SCARLATTI
Evaluation | Analytics | Insights

July 2024 (updated December 2024)

Engineering workforce pathways

Insights document

IDI disclaimer

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and/or Longitudinal Business Database (LBD) which are carefully managed by Stats NZ. For more information about the IDI or LBD please visit https://www.stats.govt.nz/integrated-data/.

The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements

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

Introduction

This report was commissioned by the member organisations of the **Engineering workforce long-term skills shortage project:**

- Waihanga Ara Rau | Construction and Infrastructure Workforce Development Council,
- Engineering New Zealand | Te Ao Rangahau, and
- Association of Consulting Engineers New Zealand |ACE New Zealand,

to help quantify the size and extent of long-term workforce shortages in the sector to help the group coordinate activity, determine the most effective interventions and inform the **Engineering workforce long-term skills shortage: Action Plan**.

The work in this report has been produced by Scarlatti from government data sources. The analysis of this data has led to the development of a model engineering workforce pathway, it does not follow a single cohort through the pathway but analyses data for each phase over time and models and sequences this into a model pathway. Scarlatti also examined the size and composition of the engineering workforce, as well as tertiary graduate enrolments and education pathways into engineering jobs.

Introduction (continued)

Following the pathway through from secondary school, 85% of tertiary enrolments have achieved 50% of more of their NCEA credits in STEM subjects. Approximately 3,400 people start tertiary study each year, 2,240 (65%) complete their study and of these 38% remain in core engineering roles two years after graduation. This equates to 855 (25%) of people choosing to study engineering at a tertiary level remaining in core engineering roles two years after graduation.

The first section 'Pathways in the engineering workforce' slides 4 to 24 provides a summary of the pathway model and important transitions between school, tertiary training and the workforce. The subsequent sections provide more detailed analysis of the workforce size and demographics or underpinning data on individual pathway components including secondary school study into engineering and tertiary study into engineering work from page 45 to 60. There is also an appendix starting on page 61 to help readers interested in the details of census data understand the occupational coding issues between 2013 Vs 2018 data.

Sources used

The results in this research are derived from analysis of data from the following three sources:

1. Ngā Kete - The secure online portal managed by the Tertiary Education Commission (TEC) to share information with Workforce Development Councils and tertiary education organisations (TEOs).

2. Education Counts - A public website developed and managed by the Ministry of Education it was developed to simplify access to quantitative education information and create an effective online "doorway" to statistical data, quantitative information, and research on education and education services in New Zealand.

3. Integrated data infrastructure (IDI) – A large research database. It holds de-identified microdata about people and households. The data is about life events, like education, income, benefits, migration, justice, and health. It comes from government agencies, Stats NZ surveys, and non-government organisations (NGOs). The data is linked together, or integrated, to form the IDI.

Pathways in the engineering workforce

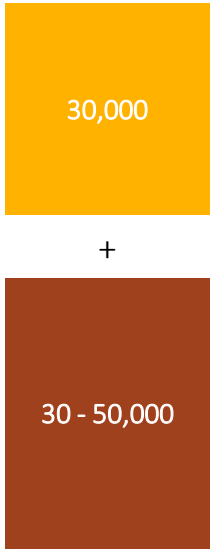
Model approach

This section aims to provide a summary of the pathways in the engineering workforce. It pulls together data from a range of sources, including the Integrated Data Infrastructure (IDI), TEC's Nga Kete online tool, and publicly available Education Counts. These data sources will have slightly different definitions and cover different time periods resulting in some inconsistencies in numbers.

In order to present consistent numbers within this section, we have taken a modelling approach – using a set of data inputs which average across recent time periods and across data sources. This means that the numbers on the slides which follow do not relate to a particular year, but rather are indicative of recent trends.

Refer to the following sections for underpinning data for Pathways from secondary school study into tertiary engineering study page 39 to 42 and for Pathways from tertiary study into engineering work from page 43

Size of the workforce



Approximate number of people working in core engineering occupations e.g. mechanical engineer.
People working in these occupations would typically hold an engineering tertiary qualification. Workforce shortages are more likely in these roles.

Indicative number of people working in engineering-adjacent occupations e.g. software engineer.
People holding engineering tertiary qualifications often work in these roles but most of this group hold a variety of other qualifications. Workforce shortages are less likely in these roles.

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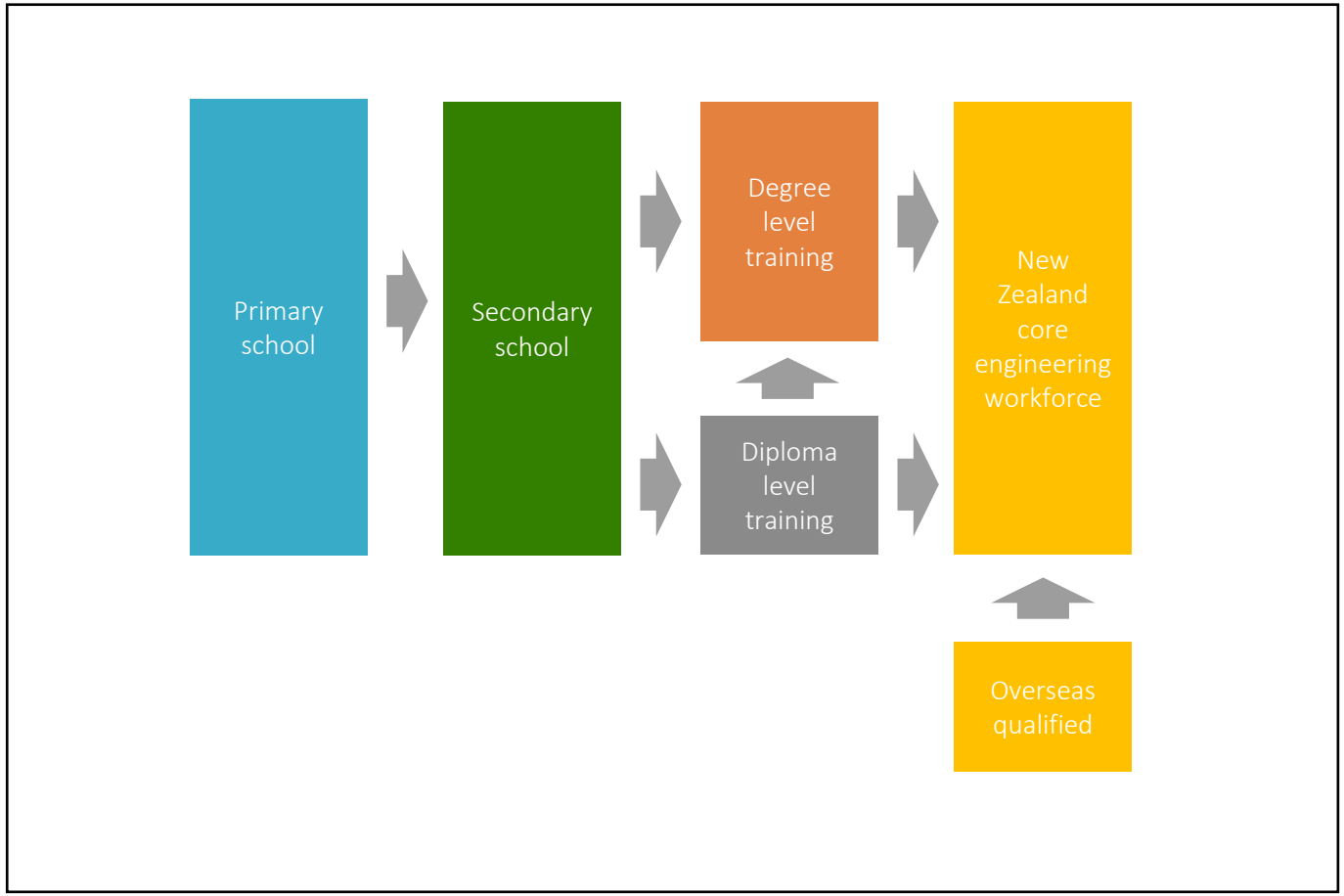
Pathways into the engineering workforce



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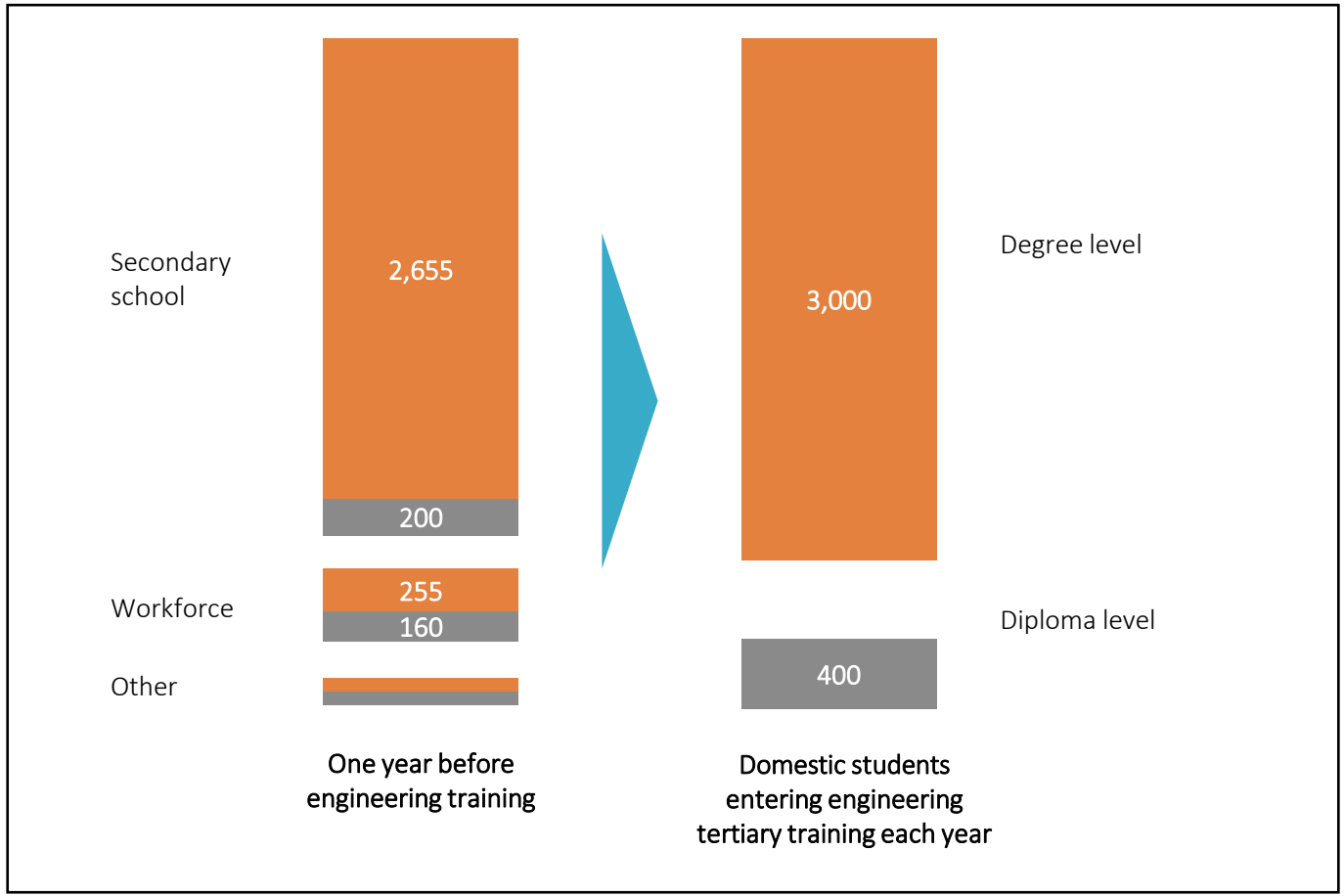
Pathways into engineering tertiary training



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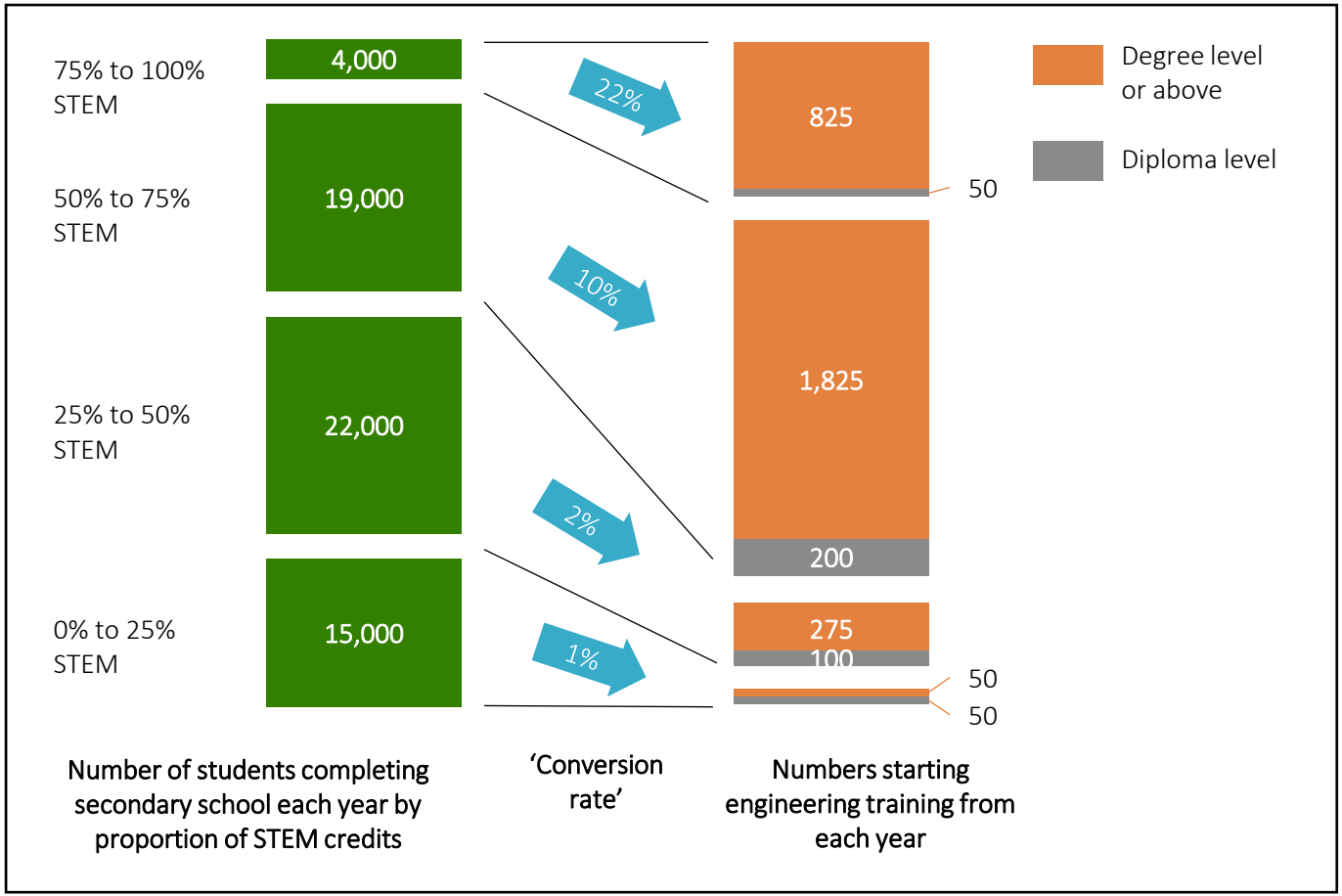
Pathways into engineering tertiary training

Insights:

Students transitioning directly from secondary school make up 80-90% of the new domestic engineering students at degree level each year. This confirms that the secondary school to tertiary study transition is a key point to focus interventions. At the diploma level there are fewer new entrants each year, and less than 50% of these come directly from schools, suggesting that interventions at schools will have less impact on diploma level enrolments.

