



Auckland's infrastructure

The cost to serve a city that's growing
upwards

January 2025

New Zealand Infrastructure Commission / Te Waihanga

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Key insights

Auckland is New Zealand's largest city and only city with a population over one million. In 2023, the Auckland region had a population of 1.66 million people, or 33% of New Zealand's total population, and it contributed 38% of the country's total economic output (GDP, or gross domestic product). However, the Auckland region only occupies 1.8% of the country's total land area.

Auckland faces different infrastructure challenges than other parts of New Zealand, due to its size, density, and growth rate. City size and density affect how much infrastructure is needed in total, what it costs to service people with infrastructure, and what types of infrastructure are needed.

Based on our previous research, we identify three ways that Auckland is different to the rest of New Zealand when it comes to infrastructure.

Auckland is cheaper to service with network infrastructure – but new projects can be more expensive

Auckland benefits from economies of density in infrastructure network provision – because it has a large population of people who live relatively close together, it needs fewer roads, electricity distribution lines, and fibre broadband cables to connect them, and it is also more viable to provide public transport services. This reduces the amount of infrastructure that is needed per person, which in turn reduces ongoing maintenance and renewal costs.

However, the cost to build new infrastructure may be higher in Auckland, due to more complex mitigation requirements and higher land prices in built-up areas. For instance, road building is more expensive in Auckland than in the rest of the country. This can offset some of the benefits of density.

Aucklanders spend a smaller share of their income on infrastructure services

Auckland households' infrastructure spending is different, reflecting differences in the amount of infrastructure services that people use as well as different costs to provide infrastructure services.

On average, Auckland households spend a smaller share of their after-tax income on infrastructure services than non-Auckland households, but because incomes are higher in Auckland they spend more in dollar terms. Auckland households' mix of spending is also different, with a greater share of infrastructure budgets spent on public transport and slightly smaller shares spent on private vehicle transport and electricity and household fuels.

Aucklanders have slightly different views about the fairness of some options for pricing infrastructure

Aucklanders are more likely to think that it was fair to price piped water based on what it costs to supply to households or based on how much water households use, and more likely to think that it is fair to price roads based on how much people drive or based on whether they are travelling at peak times. These differences are likely to reflect the city's longer experience with volumetric charging for water and increased exposure to congestion, which can be alleviated by time-of-use charging.

These differences mean that Aucklanders may be more accepting of using demand management to avoid the need for costly infrastructure upgrades.

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1. Introduction

1.1. Auckland is a large and fast-growing city

Auckland is New Zealand's largest city and only city with a population over one million. In 2023, the Auckland region had a population of 1.66 million people, or 33% of New Zealand's total population.¹ In this year, the Auckland region contributed 38% of the country's total economic output (GDP, or gross domestic product).²

Auckland is also much more densely populated than most other parts of New Zealand, which affects how it provides and uses infrastructure. The region accounts for 33% of the country's population but only occupies 1.8% of the country's total land area (4,941km² out of a total of 268,680km²).³ Moreover, Auckland's population isn't evenly distributed within its region, with 92% of Aucklanders living in only 14% of the region's area.⁴ While Auckland is less densely-populated than large European cities, it is comparable to similarly-sized Australian and Canadian cities.⁵

Lastly, Auckland is growing rapidly. Over the last century, Auckland has been the country's fastest-growing large urban area,⁶ and growth pressures from Auckland have spilled over into surrounding places.⁷ Over the last decade, its growth has been constrained by high housing prices⁸ but it has still accounted for one-third of the country's total population growth.⁹ Under Statistics New Zealand's most recent (medium) subnational population projections, Auckland is expected to account for around half of the country's total population growth in coming decades.¹⁰

Auckland has grown both through natural increase – people having more children – and through immigration. Because it has attracted a large share of immigration to New Zealand, it is our most ethnically diverse region¹¹ with two-fifths (42%) of Auckland's residents born overseas.¹²

1.2. Auckland faces different infrastructure challenges

As a result of Auckland's size, density, and growth rate, the city faces different infrastructure challenges than other parts of New Zealand. Addressing the city's urban infrastructure needs is important for achieving the 'Building attractive and inclusive cities' strategic objective of *Rautaki Hanganga o Aotearoa – New Zealand's Infrastructure Strategy*, and for our ongoing work to develop a National Infrastructure Plan.

City size and density affect how much infrastructure is needed in total, what it costs to service people with infrastructure, and what types of infrastructure are needed.

¹ <https://www.stats.govt.nz/information-releases/2023-census-population-counts-by-ethnic-group-age-and-maori-descent-and-dwelling-counts/>

² <https://www.stats.govt.nz/information-releases/regional-gross-domestic-product-year-ended-march-2023/>

³ Stats NZ. 'Geographic Boundary Viewer: Regional Council'.

<https://statsnz.maps.arcgis.com/apps/webappviewer/index.html?id=6f49867abe464f86ac7526552fe19787>

⁴ Stats NZ. 'Subnational population estimates (urban rural), by age and sex, at 30 June 1996-2023 (2023 boundaries)'.

<https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7981>

⁵ <https://chartingtransport.com/2015/11/26/comparing-the-densities-of-australian-and-european-cities/>

⁶ <https://www.motu.nz/our-research/population-and-labour/individual-and-group-outcomes/a-new-zealand-urban-population-database/>

⁷ <https://www.tandfonline.com/doi/abs/10.1080/00779954.2016.1193554>

⁸ <https://www.tandfonline.com/doi/abs/10.1080/00779954.2020.1791939>

⁹ <https://www.stats.govt.nz/information-releases/2023-census-population-counts-by-ethnic-group-age-and-maori-descent-and-dwelling-counts/>

¹⁰ [https://explore.data.stats.govt.nz/vis?tm=subnational%20population%20projection&pg=0&snb=21&dfds=ds-nsiws-disseminate&dfid=POPPR_SUB_010&dfagl=STATSNZ&dfvsl=1.0&dq=TOTALALLAGES..MEDIUM.SEX3.&lylrl=AREA_POPPR_SUB_010&lylcl=YEA R_POPPR_SUB_010&to\[TIME\]=false](https://explore.data.stats.govt.nz/vis?tm=subnational%20population%20projection&pg=0&snb=21&dfds=ds-nsiws-disseminate&dfid=POPPR_SUB_010&dfagl=STATSNZ&dfvsl=1.0&dq=TOTALALLAGES..MEDIUM.SEX3.&lylrl=AREA_POPPR_SUB_010&lylcl=YEA R_POPPR_SUB_010&to[TIME]=false)

¹¹ Stats NZ. 'Auckland Region'. <https://www.stats.govt.nz/tools/2018-census-place-summaries/auckland-region>

¹² Office of the Auditor-General. (2023). 'Auckland by Numbers'. <https://www.oag.parliament.nz/2023/auckland-performance/auckland-by-numbers>

Population and economic activity drive demand for infrastructure – places with larger populations and higher GDP tend to have more of it.¹³ Because Auckland accounts for 33% of the country's population and 38% of its economic output, it also accounts for a comparable share of the country's overall infrastructure networks. It is home to some of the country's largest current infrastructure projects, such as the City Rail Link and Central Interceptor tunnels.¹⁴

Population size and density also affect the cost to service people with infrastructure. Infrastructure networks often benefit from economies of scale and density, as the fixed costs to provide networks can be shared among more people.¹⁵ Higher population density means less network is required per person. All else equal, this will mean that cities are cheaper to serve with infrastructure than small towns and rural areas, and that higher-density places within cities are cheaper to serve than lower-density places.¹⁶

However, all else is not necessarily equal. The cost to build infrastructure in urban areas can be higher due to site constraints and higher land purchase costs.¹⁷ Higher per-unit costs can offset savings from having a smaller amount of infrastructure per person.

A further consideration is that cities can support a different mix of infrastructure than small towns and rural areas. While people need similar infrastructure services everywhere – getting clean drinking water, getting power, getting around, and communicating with each other – these needs can be met in different ways in different places. For example, public transport services are more cost-effective to provide in cities, as there are more people around to use them. On the other hand, off-grid infrastructure solutions like rainwater collection tanks and rooftop solar may be the most cost-effective way to serve low-density rural areas with water and electricity.

1.3. Our research questions

In this paper, we draw upon the Commission's previous research, including work completed as part of our 'What's Fair – Providing and paying for infrastructure' research programme¹⁸ and our *Research Insights* series, to explore how Aucklanders use infrastructure. We focus on three specific areas:

- First, we examine the **cost to service Auckland with network infrastructure**, relative to the rest of New Zealand. This high-level view can help us understand whether and how the city benefits from economies of scale in density in infrastructure provision.
- Second, we examine **what Auckland households currently spend on infrastructure**, and how this varies within the city. Households' spending patterns reflect the combination of how much infrastructure services cost, and how much of them people use. As a result, spending data can help us understand how urban form shapes infrastructure usage, and how the mix of infrastructure that is used in Auckland compares with the rest of New Zealand.
- Third, we examine **Aucklanders' perceptions of different options for paying for infrastructure**, such as volumetric charging for water and time-of-use charging for roads. This can help us

¹³ <https://tewaihanga.govt.nz/our-work/research-insights/paying-it-forward-understanding-our-long-term-infrastructure-needs>

¹⁴ City Rail Link. 'Project Overview'. <https://www.cityraillink.co.nz/city-rail-link-project-overview>
Watercare. 'Why we're building the Central Interceptor'. <https://www.watercare.co.nz/Central-interceptor/Why-we-re-building-the-Central-Interceptor>

¹⁵ **Economies of scale** occur where the average cost of producing a good or service falls as the number of units produced increases. **Economies of density** occur when the cost to service one consumer falls as the number of consumers in close geographic proximity increases.

