NEW ZEALAND
INFRASTRUCTURE
COMMISSION
Te Waihanga

Who's working in infrastructure?

A baseline report

Te Waihanga Research Insights series
December 2023

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New Zealand Infrastructure commission / Te Waihanga

Te Waihanga seeks to transform infrastructure for all New Zealanders. By doing so our goal is to lift the economic performance of Aotearoa and improve the wellbeing of all New Zealanders.

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Cut to the chase

Demand is rising, and workforce capacity is under pressure

To plan, build, operate, and maintain New Zealand's infrastructure, we need a workforce that is productive, efficient, and sized right for the job.

However, our infrastructure workforce is currently under pressure on several fronts. It's trying to catch up on a maintenance and renewal backlog. It's planning and building for future challenges, like climate change. And it is responding to unexpected events, like the need to rebuild $5 to 7.5 billion of infrastructure damaged by the Auckland floods and Cyclone Gabrielle in early 2023.[1]

Rautaki Hanganga o Aotearoa, the New Zealand Infrastructure Strategy highlights a number of workforce challenges, including current workforce capacity shortages, persistently slow productivity growth in construction, the need for new skills to tackle challenges such as decarbonisation, and limited diversity.

Our ability to respond to these pressures is only as good as our understanding of the infrastructure workforce. Data on the size and characteristics of the infrastructure workforce can help us identify where we will face capacity pressures and how we can respond to them by sequencing work better and training and recruiting new workers. This will in turn improve our ability to complete infrastructure projects on schedule and on budget.

We've developed baseline metrics for the workforce

To address these knowledge gaps, Te Waihanga has undertaken a baseline study on the infrastructure workforce.[2] This study includes workers involved in planning and designing infrastructure projects, workers involved in building new infrastructure assets, and workers involved in asset management and maintenance of existing infrastructure assets. It provides data on workers' occupations, pathways into the workforce, and demographics.

The data highlights constraints and opportunities

The infrastructure workforce is large and complex. It comprises more than 100,000 full-time equivalent workers spread across more than 100 distinct occupations. Different workers are engaged at different stages of the infrastructure lifecycle, and capacity or capability gaps at one stage can cause problems at later stages.

In the short run, our ability to deliver more infrastructure is limited by the current size, composition, and regional location of the workforce. It is crucial to understand these constraints and establish investment programmes that fit within them.

In the longer term, the infrastructure workforce can scale up to meet additional demand. Our results suggest that both recruitment and training of New Zealanders and immigration are important for growing the infrastructure workforce. Mobility from other industries appears to be

[1] www.treasury.govt.nz/sites/default/files/2023-04/impacts-from-the-north-island-weather-events.pdf
This is equivalent to three to six months of New Zealand's 'business as usual' infrastructure investment. Analysis by Te Waihanga suggests that up to 15,000 additional workers may be needed to rebuild in affected regions.
https://tewaihanga.govt.nz/the-pipeline/understanding-market-capacity

[2] Supported by consultants Scarlatti/Alta.

more important for 'blue collar' roles such as labouring and machinery operation, while international migration appears to be more important for 'white collar' roles like engineering.

Increasing the diversity of the workforce is a key opportunity to build capacity and capability. Women play a large role in the overall New Zealand workforce (47% of all workers are women) but a small role in the infrastructure workforce (only 11% of infrastructure workers are women). Recruiting and retaining a wider pool of New Zealanders can make it easier to fill skill gaps.

Our key findings for the infrastructure workforce

1 It includes over 100,000 full-time workers

In 2018, the infrastructure workforce included an estimated 108,000 full-time equivalent workers. This is around 4.7% of the overall New Zealand workforce.

These workers are split evenly between 'horizontal' infrastructure like roads, water pipes, and electricity transmission, and 'vertical' infrastructure like schools and hospitals.

2 Constructing new projects accounts for less than half of the workforce

The infrastructure workforce is broader than just people working on building new infrastructure.

We estimate that around 14% of infrastructure workers are engaged in planning and design, 46% are constructing new assets, and a further 40% of infrastructure workers are engaged in asset management and maintenance.

3 Mobility from other sectors is more important for 'blue collar' roles and migration is more important for 'white collar' roles

Pathways into the infrastructure workforce vary between occupations.

Professional and technical occupations include a higher share of migrants. These occupations are more likely to have university qualifications.

Machinery operators and drivers and labourers are less likely to be migrants, and more likely to have moved between industries in recent years.

4 It is ethnically diverse, but women make up a small share of the workforce

The overall infrastructure workforce has a similar ethnic makeup to the New Zealand population, but ethnic mix is uneven across occupational categories.

Only 11% of infrastructure workers are women. Female participation is only marginally higher among younger age cohorts, meaning that this pattern is unlikely to change as the workforce ages.

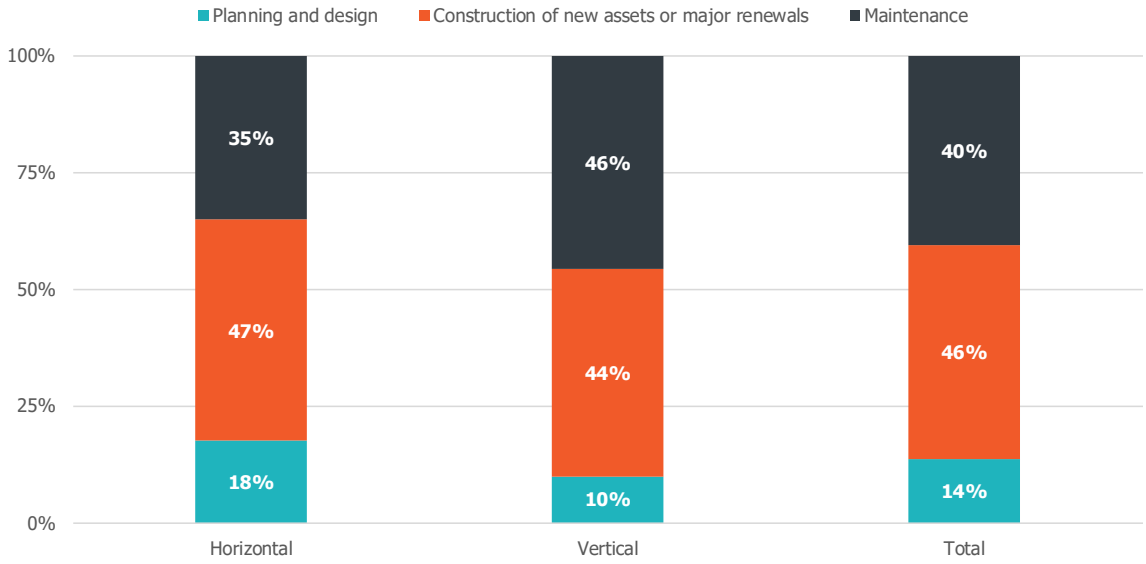
What infrastructure workers are doing

People sometimes assume that the infrastructure workforce is mainly working on building new infrastructure projects. However, our estimates show that slightly less than half of infrastructure workers (46% of the workforce) are working on new builds. Planning and design and asset management and maintenance also play a large role in the workforce.

One in seven infrastructure workers (14% of the workforce) are working on planning and design of new projects. This is an essential activity: Projects cannot be built if they aren't first planned and designed, meaning that capacity constraints at this stage can delay delivery.

Two in five infrastructure workers (40% of the workforce) are working on asset management and maintenance of existing infrastructure. This is also an essential activity: Infrastructure networks will not continue to function well if we do not devote adequate workforce resources to maintenance.

Figure 1: Breakdown of workforce by infrastructure lifecycle stage, 2022–2024



Note: Te Waihanga analysis of Scarlatti/Alta workforce estimates

The infrastructure workforce includes a mix of 'blue' and 'white' collar occupations. Around two-thirds of the infrastructure workforce works in 'blue collar' occupations, such as technicians and trades workers (36% of the workforce), labourers (22%), and machinery operators and drivers (10%).

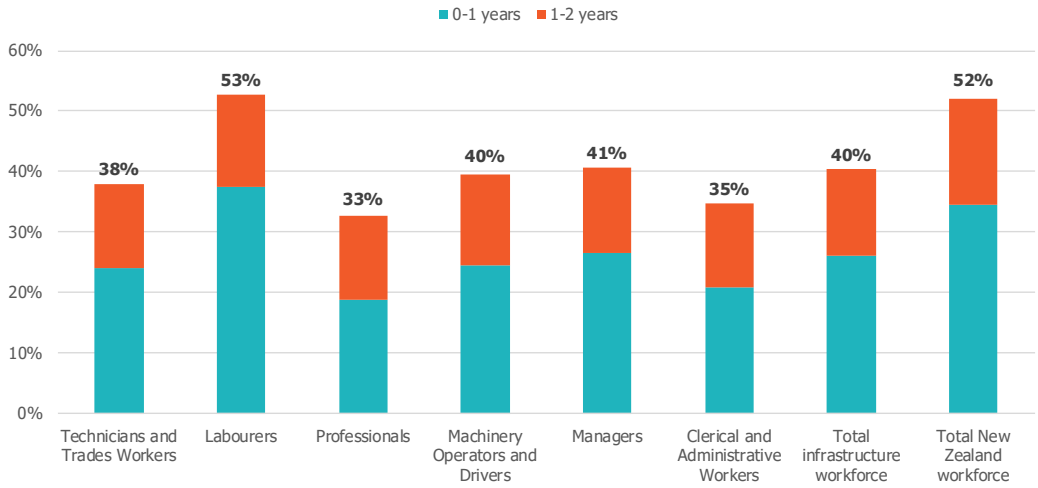
'White collar' occupations make up the remaining one-third of the infrastructure workforce. Professional occupations, such as civil engineer, architect, structural engineer, urban and regional planners, and quantity surveyor, account for 21% of the workforce, managers account for 9%, and clerical and administrative workers a further 2%.

Pathways into the infrastructure workforce

We explored the pathways that people followed into the infrastructure industry, including rates of mobility from other industries (**Figure 2**) and the share of workers on a visa (**Figure 3**). While this data is a snapshot at a point in time, it indicates how the infrastructure workforce grows.

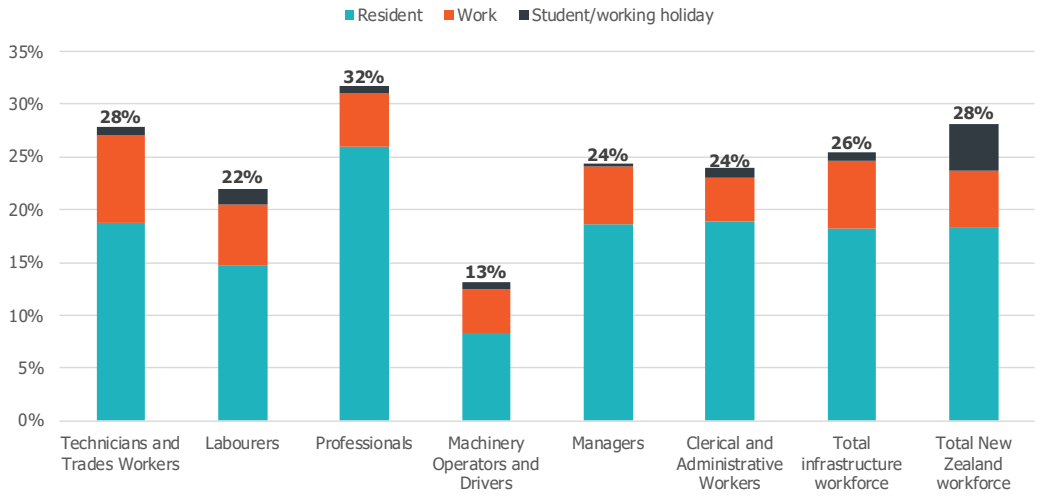
The infrastructure workforce is mobile, although slightly less so than the overall New Zealand workforce. Four in ten infrastructure workers shifted industries in the previous two years, and one in four are immigrants to New Zealand. 'Blue collar' occupations like labourers and machinery operators have higher inter-industry mobility and fewer workers on visas, while professional occupations like engineering have lower inter-industry mobility and more workers on visas. This data signals where it is likely to be easier to relieve capacity constraints by recruiting and training workers from elsewhere in the New Zealand.

