The Engineering Profession:

A statistical overview

ENGINEERS
AUSTRALIA

Fifteenth Edition

Acknowledgement

This report provides in-depth analysis and insight about the engineering profession in Australia. It has the potential to inform strategies to strengthen the engineering profession and workforce in Australia at a time when the profession is playing a critical role in shaping a more sustainable future. This report builds on the enormous amount of work done in previous years by others.

This 15th edition is dedicated to Emeritus Professor Robin King who contributed his knowledge, skills, insight and judgement over many decades to our profession. Robin passed away in July 2022 but his commitment and love for our profession lives on, through inspiring our work to understand, evolve and strengthen the engineering profession not only in Australia but globally.

The Engineering Profession: A Statistical Overview Fifteenth Edition

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‘Change is inevitable. Growth is optional.’

Foreword

As we consider the transformational changes required to create a sustainable, safe, energy efficient world, engineers are already and will increasingly become more critical. Why? Because the engineering profession touches almost every aspect of life.

Since 1919, Engineers Australia has built on the responsibility to advance the practice and science of engineering in Australia. As the nation’s engineering peak body, our membership of 120,000 professional engineers, engineering technologists and engineering associates, are committed to growing healthy and safe communities that will sustain and prosper.

We have been doing so for 104 years and are very aware that we will need to up the ante as we face an increasingly demanding and complex future. As engineers, we are charged with using scientific and mathematical principles together with engineering methods to plan, design, build, commission, operate, maintain, decommission and recycle machines, buildings, infrastructure products, materials, systems and services that enable most aspects of our modern lives.

It is worth noting that engineering is derived from the Latin ingenium, (c1250) meaning ‘cleverness, or ‘innate quality, especially mental power’. Its verb, ingeniare, means ‘to contrive or devise’, and thus creates the noun and its output, ‘a clever invention.’[i]

Into the future, we will need all this ingenuity, ‘mental power’, and ‘clever invention’ to deal with what lies ahead of us as a nation. As the natural, manufactured, and digital worlds increasingly converge, the need to understand them and the impact of their intersections, leads us to determine how to leverage their value. Our purpose is to build a sustainable future.

In 1965 Gordon Moore noted ‘that engineers had an amazing capability to double the processing power of the chips they were designing at a regular rate.’[ii]

Our role today is to ensure we have sufficient engineers to continue to do this and to do it responsibly - to use their ‘ingenuity’ and help ‘Australia increase its capacity to adapt to our new world of accelerated change.’[iii]

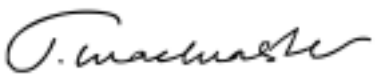
We chose the headline quote above from leadership thinker John C. Maxwell because we must ensure we have all the building blocks in place to move forward, given ‘Change is inevitable.’ And we must continue to be mindful that ‘growth is optional.’ To grow (in the broadest sense of the word), we have to be able to shape the future world ethically and responsibly and competently, and make sound decisions in the most efficient and effective ways possible. Data can help ensure these decisions are informed.

Engineers Australia publishes this report after the census data becomes available every five years. Like previous editions, it provides important high-level insights about the engineering workforce including trends (this edition covers the 2016-2021 census surveys) and demonstrates how engineers touch almost every aspect of life, identifies the challenges ahead and the achievements we’ve made as a profession. Thanks to the evolution of data analytical tools in the last five years, this 15th edition is particularly ground-breaking. We have complemented this report, which provides high level insights, with an interactive dashboard that allows any user to dive right into the data, to explore it at levels of granularity that have not been possible before. We hope you enjoy the data as much as we have.

The Overview also gives us the empirical data we need to make the necessary big decisions to develop an engineering workforce that will be the backbone of a sustainable, safe, and energy efficient future.

We look forward seeing how this data and analysis is used to provide greater insights into the profession.

Romilly Madew AO *FTSE HonFIEAust EngExec*
Chief Executive Officer, Engineers Australia



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Executive summary

This report presents and analyses statistics for the engineering profession in 2023, predominantly sourced from the Australian Bureau of Statistics 2021 Census data, of which the most relevant components were released in October 2022. Census data is supplemented by the latest education and migration datasets to provide statistics and additional insights into the sources of Australia's engineering workforce in 2023.