¹⁶ MRCagney. (2019). 'Costs and benefits of urban development.' <https://environment.govt.nz/publications/the-costs-and-benefits-of-urban-development/>

Infrastructure Victoria. (2023). 'Choosing Victoria's future: Five urban development scenarios.' <https://assets.infrastructurevictoria.com.au/assets/Resources/Infrastructure-Victoria-Choosing-Victorias-future-Five-urban-development-scenarios-2.pdf>

NSW Productivity Commission. (2023). 'Building more homes where infrastructure costs less.' https://www.productivity.nsw.gov.au/sites/default/files/2023-08/202308_NSW-Productivity-Commission_Building-more-homes-where-infrastructure-costs-less_accessible-v2.pdf

¹⁷ <https://tewaihanga.govt.nz/our-work/research-insights/protecting-land-for-infrastructure-how-to-make-good-decisions>

¹⁸ For more information about this research programme, and the final published reports, see <https://tewaihanga.govt.nz/our-work/key-topics/what-is-fair-providing-and-paying-for-infrastructure>

understand opportunities to address growth-related infrastructure pressures using demand-management measures like pricing.

This report is not intended to be a comprehensive assessment of the performance of Auckland's infrastructure, although we expect it to inform understanding of the city's infrastructure challenges and opportunities.

2. The cost to service Auckland with network infrastructure

Infrastructure provision often involves high fixed costs to provide networks that can be used by many people. This means that cities are often, although not always, cheaper to service with infrastructure, because those fixed costs can be shared among more people.

However, it can also be more expensive to build and maintain infrastructure in urban environments. Higher population densities mean higher costs to buy land for infrastructure and more site constraints that are expensive to work around.¹⁹ Unless these are managed, these added costs can overwhelm the benefits from scale and density.

In this section, we illustrate these patterns using high-level evidence on costs to service Auckland (as a region) with network infrastructure, and how these costs compare with the rest of the country. We focus on three sectors where comparable data on infrastructure prices or expenditures is available: electricity, telecommunications (fibre broadband), and land transport.²⁰ In the case of land transport, we also explore the relationship between network size, usage, and expenditure.

2.1. Electricity prices are lower in Auckland than elsewhere

Electricity prices are set to reflect the full costs of generating, transmitting, distributing, and retailing electricity.²¹ Regional price differences reflect variations in the cost of the infrastructure required to service different regions, particularly transmission and distribution costs, and the extent of competition in local electricity retail markets.²² Transmission and distribution costs can vary significantly between regions because different amounts of network infrastructure are needed to serve different regions, and the cost to build and maintain that infrastructure can depend upon local geology.

As a result, we can compare retail electricity prices to understand how the overall costs of supplying electricity varies between regions.

Figure 1 shows that retail electricity prices are lower than the national average in the central parts of the Auckland urban area, but not in Pukekohe, a satellite town with a surrounding rural area. Over the last five years, prices in Auckland Central have been, on average, 5% lower than the national average, and prices in the North Shore have been, on average, 3% lower. By contrast, prices in Pukekohe have averaged 4% higher.

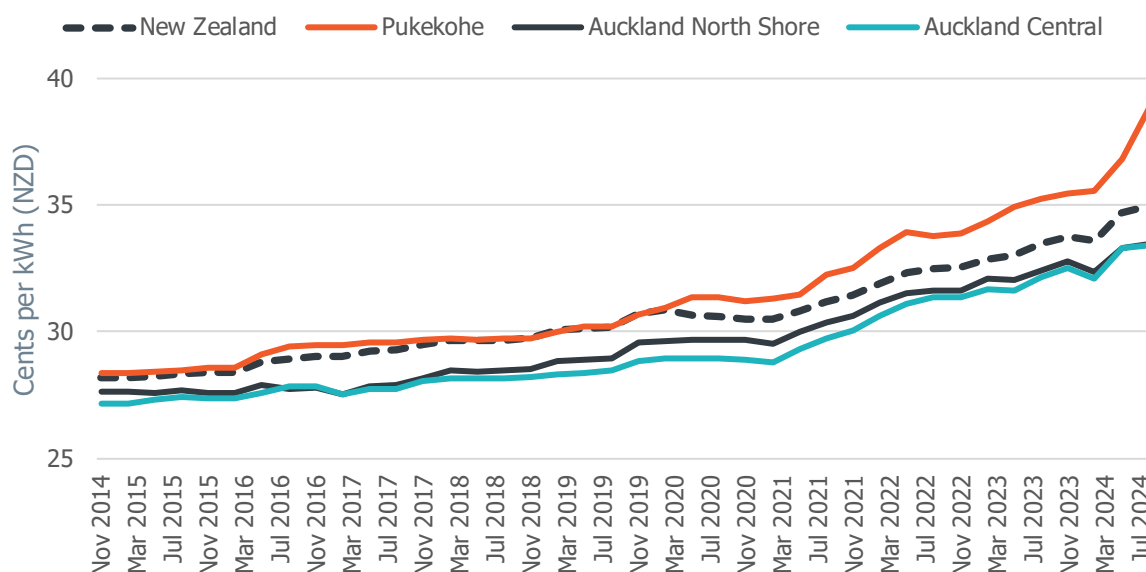
¹⁹ <https://tewaihanga.govt.nz/our-work/research-insights/the-lay-of-the-land-benchmarking-new-zealand-infrastructure-delivery-costs>

²⁰ While data on the cost of water, wastewater, and stormwater services provided by councils to households is available, this data is less comparable as different councils charge for these services in different ways and because many councils have spent less to maintain and renew water network assets than will be required to sustainably provide those assets in the long run.

²¹ <https://tewaihanga.govt.nz/our-work/research-insights/network-infrastructure-pricing-study> and <https://www.mbie.govt.nz/dmsdocument/3757-first-report-electricity-price-review-pdf>

²² Consumer NZ. (2021). 'Shocking stuff: consumers in lower income areas paying more for power'. <https://www.consumer.org.nz/articles/shocking-stuff-consumers-in-lower-income-areas-paying-more-for-power>

Figure 1: Retail electricity prices, 2014–2024



Source: Ministry of Business, Innovation and Employment. (2023). 'Quarterly Survey of Domestic Electricity Prices to 15 November 2023'. See: <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/electricity-cost-and-price-monitoring/>. Note: This only provides data on selected locations in New Zealand and does not include a detailed account of all intra-Auckland spending.

Electricity prices can be further disaggregated into transmission charges, distribution charges, and charges for energy, retail, and other components. The electricity transmission network carries power from power stations to electrical substations on high-voltage lines. Electricity distribution networks then carry electricity from substations to homes and businesses, via lower-voltage lines.

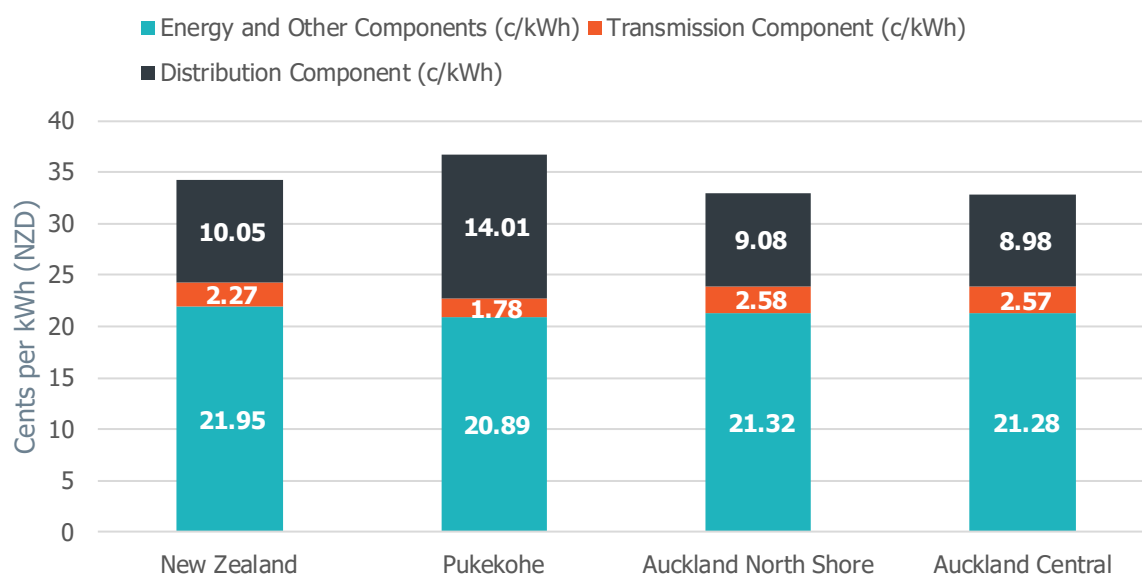
Figure 2 shows that Auckland's lower retail electricity prices are mostly due to lower distribution charges. This is likely to reflect Auckland's scale and population density, as a kilometre of electricity line in an urban area will serve more customers than a kilometre of electricity line in a rural area. However, central Auckland has higher-than-average transmission charges. This could be because the city is a long way away from most of the country's electricity generation sources, resulting in the need for more transmission infrastructure to serve it.

As we discuss in the following section, Auckland households spend less on every form of home energy (electricity, gas, firewood etc.) than the rest of the country. The average Auckland household spends around 10% less on electricity than households outside of Auckland. This is larger than the difference in retail electricity prices, suggesting that Aucklanders also use less electricity than non-Aucklanders. This could be due to lower heating costs in a warmer climate²³ and the smaller average floor size of new homes.²⁴

²³ For example, space heating was found to use 27% of operational energy in Christchurch in 2018, compared to only 4% in Auckland. Stats NZ. (2021). 'Housing in Aotearoa: 2020'. <https://www.stats.govt.nz/reports/housing-in-aotearoa-2020>

²⁴ Stats NZ. 'Median floor area of new homes consented decreases 10 percent'. <https://www.stats.govt.nz/news/median-floor-area-of-new-homes-consented-decreases-10-percent/#:~:text=Auckland%20median%20floor%20area%20smaller,the%20rest%20of%20the%20country>

Figure 2: Estimated breakdown of retail electricity prices, year ended August 2024



Source: Te Waihanga analysis of data from the Ministry of Business, Innovation and Employment. (2023). 'Quarterly Survey of Domestic Electricity Prices to 15 November 2023'. See: <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/electricity-cost-and-price-monitoring/>. Note: This only provides data on selected locations in New Zealand and does not include a detailed account of all intra-Auckland spending.