Figure 2: Share of infrastructure workers with short tenure in current ANZSIC industry, by occupational category, 2018



Note: Te Waihanga analysis of Scarlatti/Alta workforce estimates

Figure 3: Share of infrastructure workers on a visa, by occupational category, 2018

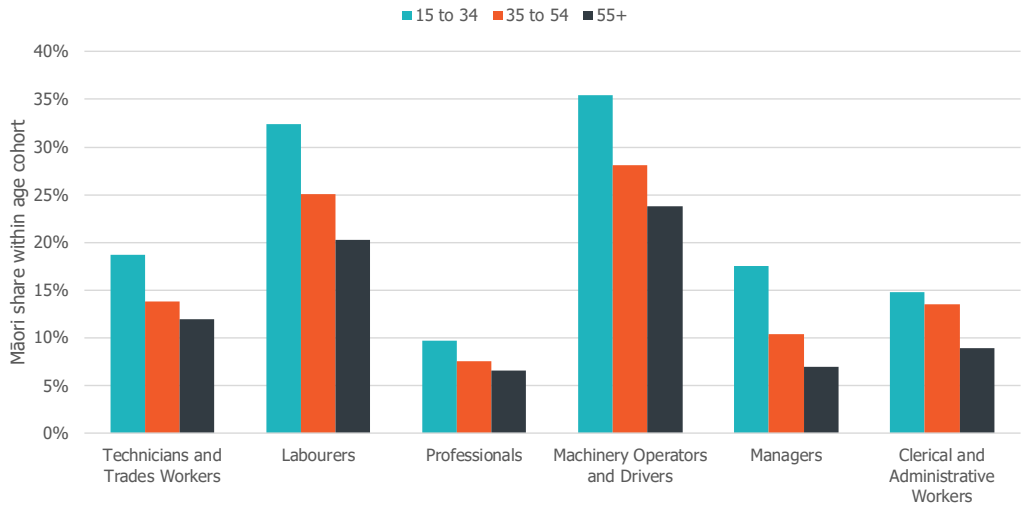


Note: Te Waihanga analysis of Scarlatti/Alta workforce estimates

Ethnic and gender diversity in the infrastructure workforce

The overall infrastructure workforce has a similar mix of ethnicities as the overall New Zealand population. However, the ethnic mix is uneven across occupational categories. For instance, labourer occupations have a higher-than-average share of Māori and Pacific workers, while professional occupations have a higher-than-average share of European and Asian workers. Within occupations, younger-age cohorts tend to be more diverse than older-age cohorts, although this trend is more pronounced in some areas than others (as shown for Māori workers in **Figure 4**).

Figure 4: Māori share of the infrastructure workforce, by occupation and age cohort, 2018



Note: Te Waihanga analysis of Scarlatti/Alta workforce estimates

Women make up only 11% of the infrastructure workforce, compared with 47% of the overall New Zealand workforce. In 18 of the 30 largest infrastructure occupations, less than 5% of workers are women. Within occupations, younger-age cohorts do not have significantly higher shares of women than older-age cohorts (**Figure 5**). This suggests that the infrastructure workforce will not necessarily move towards greater gender balance as older cohorts retire.

Figure 5: Women as a share of the infrastructure workforce, by occupation and age cohort, 2018

Note: Te Waihanga analysis of Scarlatti/Alta workforce estimates

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Introduction

Planning, building, operating, and maintaining our infrastructure takes the combined energy and effort of many New Zealanders. To meet our long-term infrastructure needs, we need an infrastructure workforce that is productive, efficient, and sized right for the job.

To get there, we first need to understand our existing workforce better. At present, we lack a detailed and comprehensive view on the infrastructure workforce. The aim of this *Research Insights* paper is to fill this gap by providing a comprehensive, quantitative evidence base on the size and characteristics of New Zealand's infrastructure workforce.

Demand is rising, and workforce capacity is under pressure

Rautaki Hanganga o Aotearoa, the New Zealand Infrastructure Strategy 2022–2052, emphasises the importance of the infrastructure workforce. It also highlights some gaps and challenges, including current workforce capacity shortages, persistently slow productivity growth in construction, the need for new skills to tackle challenges such as decarbonisation, and limited diversity in the workforce that indicates challenges to recruiting from all New Zealanders.

Since the *Infrastructure Strategy* was published, calls on the infrastructure workforce have increased. In addition to the need to plan and build the existing pipeline of infrastructure projects and continue to maintain and renew our existing assets, we also need to rebuild infrastructure damaged by the Auckland floods and Cyclone Gabrielle in early 2023.

Projections by Te Waihanga highlight that rebuilding infrastructure and buildings will require the infrastructure workforce to grow significantly in affected regions.[3] Data on the potential cost of the rebuild suggests that up to 15,000 additional workers may be needed in affected regions. In the most heavily impacted regions, this is likely to significantly exceed the current available workforce.

Better baseline data will help us to respond

A better understanding of the current infrastructure workforce, as well as what will be needed to plan, build, and maintain our infrastructure in the future, can help us identify and respond to these capacity pressures.

In late 2022, Te Waihanga commissioned consultants Scarlatti/Alta to undertake a baseline study of the infrastructure workforce. The scope of this study was to:

- define the infrastructure workforce across the planning/design, construction, and maintenance/asset management stages of the infrastructure lifecycle
- develop baseline measures of the size and characteristics of the infrastructure workforce
- provide Te Waihanga with a dataset on the infrastructure workforce and a supporting methodology report.

This *Research Insights* paper is based on infrastructure workforce estimates developed by Scarlatti/Alta.

[3] https://tewaihanga.govt.nz/the-pipeline/understanding-market-capacity

How we define the infrastructure workforce

Some previous studies on the infrastructure workforce focus narrowly on the construction sector.[4] Our definition of the infrastructure workforce is broad: It includes workers involved in planning, design, and asset management, as well as those working on building or repairing infrastructure assets.

More specifically, we define the infrastructure workforce as follows:

> *People who contribute labour directly to the planning, construction or asset management of horizontal and vertical infrastructure assets.*

This definition excludes some occupations that play an indirect role in the infrastructure lifecycle, including support occupations like human resource managers and accountants, offsite manufacturers, and operators of infrastructure assets like train drivers.

In this report, we distinguish between horizontal infrastructure, such as roads, pipes, and electricity transmission lines, and vertical infrastructure, such as schools, hospitals, and community facilities. Horizontal and vertical infrastructure assets sometimes require different skills to plan, build and maintain.

Measuring the workforce

There are no 'off-the-shelf' statistics on the size of the infrastructure workforce. The infrastructure workforce includes people in a number of different industries, from construction to electricity, gas, water, and waste utilities to professional services. Within each occupation, some people may work on infrastructure, while others work on other types of projects. For example, some carpenters work on building or maintaining vertical infrastructure assets like schools or hospitals, but most carpenters work on other projects, such as home-building.

Defining and measuring the infrastructure workforce therefore requires judgments about which occupations are relevant to the infrastructure lifecycle and to what degree these occupations are committed to infrastructure work as opposed to non-infrastructure work.

There are two ways to estimate the size and characteristics of the workforce. One approach is to look at the current population and identify the construction workforce within it. This can be described as a 'workforce supply estimate'. Another is to look at current infrastructure projects and programmes and identify the workers needed to complete them. This can be described as a 'workforce demand estimate'.

Scarlatti/Alta used both approaches to triangulate on the size and characteristics of the infrastructure workforce. They build up a workforce supply estimate using data on individual workers from Statistics New Zealand's Integrated Data Infrastructure.[5] This data, which is largely drawn from the 2018 Census, provides rich information on workers' occupations and characteristics.[6]

[4] For instance, Waihanga Ara Rau's Workforce Information Platform, which it uses to identify future residential, commercial, and infrastructure construction workforce requirements, does not currently look at non-construction occupations.
[5] Scarlatti/Alta's technical report provides further detail on the methodology for querying the IDI and using outputs to derive estimates of the size and characteristics of the infrastructure workforce.
[6] Census data is required for this analysis as the Census is the primary source of information on people's occupations. It will be possible to update these estimates when 2023 Census data is released.

The workforce demand estimate is based on data from the National Infrastructure Pipeline, which is managed by Te Waihanga and provides information on the cost and timing of a majority of infrastructure projects in planning and delivery as of 2023, plus separate estimates for the size of ongoing maintenance and renewal programmes.[7]

Both approaches arrive at broadly similar estimates of the overall size of the infrastructure workforce, although there are some differences at an occupational level that have been investigated and adjusted. However, there is some uncertainty to these estimates, and there is some evidence of current supply-demand mismatches in infrastructure planning and delivery.

In this paper, we use workforce supply estimates to estimate the overall size of the infrastructure workforce and analyse the characteristics of the people in the infrastructure workforce, such as their occupation, gender, ethnicity, and qualifications. We use workforce demand estimates to analyse the share of workers engaged in different stages of the infrastructure lifecycle, as it provides information on how work is divided between different tasks.

We report estimates of the infrastructure workforce on a full-time equivalent (FTE) worker basis. This is preferable to measuring the total number of workers engaged in the infrastructure workforce, as it accounts for the mix of full- and part-time work and for the fact that some workers may spend part of their time on infrastructure projects and part of their time on other projects.

More information on the methodology underpinning these estimates can be found in Scarlatti/Alta's methodology report, *Infrastructure workforce capacity baselining study: Technical introduction to modelling methodology and calibration*.

Key research questions

We use the Scarlatti/Alta dataset to answer the following questions about the infrastructure workforce:

- **How large is the overall infrastructure workforce?**
- **What are people working on?** This will look at types of projects that the workforce is engaged in, the stages of the infrastructure lifecycle (planning/design, construction, maintenance/asset management), and the occupations that are engaged at different stages of work.
- **What paths do people follow into the infrastructure workforce?** This will look at length of tenure in industry, training/qualifications, and visa status.
- **Who is in the infrastructure workforce?** This will look at demographic information such as age, ethnicity, and gender.

[7] While the National Infrastructure Pipeline includes a majority of infrastructure projects, sectoral and regional coverage is uneven. At present, it is likely to under-estimate the total volume of infrastructure activity. As Pipeline data continues to improve, these estimates will be refined.

Workforce size and occupations

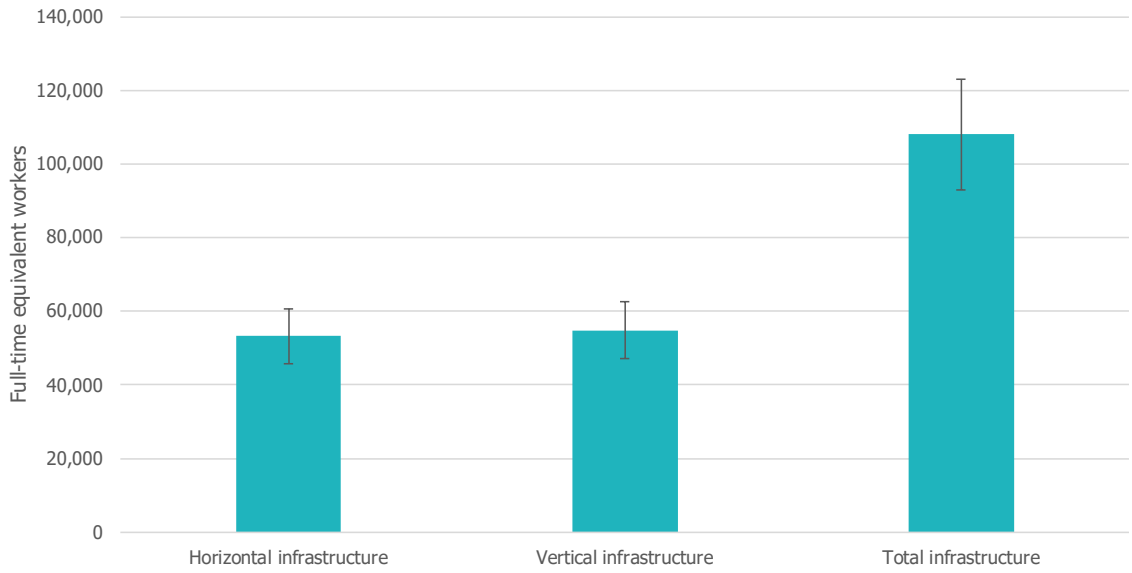
The size of the infrastructure workforce

The infrastructure workforce includes over 100,000 full-time equivalent workers

Using data from the 2018 Census, Scarlatti/Alta estimate that the infrastructure workforce included **approximately 108,000 full-time equivalent workers in 2018**, with an uncertainty range of plus or minus 15,000. This is equal to **around 4.7% of the overall New Zealand workforce**.[8]

While there is uncertainty in these estimates, both workforce supply and workforce demand estimates arrive at similar figures. Moreover, the share of the overall workforce working on infrastructure planning, construction, or maintenance is similar to the share of gross domestic product that we invest in infrastructure (New Zealand Infrastructure Commission, 2021). Our estimate is therefore that the infrastructure workforce includes over 100,000 FTEs.[9] We expect that this estimate will be improved over time as input data improves.