We examine the population of qualified engineers in Australia (those with an associate degree or advanced diploma, or higher qualification in engineering). We also examine a subset of this population who are working in 'engineering occupations' – a selection of 50 occupations which have a nexus with engineering practice and are at Skill Level 1 or 2 in the Australian and New Zealand Classification of Occupations (ANZSCO).

There are over 545,000 qualified engineers in Australia as of the 2021 Census, with approximately 433,000 in the labour force. We examine the geographic distribution of Australia's engineering workforce and the industries and occupations in which they are employed.

Our analysis finds that over 60 per cent of Australia's qualified engineers were born overseas. The qualified engineering labour force has grown by over 93,000 people in the five years to the 2021 census, over 70 per cent of this population growth is attributable to engineers born overseas.

The proportion of women in engineering has increased to 16 per cent of the qualified labour force (up from 13.6 per cent in 2016) and 14 per cent of the population working in engineering occupations (up from 11.2 per cent in 2016). There are now over 69,000 qualified female engineers in the Australian labour force, of which 74 per cent were born overseas.

There are over 243,000 qualified engineers working in engineering occupations, or around 56 per cent of the engineering qualified labour force. This report identifies a gap in occupational outcomes, with Australian born engineers considerably more likely to be working in an engineering occupation (nearly 65 per cent) when compared to overseas-born engineers (50 per cent), the differential in outcomes has improved since the 2021 census, but there is still progress to be made.

Over 140,000 people work in professional engineering occupations (such as Civil Engineer, Electrical Engineer etc), however only around 107,000 people in these occupations are captured as having engineering qualifications, which speaks to the limitations of census data in identifying Australia's qualified engineers.

We examined the age structure of the profession and find that nearly 50 per cent of Australia's qualified engineers are under the age of 40. We provide estimates on the rates of retirement of engineers based on the labour-force participation rate as it relates to age, with up to 70,000 engineers estimated to retire over the next fifteen years.

We found there were fewer unemployed engineers in 2021 than there were in 2016, both in total numbers and as a proportion of the engineering labour force. This occurred at a time of historically high vacancies for engineers in the Australian labour market. We provide an analysis of skills shortages in the context of these statistics, complemented by projections of future engineering labour market dynamics.

We examine the distribution of qualified engineers and those in engineering occupations at three levels of aggregation within the Australian and New Zealand Standard Industrial Classification, providing insight into the industrial activity of these engineers. The industries with the highest proportions of qualified engineers working in engineering occupations ("Core" industries) are Professional, Scientific & Technical Services, Mining, Information Media & Telecommunications, Electricity, Gas, Water & Waste Services, Construction, Public Administration and Safety and Manufacturing. We investigate the distribution of Australia's qualified engineers within occupations at multiple levels of the Australian and New Zealand Standard Classification of Occupations

The impact of the COVID-19 pandemic is evident, from the significant decline in international student commencements and the elevated numbers of those 'employed, away from work'.

We analyse the nature of change since the 2016 census and distil the implications for Australia - if no additional steps are taken, the growth of Australia's engineering capacity may be limited, which will have broader implications for Australia's economic growth and prosperity.

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SECTION 1

Outlook

Engineering touches almost every aspect of life. We know the engineering profession is crucial when creating better energy solutions. To build the liveable cities of the future, and safeguard communities that are sustainable, secure and prosperous, engineers are and will continue to be indispensable.

As we reflect and take stock of the world's future requirements and how these will be met in sustainable ways, Engineers Australia understands that the scale and pace of action required to achieve our goals is enormous. However, we also know it is possible with engineering.

But this will only be possible if we continue to grow the numbers of our qualified engineers in Australia and use our engineering workforce productively. Armed with the data from this Statistical Overview, we must remove the current barriers that are preventing many engineers who were born overseas from joining the engineering workforce in Australia.