Pathways to engineering training by STEM at school



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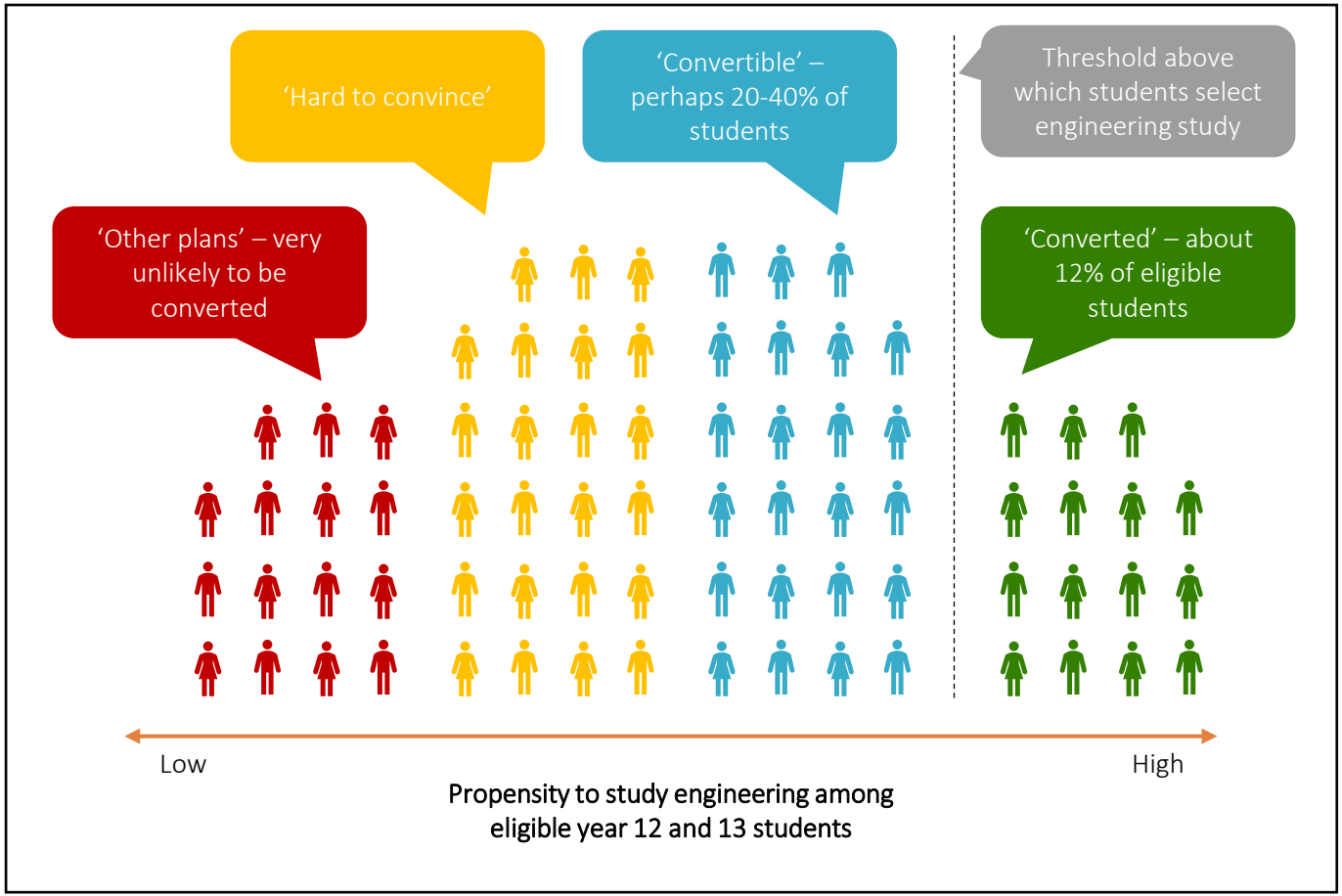
Propensity towards engineering



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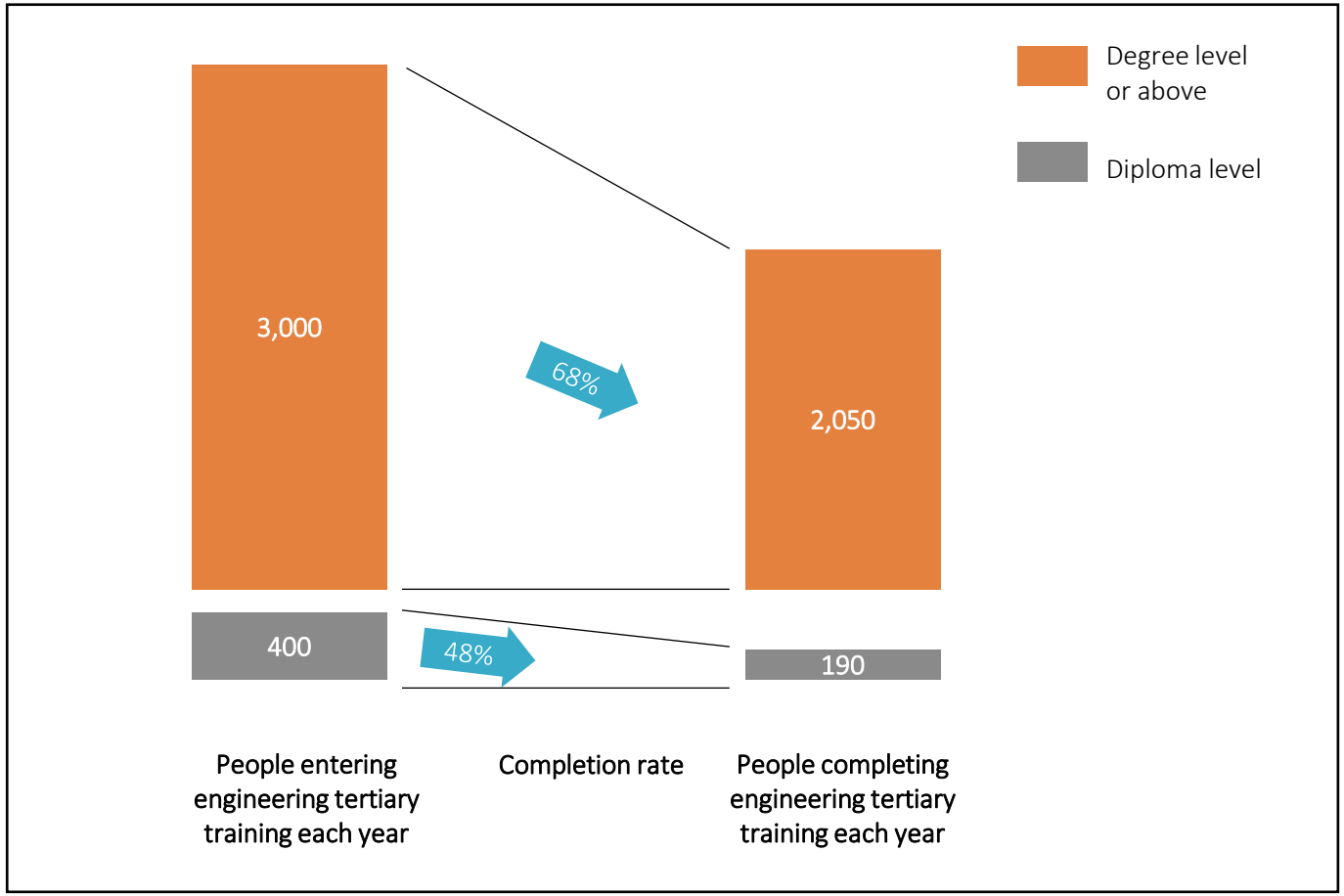
Pathways to engineering training by STEM at school

Insights:

There is, not surprisingly, a strong relationship between the amount of STEM subjects studied at secondary school and the likelihood of progressing to tertiary study in engineering. This supports the intuition that a pathway to grow the number of engineering students, and hence the engineering workforce, is to encourage secondary school students to take more STEM subjects.

This figure also points to another approach to grow the number of engineering students. Even for those secondary school students with a high proportion of STEM subjects, the proportion that progress to engineering school is low. Only about 12% of students with more than 50% STEM subjects go on to study engineering. Presumably, a significant proportion of the 88% students in this STEM-rich group that do not eventually progress to engineering school, do consider it as a study option at some point. This suggests that an additional strategy is to target students in the STEM-rich group, identify those already considering engineering (or at least those open to it), and seek to nudge them to choose engineering over their other options.

Pathways through engineering tertiary training



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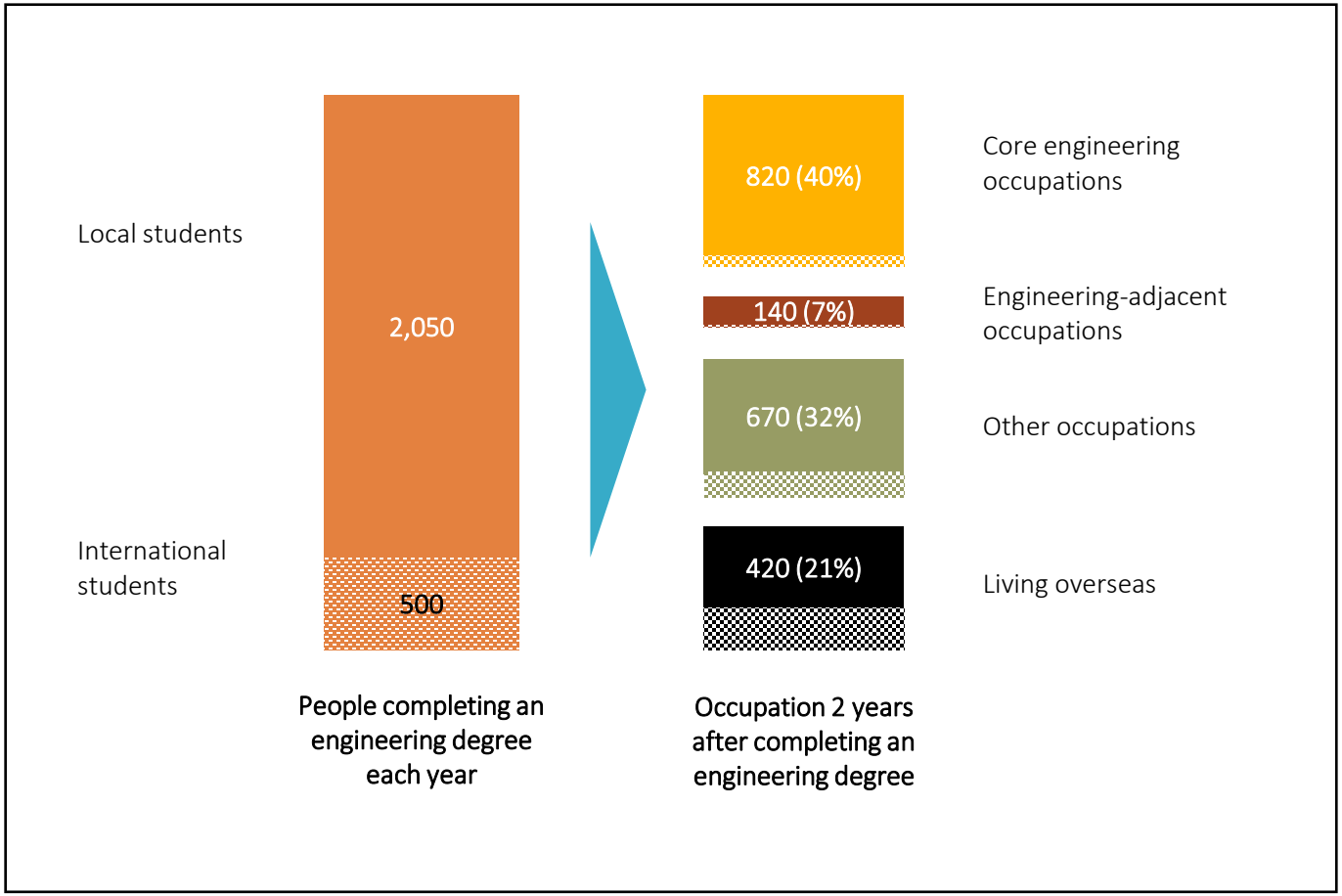
Pathways through engineering tertiary training

Insights:

On average, 68% of students complete degree level or higher training. Note that this varies between providers – Institutes of Technology and Polytechnics and Universities.

A lower percentage, about 48% complete diploma level training.

Pathways from engineering degree to the workforce



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Pathways from engineering degree to the workforce

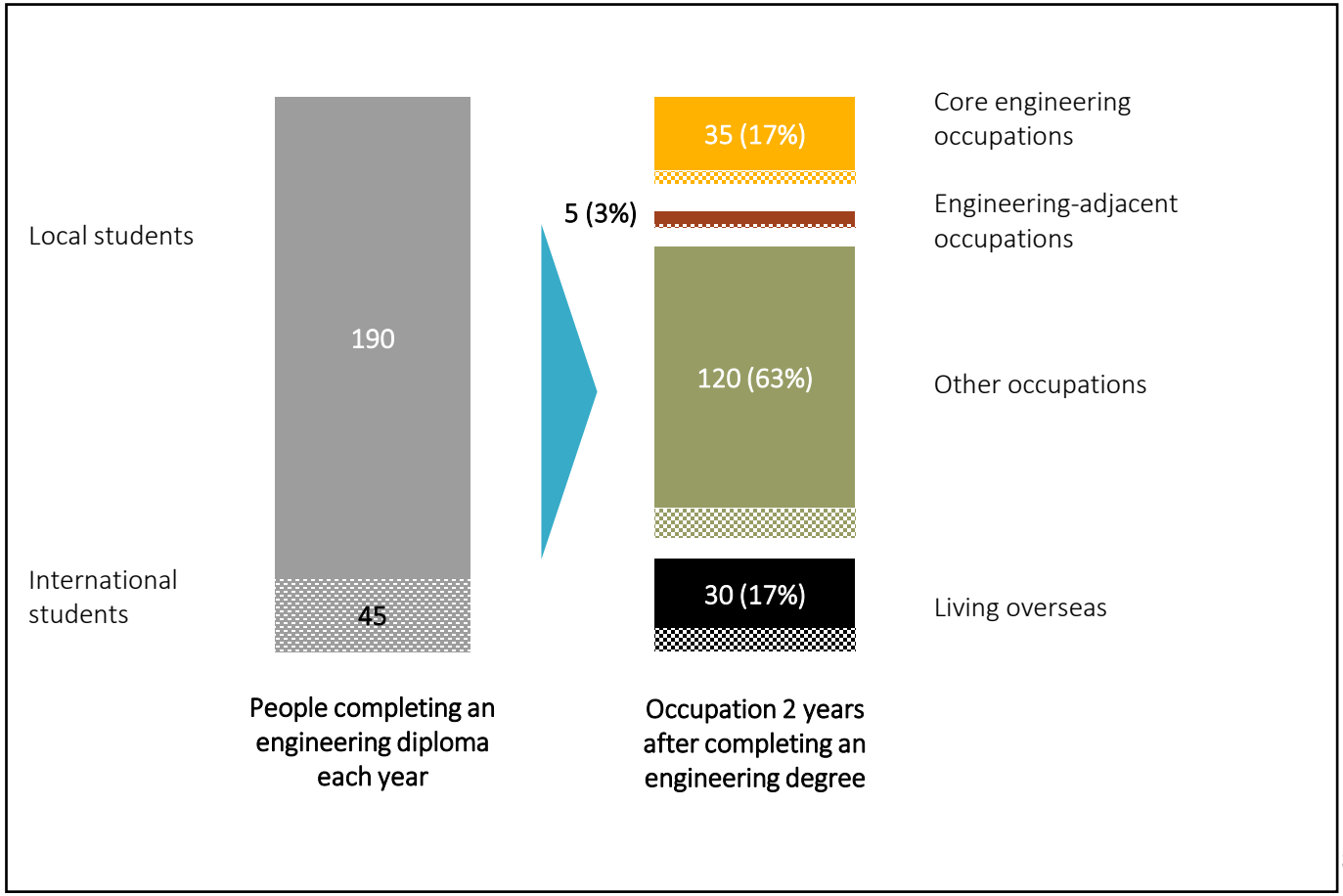
Insights:

Each year, approximately 2,550 engineering degree students graduate from New Zealand universities. Of these about 80% are domestic students and the other 20% international students.

Approximately 40% of domestic engineering degree graduates progress into core engineering occupations in the New Zealand workforce and about 7% go into engineering adjacent occupations. The remainder are split between other occupations and moving overseas.

About half of international students go on to enter the New Zealand workforce after their study, albeit this group appear less likely to go into core-engineering occupations.

Pathways from engineering diploma to the workforce



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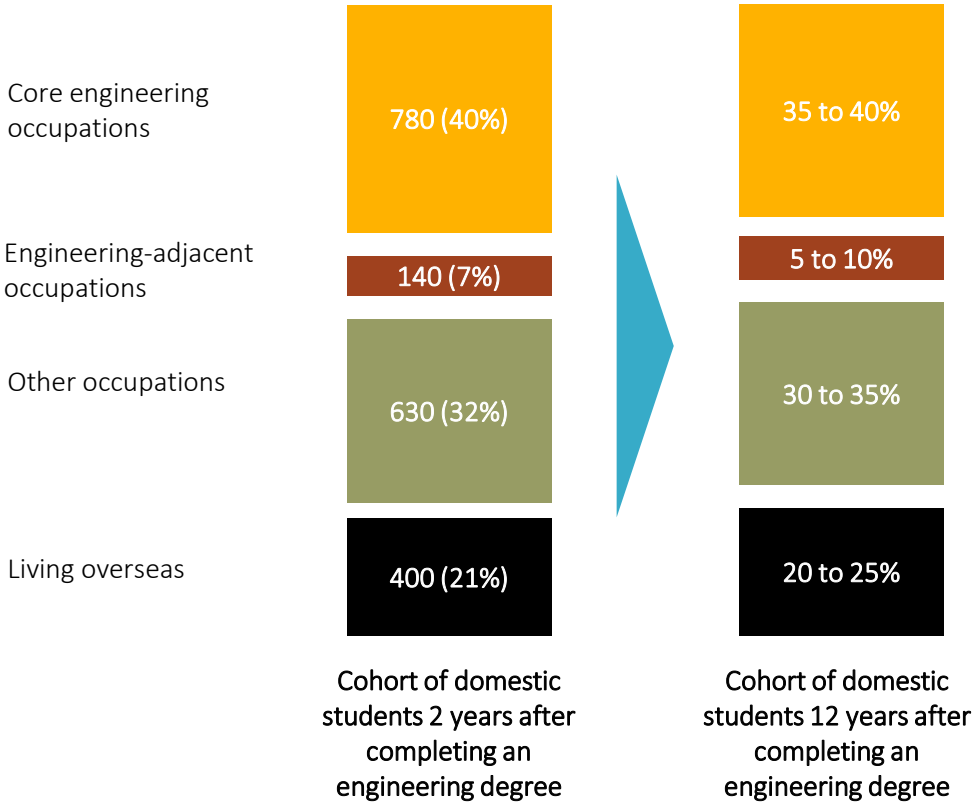
Pathways from engineering diploma to the workforce

Insights:

The proportion of engineering diploma graduates that go into in core-engineering occupations or engineering adjacent occupations is considerably lower than that of engineering degree graduates. Instead, a large proportion (63%) go on to other occupations not classified as engineering-specific.