Figure 6: Estimated size of the infrastructure workforce, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data. Height of bars shows central estimate of the size of the infrastructure workforce, while error bars indicate the perceived margin of uncertainty around these estimates.

Around half of these workers are in 'horizontal' infrastructure and half are in 'vertical'

Figure 6 shows that the workforce is split evenly between horizontal infrastructure, such as transport and electricity infrastructure, and vertical infrastructure, such as schools, hospitals, and other public buildings. In 2018, approximately 49% of the infrastructure workforce was engaged in horizontal infrastructure, while 51% worked in vertical infrastructure.

[8] The 2018 Census and Household Labour Force Survey provide data on the total number of full-time and part-time workers in New Zealand. Both data sources indicate a total of around 2.3 million full-time equivalent workers across all industries. See https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE8460; https://www.stats.govt.nz/topics/labour-market.

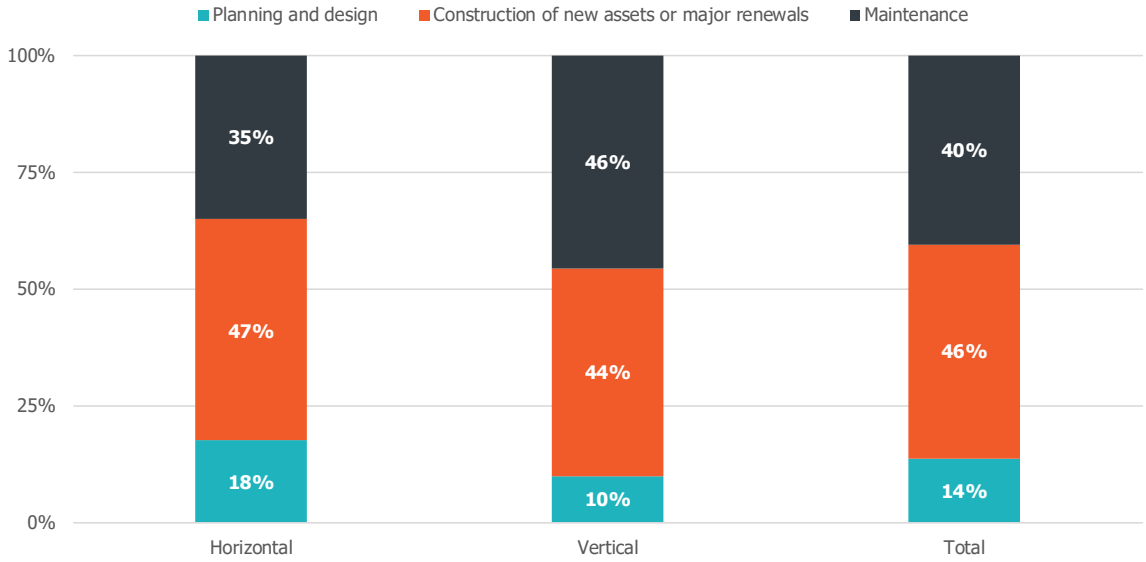
[9] These estimates are not official statistics, and do not correspond neatly to Statistics New Zealand data on employment at an occupation or industry level.

Breakdown by infrastructure lifecycle stage

We use workforce demand estimates to analyse how many workers are engaged at different stages of the infrastructure lifecycle.

Figure 7 shows the share of FTEs engaged at different stages of the lifecycle for horizontal infrastructure, vertical infrastructure, and the sector as a whole.

Figure 7: Breakdown of workforce by infrastructure lifecycle stage, 2022–2024



Note: Based on Scarlatti/Alta workforce demand estimates using project data and maintenance workload estimates. Estimates relate to the 2022–2024 period, for which the National Infrastructure Pipeline provides best coverage of projects in different stages of the lifecycle.

Less than half of the workforce is engaged in construction of new projects or major renewals

People sometimes assume that the infrastructure workforce is mainly engaged in building new infrastructure projects. These estimates suggest that, while new builds and major renewals are important, slightly less than half of the overall infrastructure workforce is engaged in this stage of the lifecycle.

We estimate that approximately 47% of the horizontal infrastructure workforce and 44% of the vertical infrastructure workforce is engaged in constructing new infrastructure projects. These figures include major projects to renew or replace existing assets.[10]

One in seven people work in planning and design

Planning and design is an essential part of the infrastructure lifecycle. Projects cannot be built if they are not first planned and designed. Capacity constraints at this early stage of the lifecycle will cause projects to be 'bottlenecked' before reaching construction.

Planning and design typically only accounts for a small share of project budgets – in the range of 5% to 10% (Merrow, 2011). However, it is more labour-intensive than the construction phase.

[10] A small share (<10%) of the value of projects in the National Infrastructure Pipeline is related to major renewal projects.

As a result, we estimate that approximately 18% of the horizontal infrastructure workforce and 10% of the vertical infrastructure workforce is in planning and design. The higher share for horizontal infrastructure reflects the fact that these projects tend to be more complex and site-specific and hence require greater planning.

Two in five people work on maintenance and renewal of existing infrastructure assets

Asset management and maintenance is an essential part of the infrastructure lifecycle. Once infrastructure assets are built, there is an ongoing 'tail' of maintenance and renewal activities. Maintenance workforce requirements need to be identified and planned for in order to ensure that infrastructure networks continue to function well over time.

We estimate that approximately 35% of the horizontal infrastructure workforce and 46% of the vertical infrastructure workforce is engaged in maintaining or renewing existing infrastructure assets. The lower share for horizontal infrastructure reflects the fact that these assets tend to be longer-lived and thus require proportionately less maintenance in an average year than vertical infrastructure assets.[11]

These estimates should be interpreted as an estimate of how much effort we are currently devoting to asset management and maintenance, rather than how much we *should* be doing. In some sectors, there is evidence of under-investment in renewals and declining asset condition that suggests that more maintenance work needs to be done.

Breakdown of infrastructure occupations

Scarlatti/Alta identified more than 110 occupations that were relevant to some or all stages of the infrastructure lifecycle. These occupations are defined using the Australia and New Zealand Standard Classification of Occupations (ANZSCO) classification, at the most detailed (six-digit) level of the classification.[12] We then aggregate to broad (one-digit) occupational categories.

The infrastructure workforce includes a mix of 'blue' and 'white' collar occupations

Table 1 shows how the infrastructure workforce is distributed between high-level ANZSCO occupational categories.

Around two-thirds of the infrastructure workforce works in 'blue collar' occupations. Technicians and trades workers, such as electricians, carpenters, drainlayers, and electrical line mechanics, make up 36% of the workforce. Labourers account for a further 22% of the workforce, and machinery operators and drivers account for 10%.

'White collar' occupations make up the remaining one-third of the infrastructure workforce. Professional occupations, such as civil engineer, architect, structural engineer, urban and regional

[11] Depreciation rates, which signal how fast physical assets wear out and need to be maintained or replaced, tend to be lower for horizontal infrastructure assets like roads, bridges, and pipes, and higher for vertical infrastructure assets like schools and hospitals.

[12] The Australian and New Zealand Standard Classification of Occupations (ANZSCO) is used to categorise workers according to the type of work they do. It was used as the foundational 'building block' for the infrastructure workforce definition. While ANZSCO level 6 is quite fine-grained, it does not capture some highly specialised roles. If needed, the ANZSCO codes could be further disaggregated, for example, using information on specialisations within detailed occupational categories. For instance, tunnel boring machine operators (a highly specialised occupation with limited local supply) is included in the ANZSCO code for 'mobile plant operators not elsewhere classified' (ANZSCO code 721999).
For further information see: https://aria.stats.govt.nz/aria/?_ga=2.152344817.979319870.1697748337-960196423.1666052395#ClassificationView:uri=http://stats.govt.nz/cms/ClassificationVersion/Z9DujoqhMVdksKZG

planners, and quantity surveyor, account for 21% of the workforce. Managers account for 9%, and clerical and administrative workers a further 2%.

Relative to the overall New Zealand workforce, the infrastructure workforce includes a higher share of technicians and trades workers (36% vs 12%), a higher share of labourers (22% vs 11%), and a higher share of machinery operators and drivers (10% vs 6%). It has a similar share of professionals (21% vs 23%), and a lower share of all other broad occupational categories.

Table 1: Distribution of occupational categories in the infrastructure workforce and the total New Zealand workforce, 2018

Occupational category (1-digit ANZSCO)	Infrastructure workforce	Total New Zealand workforce
Technicians and Trades Workers	36% of FTEs	12% of workers
Labourers	22%	11%
Professionals	21%	23%
Machinery Operators and Drivers	10%	6%
Managers	9%	18%
Clerical and Administrative Workers	2%	11%
Community and Personal Service Workers	Not included	10%
Sales Workers	Not included	9%

Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates from 2018 Census.

Ten occupations account for around half of the infrastructure workforce

Although the infrastructure workforce includes people working in many occupations, most workers are concentrated in a small number of occupations.

Figure 8 provides a more detailed breakdown of the infrastructure workforce by 6-digit ANZSCO occupation. The 10 largest occupations account for 50% of the workforce. These occupations include things like building labourers, trades (electrician, carpenter, plumber), digger operators, civil engineers, and construction project managers. The next 20 occupations account for a further 29% of the workforce.

While the majority of the workforce is concentrated in a small number of occupations, the 'long tail' of infrastructure occupations, which accounts for the remaining 21% of the workforce, is still important. These occupations may not be needed in large numbers, but they can be critical when they are needed. For instance, the infrastructure workforce only includes a few hundred geotechnical engineers, telecommunications engineers, and concrete pump operators – all occupations that may delay projects if they are not available.

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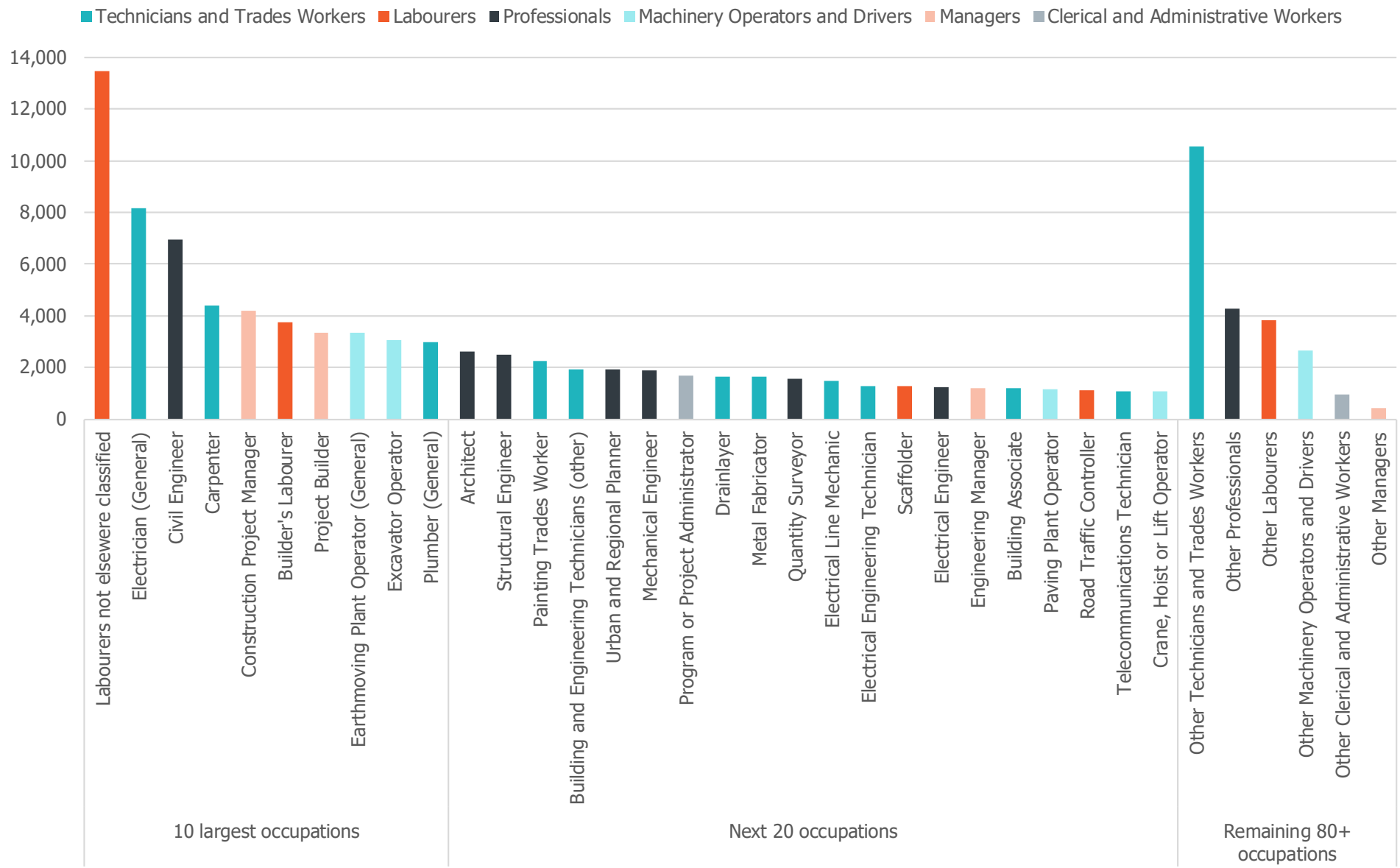
Figure 8: Detailed breakdown of occupations in the infrastructure workforce, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data. The 30 largest occupations are listed at the detailed (6-digit) ANZSCO category and colour-coded according to their high-level (1-digit) ANZSCO category. The remaining 80+ occupations are grouped by high-level ANZSCO category.