We need to identify and implement initiatives that will increase the opportunities for women engineers to join the profession. We must stem the current losses of professionals exiting our profession to work elsewhere in the economy and retain the qualified engineers over the ages of 40 to 70. We need supportive pathways to ensure that qualified engineers stay in the profession and that workers impacted by the net-zero transition are supported into new career opportunities.

We need to attract more undergraduates to engineering education. Currently only 8.5 per cent of graduates in Australia have an engineering qualification – the sixth lowest proportion in the OECD countries.

These roadblocks and others that we will find in the comprehensive statistical charts below, must be systematically dealt with. This is the only way we will achieve the solutions we need to meet the economic, social and in particular environmental requirements, necessary for a more sustainable and resilient world..

Advancing society through great engineering.

Overview

The engineering profession data dashboard

The Engineers Australia Statistical Overview 2016-2021 helps us to build a broad, deep and rich understanding of Australia's engineering profession. The data is for the first time more accessible via an interactive data dashboard implemented using Microsoft Power BI. This dashboard lets you delve into the data that most interests you. It can also direct you to even more data available to complement each section of the report. There are additional datasets that the overview does not speak to (such as hours of work, salaries, places of work etc) that will be analysed in subsequent publications.

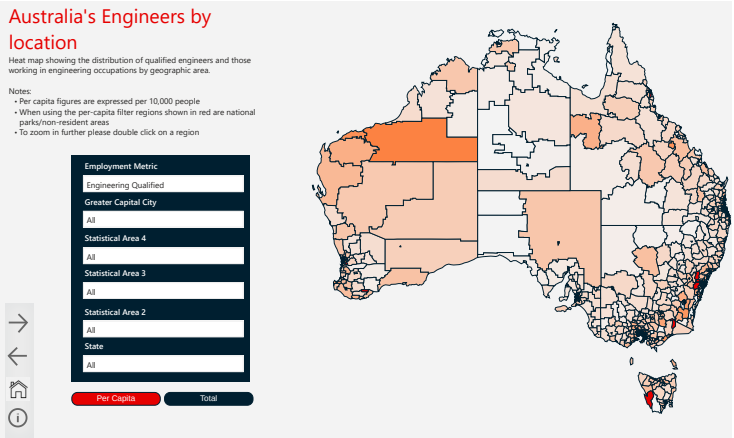


Figure 1: Sample report available via the data dashboard

We use ABS definitions and statistical classification systems as far as possible. We also draw on additional sources including migration data from the Department of Home Affairs, student data from the Department of Education and Australian Council of Engineering Deans, and job vacancy data compiled by Jobs & Skills Australia (formerly the National Skills Commission). More information on the methodology can be found below.

The pros and cons: All statistical systems involve some compromise and over time can be overtaken by social and labour market developments. For example, in engineering, the discipline of mechatronics is playing an increasingly important role in both society and industry. However, mechatronics is not currently included in either the official education or occupational classification systems in its own right[1]. Offsetting this disadvantage is that ABS classification is the mainstay of statistics used in official advice to ministers and governments.

Engineers Australia – our work

Engineers Australia is the peak national professional association for engineering in Australia. As Australia's signatory to the International Engineering Alliance (IEA), we uphold standards for engineering education through accreditation of university engineering courses and we set and maintain standards for professional practice. We encourage the development of engineering knowledge and convene engineers and other stakeholders in various forums to facilitate the exchange of ideas and information. We inform community leaders and decision makers about engineers and engineering matters. We also ensure the engineering perspective is heard on a range of national policy matters. And we recognise and promote engineering excellence and achievements of individuals and teams.

Engineering skills and expertise are unique. The training, skills, and experience of engineers are highly valued and the skillset and mindset that feature problem-solving, critical thinking, quantitative analysis and systems thinking, are transferable to many other fields of work. People with engineering qualifications contribute broadly to the Australian economy in every industry and sector.