Retention within the workforce



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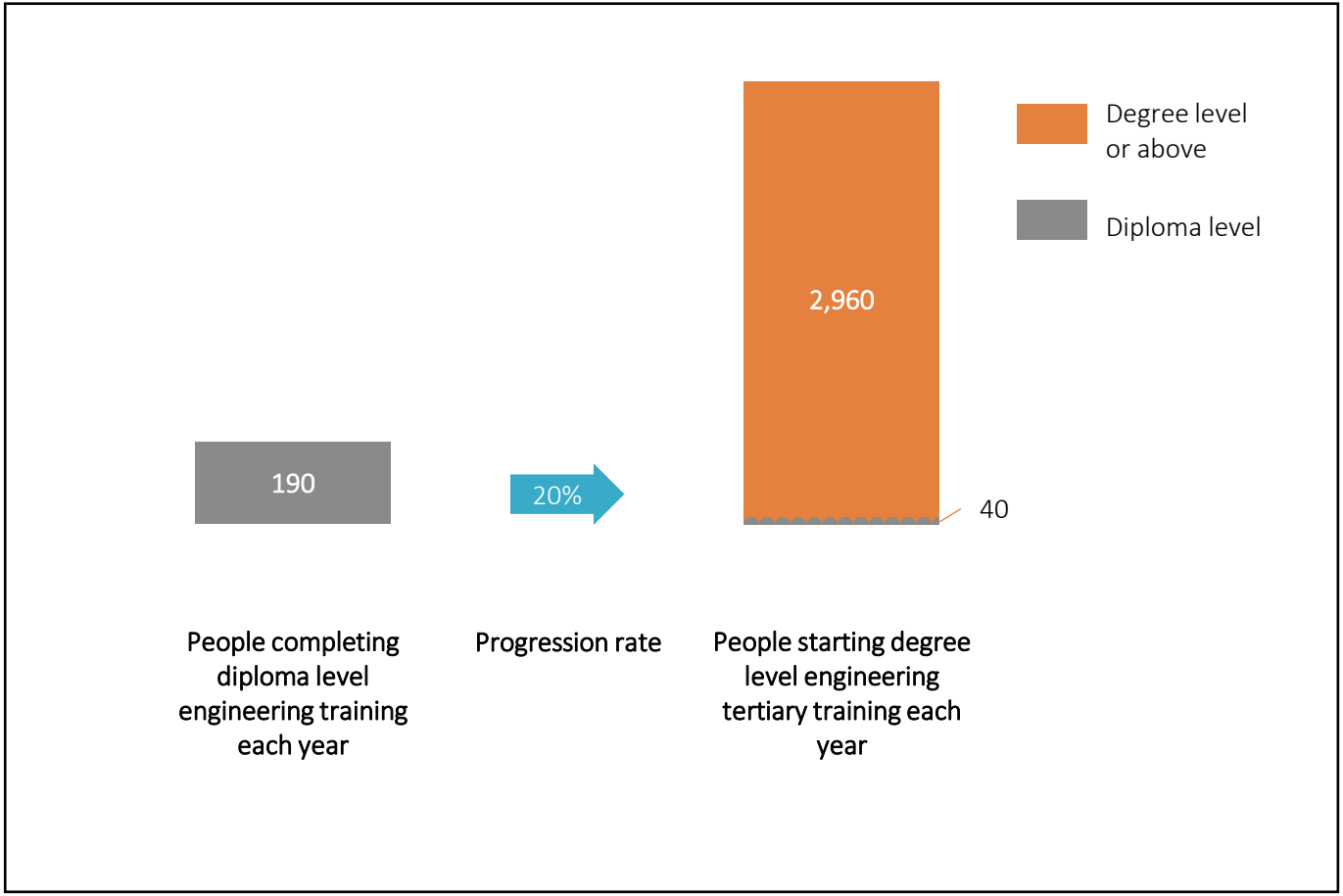
Retention within the workforce

Insights:

The proportion of a cohort of engineering degree graduates in each of core-engineering occupations, engineering adjacent occupations, other occupations and living overseas; is very stable over time. That is, the movements between these different groups largely cancel each other out and there is no clear net trend over time.

Pathways from diploma to degree engineering training



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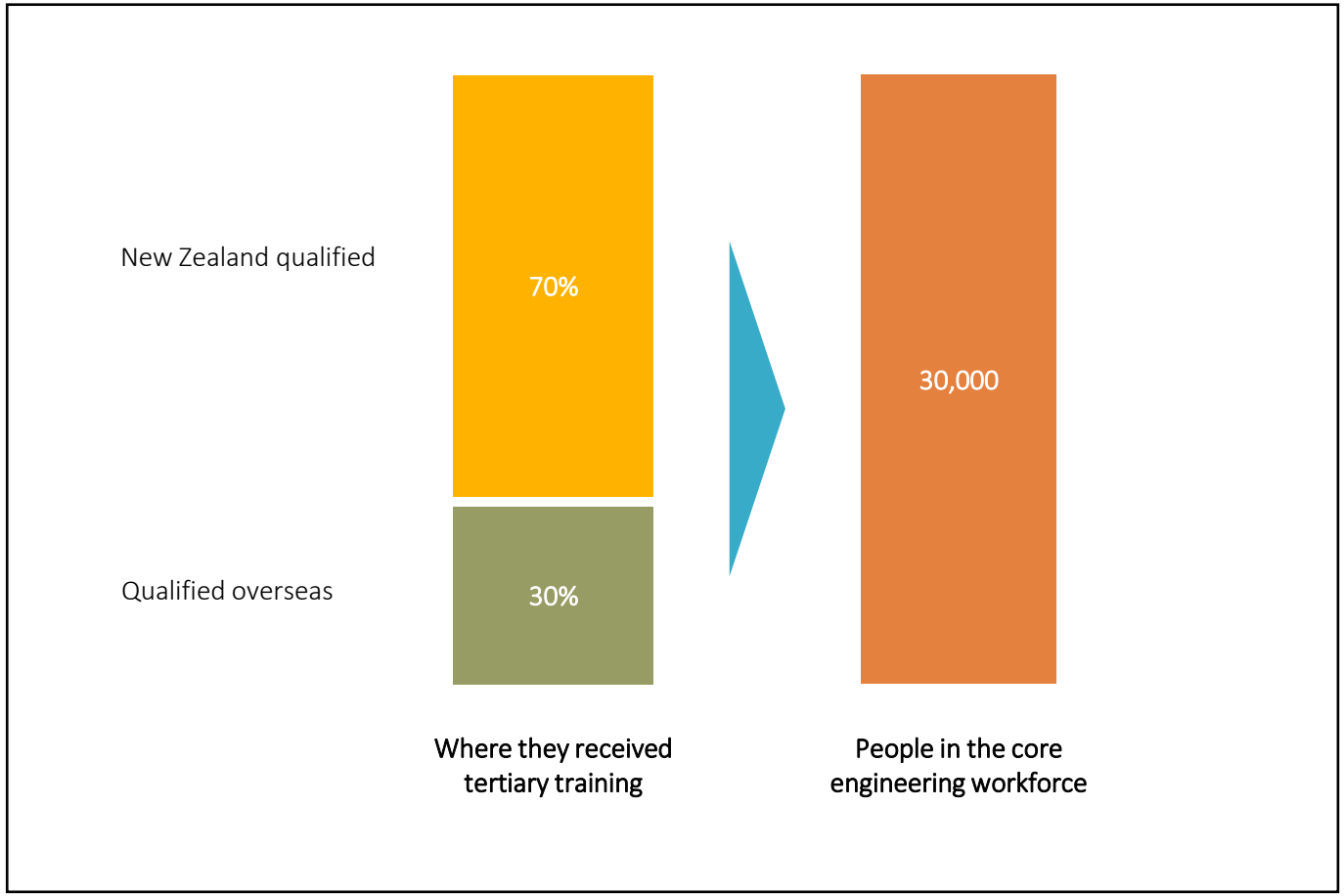
Pathways from diploma to degree engineering training

Insights:

Just over 190 students complete an engineering diploma each year. Of this group, about 15 – 20% of them continue on into an engineering degree (although not necessarily straight away). Note that this analysis does not determine whether those that progress also *complete* the degree.

It does, however, suggest that there is considerable volume of people choosing this pathway already, but also the potential to entice more of those 190 each year into the degree – either through current programme structures or 'earn while you learn' models.

Pathways from immigration to the workforce



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Pathways from immigration to the workforce

Insights:

Much of the analysis in this section so far has looked at the pathway through the New Zealand tertiary training pathway. We also acknowledge that a large proportion of the current engineering workforce undertook their tertiary engineering training overseas (we estimate about 30% of the workforce).

Although the international market is often considered when trying to fill skills gaps in a workforce quickly, the proportion coming from local sources should be prioritised for long-term workforce planning.

Workforce size

ANZSCO* core occupation codes within scope

Occupation L4 group	Occupation L5 code
Chemical and Materials Engineers	233111 Chemical Engineer
	233112 Materials Engineer
Civil Engineering Professionals	233211 Civil Engineer
	233212 Geotechnical Engineer
	233214 Structural Engineer
	233215 Transport Engineer
Electrical Engineers	233311 Electrical Engineer
Electronic Engineers	233411 Electronics Engineer
Industrial, Mechanical and Production Engineers	233511 Industrial Engineer
	233512 Mechanical Engineer
	233513 Production or Plant Engineer
Mining Engineers	233611 Mining Engineer (excluding Petroleum)
	233612 Petroleum Engineer

Occupation L4 group	Occupation L5 code
Other Engineering Professionals	233911 Aeronautical Engineer
	233912 Agricultural Engineer
	233913 Biomedical Engineer
	233914 Engineering Technologist
	233915 Environmental Engineer
	233916 Naval Architect / Marine Designer
	233999 Engineering Professionals nec
Civil Engineering Draftspersons and Technicians	312211 Civil Engineering Draftsperson
	312212 Civil Engineering Technician
Electrical Engineering Draftspersons and Technicians	312311 Electrical Engineering Draftsperson
	312312 Electrical Engineering Technician
Electronic Engineering Draftspersons and Technicians	312411 Electronic Engineering Draftsperson
	312412 Electronic Engineering Technician
Mechanical Engineering Draftspersons and Technicians	312511 Mechanical Engineering Draftsperson
	312512 Mechanical Engineering Technician
Other Building and Engineering Technicians	312999 Building and Engineering Technicians nec

* https://www.abs.gov.au/statistics/classifications/anzsco-australian-and-new-zealand-standard-classification-occupations/latest-release

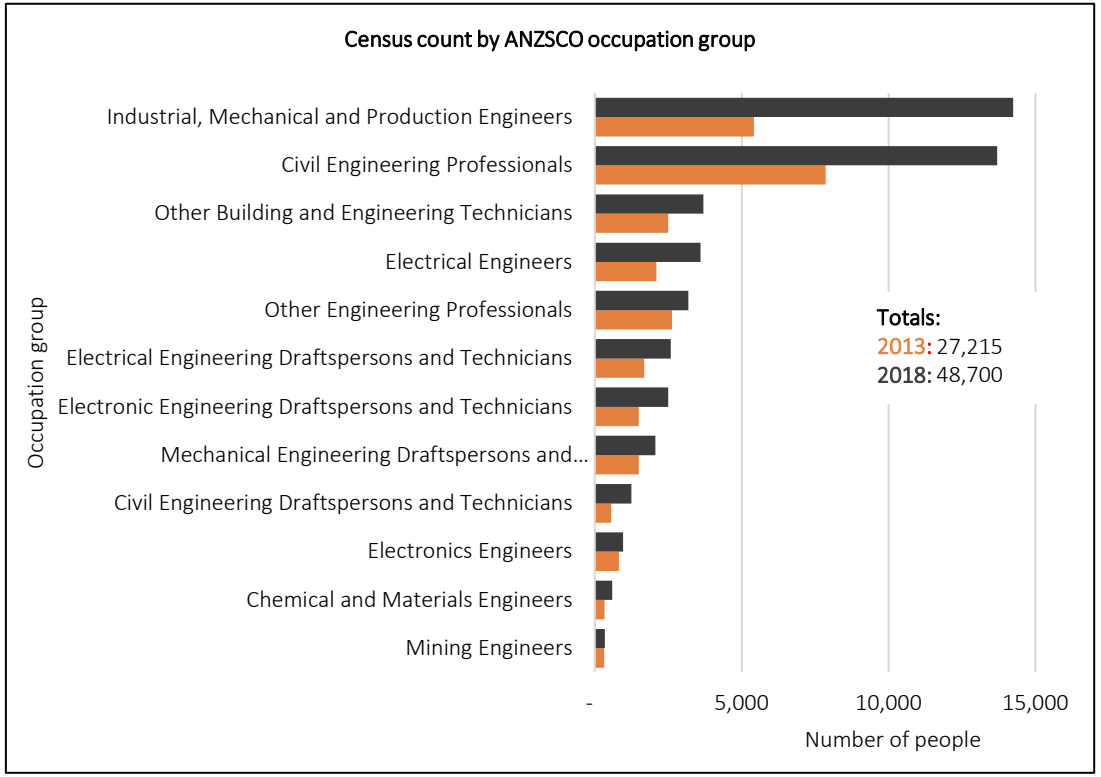
Other ‘engineering-adjacent’ codes

L5 code	Occupation
133211	Engineering Manager
231212	Ship’s Engineer
261313	Software Engineer
263111	Computer Network and Systems Engineer
263211	ICT Quality Assurance Engineer
263212	ICT Support Engineer
263213	ICT Systems Test Engineer
263299	ICT Support and Test Engineers nec
263311	Telecommunications Engineer
263312	Telecommunications Network Engineer
313212	Telecommunications Field Engineer
323111	Aircraft Maintenance Engineer (Avionics)
323112	Aircraft Maintenance Engineer (Mechanical)
323113	Aircraft Maintenance Engineer (Structures)
323411	Engineering Patternmaker
712311	Engineering Production Worker
839111	Metal Engineering Process Worker

These occupations are not within the core scope of this IDI work but were included in the PWC reporting in 2020 (see Link).

In this document, these codes have been classified as ‘engineering adjacent occupations.’

How many engineers are there?



This chart shows the number of people that described themselves as engineers in the 2013 and 2018 censuses.

Unfortunately, differences in the way that the censuses were run has resulted in quite different totals.