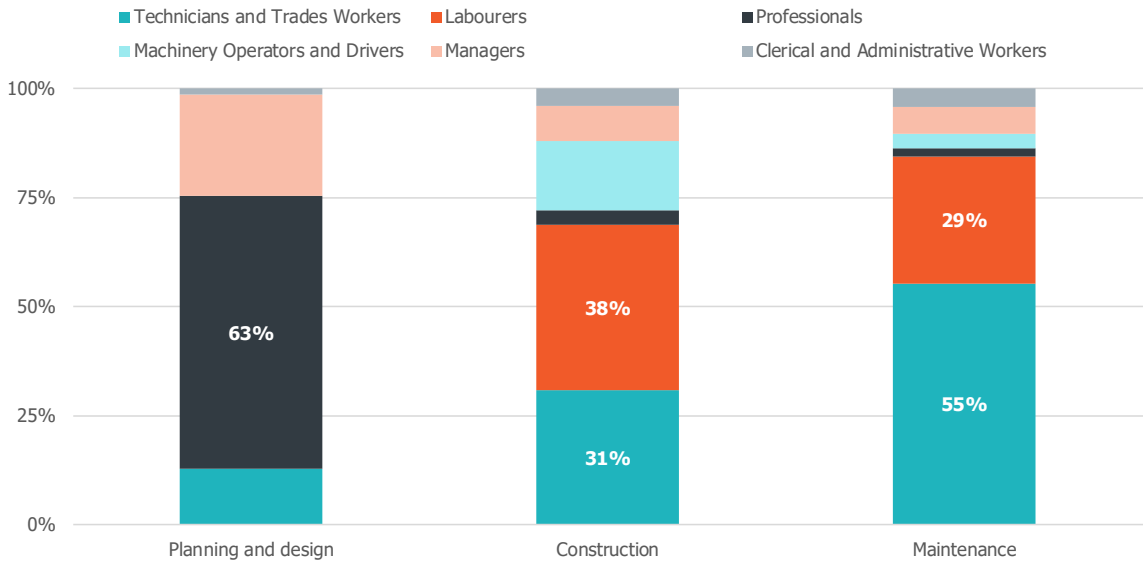
Different occupations are engaged at different stages of the infrastructure lifecycle

Figure 9 shows which occupations are engaged at different stages of the infrastructure lifecycle.

In the planning and design stage, professionals such as engineers, architects, and quantity surveyors play the largest role. These workers account for almost two-thirds of the planning and design workforce.

By contrast, technicians and trades workers and labourers play the largest role in the construction and maintenance stages of the infrastructure lifecycle. These workers account for two-thirds or more of the construction and maintenance workforce.

Figure 9: Distribution of occupational categories by infrastructure lifecycle stage, 2018



Note: Based on Scarlatti/Alta workforce demand estimates using project data and maintenance workload estimates. Estimates relate to the 2022–2024 period, for which the National Infrastructure Pipeline provides best coverage of projects in different stages of the lifecycle. Overall occupational breakdown does not reconcile exactly with workforce supply estimates.

Breakdown by region

Table 2 shows that the infrastructure workforce is concentrated in Auckland, Canterbury, Waikato, and Wellington. This is not surprising as these are four large and fast-growing regions.

In 2018, there were an average of 23 infrastructure FTE workers per 1000 New Zealanders. Most regions had a similar ratio of infrastructure workers to population. The main exception is Canterbury, which at that time had a considerably higher ratio due to the ongoing rebuild from the Christchurch Earthquakes.

Table 2: Estimated size of infrastructure workforce by region, 2018

Region	Regional infrastructure workforce (FTEs)	Share of national infrastructure workforce	Infrastructure FTEs per 1000 population
Auckland Region	33,000	30.5%	21
Canterbury Region	19,000	17.6%	32
Waikato Region	10,400	9.6%	23
Wellington Region	10,200	9.5%	20
Bay of Plenty Region	6,900	6.4%	22
Otago Region	5,600	5.2%	25
Manawatu-Wanganui Region	4,500	4.2%	19
Hawke's Bay Region	3,800	3.5%	23
Northland Region	3,500	3.2%	19
Taranaki Region	3,000	2.7%	25
Southland Region	2,600	2.4%	27
Nelson Region	1,300	1.2%	26
Tasman Region	1,400	1.3%	26
Marlborough Region	1,200	1.1%	25
Gisborne Region	1,000	1.0%	22
West Coast Region	800	0.7%	25
New Zealand total	108,200		23

Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

Pathways into the workforce

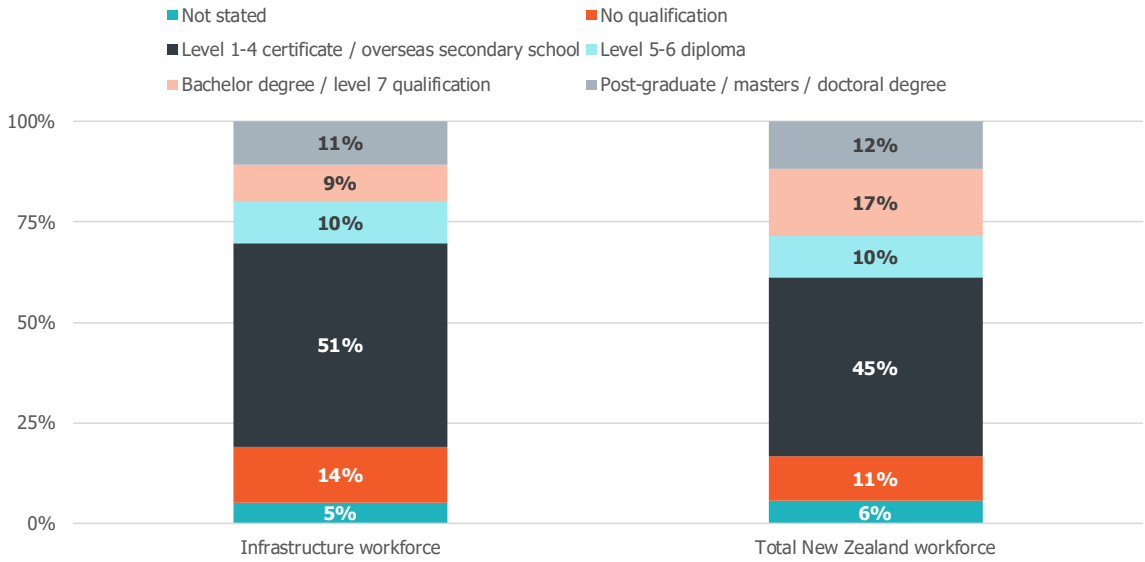
Infrastructure workers' qualifications

The infrastructure workforce includes people with a variety of qualifications

Figure 10 shows that the infrastructure workforce includes people with a wide range of formal qualifications. Half of the workforce has a secondary school-level qualification (level 1-4 certificate or overseas secondary school qualification), one in seven workers have no qualification, and one in three have a level 5-6 diploma or university-level qualification (bachelor's degree/level 7 qualification or a postgraduate/master's/doctoral degree).[13] These figures do not include on-the-job training or micro-credentials, which are important in some occupations.

Relative to the overall New Zealand workforce, the infrastructure workforce is less likely to have university-level qualifications (20% vs 27%) and more likely to have no qualification (14% vs 11%) or a secondary school qualification (51% vs 45%).

Figure 10: Distribution of highest qualification in the infrastructure workforce and the total New Zealand workforce, 2018



Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates from 2018 Census.

People with university-level qualifications are concentrated in engineering and technical occupations …

An estimated 20% of the entire infrastructure workforce has a university-level qualification (bachelor's degree/level 7 qualification or a postgraduate/master's/doctoral degree).

Table 3 shows the mix of qualifications within each high-level occupational category.

[13] Qualification levels are defined based on the NZ Qualifications Authority's qualifications and credentials framework: https://www2.nzqa.govt.nz/qualifications-and-standards/about-new-zealand-qualifications-credentials-framework/

People in professional occupations, such as engineering, are most likely to have university-level degrees. 22% of these workers have a bachelor's degree/level 7 qualification and 38% have a post-graduate, master's, or doctoral degree. Specific occupations with the highest share of university-level degrees include civil engineer (62% university-level degree), structural engineer (65%), architect (73%), urban and regional planner (87%), quantity surveyor (44%), electrical engineer (54%), and engineering manager (46%).

People working in the machinery operator/driver occupations are least likely to have university-level qualifications. Only 3% of these workers have a bachelor's degree/level 7 qualification or higher. Six percent of people working as labourers have a university-level qualification.

Table 3: Distribution of highest qualification among different occupational groups in the infrastructure workforce, 2018

Occupational category (1-digit ANZSCO)	Share of workers within each occupation, by type of qualification					
	Not stated	No qualification	Level 1-4 certificate / overseas secondary school	Level 5-6 diploma	Bachelor's degree / level 7 qualification	Post-graduate / master's / doctoral degree
Technicians and Trades Workers	5%	10%	65%	11%	6%	3%
Labourers	8%	25%	55%	6%	4%	2%
Professionals	2%	3%	21%	13%	22%	38%
Machinery Operators and Drivers	7%	34%	51%	5%	2%	1%
Managers	4%	7%	54%	13%	11%	11%
Clerical and Administrative Workers	2%	6%	47%	15%	19%	12%
Total infrastructure workforce	**5%**	**14%**	**51%**	**10%**	**9%**	**11%**

Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

… while people without qualifications are concentrated in 'blue collar' occupations

An estimated 14% of the infrastructure workforce has no formal qualification. **Table 3** shows that workers without qualifications tend to be most common among labourers (25% had no qualification) and machinery operators and drivers (34% had no qualification). These findings highlight that the infrastructure workforce offers different pathways for workers with different levels of qualifications.

Mobility of workers between industries

Four in ten workers have shifted industry in the last two years

We use length of tenure in current 4-digit ANZSIC industry as a proxy for how rapidly workers move between jobs and industries.[14] In some cases, this may involve moving between different types of organisations that work within the infrastructure sector – for instance, moving from a construction firm to an engineering consultancy. In other cases, it may involve entering the infrastructure sector from an unrelated area – for instance, moving from a retail services role to a construction apprenticeship – or entering the workforce from education or unemployment.

Occupations with higher rates of mobility between industries are likely to require less job- or industry-specific training.[15] In these occupations, it may be easier to expand capacity by recruiting and training new workers.