2.2. Ultra-fast broadband was cheaper to roll out in Auckland

Telecommunication prices are also set to cover the full costs to provide infrastructure and services.²⁵ However, we do not have data on regional variations in telecommunications prices, so we instead compare the costs to deploy fibre broadband in Auckland with the cost to deploy it in other parts of the country. This is a useful comparison since public investment was used to ensure that a common standard of infrastructure was deployed to most households and businesses in New Zealand.

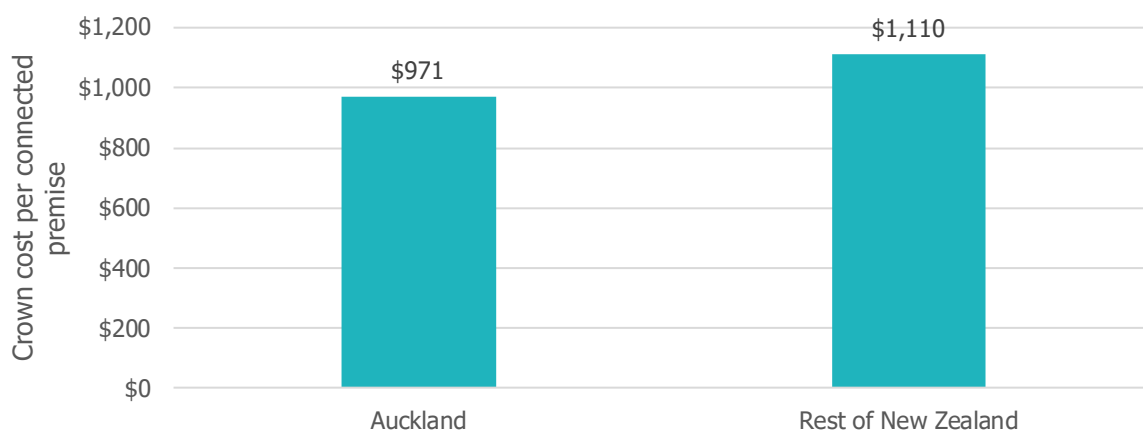
The Ultra-Fast Broadband (UFB) Initiative was established to partner with private companies to build fibre broadband infrastructure in 412 towns and cities between 2009 and 2022. In total, the programme made fibre services accessible to around 1.8 million households and business premises, including 469,000 in Auckland, for a total cost to the Crown of around \$1.7 billion.²⁶

Figure 3 shows that the cost to the Crown to roll out UFB to Auckland households and businesses was around 13% lower than the cost elsewhere in New Zealand. Lower rollout costs are likely to reflect Auckland's scale and population density, as a kilometre of broadband line in an urban area will serve more customers than a kilometre in a rural area.

²⁵ <https://tewaihanga.govt.nz/our-work/research-insights/network-infrastructure-pricing-study>
<https://www.mbie.govt.nz/dmsdocument/3757-first-report-electricity-price-review-pdf>

²⁶ NZ Government. 'New Zealand's broadband network – Factsheet'. <https://www.beehive.govt.nz/sites/default/files/2017-09/Regional%20fact%20sheets.pdf>

Figure 3: Crown cost per household or business connected through the UFB rollout



Source: Te Waihanga analysis of UFB rollout data. See: <https://www.beehive.govt.nz/sites/default/files/2017-09/Regional%20fact%20sheets.pdf>

2.3. Land transport expenditures show the impact of offsetting factors

At present, land transport prices are not necessarily set to cover the full costs to build and maintain land transport infrastructure.²⁷ And unlike electricity prices, key land transport prices, such as fuel excise duty and road user charges, are set at a national level to reflect national average costs to provide land transport networks, rather than reflecting regional variations.²⁸

As a result, we use information on central and local government land transport expenditure in the National Land Transport Fund (NLTF) to understand the costs that have actually been incurred to service Auckland with land transport infrastructure, relative to the rest of New Zealand.²⁹

For the most part, the NLTF is spent on building and maintaining state highways, which are provided by NZTA and funded entirely out of central government revenues, building and maintaining local roads and transport infrastructure, which are partly funded by central government and partly funded by local government out of rates and other charges, and providing public transport services, which are funded through a mix of public transport fares, central government revenues, and local government rates.

Reported NLTF expenditure includes both central government and local government funding contributions, but it excludes direct Crown expenditure on some transport projects, such as the City Rail Link, and council expenditure that does not receive co-funding from the NLTF.

As context for this analysis, we also provide information on network usage and network size that is reported alongside NLTF expenditure data.

2.3.1. Aucklanders drive less and use public transport more

Relative to the national average, Aucklanders drive less and use public transport more. While Auckland accounts for 33% of national population, it accounts for only 28% of total vehicle kilometres travelled (VKT), a measure of how far cars, trucks, and other road vehicles travel, but 55% of total public transport (PT) boardings.

²⁷ <https://tewaihanga.govt.nz/our-work/research-insights/buying-time-toll-roads-congestion-charges-and-transport-investment>
<https://tewaihanga.govt.nz/our-work/research-insights/network-infrastructure-pricing-study>

²⁸ For further information on how land transport pricing and investment works, see Appendix 1 in <https://tewaihanga.govt.nz/our-work/research-insights/buying-time-toll-roads-congestion-charges-and-transport-investment>

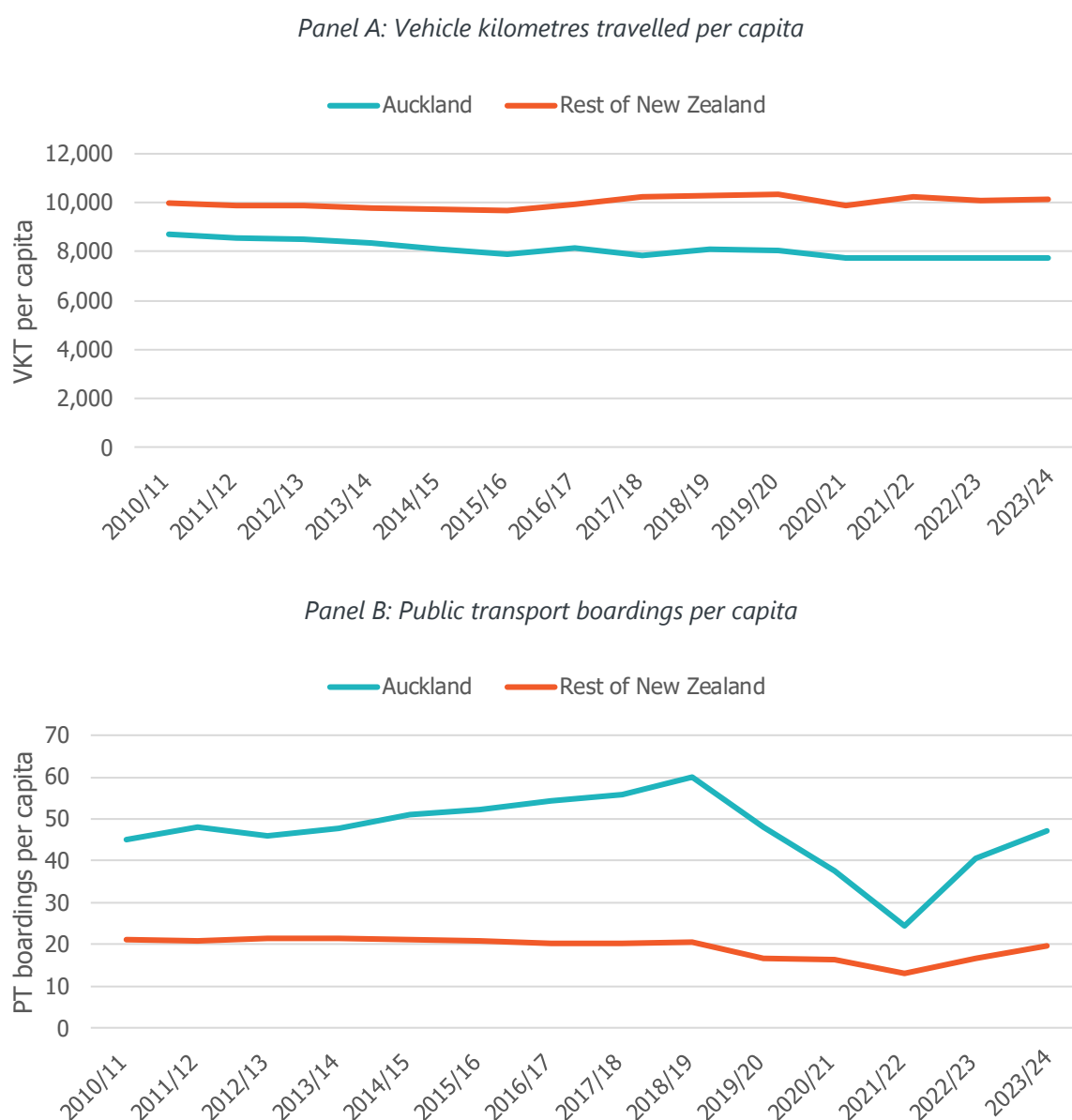
²⁹ Urban passenger rail operating subsidies are included in the NLTF, but rail infrastructure investment generally falls outside the NLTF. Auckland has experienced significant Crown-funded rail network investment in the 2010s and 2020s, but it is difficult to obtain a regional breakdown of the Crown's rail investment costs. For information on the Crown's total spending on rail, see Appendix 1 in <https://tewaihanga.govt.nz/our-work/research-insights/buying-time-toll-roads-congestion-charges-and-transport-investment>

Over time, Aucklanders are driving less and taking public transport more. This trend has coincided with increased urban intensification, which means more people are living in places where public transport is viable, and rising traffic congestion, which makes driving less attractive.