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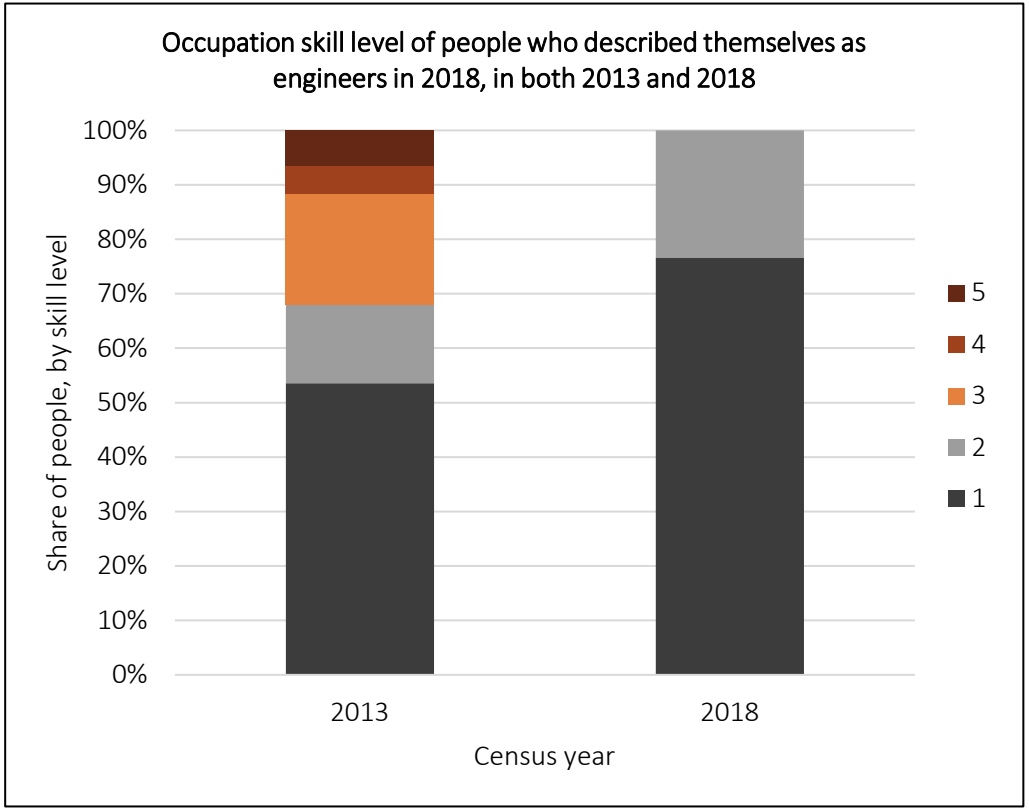
Explanation: Self-reported roles were inflated



A large proportion of people in lower skilled occupations (skill level 3-5) in 2013, appear to have been recategorised as engineers (with skill level 1-2) in 2018

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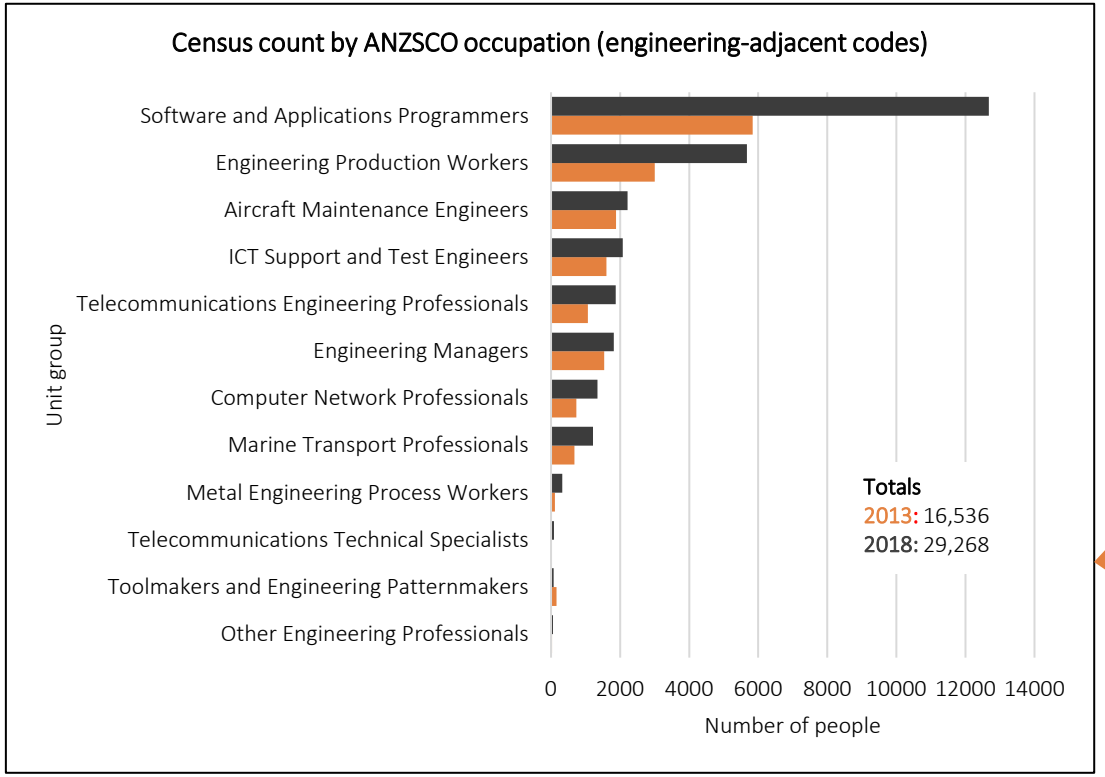
Engineering-adjacent occupation codes



Taking a broader list of occupations, we have an additional 29,300 people

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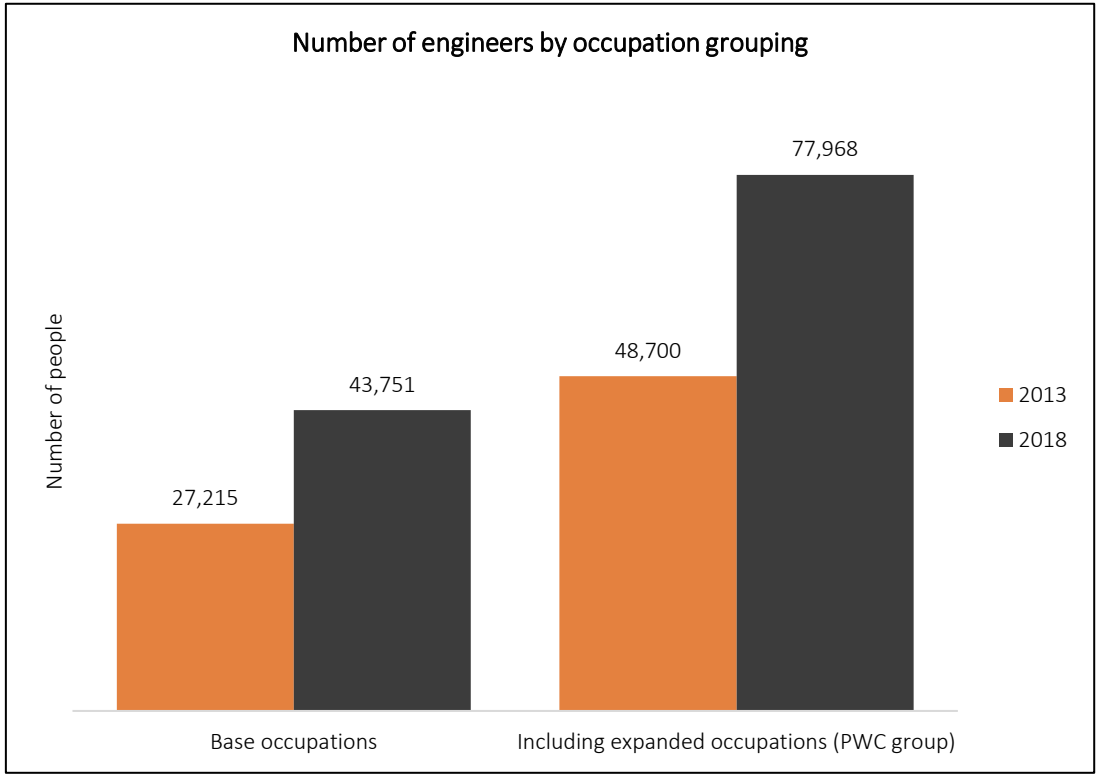
Number of engineers by grouping and census year



The estimate of the number of engineers is sensitive to both the census year and the choice of occupations included

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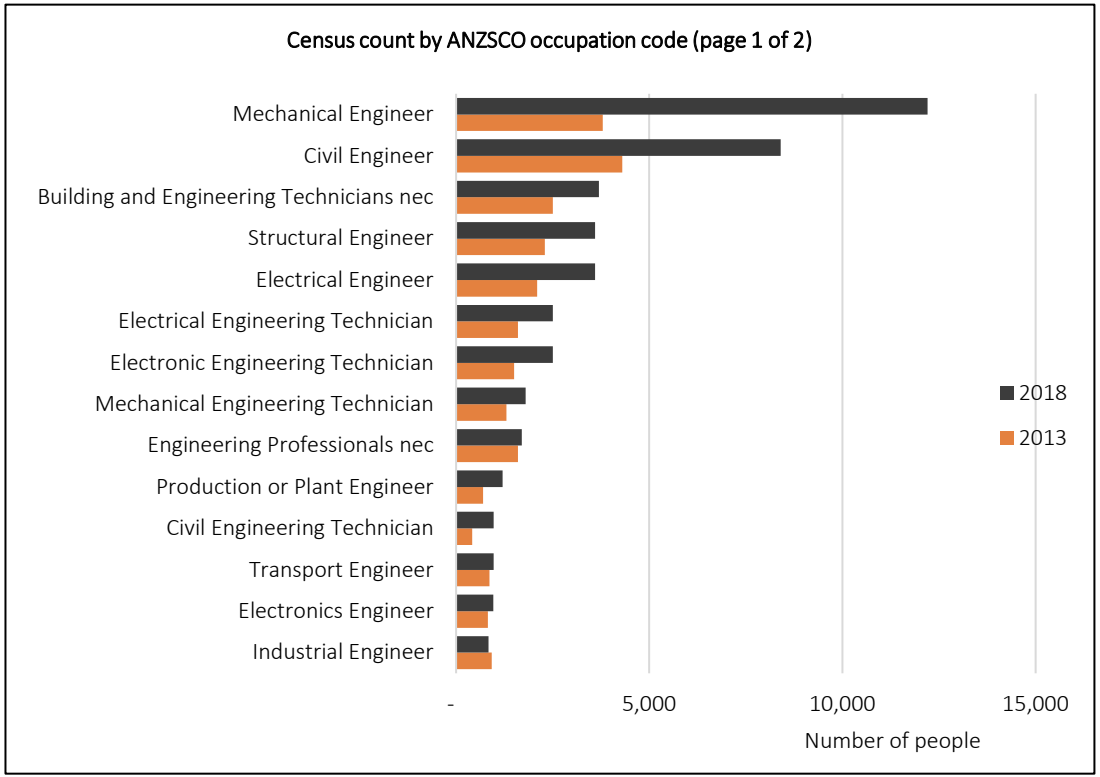
And breaking down by ANZSCO occupations...



We see a large increase in mechanical engineers (from 3,800 to 12,200) and civil engineers (from 4,300 to 8,400) at least partially due to Census classification changes.

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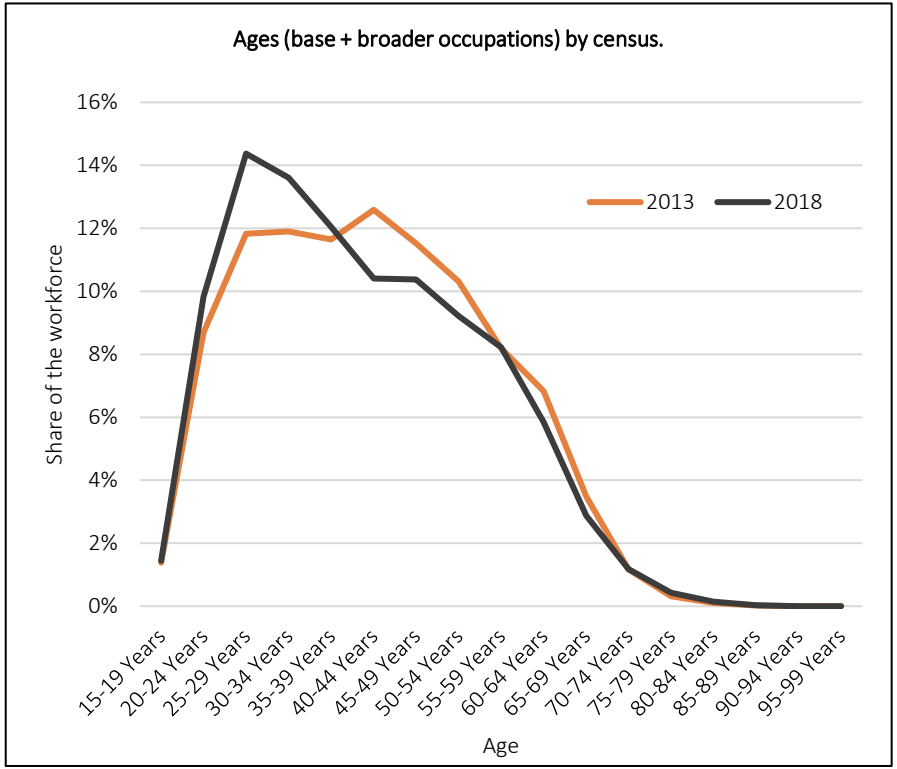
Demographics

Age distribution in 2013 vs 2018



Possible indication of a 'younger' workforce in 2018, but probably negligible amount and likely to be influenced by the changes categorisation between censuses

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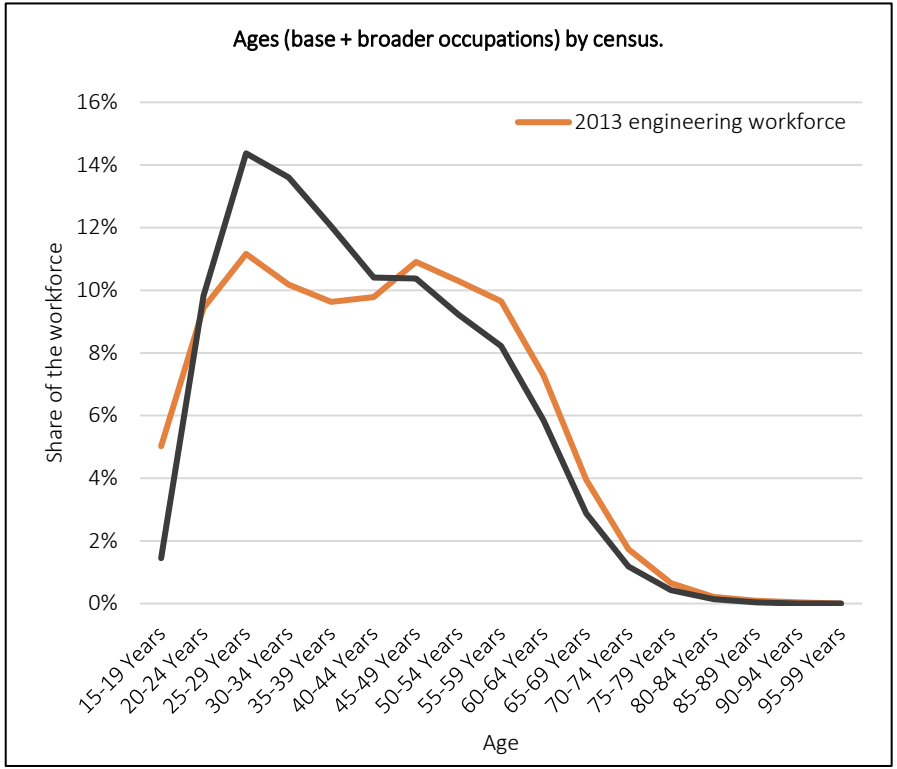
Age distribution in 2018 vs NZ total workforce



The age distribution of the engineering workforce is broadly similar to that of the overall workforce. NB the engineering workforce is calculated using the 2013 census, as in 2018 many people were 'Not Stated'

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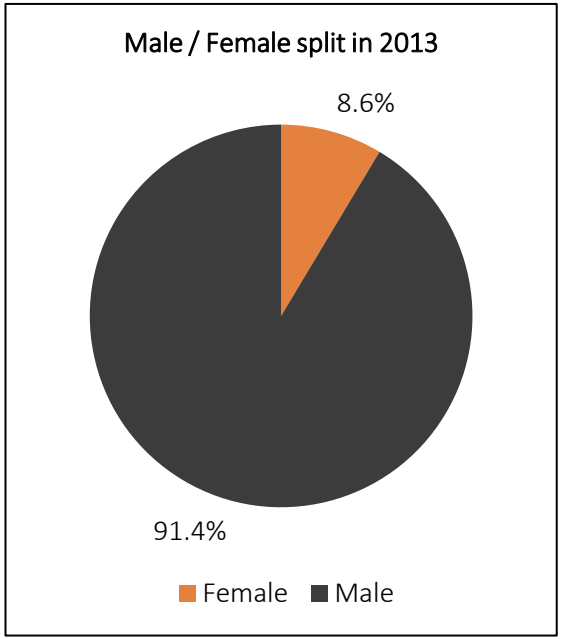
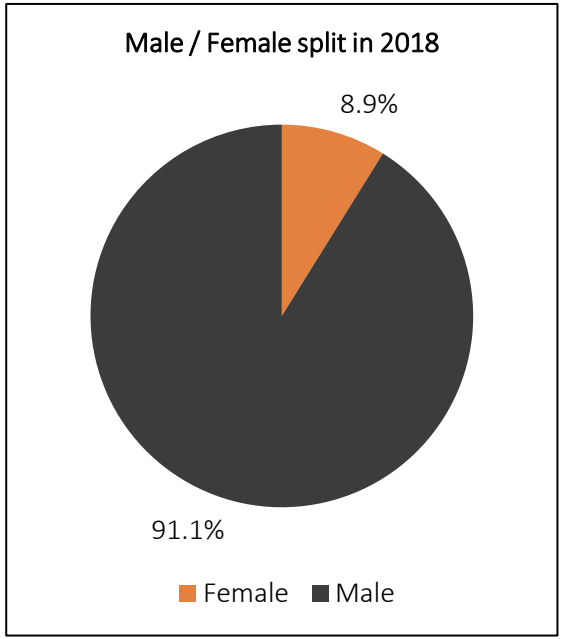
Gender split – base workforce definition





As expected, engineering occupations are largely male dominated (90%).