In practice this means that only around 56 per cent of Australia's engineers are employed in occupations closely related to engineering. The remaining 44 per cent are employed in a range of other occupations also needing analytical and problem-solving ability. A significant contributing factor to this is the lower proportion of overseas-born engineers employed in engineering occupations.

There are many complex and varied reasons contributing to this situation. For some engineers, not working in an engineering role is a choice. For others it is due to circumstance.

Many of these circumstances are identified in Engineers Australia's 2021 report on migrant engineers. Engineers Australia surveyed 817 migrant engineers on their experiences and the barriers they encountered while seeking work in the engineering profession in Australia[2]. Engineers Australia's *Women in Engineering* report, published in 2022, also identifies issues contributing to low participation of women in the profession. It found that two out of three female engineers surveyed, left the profession because they felt that their opportunities for career progression were limited, or, they experienced gender discrimination, bullying and/or sexual harassment[3].

1 Mechatronics is recognised under the 6-digit ANZSCO occupation category 233999 Engineering Professionals nec, along with 7 other distinct engineering disciplines, including Acoustic engineers, Corrosion, Fire Safety, etc

2 Romanis, J. "Barriers to Employment for Migrant Engineers; Research Report' Engineers Australia, October 2021 https://engineersaustralia.org.au/sites/default/files/resource-files/2021-10/barriers-employment-migrant-engineers.pdf

3 Romanis, J. 'Women in Engineering' Engineers Australia (June 2022) https://engineersaustralia.org.au/sites/default/files/women-in-engineering-report-june-2022.pdf

The engineering team

In Australia, there are three occupational categories that contribute to the engineering team: Professional Engineers, Engineering Technologists and Engineering Associates. These categories have different underpinning educational qualifications and contribute in different ways to engineering work. Although distinct, there is significant complementarity between the groups in practice and all occupational categories are critically important to the achievement of engineering outcomes. In practice there is a degree of overlap between the roles of the occupational categories.

Professional Engineers apply their structured learning, critical perception and engineering judgement to challenge current thinking, often engaging in research and development in new and existing fields. They reframe situations by applying their powers of analysis, synthesis and a well-developed grasp of engineering theory to plan and design original and novel solutions to problems. Their understanding of fundamental principles in science and technology equips them to create and apply new engineering practices on a regular basis. Professional Engineers resolve complex engineering problems, using a complex range of engineering activities.

Professional Engineers require at least the equivalent of the competencies developed through a four-year full-time Bachelor's Degree (Honours) in engineering to the standards defined by the IEA's Washington Accord, of which Engineers Australia is a founding signatory.

Engineering Technologists apply scientific and technological principles to deliver in-depth knowledge of devices, equipment, components and processes in their particular technical fields. Their education and experience fits them to modify established engineering technology and apply newly developed engineering techniques on a regular basis and to provide leadership in design, design review, operational and supervisory activities within their field. Engineering technologists are equipped to resolve broadly-defined engineering problems, using a broadly-defined range of engineering activities.

Engineering Technologists require at least the equivalent of the competencies in a three-year full time Bachelor's Degree in engineering to the standards defined by the IEA's Sydney Accord, of which Engineers Australia is a founding signatory.

Engineering Associates apply practical techniques of analysis, technical principles, standards and practices to achieve given engineering objectives within the scope of prescriptive codes of practice and recognized standards, relying on precedent and established procedure for guidance. Their detailed knowledge of specific practices enables them to have regard to financial, environmental and risk factors in managing and supervising such activities. Engineering associates are equipped to resolve well-defined engineering problems, using a well-defined range of engineering activities.

Engineering Associates require either the equivalent of the competencies in a two-year full-time Associate Degree in engineering, or a two-year full time Advanced Diploma in engineering from a university or TAFE college to the standards defined by the IEA's Dublin Accord, of which Engineers Australia is a founding signatory.