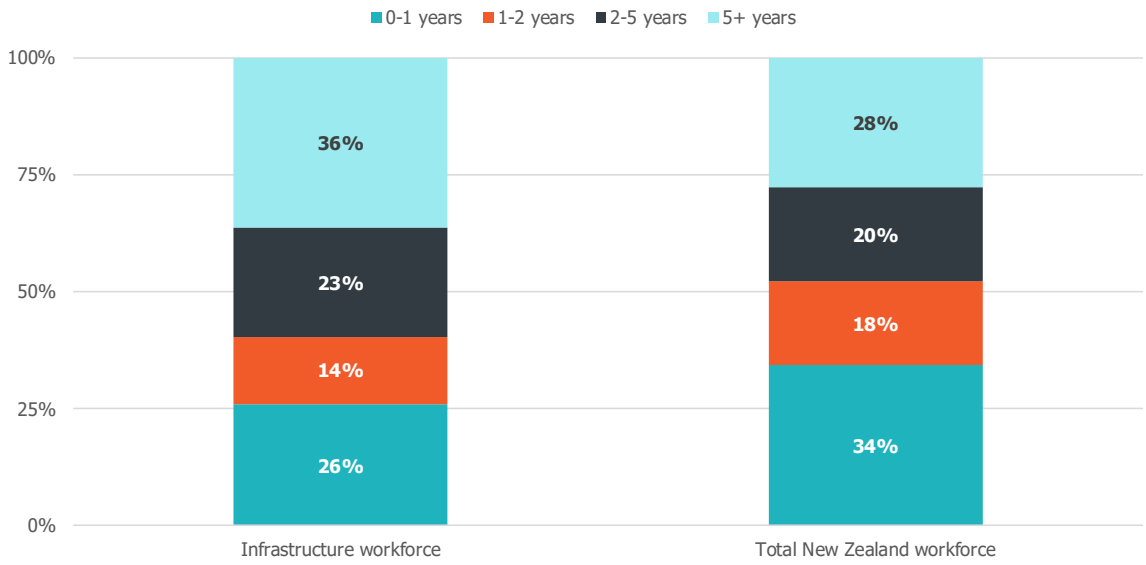
Figure 11 shows that while many workers have stayed within their industry for many years, a large share have moved industries either within the last year (26%) or between one and two years ago (14%). High rates of mobility between industries suggests that the infrastructure workforce is very flexible, with many workers entering and exiting on an ongoing basis. At the other end of the spectrum, 36% of infrastructure workers have remained in their current industry for five years or more.

Inter-industry mobility rates are somewhat higher elsewhere in the New Zealand economy. Across the entire workforce, 34% of workers moved industries either within the last year and a further 18% moved between one and two years ago. This suggests that, while the infrastructure workforce is reasonably mobile, it faces slightly greater barriers to recruiting from outside the sector, such as a greater need for specialist skills or training. However, in recent decades these have not prevented the infrastructure construction sector from scaling up considerably (New Zealand Infrastructure Commission, 2022).

[14] The Australia New Zealand Standard Industry Classification (ANZSIC) is used to develop and publish statistics on industries and employment. There is no single ANZSIC industry, or set of ANZSIC industries, that neatly corresponds to the infrastructure sector. For further information see https://catalogue.data.govt.nz/dataset/industrial-classification-anzsic06

[15] Among the 30 largest infrastructure occupations, there is a modest negative correlation between the share of workers with university-level degrees and the share of workers who moved between industries in the last two years. Among the ten detailed occupations with the highest rates of inter-industry mobility, only one (quantity surveyor) had more than 6% of workers with university-level qualifications.

Figure 11: Distribution of workers' length of tenure in their current ANZSIC industry in the infrastructure workforce and the total New Zealand workforce, 2018



Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates are based on a similar analysis of 2018 Census data for all industries.

Mobility between industries is highest for labourers, and lowest for professionals

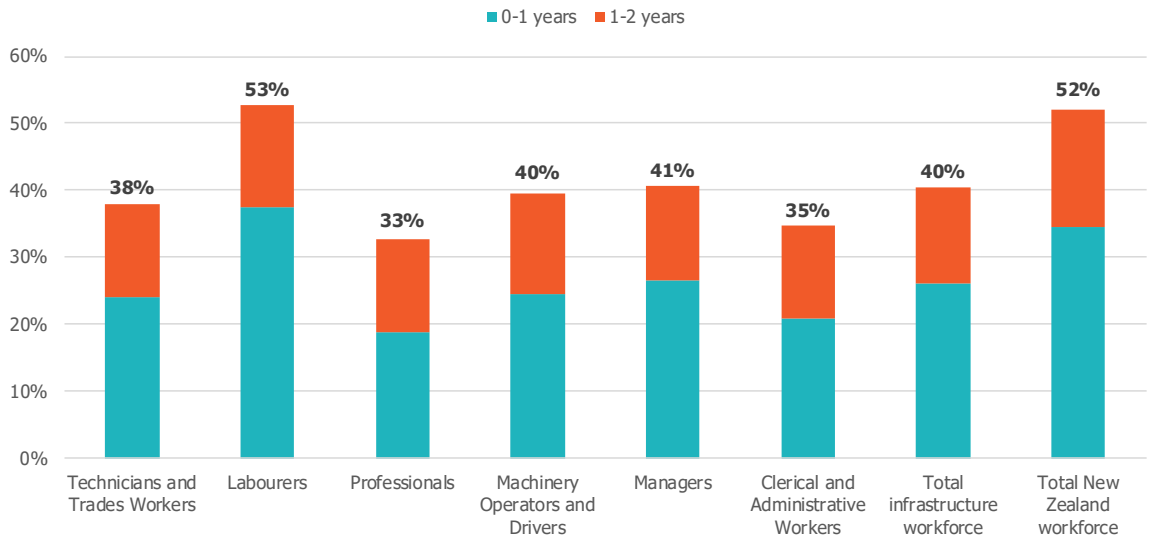
Figure 12 shows the share of workers in each occupational category that have a short tenure in their current 4-digit ANZSIC industry. It shows the share of people who shifted industry within the last one year or two years.

While all occupations exhibit reasonable levels of mobility between industries, mobility seems is highest among labourers. At the detailed occupation level, 71% of road traffic controllers moved industry within the last two years, along with 52% of labourers not elsewhere classified, 49% of scaffolders, and 48% of builder's labourers.

Mobility between industries was lowest in professional occupations and some specialised technical roles. At the detailed occupation level, only 22% of engineering managers moved industry within the last two years, along with 26% of electrical line mechanics, 29% of architects, 30% of structural engineers, and 31% of civil engineers.

These findings highlight where it may be easier or harder to rapidly scale up workforce capacity. Occupations that experience more inter-industry mobility may find it easier to scale up by attracting workers from elsewhere in the economy. Conversely, occupations that experience less inter-industry mobility may require occupation- or sector-specific skills that make it difficult to scale up by attracting workers from elsewhere in the economy.

Figure 12: Share of infrastructure workers with short tenure in current ANZSIC industry, by occupational category, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

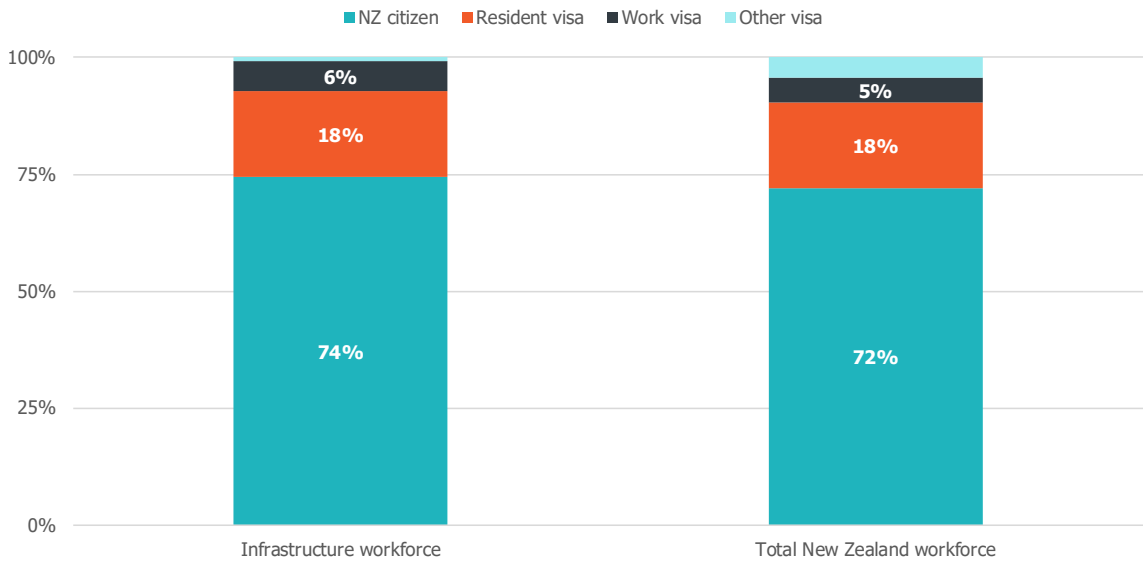
The role of immigration

One in four infrastructure workers is on a visa

Figure 13 shows that roughly one in four infrastructure workers is on a visa. We estimate that 18% of infrastructure workers arrived on residence visas, 7% arrived on temporary work visas, and a further 1% are on student or working holiday visas. New Zealand citizens account for 74% of the infrastructure workforce.

These proportions are similar to the overall New Zealand workforce, where 28% of workers arrived on visas and 72% are New Zealand citizens. Previous studies suggest that immigrants have played an increasing role in the overall New Zealand construction sector over time, but it is unclear whether infrastructure construction has followed a similar trend (Schiff, 2022).

Figure 13: Distribution of workers' visa status in the infrastructure workforce and the total New Zealand workforce, 2018



Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates are based on a similar analysis of 2018 Census data for all industries.

Workers on visas play a larger role in engineering and technician occupations

Figure 14 shows that visa status varies significantly between different categories of infrastructure occupations.

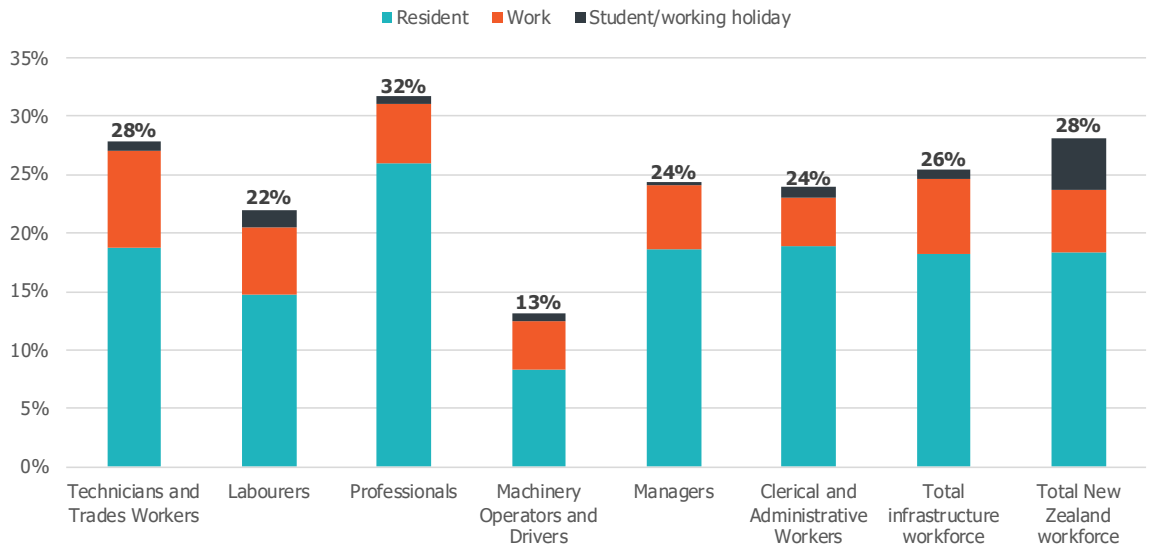
Professionals and technicians and trades workers are most likely to be on visas. In professional occupations, one in three workers (32%) is on a visa. At a detailed occupational level, migrant workers are most common among quantity surveyors (42% on a visa), telecommunications technicians (41%), electrical engineers (37%), and civil engineers (35%).

By contrast, only one in eight (13%) machinery operators and drivers were on visas. At a detailed occupational level, migrant workers were least common in trades like earthmoving plant operators (10%), excavator operators (12%), paving plant operators (16%), and drainlayers (16%).