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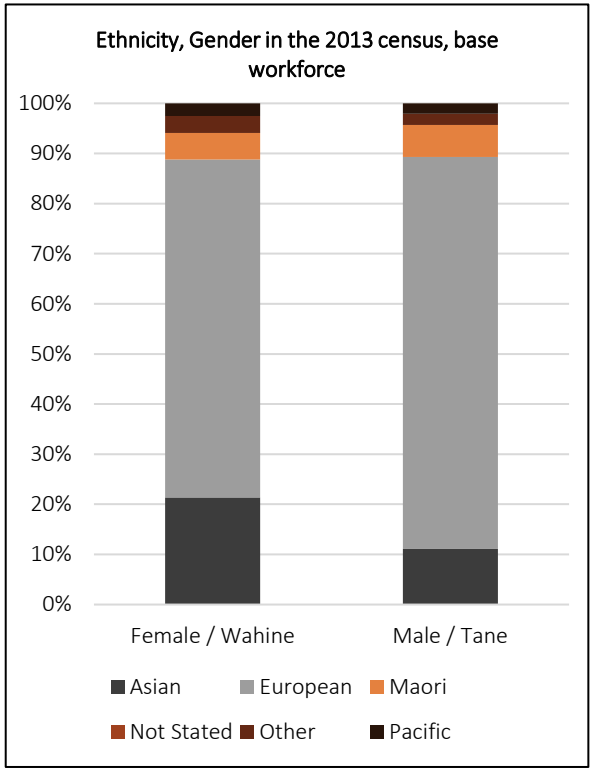
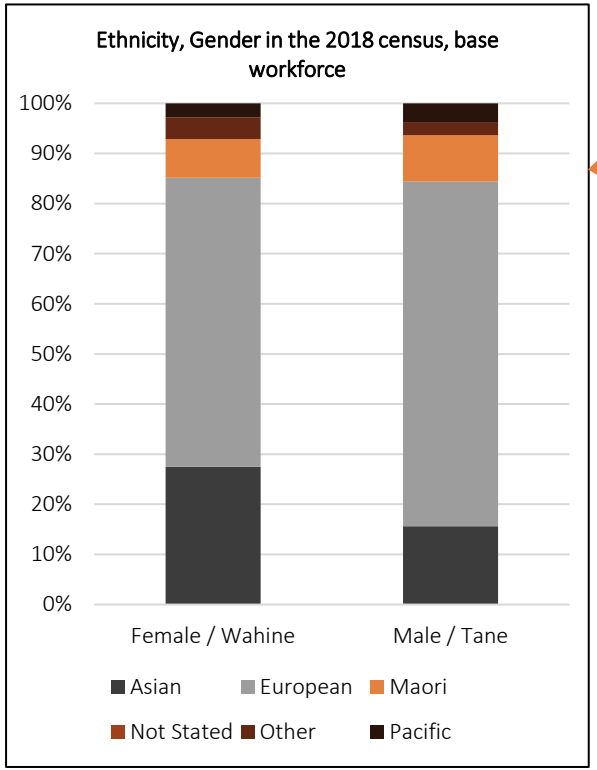
Gender / Ethnicity in our base workforce





70% of the engineering workforce is ‘European’, 9% Māori, and 4% Pacific.

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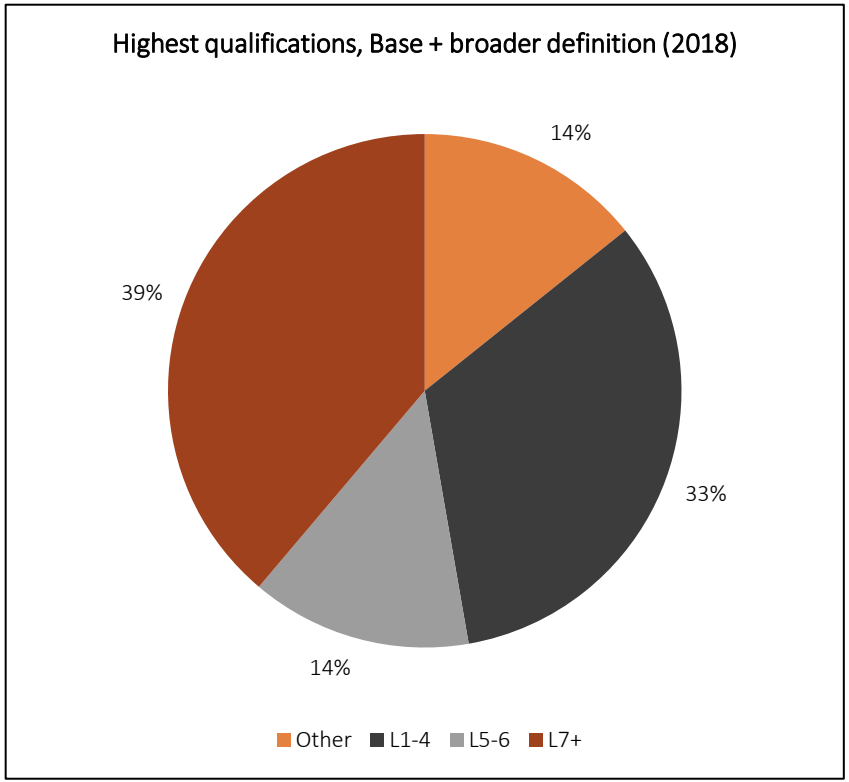
Highest qualification



39% of the engineering workforce have a level 7 qualification (e.g. Bachelor's degree) or higher.

Note though that this percentage is likely to be sensitive to the workforce definition used.

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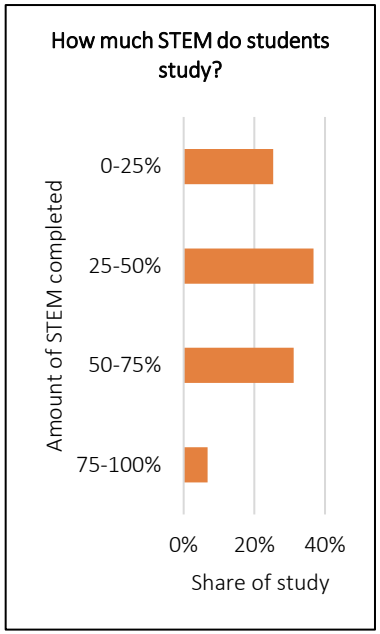
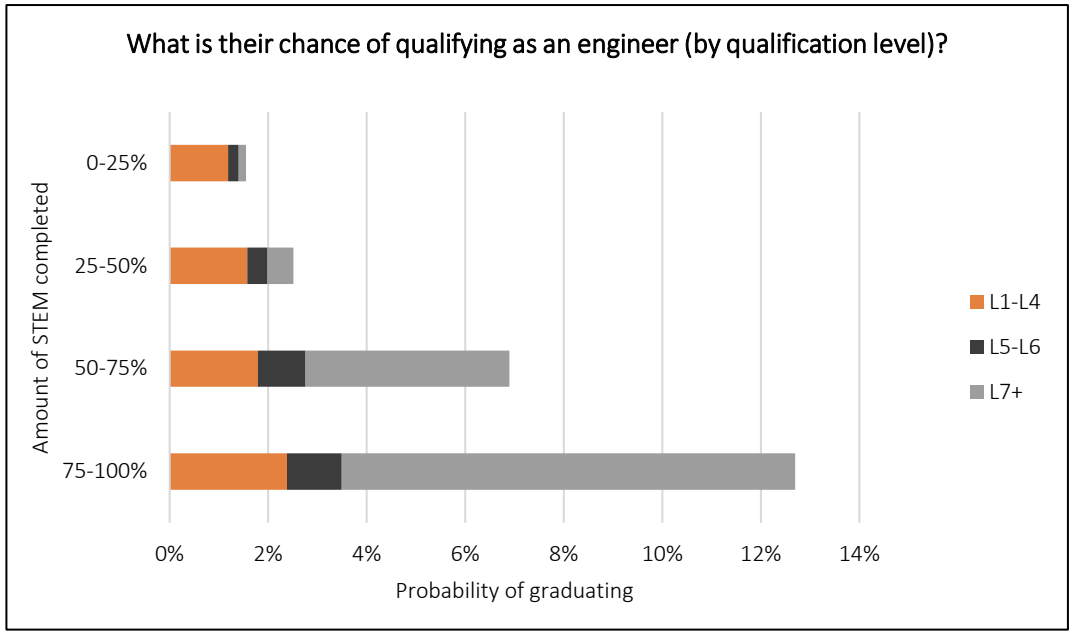
Pathways from secondary school study into engineering

Graduates by amount of STEM in high school





STEM share was based on school leaver's study at level 12 and 13. We take all standards at level 12 or 13 each school leaver was enrolled in for the preceding 2 years. We then look up the corresponding 'learning area code' for each standard. Those with a "Math", "Science" or "Tech" code are counted and divided by the total. We filter out people who were enrolled in fewer than 5 standards over the 2 years.

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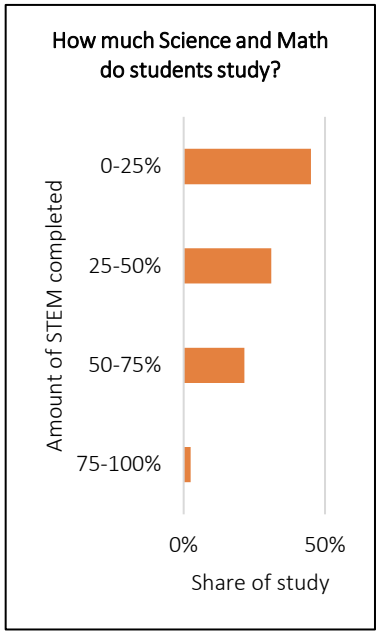
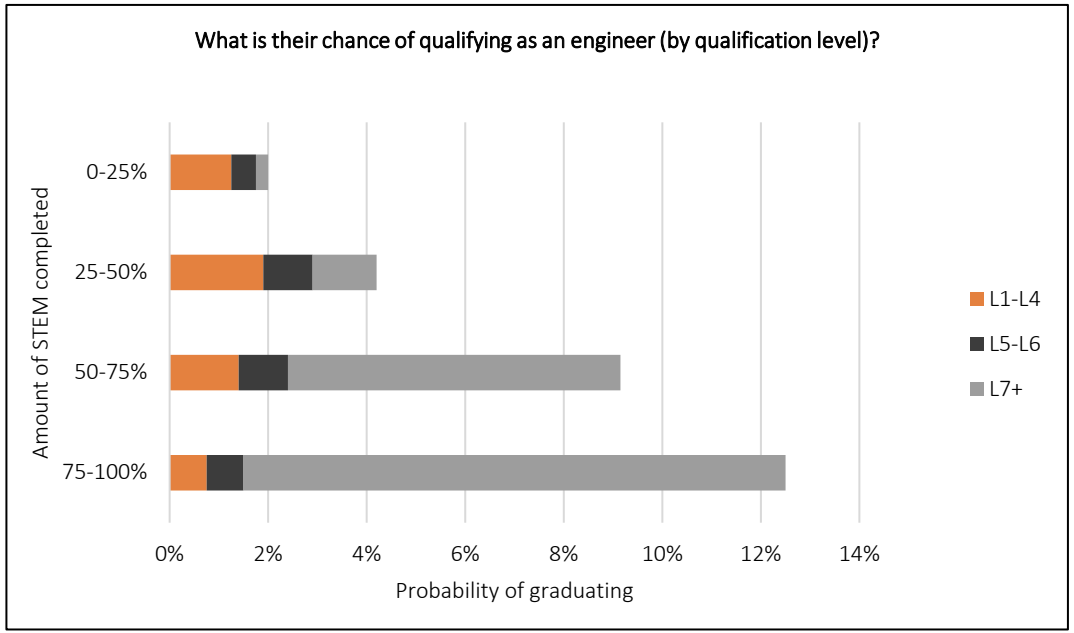
Graduates by amount of Science and Math in high school





A similar result is seen if only “Science” and “Maths” are considered (i.e. “Tech” is removed).

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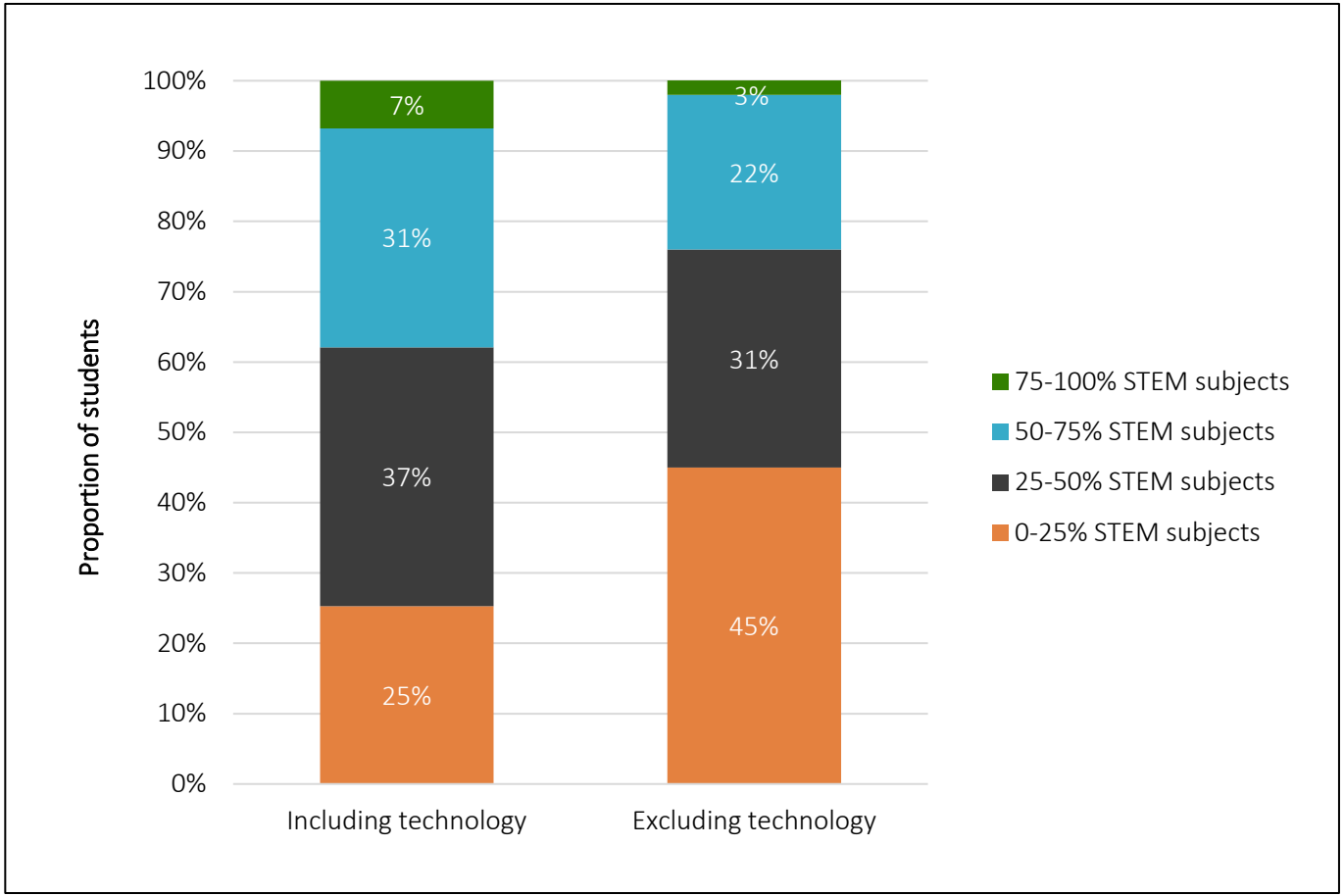
Graduates by amount of STEM in high school