Alternative pathways are an important entry mechanism into the profession. One of our obligations as a member of the IEA is that the national standards Engineers Australia sets for engineering education and independent practice need to align with the IEA international standards (benchmarks). All the pathways that people can use to become engineers (which include all members of the engineering team) must comply with these standards, including the traditional, accredited engineering programs, typically offered by universities and TAFEs, as well as what we refer to as 'alternative pathways' which usually include a combination of qualifications and experiential learning. Ensuring that all pathways are compliant with these standards ensures that everyone who is qualified, registered and/or Chartered in Engineering, have satisfied widely accepted standards for the profession, which is important for helping to ensure that engineers practice ethically, competently and contribute high value to the community through their work. This in turn contributes to maintaining the high levels of trust the community generally has in the engineering profession. These standards also provide international mobility for engineers, to help promote innovation and to correct supply and demand imbalances.

Looking ahead - methodology and data sources

In Section Two of the Statistical Overview, we share the numbers, distribution, geography, and demographics of Australia's engineering populations in industries and occupations from the Australian Bureau of Statistics (ABS) census data. We also provide non-census statistics for migration, engineering education and employment vacancies produced by Commonwealth entities and the Australian Council of Engineering Deans (ACED).

In Section Three we examine the changes observable between census intervals and the nature of change for the engineering profession over the last census interval – 2016-2021.

Definitions of terms for industries, occupations, fields of education and other parameters are per the ABS[4], or where applicable, the respective entity responsible for that data. We note the limitations in using the ANZSCO (Australia and New Zealand Standard Classification of Occupations[5]), ANZSIC (Australia and New Zealand Standard Industrial Classification[6]) and ASCED (Australian Standard Classification of Education) schemes used in classifying census data in the Appendix 1.

The Population Sets - The two sets of interest to Engineers Australia to retain and attract engineers to grow the available pool, are 'qualified engineers' and those engineers 'working in engineering occupations'.

Qualified Engineers include all individuals in the Australian economy with engineering qualifications. They cover qualifications from an advanced diploma and/or associate degree level (AQF6) and higher in engineering and related technologies.

Working in engineering/engineering occupations includes qualified engineers working in an occupation that have a demonstrated degree of attachment to engineering work. Of the 364 ANZSCO listed occupations, 50 were considered to fit the criteria of an engineering occupation which is:

- work undertaken that satisfies Work Skill Levels 1 or 2 in the ABS classification
- an attachment to engineering in an occupation, that is rated at least three in a five-point scale, where five is complete attachment, and one little attachment.

The 'working in engineering' grouping was originally devised in 2010[7], when the 'engineering-related' occupations were vigorously debated. With the release of 2021 census data, we took the opportunity to review our methodology and make three revisions:

01. We included the narrow field of geomatic engineering within our two population sets. This increased the qualified population of engineers by approximately three per cent. In the 2016 census this equated to around 13,000 people not previously counted.

02. We excluded 'Engineering Professionals-not further defined' as those working in engineering occupations, noting that the ABS specifies that the nfd[8] (Not Further Defined) codes are designed to facilitate processing by allowing inadequately described or non-specific responses to be coded to a broader level of the classification, rather than be lost altogether. This impact reduced the population of those in engineering occupations by approximately four per cent – around 9,800 qualified engineers.

03. For a similar reason, we substituted 'Natural Science Professionals-nfd' with Geologists, Geophysicists and Hydrogeologists. These are occupations in which members of Engineers Australia work. The population sizes were similar in 2021, at around 450 engineers.

4 See 'Guide to Census data', https://www.abs.gov.au/census/guide-census-data
5 ANZSCO - Australian and New Zealand Standard Classification of Occupations, Australian Bureau of Statistics, June 2022 https://www.abs.gov.au/statistics/classifications/anzsco-australian-and-new-zealand-standard-classification-occupations/latest-release
6 Australian and New Zealand Standard Industrial Classification (ANZSIC), Australian Bureau of Statistics, June 2013, https://www.abs.gov.au/statistics/classifications/australian-and-new-zealand-standard-industrial-classification-anzsic/latest-release
7 The Engineering Profession in Australia; A Profile from the 2006 Population Census, Andre Kaspura Engineers Australia, 2010
8 NFD codes are not a formal part of a classification.

