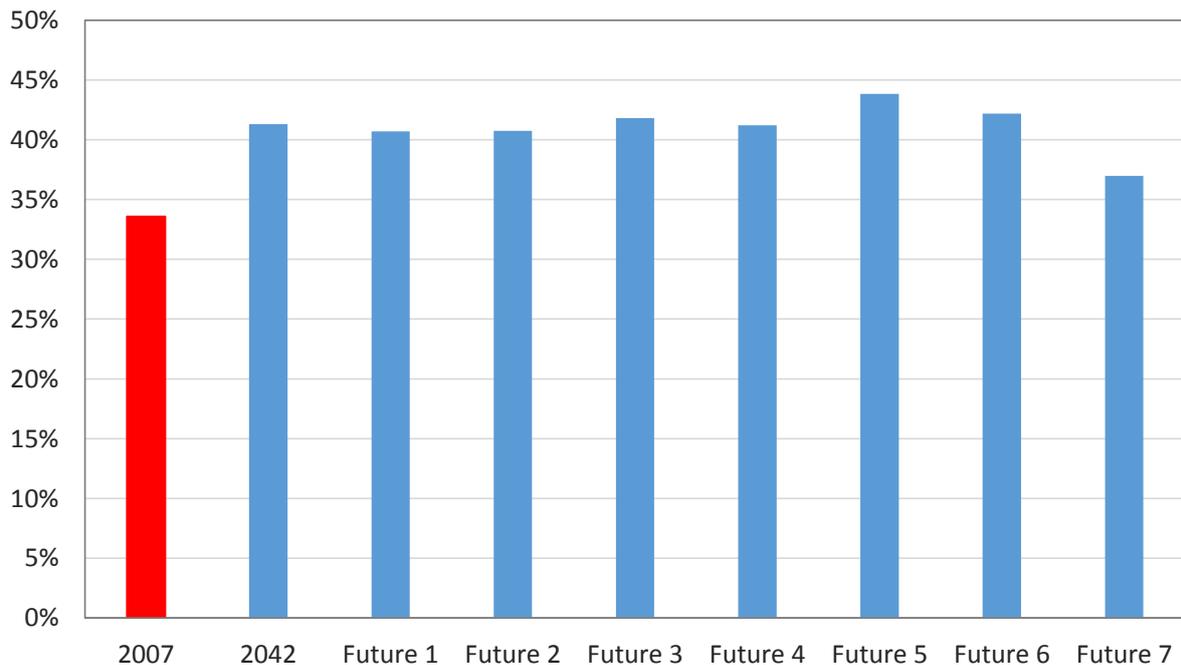


Figure 3: Share of Auckland in the National Economy in the FONZE Model, 2007 and 2042

4. Transport implications of the FONZE analysis

The Ministry of Transport has completed an initial assessment of the transport implications of the baseline and seven futures analysed in the FONZE model. This assessment does not suggest any major shocks to the transport system, except in some parts of the network that are already heavily utilised or subject to future growth pressures, where investment may be needed to mitigate localised congestion at peak times and at specific pinch-points in the overall system. The Ministry welcomes feedback on transport challenges not picked up in this assessment.

Roads

Most of the national state highway network appears to have sufficient capacity to handle substantially increased freight. Some projects would be required in some instances (for example, additional passing lanes) or more substantive projects moved forward (bridge replacements, four-laning). Four-laning to relieve route congestion and address safety issues is typically undertaken once traffic levels reach a threshold level. All routes likely to exceed the threshold have adequate planned four-laning projects, largely in the form of Roads of National Significance projects.

However, there are significant pinch-points on the network where additional truck movements could create adverse effects, notably additional congestion. This is mainly within major urban areas:

- ▶ Auckland (to and from Ports of Auckland)
- ▶ Tauranga (over SH29, and to and from Port of Tauranga)
- ▶ within Christchurch (to and from Port of Lyttelton) and to a lesser degree through Dunedin (SH88 and access to Port of Otago).

The mitigation cost for these is likely to be significant because of the additional road capacity required in an urban environment. The following significant pinch-points have imminent or readily available mitigations:

- ▶ Auckland's Central Motorway Junction (western ring route complete within the next few years)
- ▶ Wellington's Ngauranga Gorge and SH1/2 interchange (New Petone–Grenada route, and Cross Valley Link)
- ▶ Rimutakas (realignments)

Pinch-points with the highest technical and cost challenge include:

- ▶ Brynderwyn Hills, between Auckland and Whangarei
- ▶ Kaikoura Coast

Other potential problems, notably access across the Kaimais to Tauranga, are being avoided through increasing the use of rail freight.

Passenger traffic is a problem in large metropolitan areas. A decline in vehicles travelled per capita has offset population increases and helped avoid increased congestion. Metropolitan traffic growth is also being addressed with a combination of:

- ▶ better bus networks (for example, route rationalisation, increased frequency, improved interchanges and more bus lanes being implemented in Auckland and planned in Wellington)
- ▶ recent urban rail upgrades in Auckland and Wellington
- ▶ demand management, for example, Auckland has ramp access control on the main motorway and is discussing congestion pricing
- ▶ plans to increase density in some areas combined with public transport improvements.

Rail

KiwiRail has spare capacity on almost all its network, and would benefit financially from increased freight. The KiwiRail turnaround plan has seen substantial investment in its infrastructure, which has improved its capacity and the reliability of journey times. Further upgrades and replacements are planned. Other capacity-related projects, subject to funding, include:

- ▶ improvements to some freight yards
- ▶ installation of a third line between Westfield and Wiri
- ▶ other improvements in Auckland where there is congestion from the mix of passenger and freight services.