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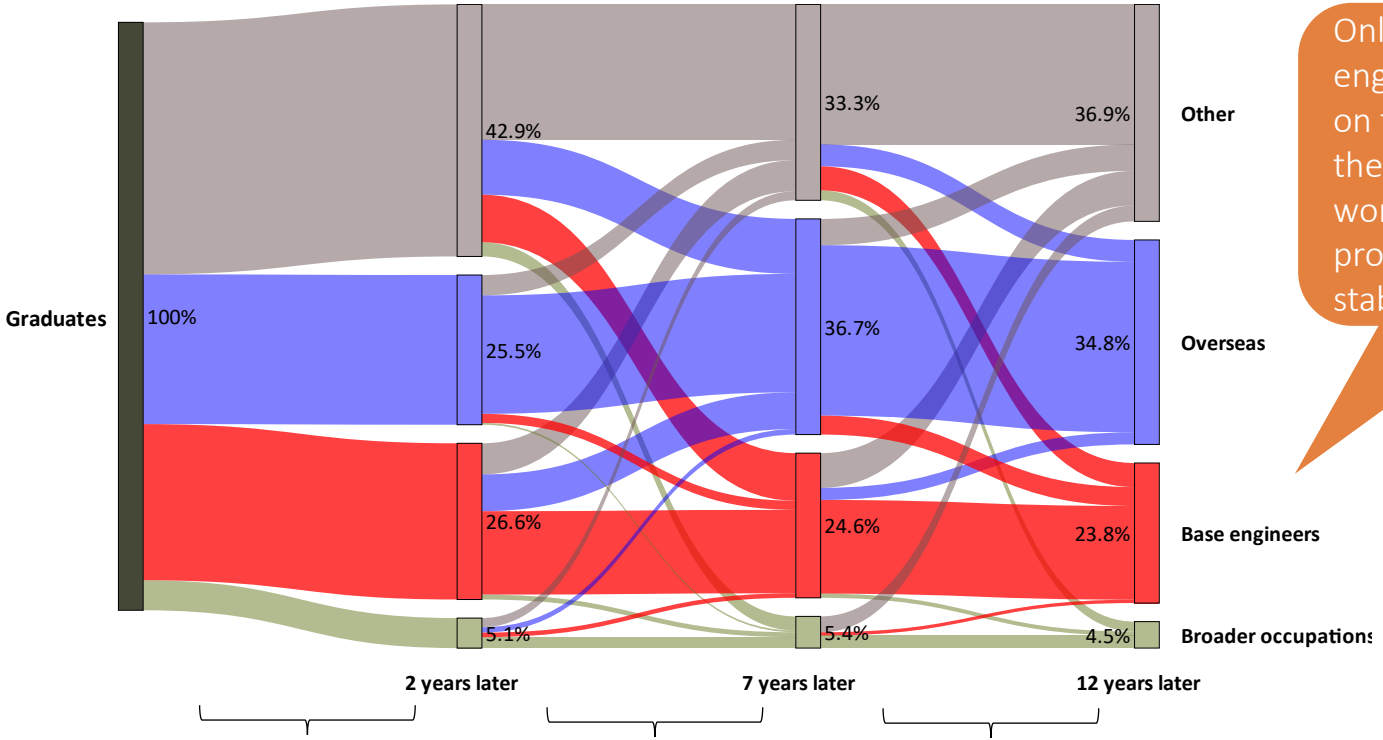
Pathways from tertiary study into engineering work

Graduate pathways – L7+ (2018)



Only about 25-30% of engineering graduates go on to become members of the core engineering workforce. However, this proportion stays relatively stable over time.

2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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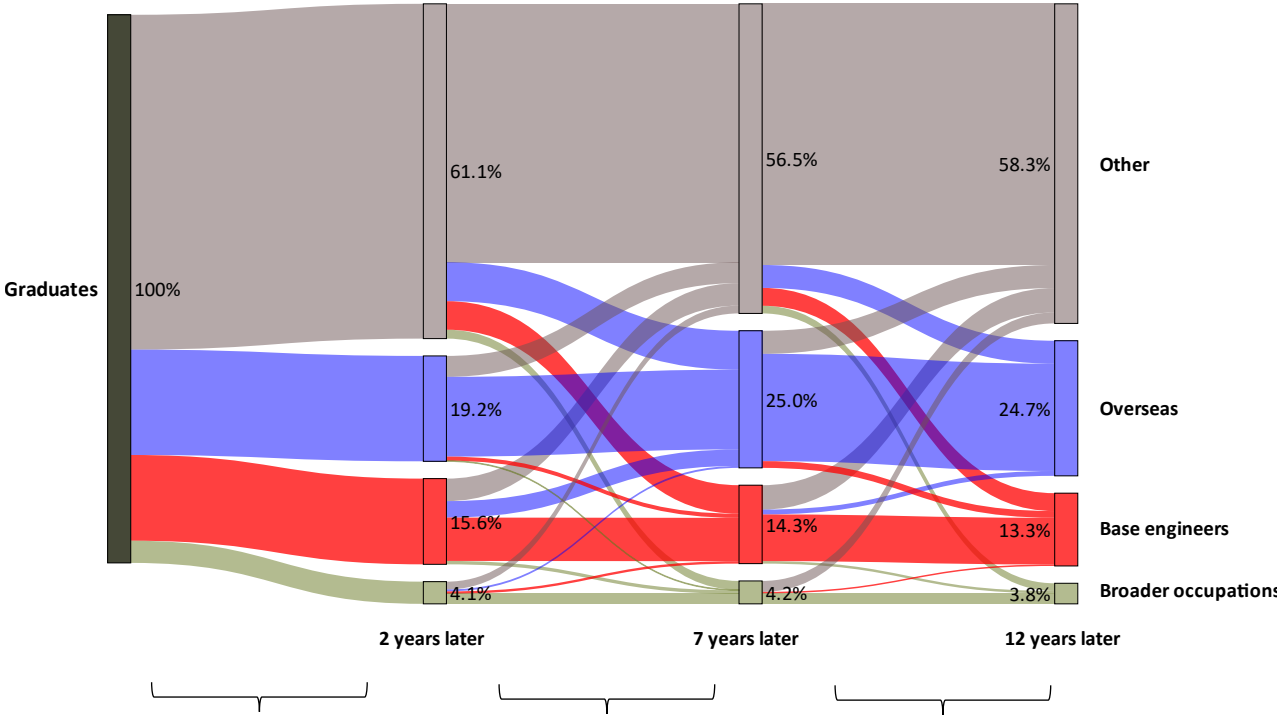
Graduate pathways – All levels (2018)



2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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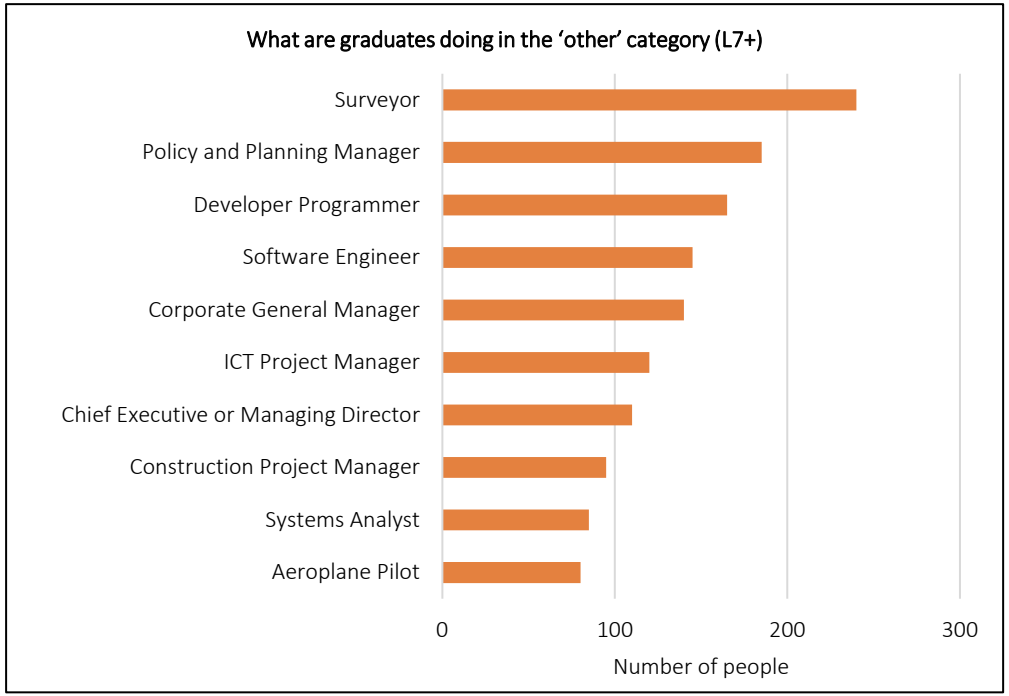
What are those ‘other’ roles? – L7+



Many of the engineering graduates not in the core engineering workforce are in engineering-adjacent roles.

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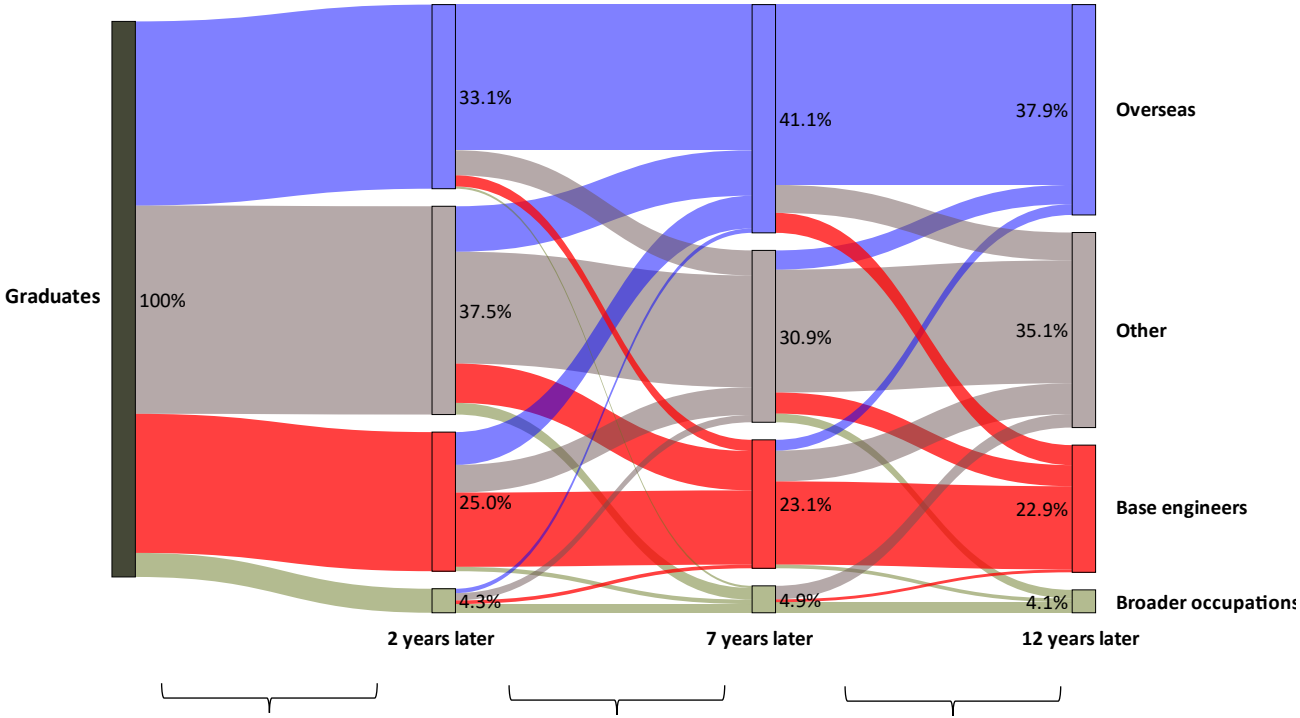
Graduate pathways – L7+ (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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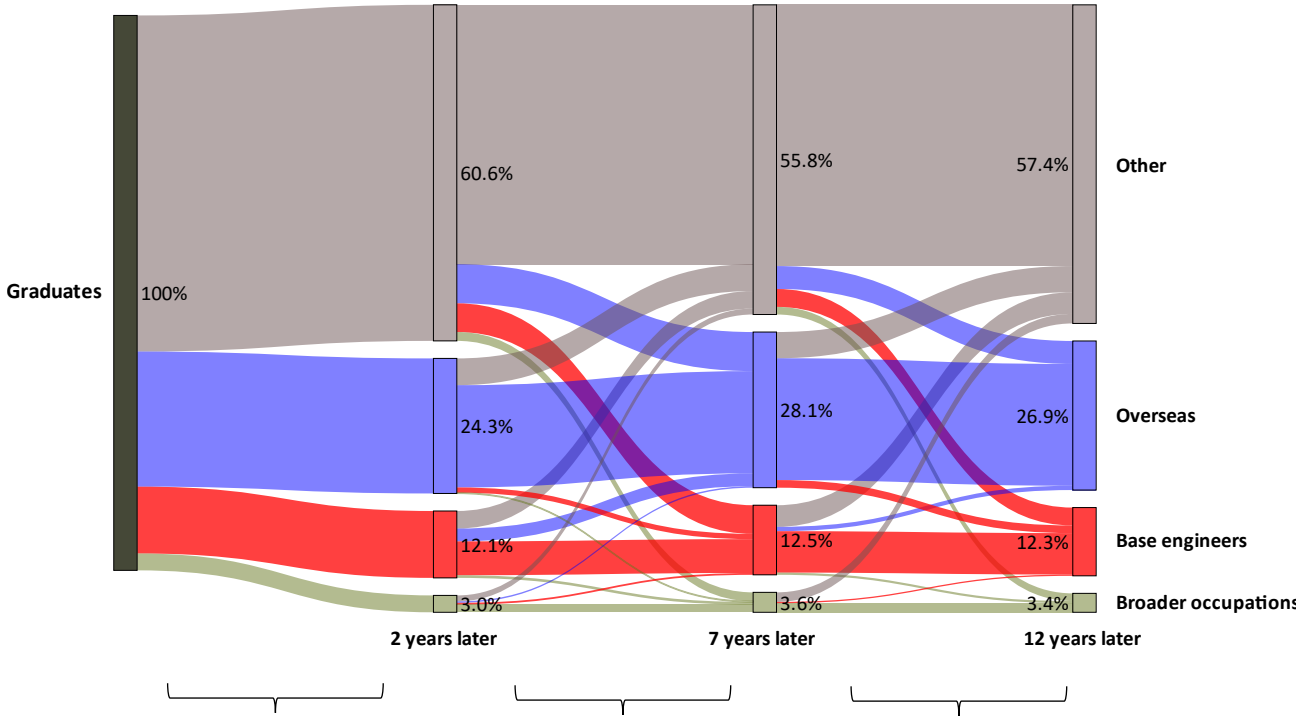
Graduate pathways – All levels (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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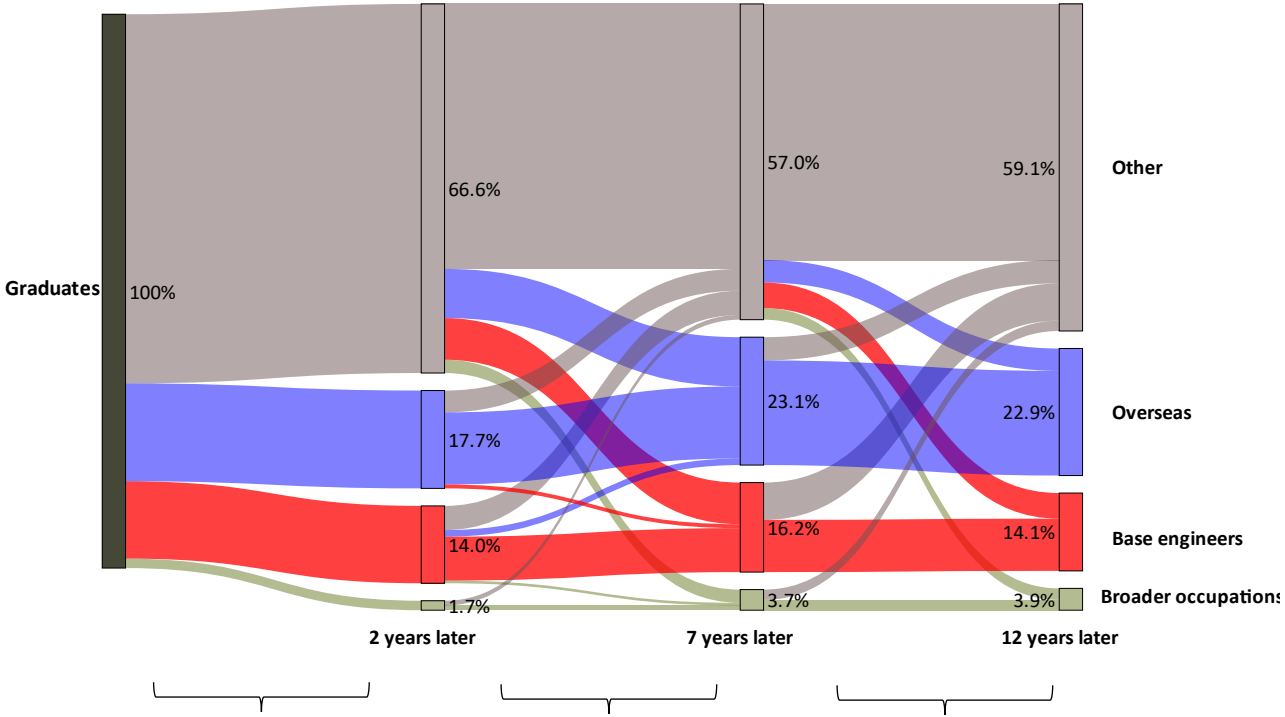
Graduate pathways – L5-L6 (2018)