These revisions do not invalidate previous statistics published by Engineers Australia – they complement them. However, there are shifts in the data due to the slight differences in the populations being examined.

With the review of ANZSCO by 2026 we will need to revisit what is considered an 'engineering occupation' under the revised classification scheme.

There are a few important points to note regarding the figures presented in this report:

- The census records the highest qualification attained by a respondent. The Organisation of Economic Co-operation and Development (OECD) estimates nine per cent of Australian adults held a Master's qualification in 2021. However, it is not uncommon for an engineer to obtain postgraduate qualifications (such as an MBA or Masters of International Relations). When examining the 2021 census, there were 1,520,007 Australians with a qualification of a higher level than a Bachelor's degree. With a labour force of 12,692,783 almost 12 per cent hold postgraduate qualifications, which might mean there are up to 12 per cent more qualified engineers in Australia.
- When encoding a census response to a particular occupation the ABS give consideration to the answers provided for the census question as to the tasks performed in a person's usual occupation, as well as the occupation nominated by the respondent. There is no connection to a respondent's answers for education/qualification related Census questions and the encoding of their response to an occupation.
- Census data is self-reported. It relies on the judgement of respondents to answer the survey honestly and accurately.
- 'Engineer' is not a legally protected title within Australia (excluding statutory registration schemes which require particular types of engineering work to be undertaken by those with appropriate qualifications and experience). There is a non-trivial population of Australians who are working within engineering occupations and hold a role or job title provided to them by their employers, but do not in fact hold engineering qualifications (e.g. a 'sound engineer' may hold a qualification that is not consistent with one of the qualifications considered necessary for the three engineering occupational categories, see The engineering team section above). Engineering practice requires suitable underpinning qualifications and should only be carried out by people who are duly qualified.
- The ABS apply Perturbation[9] to the outputs of TableBuilder to minimise the risk of identifying individuals in aggregate statistics, the effect of which is to randomly adjust cell values. Perturbation is applied across all non-zero cells in a table, including the totals cells. Perturbation may change the true cell value by either increasing or decreasing the value by a small amount. Within this context, although cells may appear to contain none, or all, of a relevant sub-population, this is not necessarily a reflection of the true value of the cell. These adjustments result in introduced random errors, but with almost no bias. The information value of the table as a whole is not significantly impaired. In TableBuilder, totals are not calculated by summing the interior values of the table. Instead, more accurate totals are provided by calculating the true total, and then perturbing this value.
- We take segments (or slices) of the population at different levels of detail in the classification schemes with other census parameters. We provide the population size of engineers that these segments represent, as not all respondents are able to be encoded at all levels of detail within ANZSIC, ANZSCO and ASCED. This means that the entire population of engineers and those working in engineering are unable to be represented at lower levels of the classification scheme. Also, at the highest levels of the classification schemes, there are significant proportions of responses which are 'inadequately described' or 'not stated'.

The populations presented and analysed in this Overview are those most likely to contribute to Australia's stock of qualified engineers and those working in engineering occupations. **However, there are likely to be more qualified engineers in Australia, than presented here, for the reasons outlined above.**

See more detailed information on fluctuations in the count in Appendix 1.

9 See https://www.abs.gov.au/statistics/microdata-tablebuilder/tablebuilder/confidentiality-and-relative-standard-error

The state of the engineering profession in 2023

Scene setting

2016

- Commodity prices at lowest since GFC
- Donald Trump elected end 2016
- Brexit alters the UK's relationship with Europe and Australia's trading partnerships
- **December** – economic weakness globally

Hottest year recorded since start of modern recordkeeping in 1880

2017

- **October** – last production vehicle rolls off Holden Assembly line
- South Australia announces construction of largest lithium-ion battery in the world completed in November in the record time of 63 days since signing
- Batteries to increase renewable energy capacity, reduce risk of shortages, and save South Australian consumers more than $150 million by 2022