In 2023/24, the average Aucklander drove 11% less than they did in 2010/11, while VKT per capita stayed constant elsewhere in the country. Prior to COVID-19, PT boardings per capita were rising more rapidly in Auckland than they were for the whole country, although post-COVID-19 declines in PT use have not yet been fully reversed.

Differences in transport use reflect Auckland's greater population size and density. Density reduces the average distance that people need to travel to reach their destination and increases the viability of providing public transport services.

Figure 4: Transport volumes in Auckland relative to New Zealand as a whole, 2010/11 to 2023/24



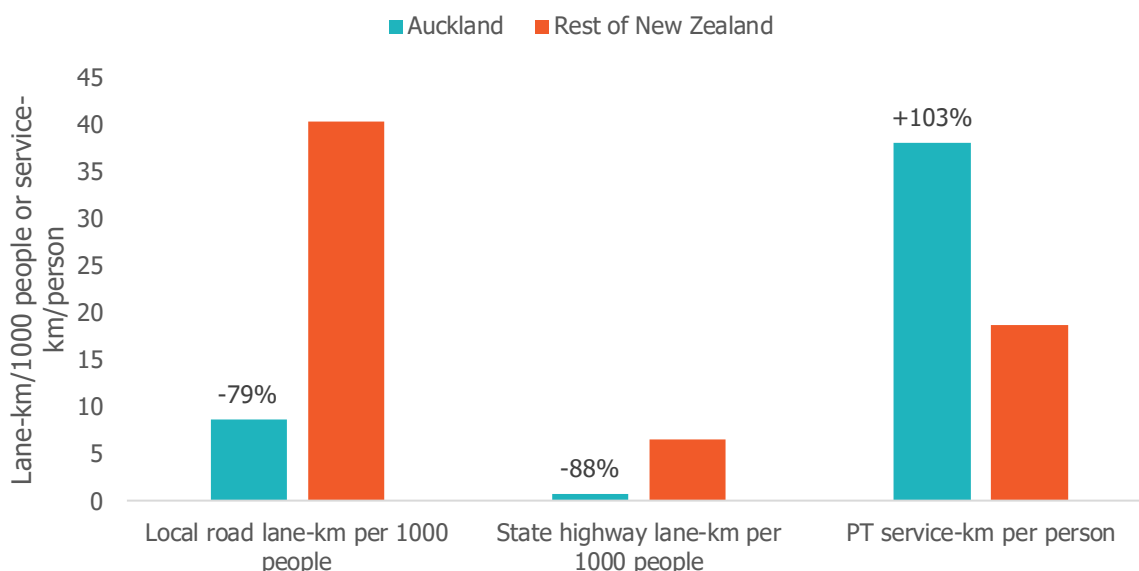
Source: Te Waihangā analysis of NZTA data and Statistics New Zealand subnational population estimates.³⁰

³⁰ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>
<https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/>

2.3.2. Auckland has fewer roads per capita and more public transport service

Figure 5 shows that Auckland has fewer road lane-kilometres per capita than the rest of New Zealand, but more public transport service-kilometres. In 2023/24, it had 79% fewer local roads per capita, 88% less state highways, and 103% more public transport services than the rest of New Zealand. These ratios have been fairly stable over time.

Figure 5: Road lane-kilometres and public transport service-kilometres per capita, 2023/24



Source: Te Waihanga analysis of NZTA data and Statistics New Zealand subnational population estimates.³¹

2.3.3. Auckland's mix of transport spending is different

From 2010/11 to 2023/24, Auckland received 33% of total National Land Transport Fund spending – similar to its share of national population. However, Auckland has a different mix of spending than the rest of the country, due to its different patterns of transport infrastructure supply and use.

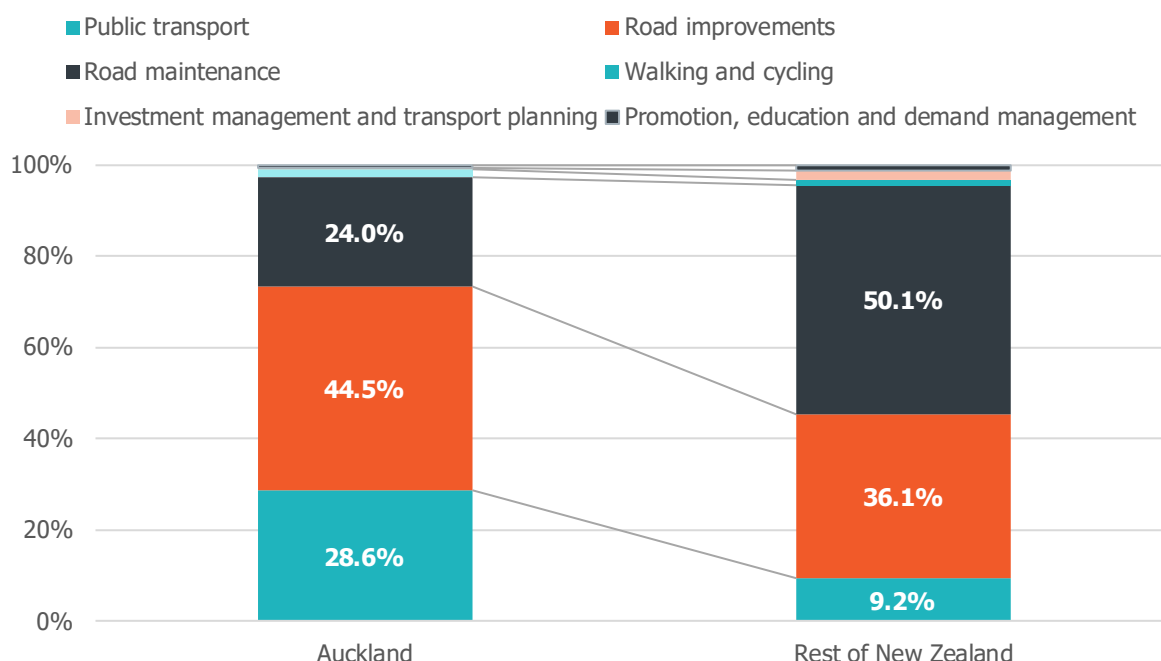
Figure 6 illustrates this using data for the decade from 2009/10 to 2018/19.³² Auckland spends less on road maintenance as it has a smaller network to maintain. It spends more on public transport operations and capital investment, reflecting higher levels of public transport provision and use. Auckland also spends more on road improvements due to more complex mitigation requirements in an existing urban environment and higher land acquisition costs. Other categories of spending, like walking and cycling infrastructure, make up less than 5% of NLTF spending.

We explore these differences further below, showing how the cost of road improvements, road maintenance, and public transport services varies between Auckland and the rest of New Zealand.

³¹ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>
<https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/>

³² Spending data for the period from 2019/20 to 2023/24 is significantly affected by several policy decisions, including injections of Crown funding for road building and temporary discounts to public transport fares following COVID-19.

Figure 6: Breakdown of NLTF spending by high-level activity class, 2009/10 to 2018/19



Source: Te Waihangā analysis of NZTA data.³³ Expenditure excludes 'road policing' and 'freight' activity classes, which are funded at the national level.

2.3.4. Road improvements: Urban roads are more expensive to build

Road building is more expensive in Auckland than it is in the rest of the country, reflecting the higher costs of working in built-up areas with more complex mitigation requirements and higher land acquisition costs.³⁴ This means that although Auckland accounts for one-third of total road improvement spending, it is building new roads at a slower rate than the rest of the country. However, as noted above, this is offset by the fact that Aucklanders are driving less over time.

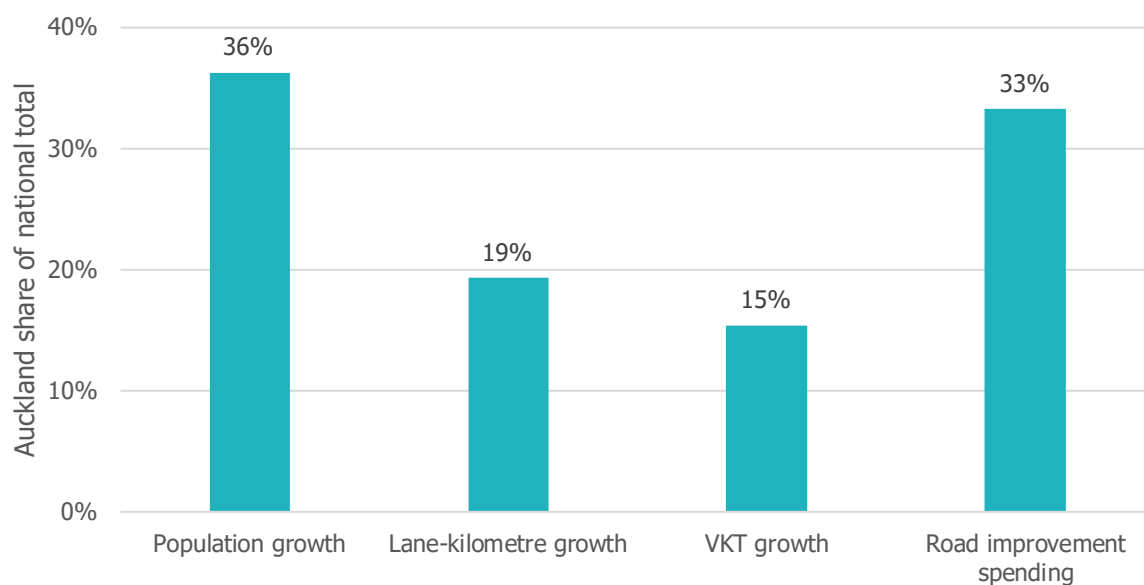
Figure 7 compares Auckland's share of population growth and growth in road network length and road use with its share of overall road improvement spending over the 2010/11 to 2023/24 period. Over this time, Auckland accounted for 36% of national population growth but only 19% of growth in road network length (as measured by total lane-kilometres) and 15% of total growth in traffic volumes (as measured by vehicle kilometres travelled).