2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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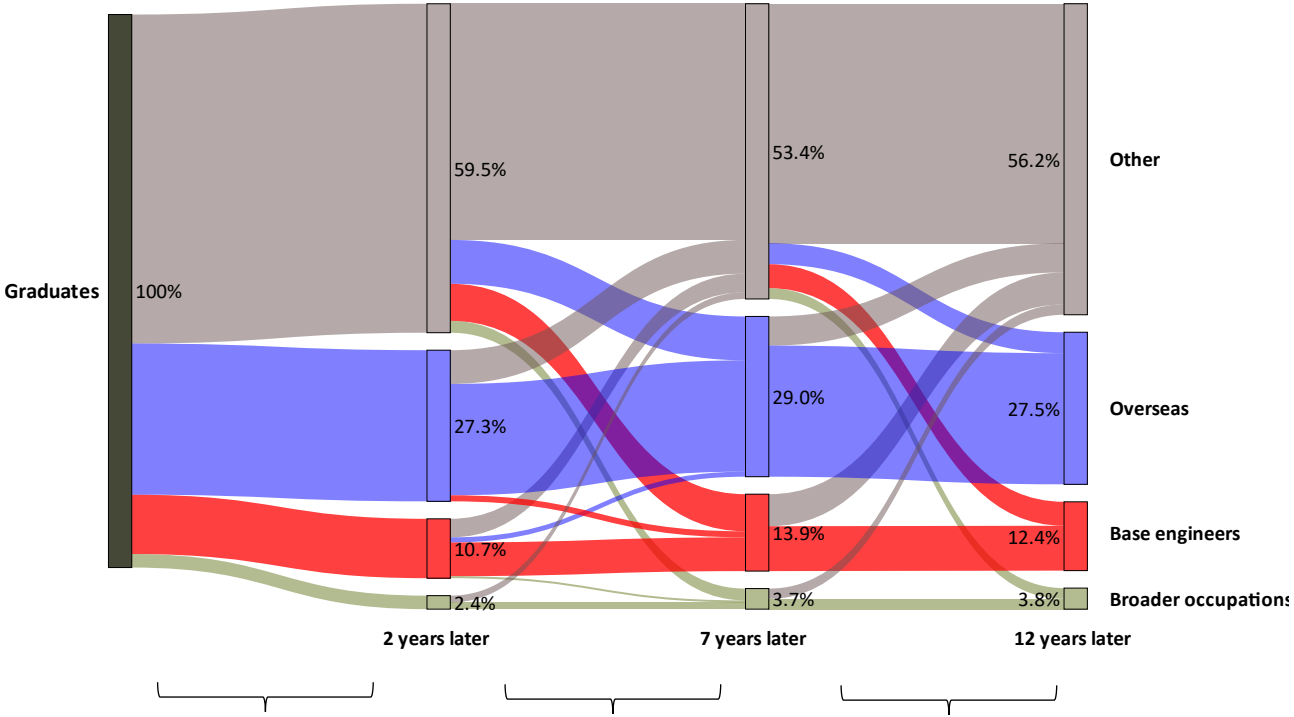
Graduate pathways – L5-L6 (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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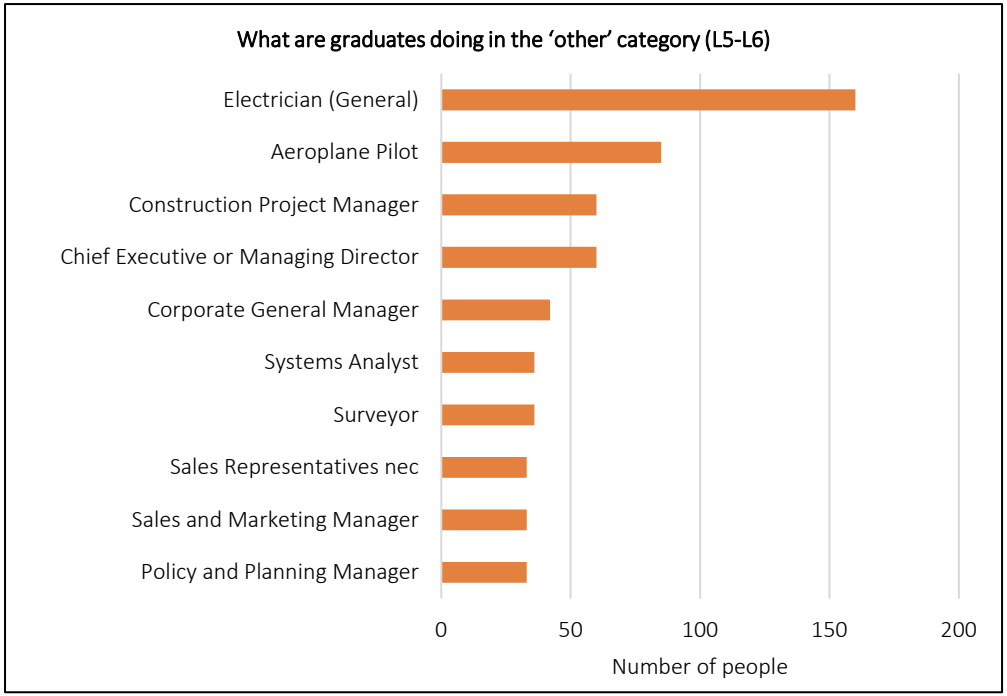
What are those ‘other’ roles? – L5-L6



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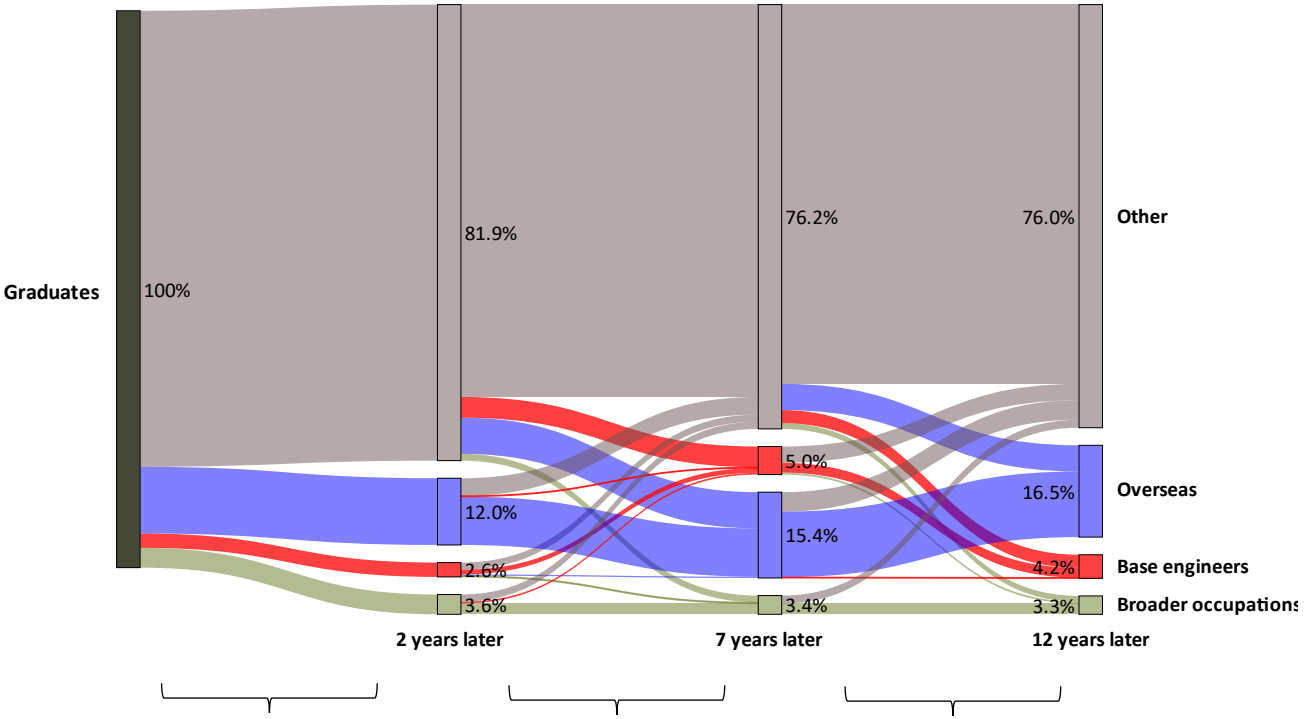
Graduate pathways – L1-L4 (2018)



2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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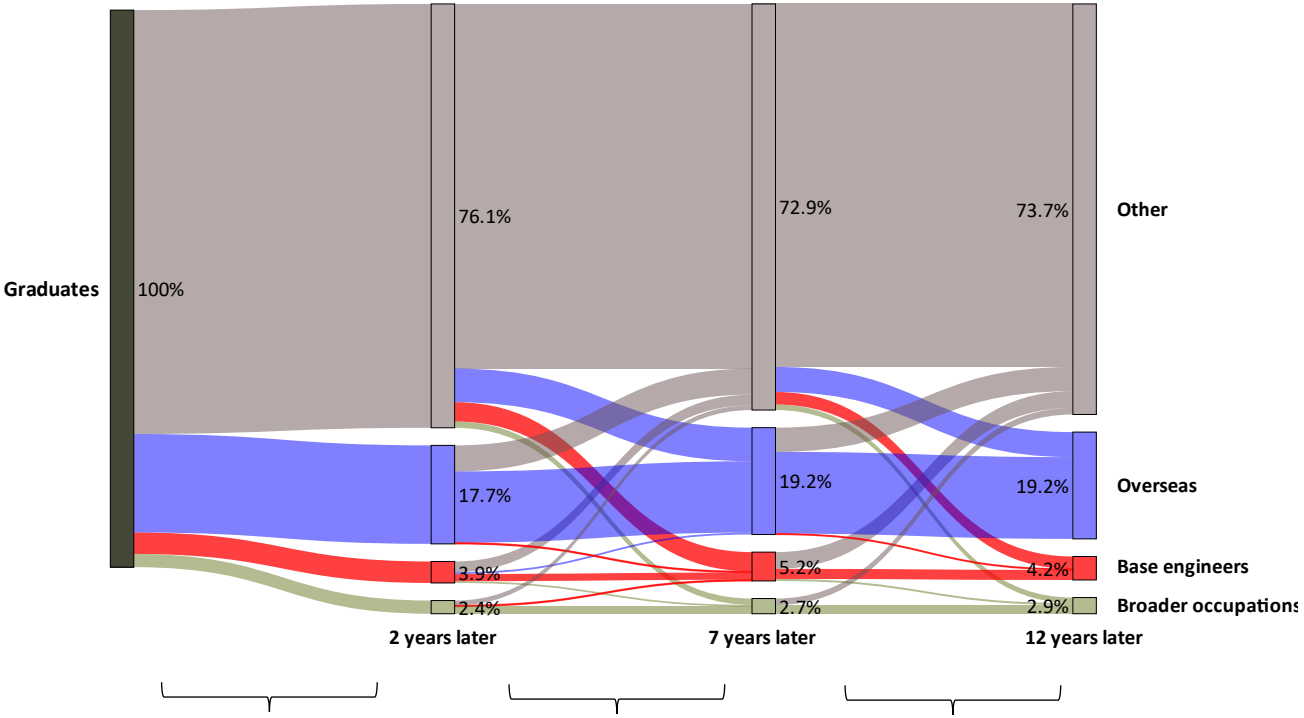
Graduate pathways – L1-L4 (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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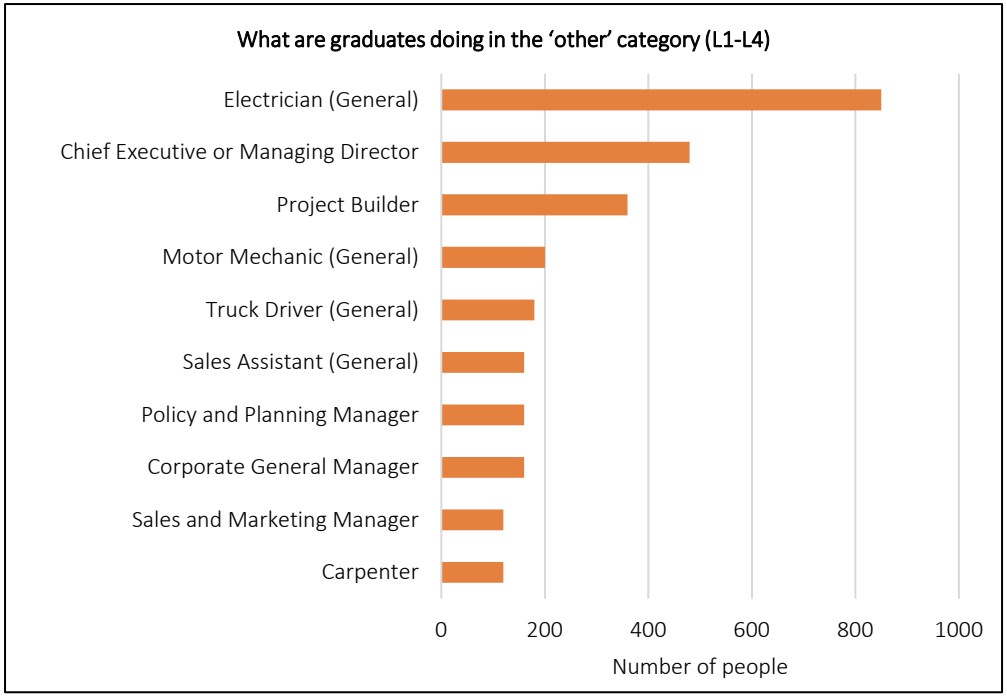
What are those ‘other’ roles? – L1-L4



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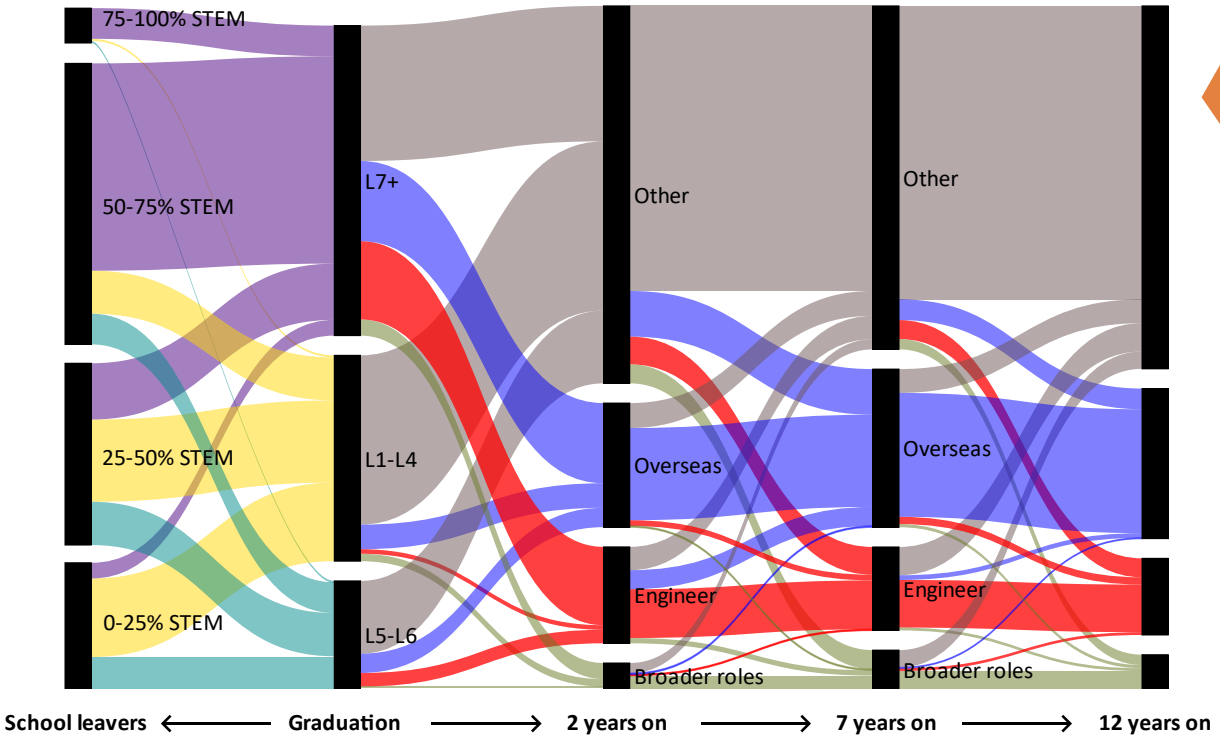
Graduate pathways – combined (methodology notes)



This is our estimate of the overall flows, based on the charts above.

Almost all of the core engineering workforce is drawn from school students with a STEM component above 50%.