4th
Hottest year on record

2018

- **24 August** – Scott Morrison deposes Malcolm Turnbull as Prime Minister

6th
Hottest year on record

2019

- **May** – RBA advises economy weakening - rba.gov.au/publications/smp/2019/may/economic-outlook.html
- **18 May** – Coalition government returned at federal election, with pre-polling incorrectly predicting ALP win
- **June** – economic growth stalls - theguardian.com/business/2019/jun/05/australias-economic-growth-slowest-in-10-years-amid-calls-for-swift-action
- **September** - ABC reports slowest economic growth in a decade - abc.net.au/news/2019-09-04/gdp-q2-2019/11474470
- **2019/2020** Black Summer bushfires – economists estimate the Australian bushfires may cost more than A$100 billion in property damage and economic losses, making them Australia's costliest natural disaster to date

- Australian government commits to the Paris climate accords

3rd
Hottest year on record

2020

- Natural disasters, fire, then storms and floods across the east coast of Australia
- **February** – breaking of drought, La Niña
- **March** – COVID-19 pandemic
- **August** – Economy shrunk to 2016 levels - smh.com.au/politics/federal/an-economy-like-2016-as-sales-and-wages-collapse-20200831-p55qya.html

- Australian government reports GDP contracts 2% - dfat.gov.au/sites/default/files/aust-cef.pdf
- AEMO publishes *2020 ISP – a seminal moment, first expression of what could be done for the clean energy transition*

2nd
Hottest year on record

6

2021

- **February** – first COVID vaccinations provided, vaccination program takes most of the year to inoculate majority of Australians
- COVID economic recovery commences, instability throughout the year, but rising demand for engineering skills from June 2021 driven by state and commonwealth infrastructure commitments and generally improving economic prospects

- Floods across east coast causes widespread damage
- Snowy Hydro 2.0 commences construction (first announced April 2019)
- Government passes job-ready graduates' reform
- **September** – AUKUS announced by Morrison government, bipartisan support
- **October** – Commonwealth government outlines pathway to net zero by 2050, concerns around reliance on technology not yet developed
- **November** – Australia reopens borders to students and skilled workers after nearly two years
- Natural disasters, fires (WA predominantly, '21-'22 summer)

2022

- **February** – Russia invades Ukraine, causes surge in commodity prices, global energy shortages
- **March** – catastrophic NSW and Queensland floods
- **May** – Albanese government elected, commits to 43 per cent emissions reduction target by 2030

- Record third La Niña year in a row
- Flooding continues with destruction across the east coast
- Widespread damage to road network
- IPCC publishes *6th synthesis report – climate change posing catastrophic cascading risks*
- UN warns global action not taking place at scale or pace required

5th
Hottest year on record

2023

- **March** – roadmap for AUKUS trilateral partnership announced for delivering Australia a nuclear-powered submarine capability, one of Australia's largest ever projects requiring a skilled workforce, a complex project to be delivered by three nations over 30 years
- Heatwaves and bushfires impact the northern hemisphere
- El Niño announced for the 2023-24 Australian summer

- 6 July 2023
  Hottest day *ever* recorded.

SECTION 2

The population of engineers in Australia and its characteristics

National statistics

There were 546,905 qualified engineers in Australia in 2021, with almost 80 per cent participating in the labour force (433,353). This was an increase of almost 27 per cent of engineers since the last census in 2016 (115,953) when 430,952 engineers were recorded. As of 2021, 243,157 qualified engineers were working in engineering occupations, or 56.1 per cent of the qualified engineering labour force.

Labour force statistics for the 2011 – 2021 census are presented in Tables 1 and 2 for qualified engineers and those working in engineering occupations. The total engineering labour force of 433,353 in 2021 is 3.4 per cent of the total Australian labour force. The change in population size can be seen in Figure 2 below.