Although Auckland was building fewer new roads and experiencing less growth in traffic volumes, it accounted for 33% of total road improvement spending over this period. This suggests that the cost of road improvements is higher in Auckland than the rest of the country.

³³ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>

³⁴ <https://tewaihang.govt.nz/our-work/research-insights/the-lay-of-the-land-benchmarking-new-zealand-infrastructure-delivery-costs>

Figure 7: Auckland's share of growth and road improvement spending, 2010/11 to 2023/24



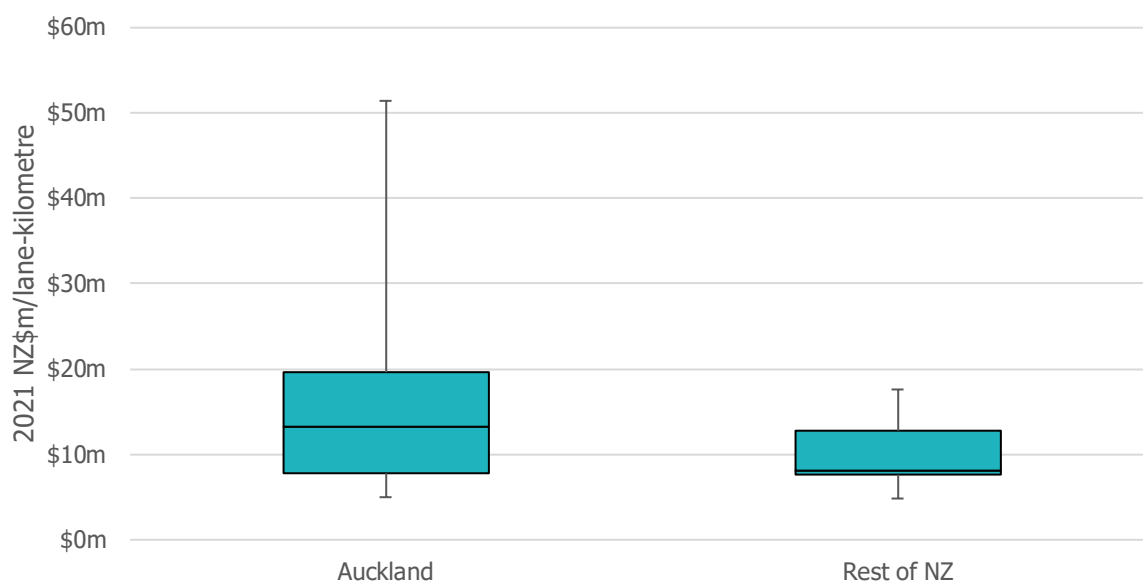
Source: Te Waihanga analysis of NZTA data and Statistics New Zealand subnational population estimates.³⁵

³⁵ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>
<https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/>

Figure 8 shows how motorway construction costs in Auckland compare with costs elsewhere in New Zealand in a 'box and whisker' plot. This chart shows average (median) costs in each region as well as the distribution of costs at a project level. The blue 'boxes' show the range from the 25th percentile of unit costs to the 75th percentile, while the 'whiskers' show minimum and maximum values, excluding outliers.

The median motorway expansion project in Auckland cost around \$13.2 million per lane-kilometre (in 2021 New Zealand dollars), which is equal to over \$50 million per kilometre for a four-lane road. This is 62% higher than the median cost of around \$8.2 million per lane-kilometre in the rest of New Zealand. Moreover, Auckland has more variation in project costs than the rest of the country, suggesting that some parts of the city are unusually expensive to build roads in.

Figure 8: Distribution of motorway construction costs in Auckland and the rest of New Zealand



Source: Te Waihangā re-analysis of data in 'The lay of the land: Benchmarking New Zealand's infrastructure delivery costs'. (2024). The shaded 'box' shows the 25th percentile value (lower end of box), 50th percentile/median value (black line in middle of box), and 75th percentile value (top end of box), while the 'whiskers' show the minimum and maximum values, excluding outliers. Chart is based on data for 14 motorway capacity projects in Auckland and 19 in the rest of the country, including both road widening and new road projects but excluding tunnel projects.

2.3.5. Road maintenance: A smaller network with higher traffic volumes is cheaper to maintain

Road maintenance expenditures are lower in Auckland than in the rest of the country, reflecting the effect of two offsetting factors. Auckland has fewer roads per capita than the rest of the country, which means that it has a smaller network to maintain. However, traffic volumes on Auckland roads are higher, which increases road maintenance costs.³⁶ The overall impact is that Auckland needs to spend less on road maintenance, relative to either population or traffic volumes, than the rest of the country.

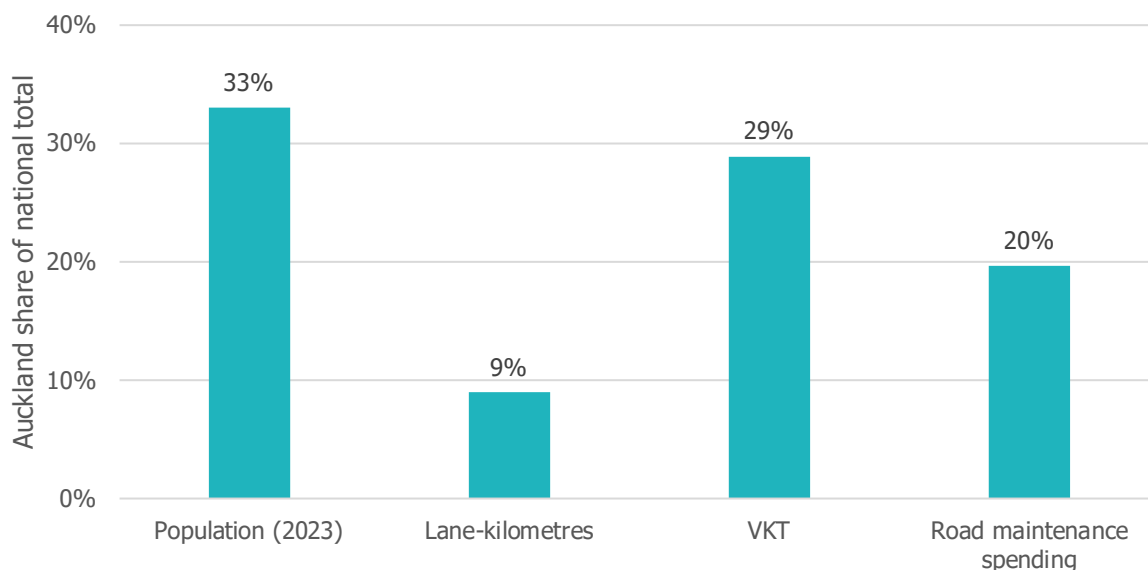
Figure 9 compares Auckland's share of the country's population, road network length, and road use with its share of overall road maintenance spending over the 2010/11 to 2023/24 period. Auckland accounts for 33% of national population but only 9% of total road network length (as measured by total lane-kilometres) and 29% of total traffic volumes (as measured by vehicle kilometres travelled).

By comparison, Auckland accounts for 20% of total road maintenance spending over this period – halfway between its share of lane-kilometres and its share of vehicle kilometres travelled. On the whole, this suggests that Auckland's road network is cheaper to maintain relative to the traffic volumes that it serves.

³⁶ In previous work, we estimate that the elasticity of local road maintenance costs with respect to vehicle kilometres travelled is around 0.4, indicating that a 10% increase in traffic on the network is expected to increase road maintenance spending by 4%.

<https://tewaihanga.govt.nz/our-work/research-insights/does-size-matter-the-impact-of-local-government-structure-on-cost-efficiency>

Figure 9: Auckland's share of road provision and use and road maintenance spending, 2010/11 to 2023/24



Source: Te Waihangā analysis of NZTA data and Statistics New Zealand subnational population estimates.³⁷ Share of lane-kilometres, VKT, and road maintenance spending is averaged over the full 2010/11 to 2023/24 period.

2.3.6. Public transport: Auckland provides more services at a competitive cost

Higher public transport spending in Auckland reflects higher levels of provision and use relative to the rest of New Zealand. However, Auckland provides public transport services at a similar cost to other parts of the country.

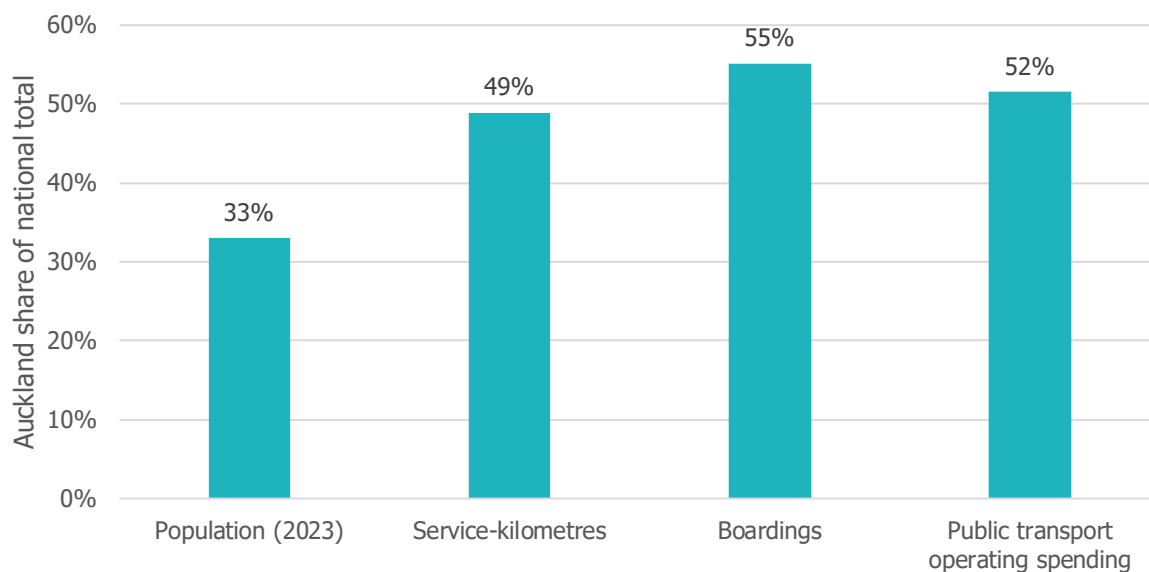
Figure 10 compares Auckland's share of the country's population, public transport services, and public transport use with its share of overall public transport operating spending over the 2010/11 to 2023/24 period. Auckland accounts for 33% of national population, 49% of total PT service provision (as measured by total service-kilometres) and 55% of total PT use (as measured by boardings).