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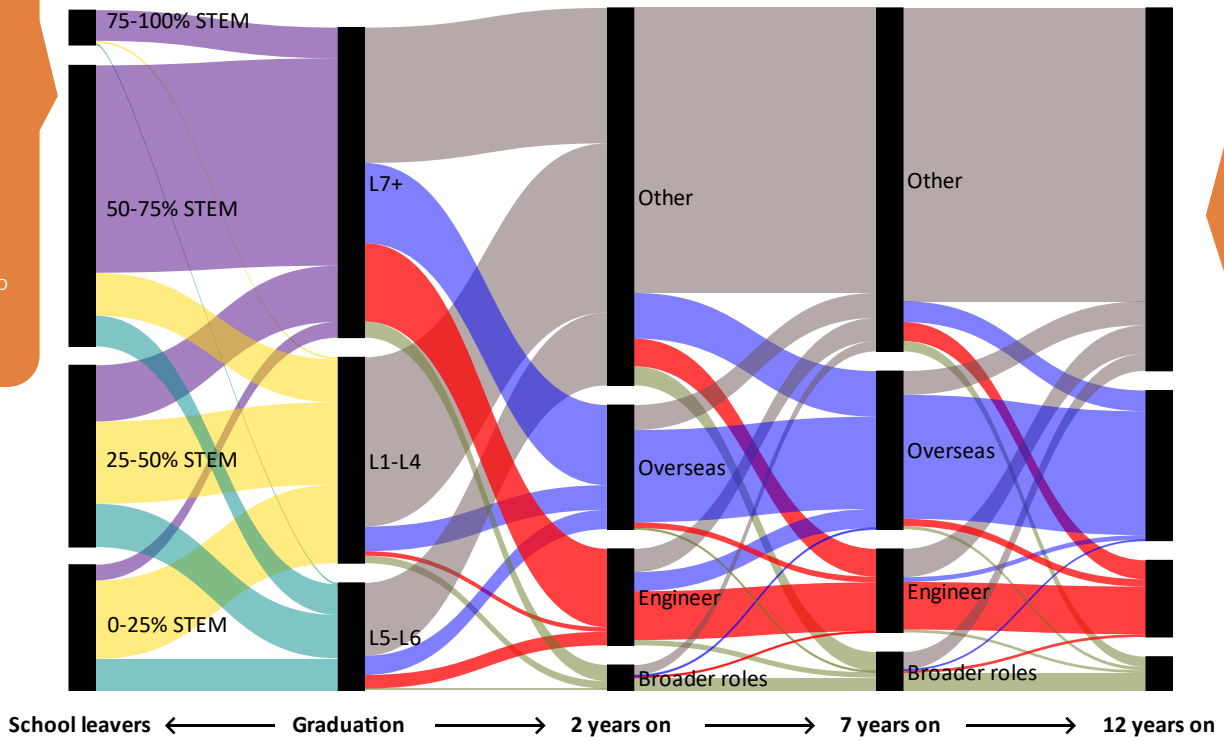
Graduate pathways – combined (methodology notes)

These numbers are going BACK from the graduates, not forward. This chart is missing all the people who leave school and then don't go on to graduate in engineering.



This is our estimate of the overall flows, based on the charts above. We have made a few assumptions:

1. Of the people who graduate at L7+, 5% who say they are engineers are in fact not.
2. Of the people who graduate at L5-L6, 10% who say they are engineers are in fact not.
3. Of the people who graduate at L1-L4, 15% who say they are engineers are in fact not.
4. Overall, 8% of the people who say they are engineers in the 2018 census are not.

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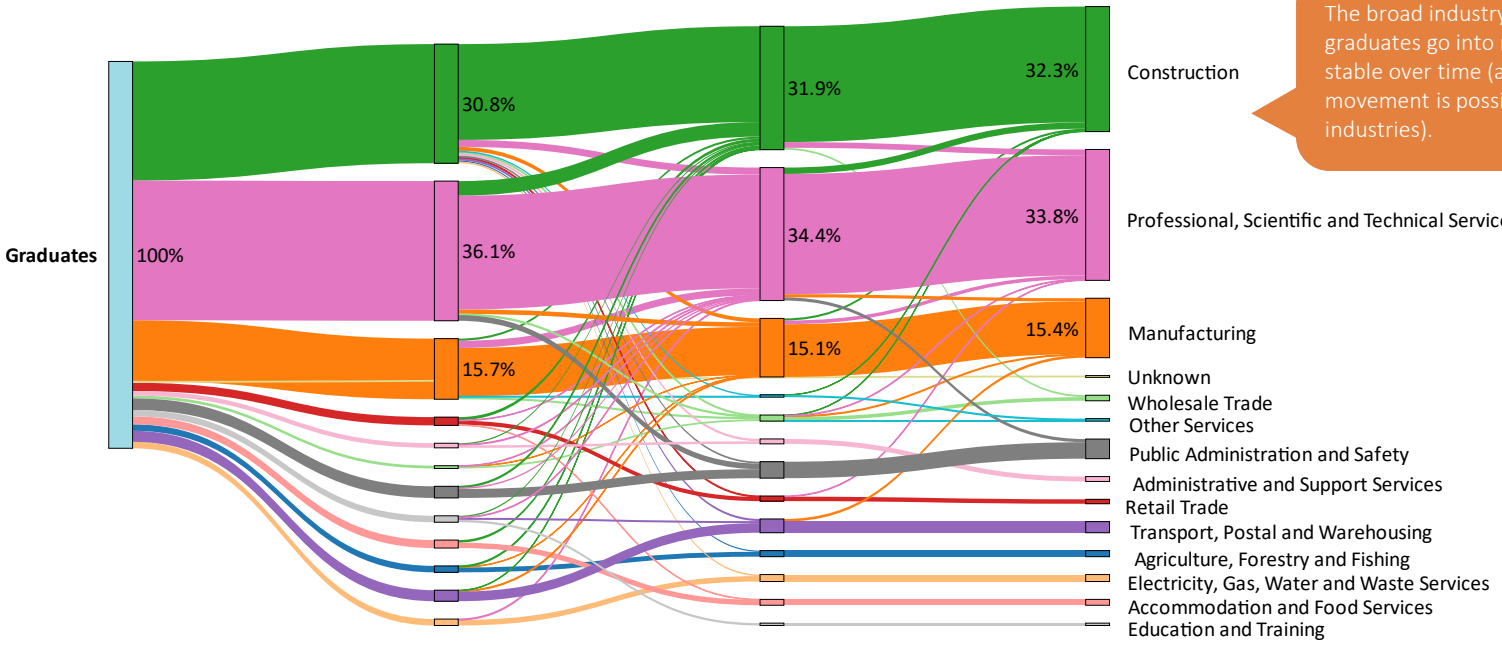
Graduate pathways – ANZSIC broad (2018)



The broad industry fields that graduates go into remain very stable over time (albeit lots of movement is possible within industries).

2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

Very small links are not shown

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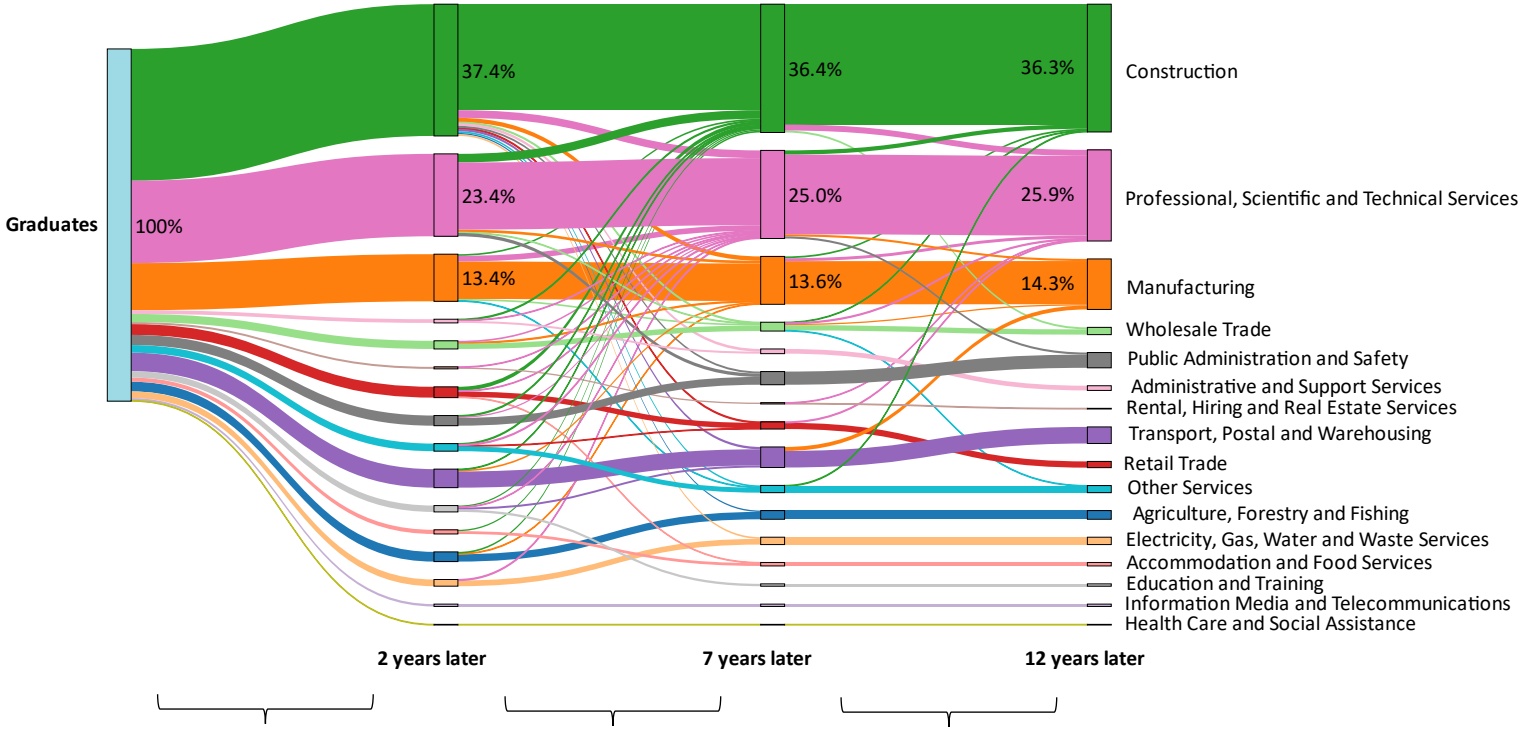
Graduate pathways – ANZSIC broad (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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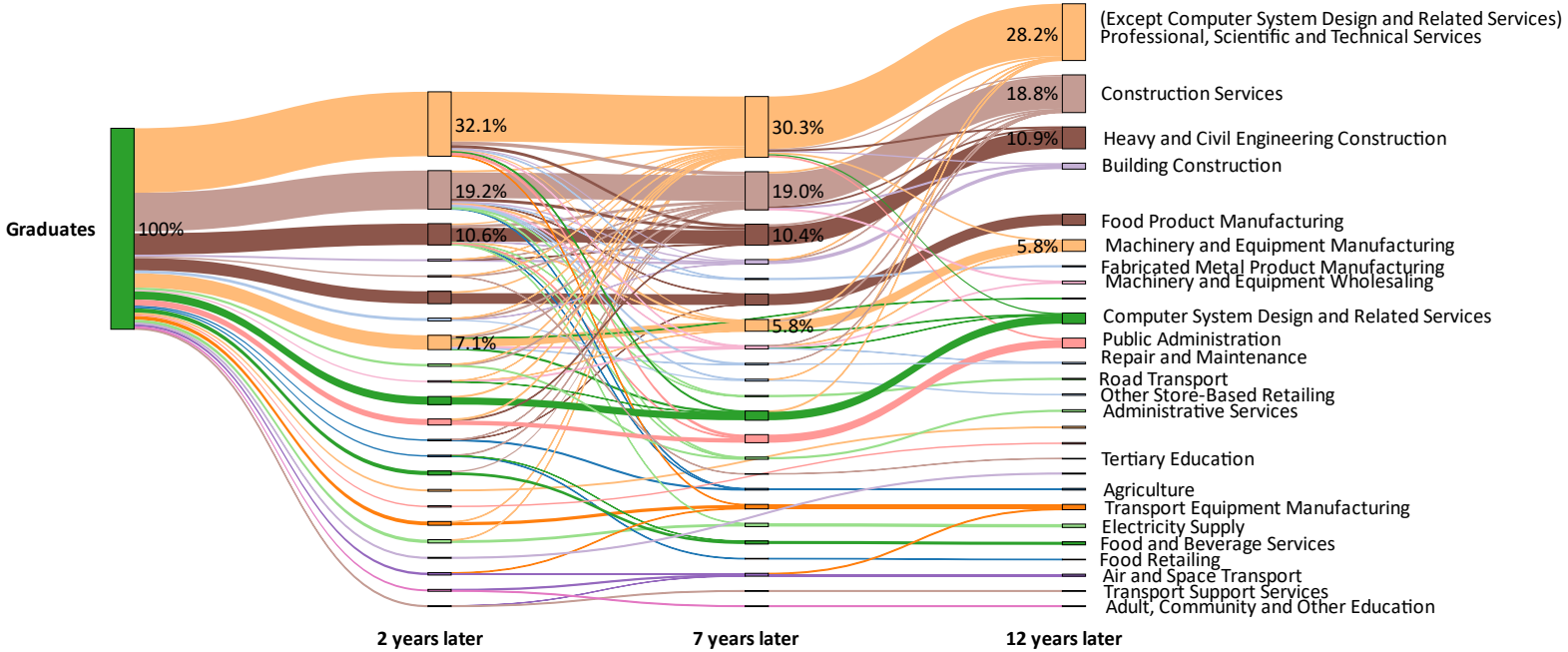
Graduate pathways – ANZSIC more specific (2018)



2015-2017 cohort in 2018

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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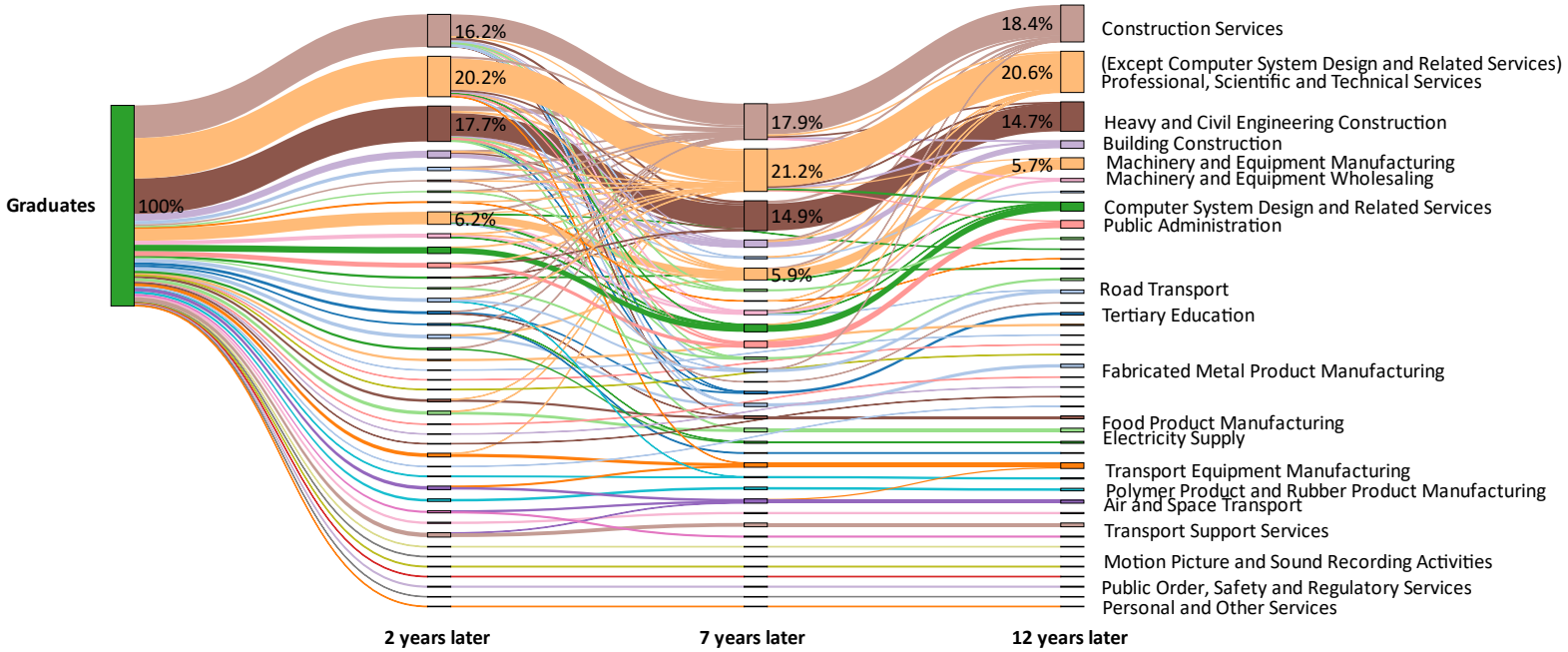
Graduate pathways – ANZSIC more specific (2013)



2010-2012 cohort in 2013

2010-2012 cohort in the 2013 & 2018 census.

2005-2007 cohort in the 2013 & 2018 census.

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