Because immigration is more common among professional and technical occupations, workers on visas also tend to have higher qualifications than the average worker in the infrastructure sector.

This suggests that we may rely more on migration to scale up workforce capacity in technical occupations, relative to the trades. This could reflect longer lead times to train technical occupations, gaps in local training options, or a tendency for firms to recruit overseas for certain types of roles and locally for others.

Figure 14: Share of infrastructure workers on a visa, by occupational category, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

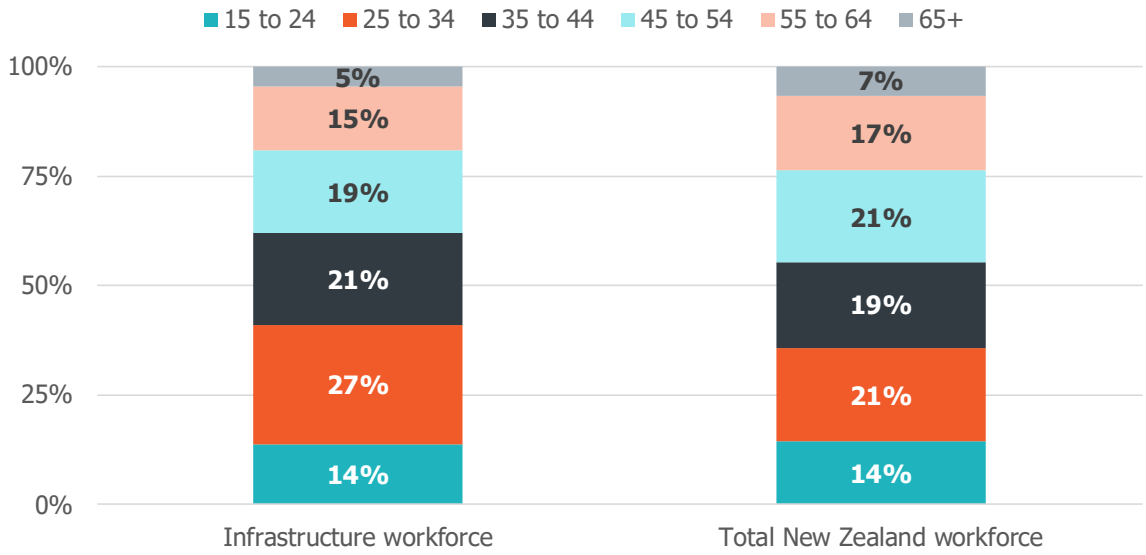
Demographic characteristics

Age structure of the infrastructure workforce

The infrastructure workforce is younger than the overall New Zealand workforce

Figure 15 compares the age distribution of the infrastructure workforce with the overall New Zealand workforce. On the whole, the infrastructure workforce is slightly younger. It has a lower share of people aged 55 and over (20% compared with 24%) and a higher share of people aged 25 to 34 (27% compared with 21%).

Figure 15: Age distribution of the infrastructure workforce and the total New Zealand workforce, 2018



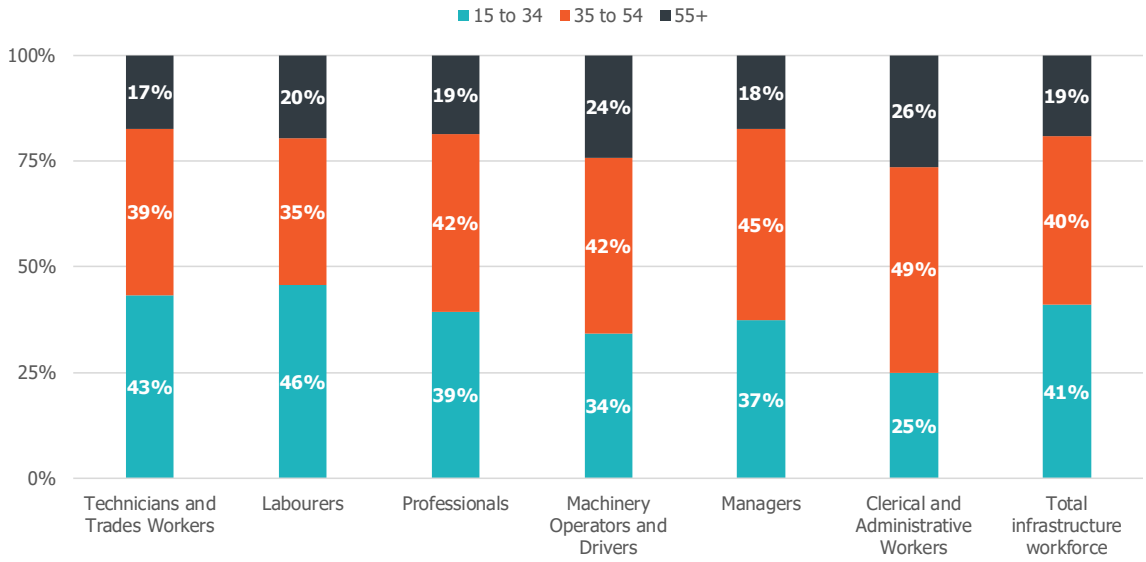
Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates from 2018 Census.

Age profiles vary between occupational groups

Figure 16 shows the age structure of broad occupational groups in the infrastructure workforce. While most occupational groups have a similar age profile, there is a slightly higher proportion of workers aged 55 and over among machinery operators and drivers and clerical and administrative workers.

Age structure varies more at the detailed occupational level. The occupations with the highest share of people aged 55 and over are electrical engineering technician (30% aged 55 and over), telecommunications technician (30%), engineering manager (28%), builder's labourer (27%), and programme or project administrator (27%). These occupations will face slightly higher medium-term needs to train and recruit younger workers as older cohorts retire.

Figure 16: Age distribution of the infrastructure workforce, by occupational category, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

The infrastructure workforce by ethnicity

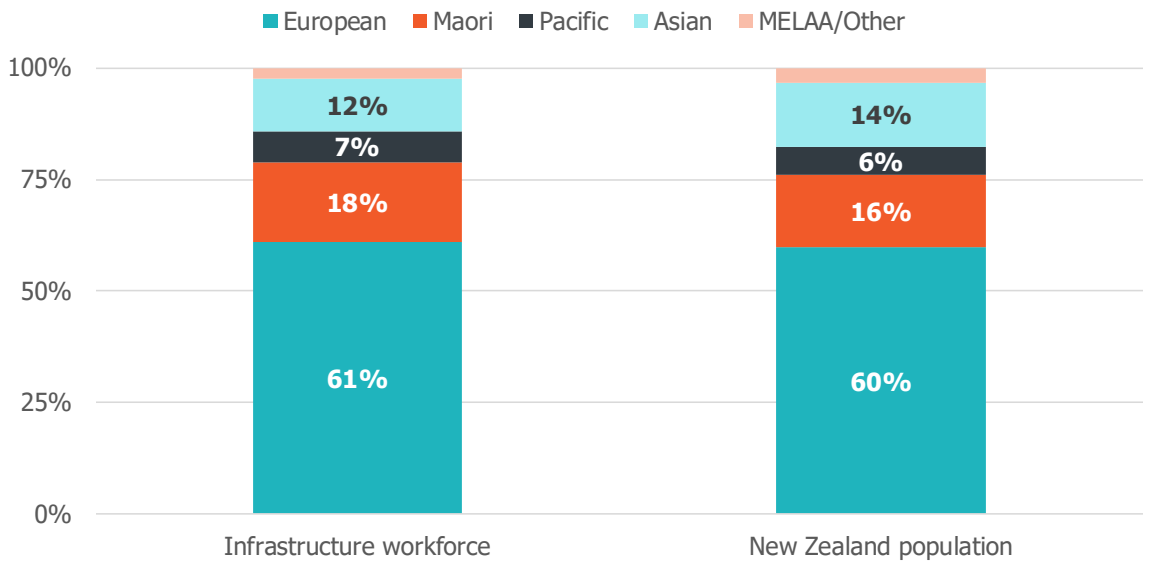
The ethnic diversity of the overall infrastructure workforce reflects New Zealand's diversity

Estimates of the infrastructure workforce include information on workers' ethnicity.[16]

Figure 17 shows the estimated ethnicity breakdown of the infrastructure workforce in 2018. We find that people of European ethnicity make up 61% of the workforce, people who are Māori make up 18%, Pacific peoples make up 7%, people who are Asian make up 12% of the workforce, and other ethnicities account for the remaining 3%. These proportions are close to the ethnic mix of the overall New Zealand population.

[16] In these estimates, an individual's ethnicity is coded based on their 'primary' or 'prioritised' ethnicity. What this means is that when somebody reports multiple ethnicities on the Census, they are coded to one specific ethnicity based on a priority ranking. It is reasonably common to report multiple ethnicities. As a result, these estimates will misestimate some aspects of ethnic diversity. For further information on Statistics New Zealand's 'prioritised ethnicity' measures see: https://datainfoplus.stats.govt.nz/item/nz.govt.stats/0b593a66-4164-4eaf-b071-db4f77a45fcc

Figure 17: Distribution of primary ethnicity in the infrastructure workforce and the total New Zealand population, 2018



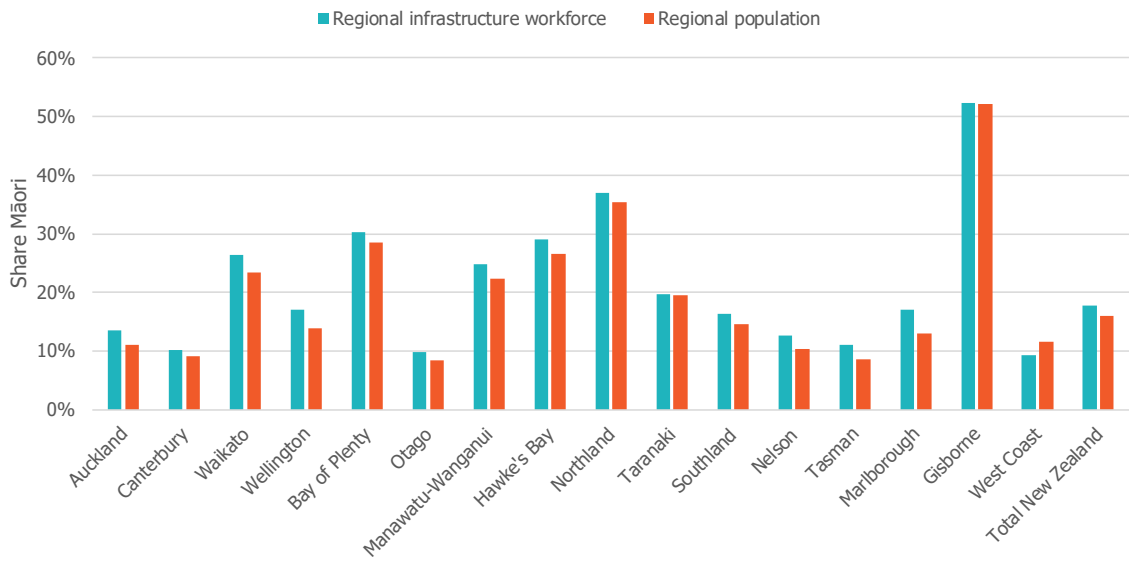
Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; New Zealand population estimates from 2018 Census.

The ethnic mix of regional infrastructure workforces reflects regional populations

At a national level, Māori workers make up 18% of the overall infrastructure workforce. **Figure 18** shows that Māori participation in the infrastructure workforce is highest in Gisborne (52%), Northland (37%), Hawke's Bay (29%), Bay of Plenty (30%), and Waikato (26%). These proportions are similar to the Māori share of regional populations.

By contrast, Auckland's infrastructure workforce has a higher-than-average share of Pacific peoples (14%, compared with national average of 7%) and Asian workers (23%, compared with national average of 12%). Again, this reflects regional demographics.

Figure 18: Māori share of regional infrastructure workforce and regional population, 2018



Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; regional population estimates from 2018 Census. Regions are ordered according to the size of their infrastructure workforce.

Ethnic mix differs between occupations

Table 4 shows that the ethnic mix of the workforce varies significantly between occupations.

Labouring occupations tend to have a higher-than-average share of Māori workers (27% of labourers are Māori) and Pacific workers (13% are Pacific), while machinery operating and driving occupations have a higher-than-average share of Māori workers (30%).