Auckland accounts for 52% of total PT operating spending over this period – similar to its share of services-kilometres and public transport boardings.³⁸ On the whole, this suggests that Auckland's public transport services are being provided at a comparable cost to services elsewhere in the country, mainly in other cities.

³⁷ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>
<https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/>

³⁸ This analysis does not include capital investment on new or improved public transport infrastructure. Over the 2010/11 to 2023/24 period, Auckland accounted for 76% of total public transport infrastructure spending through the NLTF, which is similar to its share of growth in public transport boardings over this period.

Figure 10: Auckland's share of public transport provision and use and public transport operating spending, 2010/11 to 2023/24



Source: Te Waihangā analysis of NZTA data and Statistics New Zealand subnational population estimates.³⁹

³⁹ <https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/>
<https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/>

3. Auckland households' spending on infrastructure services

In the previous section, we explored how larger and denser cities like Auckland tend to have different patterns of infrastructure usage and different costs to supply infrastructure services. These differences flow through to different patterns of household spending on infrastructure services.

Moreover, people living in different parts of a city may use infrastructure differently. People in centrally located or higher-density suburbs tend to have smaller homes and better access to public transport services, which affects their spending on energy and transport. And because incomes tend to be higher in urban areas, people may use more infrastructure services, and pay more for them.

In this section, we examine what Auckland households currently spend on infrastructure, relative to the rest of the country, and how households' infrastructure spending varies between different parts of the city. We illustrate these patterns using Auckland-specific analysis of Stats NZ Household Economic Survey data used for our 2023 report *How much do we pay for infrastructure? Household expenditure on infrastructure services*.⁴⁰

3.1. Aucklanders spend a smaller share of income on infrastructure

Household expenditure data indicates that Auckland households spend an average of \$14,500 on infrastructure services per year, compared to an average of \$12,000 in the rest of New Zealand. These figures account for the different ways that households pay for infrastructure networks, including via user charges, rates and general taxation, as well as what they spend on items like vehicles and mobile phones that are needed to access infrastructure networks.

The analysis in the previous section suggests that the cost to service Auckland with network infrastructure may be slightly lower than costs elsewhere in the country. As a result, higher spending may reflect the fact that Auckland households use more infrastructure services, overall, relative to households elsewhere in New Zealand.

Auckland households can afford to use more infrastructure because they tend to have higher incomes. In general, higher incomes lead to increased infrastructure spending.⁴¹ Auckland households earn more (\$89,000), on average per year, than those in the rest of the country (\$69,400). This reflects Auckland's higher wages as well as the fact that Auckland households tend to be slightly larger than the national average, and hence likely to have more income-earning household members.⁴²

⁴⁰ New Zealand Infrastructure Commission. (2023). 'How much do we pay for infrastructure? Household expenditure on infrastructure services'. <https://media.umbraco.io/te-waihanga-30-year-strategy/3segaqje/household-spending-on-infrastructure-services.pdf>

Findings are largely based on data from Stats NZ's Household Economic Survey (HES) which collects information on household income and housing costs on an annual basis and information on wealth and household spending every three years. We used aggregated household-level income and expenditure data from the 2006/07, 2009/10, 2012/13, 2015/16, and 2018/19 survey years which included data from 16,008 households – including 3933 from Auckland. In our calculations of what Auckland households paid for infrastructure services we accounted for the different ways that households pay for infrastructure networks, including via rates and general taxation, as well as what they spend on items like vehicles and mobile phones that are needed to access infrastructure networks. Note the following disclosures in relation to this data: These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), which is carefully managed by Stats NZ. For more information about the IDI please visit <https://www.stats.govt.nz/integrated-data/>. Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers.

⁴¹ We estimate an income elasticity of infrastructure spending of around 0.6, meaning that a 1% increase in income is associated with a 0.6% increase in infrastructure spending and use.

<https://tewaihanga.govt.nz/our-work/research-insights/paying-it-forward-understanding-our-long-term-infrastructure-needs> and <https://tewaihanga.govt.nz/our-work/research-insights/understanding-how-infrastructure-charges-affect-households>

⁴² Stats NZ. (2020). 'New data shows 1 in 9 children under the age of five lives in a multi-family household'. <https://www.stats.govt.nz/news/new-data-shows-1-in-9-children-under-the-age-of-five-lives-in-a-multi-family-household#:~:text=Newly%20released%20data%20shows%20that%201%20in%209,family%20at%20the%20time%20of%20the%202018%20Census.>

Overall, we found that Auckland households spend 16% of their after-tax income on infrastructure services compared to an average of 19% in the rest of New Zealand.

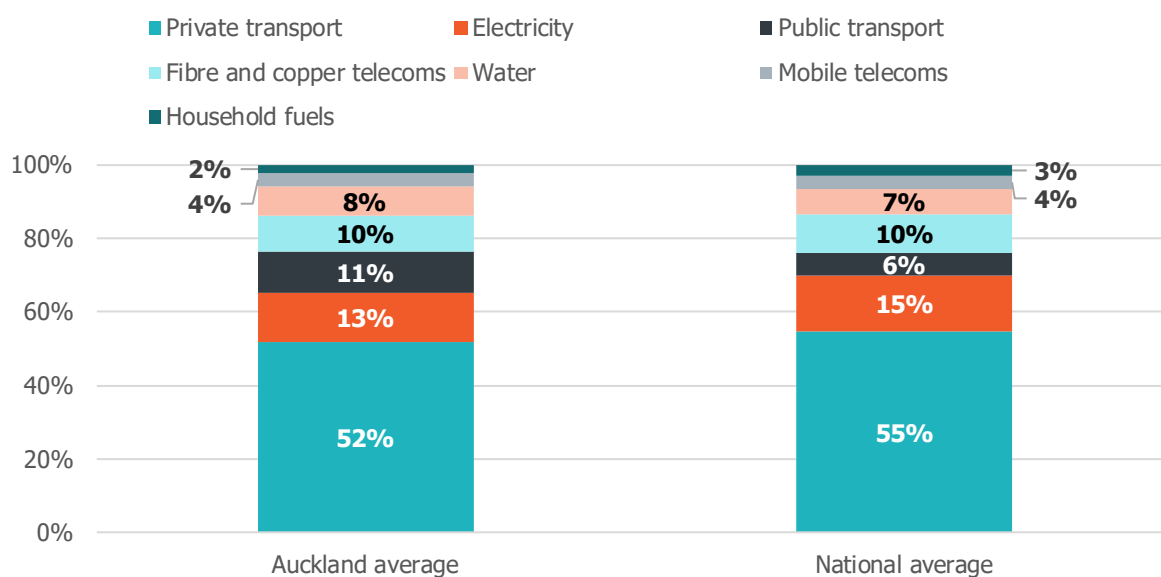
3.2. Aucklanders spend less on energy and more on transport

Auckland households also have different patterns of infrastructure spending than households elsewhere in New Zealand. These reflect different use of infrastructure services as well as differences in the cost to service Auckland with infrastructure.

Figure 11 compares Auckland households' infrastructure spending patterns with spending patterns in New Zealand as a whole. While spending patterns are broadly similar, there are some differences:

- Auckland households spend a slightly smaller share on private transport (52% of total infrastructure spending compared with 55%) and a larger share on public transport (11% vs 6%). This may reflect different patterns of driving and public transport use in Auckland.
- Auckland households spend a similar share on telecommunications services as non-Auckland households.
- Auckland households spend slightly less on energy than non-Auckland households (13% on electricity and 2% on household fuels, compared with 15% and 3% elsewhere in the country). This may reflect slightly lower electricity prices in Auckland, as well as lower usage due to smaller average house sizes.

Figure 11: Composition of infrastructure spending, averaged over the 2006/07 to 2018/19 period