Airports

All New Zealand airports with scheduled flights have spare capacity. The airport most affected under all the scenarios in this study is Auckland. Rapid or accelerated growth in Auckland may bring forward the date when a second runway is needed; the airport company already has the land and planning permission for that option and some preliminary construction work has already been undertaken.

Jets and turboprops operate domestic flights between Auckland, Wellington, Christchurch, Queenstown and Dunedin. Services to other airports are by turboprops although some have had jet service in the past (for example, Hamilton, Palmerston North, Invercargill). The main implications of the studied scenarios, besides increased activity at Auckland, are for increased demand at Christchurch and some provincial airports, all of which have ample spare capacity.

Some provincial airports would not be able to accommodate regular jet services without runway lengthening and/or strengthening, but increased turboprop frequency would be the best response to increased demand — their smaller capacity allows higher frequencies and their journey times are similar to jet journey times on shorter flights. Turboprops also have a significant advantage with respect to fuel consumption. If scheduled services to particular provincial airports ceased, the impact on economic activity would depend on whether there was another scheduled-service airport within reasonable driving distance.

Trans-Tasman services are provided to the three main airports, Queenstown and, less frequently, to Dunedin, with seasonal flights elsewhere (although those to Rotorua are about to be dropped). Long-haul international services are all through Auckland except for a daily Christchurch–Singapore flight; there is debate about whether a proposed lengthening of Wellington’s runway would lead to long-haul services there. Most of New Zealand's major international air routes are open to competition (those to Australia, North America, Japan, Singapore and the UK) and the Ministry is negotiating with overseas governments to liberalise restrictions on other routes.

If a natural disaster or extreme weather closed particular airports, in most cases another one that could be used is within a one or two hour drive, although not always by larger aircraft.

Most freight goes in the belly holds of passenger aircraft, adding to the importance of capacity liberalisation. Effectively no restriction is in place on freight-only aircraft to or from the major markets including China.

Ports

Some of New Zealand's major ports are increasing their capacity — Auckland, Tauranga and Lyttelton, for example. Others have spare capacity or the potential to add capacity. Some have constraints that would need to be overcome in the medium term to support the economic development of their regions. Rapid growth in logging freight, for example, is placing increasing demands on Eastland Port in Gisborne. While there are issues with handling the logs within the port, the most significant issue is the capacity to store logs prior to export.

Capacity constraints at any one port can largely be mitigated by competition between ports; for example, between Tauranga and Auckland, Timaru and Lyttelton, or Napier and Wellington. Broader competitive potential is shown by the recent Kotahi deal involving the Ports of Tauranga and Timaru.

Potential future demand at particular ports will be affected not only by the scenarios in this study but also by the advent of larger container ships. These have lower costs per container, are expected to make fewer port calls and so are likely to require greater use of road and rail links to connect to some freight origins and destinations. They will also involve investment in some ports. Currently our ports are

equipped to service container ships of around 5,000 TEU (20-foot container equivalents). The trend to larger ships is driving the need for some ports to decide to invest in upgrades to enable them to service these new ships.

In total the land side investment coupled with the cost of the additional domestic journey for some cargo (in accessing a hub port) means that those links cost more per net tonne kilometre than ships. There will be a competitive dynamic between larger ships making fewer port calls, smaller ships making more calls, and coastal shipping. Nevertheless, the broad picture is that New Zealand's ports will be able to cope with the increased freight implied by the scenarios, but the pattern between ports will be dynamic.

Conclusions

As explained in this paper's introduction, the purpose of this project has been to explore how the country's transport system can support New Zealand's economic development. The project has drawn on the neoclassical growth model to construct the Future Options for the New Zealand Economy model, which has been used to analyse a baseline and seven plausible futures. A key result from that exercise is the importance of the Auckland region to the national economy; in the baseline analysis, it grows from 33.6 percent of national gross domestic product in 2007 to 41.3 percent in 2042.

This observation suggests that policy advisors will need to pay particular attention to the transport network in the Auckland region. This may include planning to ensure good direct access between the Auckland International Airport and commercial centres in Auckland city (including the central business district and the North Shore). It may also include attention to road transport in and out of the city for international tourists, urban holidaymakers and freight movements. This does not mean that other regions should be neglected, since they will continue to contribute more than half of New Zealand's gross domestic product in all of the scenarios considered in this study.

The literature cautions against using transport infrastructure investment as a stabiliser of economic activity at the national level or in slow-growing regions. Instead the focus should be on investments that enhance underlying competitiveness and productivity. Decision-makers need to be cognisant that investments can affect the location and type of economic activity in different parts of the country. The literature emphasises, therefore, that investments in regional transport infrastructure should be integrated with each region's systems for developing its human capital and fostering knowledge creation and innovation. Each region must build on its particular strengths and opportunities (including its key linkages with other regions and the global marketplace), rather than being supported by taxpayer-funded subsidies of one sort or another.

In conclusion, increased transport demands implied by the scenarios examined in this study are not expected to create major capacity problems in most of the transport network, but may bring forward the dates for routine capacity enhancements such as additional road lanes and rail passing loops.

Increased demands may add to existing difficulties with certain pinch-points in the road network; the most notable cases under all scenarios are in Auckland. There are potential investments to address the main freight related problems, while broader policies will be needed for general urban traffic.