Professional occupations like engineering have a higher-than-average share of workers of European and Asian ethnicity (70% and 16%, respectively), while manager occupations and clerical and administrative occupations have higher-than-average shares of European workers (73% and 71%, respectively).

Table 4: Distribution of primary ethnicity in the infrastructure workforce, by occupational category, 2018

Occupational category (1-digit ANZSCO)	Share of workers by ethnicity				
	European	Māori	Pacific	Asian	MELAA/ Other
Technicians and Trades Workers	62%	16%	6%	13%	3%
Labourers	47%	27%	13%	11%	2%
Professionals	70%	8%	3%	16%	3%
Machinery Operators and Drivers	56%	30%	8%	5%	1%
Managers	73%	12%	4%	8%	2%
Clerical and Administrative Workers	71%	13%	5%	10%	2%
Total infrastructure workforce	**61%**	**18%**	**7%**	**12%**	**2%**

Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

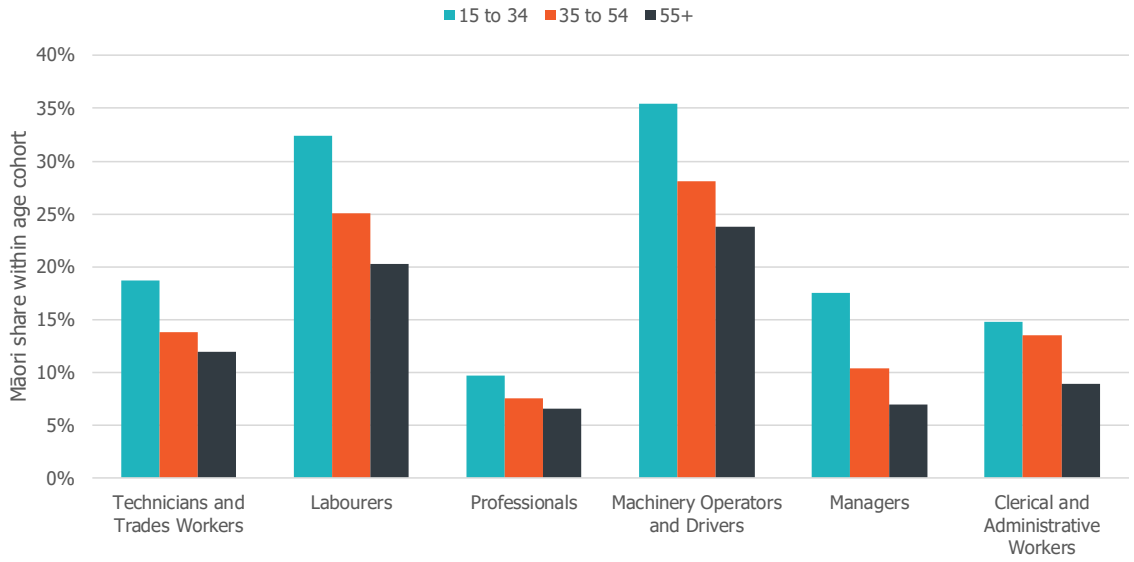
Younger-age cohorts tend to be more diverse than older age cohorts

Within occupations, younger cohorts of infrastructure workers tend to be significantly more ethnically diverse than older cohorts. However, the ethnic mix of different occupational groups does not appear to be converging over time. Rather, occupations such as professionals and managers that are relatively less diverse among older cohorts remain relatively less diverse among younger cohorts.

Figure 19 shows the Māori share of workers within different age cohorts, broken down by occupation. Twenty-one percent of infrastructure workers aged 15 to 34 are Māori, relative to 14% of infrastructure workers aged 55 and over. Similar trends are observed for Pacific peoples (8% of workers aged 15 to 34 vs 5% of workers aged 55 and over) and people of Asian ethnicity (12% of workers aged 15 to 34 vs 6% of workers aged 55 and over).

However, trends vary between occupational categories. **Figure 19** shows that the increase in the Māori share of the workforce in younger cohorts is largest among labourers, machinery operators and drivers, and managers, and smallest among professionals.

Figure 19: Māori share of the infrastructure workforce, by occupation and age cohort, 2018

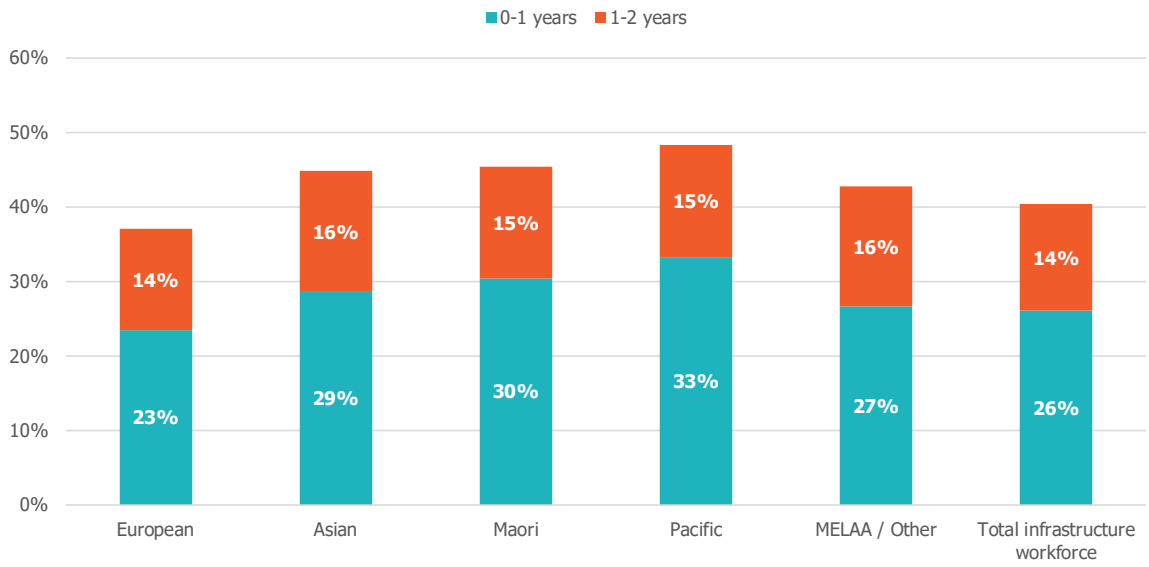


Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

Rates of inter-industry mobility vary slightly by ethnicity

Figure 20 shows that Asian, Māori, and Pacific workers are slightly more likely to have moved between ANZSIC industries in the last two years than workers of European ethnicity. These differences are fairly modest and appear to mostly reflect the fact that Māori and Pacific workers tend to work in occupations with higher rates of between-industry mobility.

Figure 20: Share of infrastructure workers with short tenure in current ANZSIC industry, by ethnicity, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

Highest qualifications vary significantly by ethnicity

Table 5 shows that the mix of qualifications varies by ethnicity. For instance:

- Māori and Pacific workers were more likely to have no qualification (23% and 21% of workers of these ethnicities, respectively) or a secondary school qualification (57% and 52%, respectively).
- Asian workers were more likely to have university-level qualifications (23% bachelor's degree/level 7 qualification; 19% postgraduate/master's/doctoral degree).

These differences are related to the ethnic mix in different occupations. However, we also find that Māori and Pacific workers also tend to have lower formal qualifications than other workers within each broad occupational group. This could reflect the fact that these workers tend to occupy roles within occupations that require fewer formal qualifications, or it could reflect the fact that they are more likely to enter occupations through non-degree paths like apprenticeships or on-the-job training.

Table 5: Distribution of highest qualification by ethnicity in the infrastructure workforce, by occupational category, 2018

Occupational category (1-digit ANZSCO)	Share of workers by highest qualification					
	No qualification	Level 1-4 certificate/ overseas secondary school	Level 5-6 diploma	Bachelor's degree/ level 7 qualification	Post-graduate/ master's/ doctoral degree	Not stated
European	12%	52%	12%	9%	12%	3%
Asian	6%	33%	10%	23%	19%	9%
Māori	23%	57%	7%	4%	2%	7%
Pacific	21%	52%	7%	4%	2%	13%
MELAA	5%	32%	8%	21%	23%	11%
Other	9%	54%	16%	9%	9%	3%
Total infrastructure workforce	**14%**	**51%**	**10%**	**9%**	**11%**	**5%**

Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

Women in infrastructure

Women only make up 11% of the infrastructure workforce …

Census data shows that women made up around 47% of the overall New Zealand workforce in 2018.[17] Women also account for around half of total infrastructure usage.

However, we estimate that women only make up 11% of New Zealand's infrastructure workforce in 2018. To put that figure into perspective, women made up 24% of the overall New Zealand workforce in 1951.[18]

… and women are concentrated in certain occupations

Figure 21 shows the share of people working in different infrastructure occupations who are women. With the exception of clerical and administrative workers, women make up a small minority of workers in all other occupational categories. 20% of professionals, such as engineers, are women, and 15% of labourers are women.

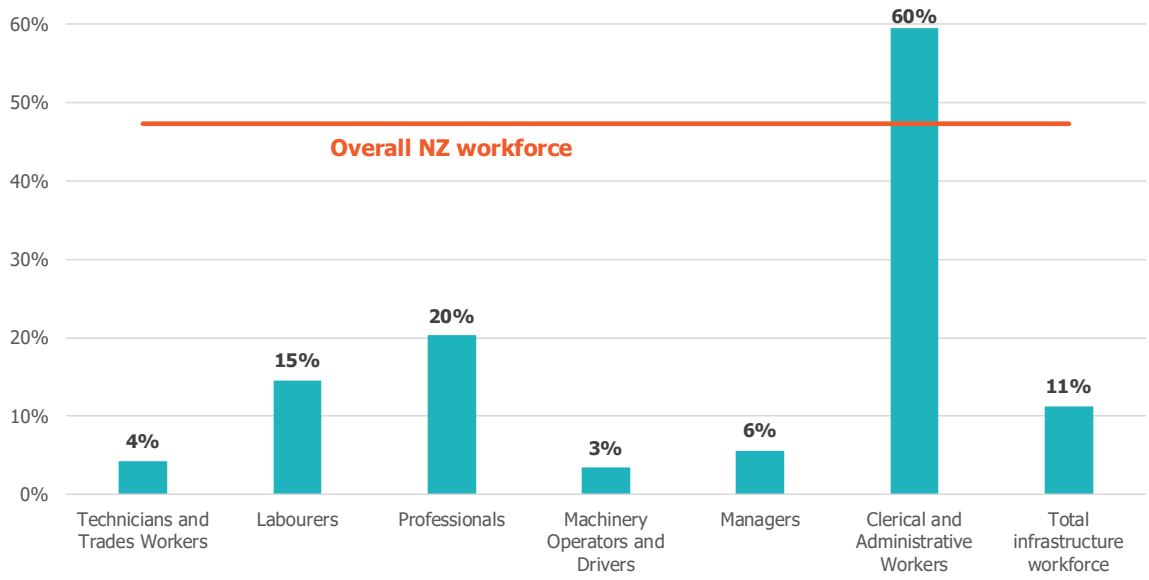
At a detailed occupational level, women make up a majority of workers in only two out of the 30 largest infrastructure occupations ('urban and regional planner' and 'programme or project administrator') and account for more than 20% of total workers in a further three occupations ('labourers not elsewhere classified', 'architects', and 'road traffic controllers').

In 18 of the 30 largest infrastructure occupations, women make up less than 5% of total workers.

[17] The 2018 Census, and prior Censuses, Statistics New Zealand classified people as male or female, with no provision for other genders: https://datainfoplus.stats.govt.nz/Item/nz.govt.stats/4600a913-7cf8-45ae-a624-e7fff34d0bd5. This classification has been extended for the 2023 Census.

[18] https://www.nzier.org.nz/data-1850

Figure 21: Women as a share of the infrastructure workforce, by occupational category, 2018



Note: Infrastructure workforce estimates from Scarlatti/Alta workforce supply estimates using 2018 Census data; total New Zealand workforce estimates from 2018 Census.

Women do not make up a significantly higher share of younger cohorts of workers

Figure 22 shows the share of women within different age cohorts, broken down by occupation. While one might expect higher female participation in younger age cohorts, that does not seem to be the case. Eleven percent of infrastructure workers aged 15 to 34 are women, which is only marginally higher than the 10% of infrastructure workers aged 55 and over that are women.