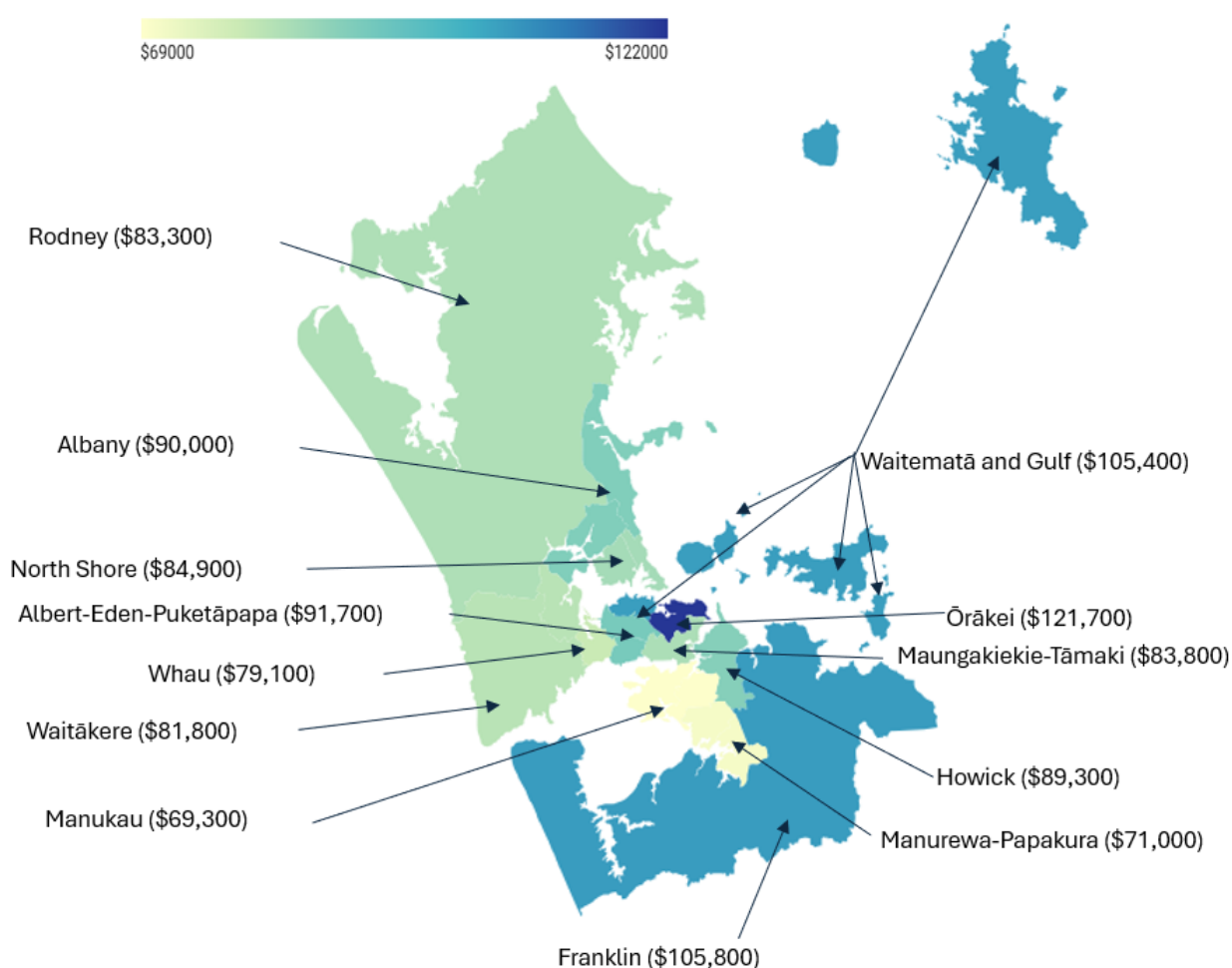
Source: Te Waihangā analysis of SNZ Household Economic Survey data.

3.3. Household spending on infrastructure services varies throughout Auckland

The Auckland region is divided into 13 council wards and 21 local boards.⁴³ We examine how household spending on infrastructure services varies across Auckland's 13 wards.

As context for this analysis, **Figure 12** shows how average after-tax household incomes vary across wards. Average after-tax incomes range from \$69,300 in the Manukau ward to \$121,700 in the Ōrākei ward. This is important as higher incomes tend to increase demand for infrastructure services, as well as increasing households' ability to pay for infrastructure. For instance, people on higher incomes tend to own larger houses, which tends to increase electricity use, and travel more.

Figure 12: Auckland households' average annual after-tax household income by ward, averaged over the 2006/07 to 2018/19 period



Source: Te Waihanga analysis of SNZ Household Economic Survey data. Figures are rounded to the nearest \$100.

Households in Auckland's higher-income wards spend more in total on infrastructure services than lower-income wards, but because of their higher average income, this takes up a lower proportion of their income.

⁴³ Auckland Council. 'About wards and local boards'. <https://www.aucklandcouncil.govt.nz/elections/how-council-works/Pages/about-wards-local-boards.aspx>

Table 1 shows that households in Ōrākei, the highest-earning ward, spend about one-quarter more on infrastructure than households in Manukau, the lowest-earning ward. However, households in Ōrākei spend a smaller share of their after-tax household income on infrastructure services than households in Manukau. This means that although the average Ōrākei household uses more infrastructure services, paying for those services is less of a financial burden.

Table 1: Infrastructure spend by highest- and lowest-earning wards (total and as % of income), averaged over the 2006/07 to 2018/19 period

Household average	Highest earning ward Ōrākei	Lowest earning ward Manukau
Income	\$121,700	\$69,300
Spend on infrastructure (total)	\$17,000	\$13,800
Spend on infrastructure (% of income)	14%	20%

Source: Te Waihanga analysis of SNZ Household Economic Survey data. Figures are rounded to the nearest \$100.

Figure 13 shows how average household infrastructure spending varies across Auckland’s 13 wards, both in dollar terms and as a share of household income. **Figure 14** shows how the mix of household infrastructure spending varies between wards.

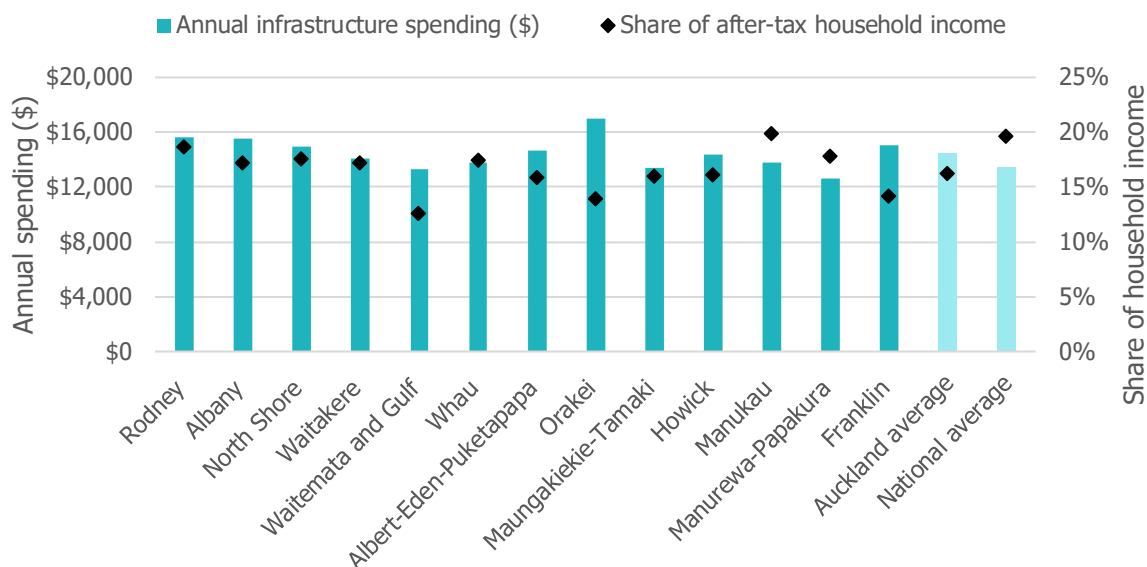
Wards with similar average household incomes can have quite different spending patterns. This is because income isn’t the only thing that drives spending on infrastructure services.⁴⁴ Differences in access to infrastructure can drive differences in spending patterns.

For example, the Rodney and Maungakiekie-Tāmaki wards have similar average household incomes (\$83,300 compared to \$83,800). Nonetheless, households in Rodney spend about one-quarter more on private transport each year than those in Maungakiekie-Tāmaki (\$8,800 compared to \$7,000) and about one-third more on electricity (\$2,200 compared to \$1,700).

Spending on private transport is likely to be higher in Rodney, the city’s northernmost ward, because households are further away from jobs and services and have less access to public transport. Maungakiekie-Tāmaki is more central, and households may therefore not need to drive as much. Houses in Maungakiekie-Tāmaki may also be smaller than those in Rodney, which would reduce electricity use. Lastly, prices for infrastructure services, like electricity, may differ between wards (see **Figure 1**).

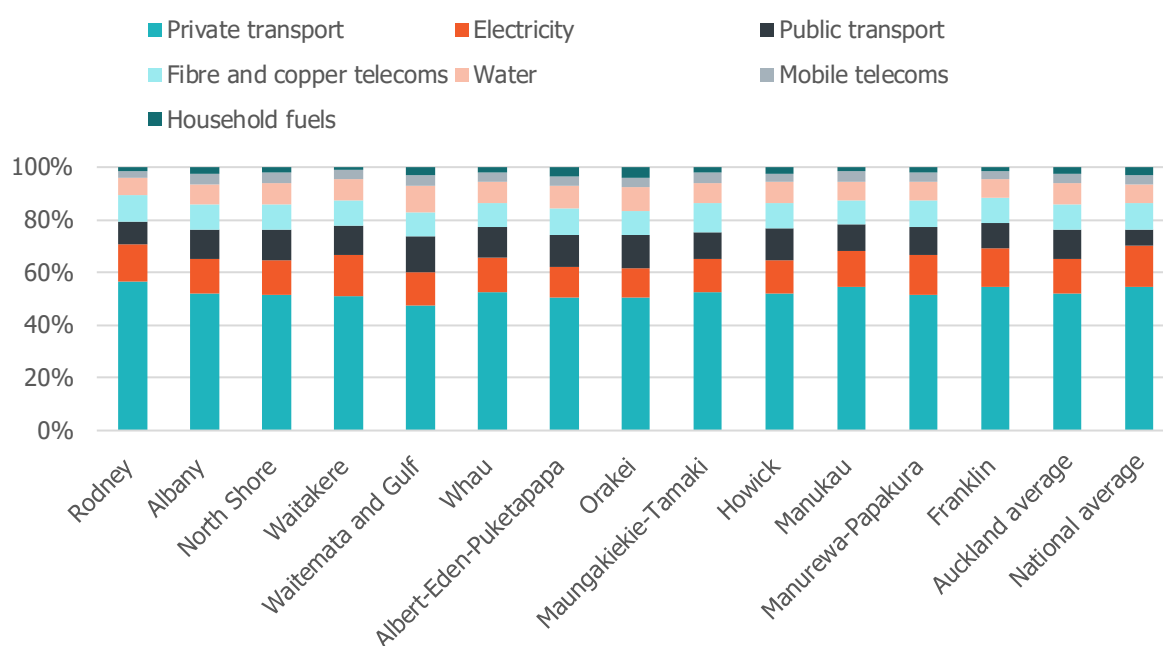
⁴⁴ See also: New Zealand Infrastructure Commission. (2024). ‘Drivers of household expenditure on infrastructure: An analysis of the factors that explain variations in household infrastructure spending’. <https://media.umbraco.io/te-waihanga-30-year-strategy/0mhfeukh/drivers-of-household-expenditure-on-infrastructure.pdf>

Figure 13: Household infrastructure spending by Auckland ward, averaged over the 2006/07 to 2018/19 period



Source: Te Waihangā analysis of SNZ Household Economic Survey data.