At the occupational level, we find that women's participation in the infrastructure workforce is modestly higher among younger labourers, professionals, and clerical and administrative workers. However, younger cohorts of technicians and trades workers, machinery operators and drivers, and managers are no more likely to be women than their older counterparts.

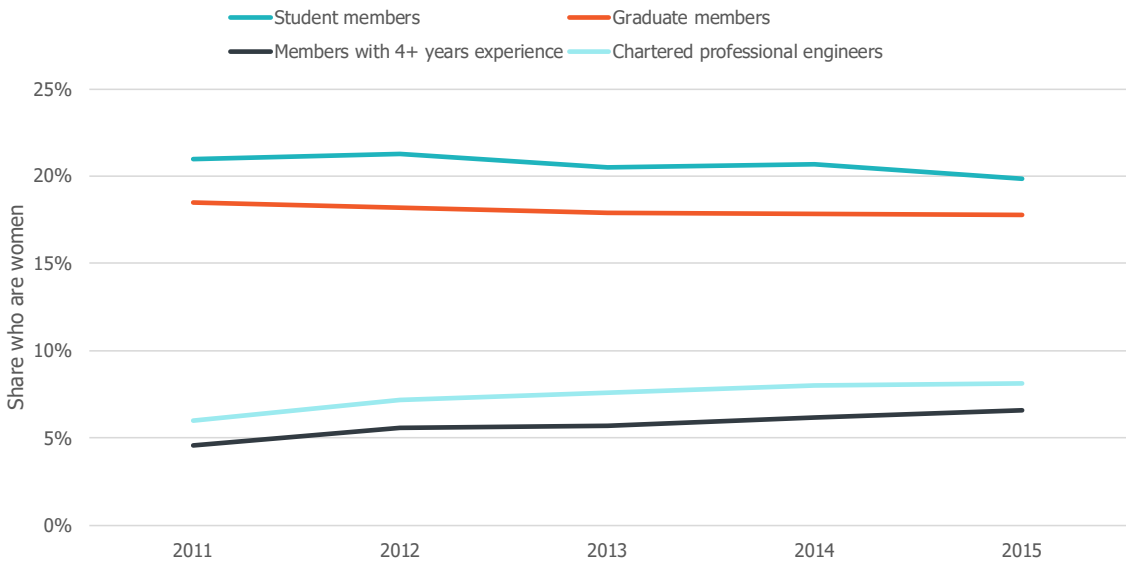
This suggests that the infrastructure workforce will not necessarily move towards greater gender balance as older cohorts of workers retire.

Figure 22: Women as a share of the infrastructure workforce, by occupation and age cohort, 2018

Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

These patterns may reflect ongoing challenges with both recruitment and retention of women in the infrastructure workforce. **Figure 23**, based on data from Engineering New Zealand's *Women in Engineering* project, highlights that few women enter the training pipeline for engineers, and women make up a smaller share of the engineering workforce at a more senior level.[19] Between 2011 and 2015, the share of student and graduate members who were women declined slightly, while the share of experienced members who were women rose slightly. More recent data is not available, so it is unclear whether these trends have changed since 2015.

Figure 23: Trends for women in engineering, 2011–2015



Source: Te Waihanga analysis of data from Institution of Professional Engineers New Zealand (2015)

[19] https://www.engineeringnz.org/resources/women-engineering/

Women and men working in infrastructure move between industries at similar rates

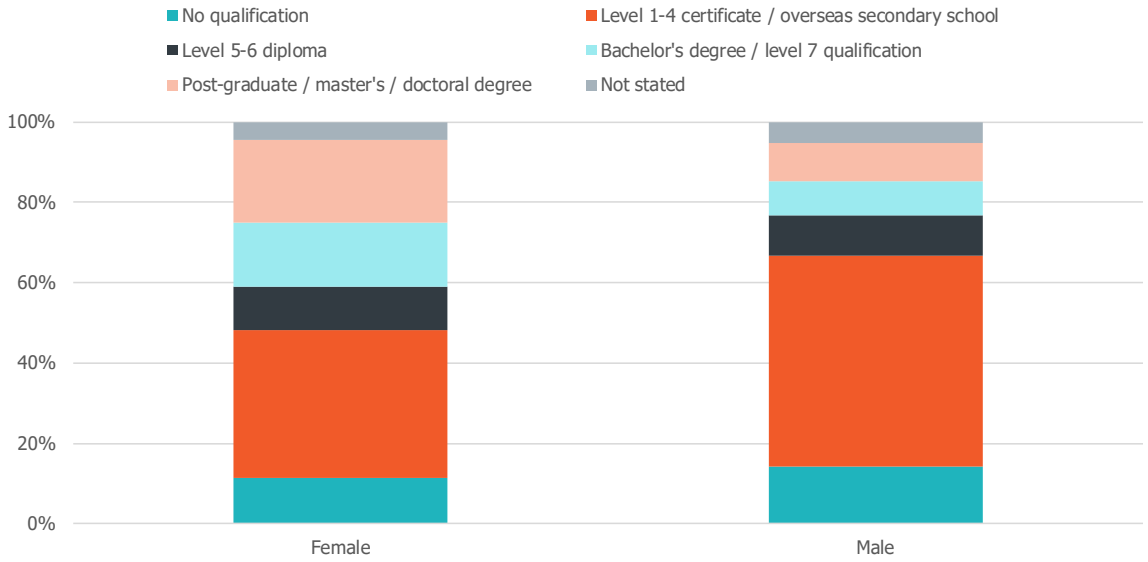
Women working in infrastructure do not appear to move between industries at a much faster or slower rate than their male colleagues. In 2018, we estimate that 42% of female infrastructure workers had moved between ANZSIC industries in the last two years, compared with 40% of male infrastructure workers. Thirty-three percent of female infrastructure workers had remained in the same ANZSIC industry for five or more years, compared with 37% of male infrastructure workers.

Women working in infrastructure tend to have higher qualifications than men

Figure 24 shows that women working in infrastructure tend to have higher qualifications than men. Thirty-six percent of women working in infrastructure have a university-level qualification (bachelor's degree or higher), compared with 18% of men working in infrastructure. They are also less likely to have only a secondary school qualification (37% of women vs 52% of men).

For the most part, these differences reflect the fact that women tend to be more likely to have university-level qualifications than men working in similar types of occupations. For instance, 40% of women working in managerial occupations have university-level degrees, compared with 22% of men working in these occupations.

Figure 24: Distribution of highest qualification by gender in the infrastructure workforce, 2018



Note: Based on Scarlatti/Alta workforce supply estimates using 2018 Census data.

Conclusion

In this report, we draw upon findings from a baseline study of the infrastructure workforce to understand the capacity and characteristics of the workforce. How large is the infrastructure workforce? What occupations and types of projects does it include? What paths do people follow into the infrastructure workforce? And what types of people work in infrastructure?

Our key findings

Finding 1: The infrastructure workforce includes over 100,000 full-time equivalent workers

In 2018, the infrastructure workforce included an estimated 108,000 full-time equivalent workers, which is equal to around 4.7% of the overall New Zealand workforce.

These workers are split evenly between 'horizontal' infrastructure like roads, water pipes, and electricity transmission, and 'vertical' infrastructure like schools and hospitals.

Finding 2: Constructing new projects accounts for less than half of the workforce; most workers are occupied on planning and design or asset management

The infrastructure workforce is broader than just people working on building new infrastructure. We estimate that around 14% of infrastructure workers are engaged in planning and design, and a further 40% of infrastructure workers are engaged in asset management and maintenance. Around 46% of the workforce is engaged in building new infrastructure projects.

Finding 3: Mobility from other sectors is more important for 'blue collar' roles and migration is more important for 'white collar' roles

Pathways into the infrastructure workforce vary between occupations. Professional and technical occupations include a higher share of migrants. These occupations are more likely to have university qualifications. Machinery operators and drivers and labourers are less likely to be migrants, and more likely to have moved between industries in recent years.

Finding 4: The infrastructure workforce is ethnically diverse, but women make up a small share of the workforce

The overall infrastructure workforce has a similar ethnic makeup to the New Zealand population. However, ethnic mix is uneven across occupational categories.

Only 11% of infrastructure workers are women. Female participation is only marginally higher among younger age cohorts, meaning that this pattern is unlikely to change as the workforce ages.

Implications of our findings

The infrastructure workforce is large and complex. It comprises more than 100,000 full-time equivalent workers spread across more than 100 distinct occupations. Different workers are engaged at different stages of the infrastructure lifecycle, and capacity or capability gaps at one stage can cause problems at later stages.

Baseline workfore data can help us to understand short-term constraints

In the near term, our ability to deliver more infrastructure is limited by the current size, composition, and regional location of the workforce. It is crucial to understand these constraints and establish investment programmes that fit within them.

This data paints a picture of how the infrastructure workforce grows

In the longer term, the infrastructure workforce can scale up to meet additional demand. Between 2000 and 2020, labour inputs to the heavy and civil construction industry grew by 79%, which is three times faster than growth in labour input elsewhere in the economy (New Zealand Infrastructure Commission, 2022). Our results suggest that both recruitment and training of New Zealanders and immigration are important for growing the infrastructure workforce.

In general, 'blue collar' occupations, which tend to have lower formal qualifications, tend to be filled by New Zealand citizens. These occupations are more likely to draw in labour from other industries, as indicated by the relatively high share of people who shifted between ANZSIC industries in the last one to two years. For these occupations, recruitment of workers from other parts of the New Zealand economy is important for labour supply response.

Engineering and technical occupations, which are more likely to require degrees or other formal qualifications, are more likely to be filled by people on a visa. These occupations appear to face higher barriers to drawing in labour from other industries, as indicated by the lower share of people who shifted between ANZSIC industries in the last one to two years. In the long term, local training should help to meet these workforce needs, but at present migration appears to be an important part of the labour supply response.

Increasing diversity is an opportunity to build capacity and capability

Increasing the diversity of the workforce is a key opportunity to build capacity and capability. Women play a large role in the overall New Zealand workforce (47% of all workers are women) but a small role in the infrastructure workforce (only 11% of infrastructure workers are women). Recruiting and retaining a wider pool of New Zealanders can make it easier to fill skill gaps.

Areas for further research

This report provides the first comprehensive baseline analysis of the infrastructure workforce. In the process, it has highlighted several areas where further research would be useful.

Updating baseline metrics over time

Our baseline analysis is based on data from the 2018 Census. The release of 2023 Census data will an opportunity to update infrastructure workforce baseline metrics. This will help to understand how the infrastructure workforce has grown and changed over time.

Analysing wage and productivity dynamics

Our baseline analysis focuses exclusively on the number of people working in infrastructure, rather than analysing wage and productivity dynamics for infrastructure occupations.

However, wages and productivity are also important. Higher wages and productivity are a signal that workers are more experienced or more sought-after by employers. Unusually high wages, or wages that are rising more rapidly for some occupational categories, may be a signal of capacity

shortages or highly specialised skills that are not easy to obtain. Likewise, if wages rise more rapidly with increasing tenure in an industry, it may indicate that job-specific skills play a stronger role than for another occupation where wages don't increase as much with increasing tenure.

Data in Statistics New Zealand's Integrated Data Infrastructure could be used to investigate wage and productivity dynamics for infrastructure occupations.

Analysing how the infrastructure workforce changes in response to changes in demand

Our baseline analysis is a snapshot at a point in time. While it provides some insight into the pathways that people follow into the infrastructure workforce, further work is required to understand how the workforce changes in response to changes in demand.

When demand for infrastructure planning, construction, or maintenance increases, there are several potential responses. The workforce could expand, either by recruiting and training more people within New Zealand or by recruiting migrants. It could invest in lifting labour productivity, for instance by training existing workers better or substituting equipment for workers. Or, if it is unable to expand or lift labour productivity, wages could increase as increased demand chases a fixed pool of workers. Some of these responses can be implemented rapidly, while others may take more time.

Analysing how different occupations respond to increased demand in the short and long term would help us to understand where and how workforce capacity constraints arise, and how they can be mitigated in practice.

Exploring the drivers of age cohort trends in gender and ethnicity

Our analysis highlights that, within occupations, younger age cohorts tend to be more ethnically diverse than older age cohorts, but that they tend to have a similar share of women as older age cohorts.

These findings illustrate how the workforce may be diversifying over time, but they do not help us to explain what is driving these trends. Further work is needed to understand what factors are influencing demographic outcomes for different age cohorts, and how these factors might change over time.

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