Figure 14: Breakdown of household infrastructure spending by category, by Auckland ward, averaged over the 2006/07 to 2018/19 period



Source: Te Waihangā analysis of SNZ Household Economic Survey data.

4. Aucklanders' perceptions of options for paying for infrastructure

In the previous sections, we explored how the cost to serve Auckland with infrastructure compares with the cost to serve the rest of New Zealand, and examined how household spending patterns compare between Auckland and the rest of New Zealand.

Infrastructure is not free to build or maintain. Where we provide infrastructure, and how much of it we use, can affect how much we need to spend on infrastructure. And we face choices about how to pay.

We therefore conclude by examining Aucklanders' perceptions of different options for paying for network infrastructure. We focus on options like volumetric charging for water and time-of-use charging for roads. In addition to raising revenue to pay for infrastructure, these pricing options can help to manage demand on existing infrastructure networks and help to avoid or defer costs to add capacity.

We explore Aucklanders' perceptions of pricing options using data from a representative survey of 3002 New Zealanders aged 18 or older that was undertaken by Kantar Public in 2023.⁴⁵

4.1. We asked respondents which options they considered to be fair

There are many ways to pay for network infrastructure services. One option is for everyone who connects to the network to pay the same price, regardless of where they live, how much they use, or when they use services. Another option is to pay through the tax system, which also means that the price that people pay doesn't depend on where they live, how much they use, or when they use services.

We asked respondents about three pricing options that result in different users paying different amounts. The first option was to price based on the cost to provide infrastructure to different people. The second option was to price based on how much people use. The third option was to price based on whether people use infrastructure at peak times (or periods where less supply is available).

Respondents were asked to state whether they thought that each of these options was a fair way to price piped water, electricity, and roads. They were not asked to consider trade-offs between different options, or trade-offs between how they paid and how much infrastructure was supplied.

As a result, these results should be interpreted as an indication of respondents' perceptions, rather than an indication of which pricing approach should be adopted.

4.2. Aucklanders have different views about water and road pricing

Figure 15 compares how Aucklanders and non-Aucklanders responded to these questions. It shows the share of people who stated that they thought a given pricing option was fair in Auckland and elsewhere in the country. It also indicates areas where there are large differences between Aucklanders' responses and responses from people in the rest of New Zealand.

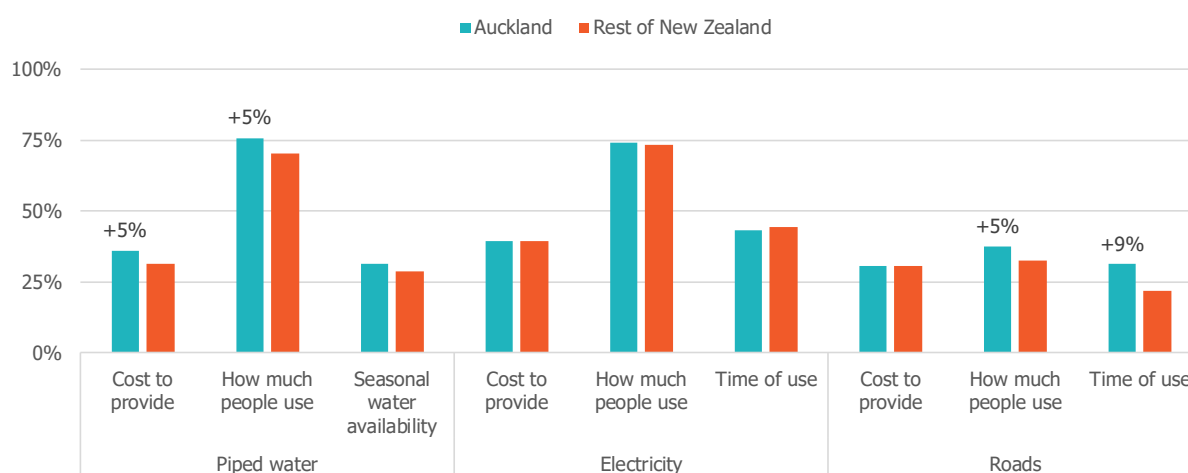
First, we find that the perceived fairness of different options for pricing electricity is similar in Auckland and the rest of New Zealand. For instance, 74% of adults in Auckland and 73% of adults in the rest of New Zealand said that they thought it was fair for households that use more electricity to pay more.

⁴⁵ <https://media.umbraco.io/te-waihanga-30-year-strategy/nqfm3lif/what-new-zealanders-think-is-a-fair-way-to-pay-for-infrastructure-survey-insights.pdf>

Second, we find that Aucklanders are more likely to think it is fair to price piped water based on what it costs to supply to households or based on how much water households use. 36% of adults in Auckland thought that it was fair to pay for piped water based on what it costs to provide, compared with 31% elsewhere in the country. 76% of Auckland adults thought that it was fair to pay based on how much water households use, compared with 71% elsewhere in the country.

Third, we find that Aucklanders are more likely to think that it is fair to price roads based on how much people drive or based on whether they are travelling at peak times. 38% of adults in Auckland thought that it was fair for households to drive more to pay more for roads, compared with 32% elsewhere in the country. 31% of Auckland adults thought that it was fair to pay based on time of use, compared with 22% elsewhere in the country.

Figure 15: Share of people who agreed that it was fair to pay for infrastructure using each approach



Source: Te Waihanga analysis of data from 'Public perceptions of fairness in how households pay for key infrastructure services in New Zealand' prepared by Kantar Public. (2023). Responses are weighted to ensure that the sample is demographically representative of New Zealand as a whole.

4.3. Differences in perceptions might reflect different circumstances

Aucklanders' higher support for use-based water pricing, also called volumetric charging, and time of use road pricing, also called congestion charging, might reflect the city's different circumstances.

First, Auckland has longer experience with volumetric charging for water than most of the rest of the country. Volumetric charging based on water metering was introduced throughout most of the region in the 1980s and 90s, and use-based wastewater charging was also introduced in recent years.⁴⁶ Familiarity with water metering may have helped to build support for this pricing approach – although we note that support for use-based water prices is high even in regions that mainly use other pricing approaches.

Second, Aucklanders may be more supportive of time-of-use pricing because the city is more congested than most other parts of New Zealand and hence would benefit more from introducing it. Moreover, time-of-use charges have long been considered an option to alleviate Auckland's congestion, with recent in-principle commitments from Auckland Council and central government to implement them.⁴⁷

Implementation may lead to further changes in perceptions of time-of-use pricing. Overseas experience suggests that public support for congestion charging tends to increase after it is introduced, likely as the benefits start to be experienced.

⁴⁶ Reed, J. & K. Hermens. (N.D.). 'A review of water metering practice in New Zealand and overseas'.

https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=581

New Zealand Infrastructure Commission. (2024). 'Valuing water: Sustainable water services and the role of volumetric charging'.

<https://media.umbraco.io/te-waihanga-30-year-strategy/slufddop/valuing-water-sustainable-water-services-and-the-role-of-volumetric-charging.pdf>

⁴⁷ Ministry of Transport. (2006). 'Tackling Congestion in Auckland: Auckland Road Pricing Evaluation Study'.

<https://www.transport.govt.nz/assets/Uploads/Report/TracklingCongestioninAuckland.pdf>

5. Conclusion

We conclude with some brief observations based on the data that we have presented in previous sections.

First, **the cost to service Auckland with network infrastructure is different**, reflecting the offsetting impacts of urban size and density. On one hand, the city benefits from economies of density in infrastructure network provision – because it has a large population of people who live relatively close together, it needs fewer roads, electricity distribution lines, and fibre broadband cables to connect them. It is also more viable to provide public transport services to larger or denser populations. This reduces the amount of infrastructure that is needed per person, which in turn reduces ongoing maintenance and renewal costs.

On the other hand, the cost to build new infrastructure may be higher in Auckland, due to more complex mitigation requirements and higher land acquisition costs in built-up areas. For instance, we show that road building is more expensive in Auckland than in the rest of the country. This can offset some of the benefits of density.

Second, **Auckland households' infrastructure spending is different**, reflecting differences in the amount of infrastructure services that people use as well as different costs to provide infrastructure services. On average, Auckland households spend a smaller share of their after-tax income on infrastructure services than non-Auckland households, but because incomes are higher in Auckland they spend more in dollar terms. Auckland households' mix of spending is also different, with a greater share of infrastructure budgets spent on public transport and slightly smaller shares spend on private vehicle transport and electricity and household fuels.

Third, **Aucklanders have slightly different perceptions about the fairness of some options for pricing infrastructure**. While they had similar views about the fairness of options for pricing electricity to people elsewhere in New Zealand, they had different views about options for pricing piped water and roads.

Aucklanders were more likely to think that it was fair to price piped water based on what it costs to supply to households or based on how much water households use, and more likely to think that it is fair to price roads based on how much people drive or based on whether they are travelling at peak times. These may reflect differences in the city's circumstances, such as its longer experience with volumetric charging for water and increased exposure to congestion, which can be alleviated by time-of-use charging.

These differences have implications for the city's infrastructure needs and how it meets them. Information on what it costs to service Auckland with infrastructure, how households use infrastructure, how much infrastructure services cost them, and how Aucklanders perceive options for pricing infrastructure can inform our understanding of how to address the current and future challenges of a growing urban economy.