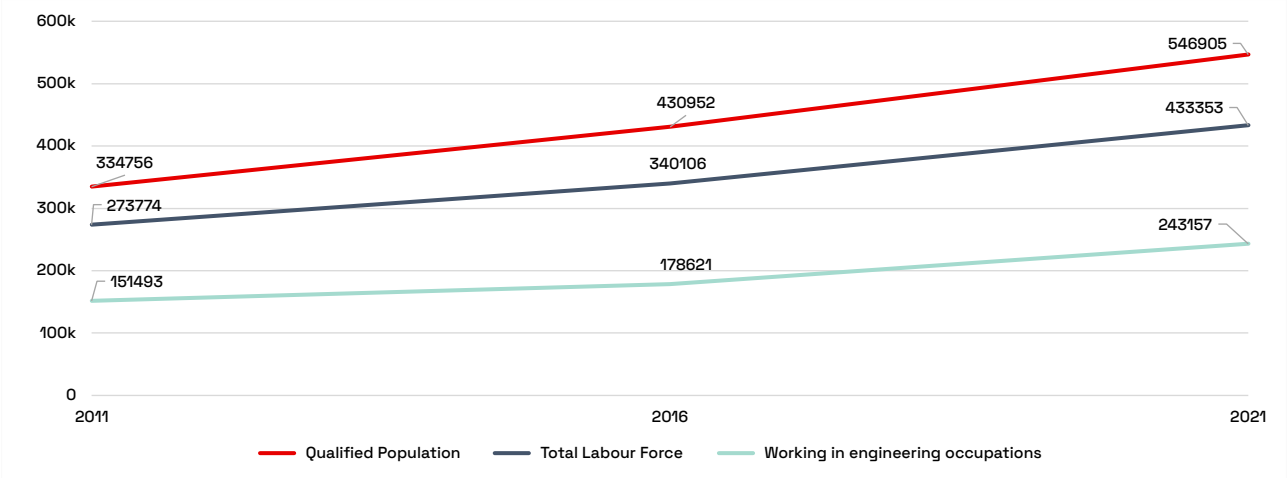
Table 1: Count of qualified engineers for the last three censuses and labour force status.

Census Year	2011		2016		2021		2016–2021	
Labour Force Status	Number	%	Number	%	Number	%	Number	% Growth
Employed, away from work	11,063	3.3%	11,449	2.7%	18,827	3.4%	7,378	**64.4%**
Employed, worked full-time	219,500	65.6%	257,507	59.8%	329,622	60.3%	72,115	**28.0%**
Employed, worked part-time	33,629	10.0%	51,078	11.9%	69,292	12.7%	18,214	**35.7%**
Not in the labour force	60,407	18.0%	90,121	20.9%	112,540	20.6%	22,419	**24.9%**
Not stated	575	0.2%	725	0.2%	1,012	0.2%	287	**39.6%**
Unemployed, looking for full-time work	7,000	2.1%	14,350	3.3%	11,213	2.1%	-3,137	**-21.9%**
Unemployed, looking for part-time work	2,582	0.8%	5,722	1.3%	4,399	0.8%	-1,323	**-23.1%**
Total Labour Force	273,774	81.8%	340,106	78.9%	433,353	79.2%	93,247	**27.4%**
Total Population	334,756	100.0%	430,952	100.0%	546,905	100.0%	115,953	**26.9%**
Working in engineering occupations	151,493	55.3%	178,621	52.5%	243,157	56.1%	64,536	**36.1%**

Table 2: Count of engineers working in engineering occupations for the last three census.

Census Year	2011		2016		2021	
Labour Force Status	Number	%	Number	%	Number	%
Employed, away from work	5,961	3.9%	5,824	3.3%	8,078	3.3%
Employed, worked full-time	133,383	88.0%	157,098	88.0%	211,963	87.2%
Employed, worked part-time	12,149	8.0%	15,699	8.8%	23,116	9.5%
Total	151,493	100.0%	178,621	100.0%	243,157	100.0%

Figure 2: Population of qualified engineers in Australia, the total labour force and qualified engineers working in engineering occupations



Professional diversity

The population of overseas-born engineers, both male and female, has grown at approximately twice the rate of Australian-born engineers over the last five years. Overall, there is a continued increase in the proportion and population of all demographics of the engineering qualified labour force, except for Australian born male engineers. Although their population has grown, it has done so at a much slower rate than all other demographics, leading to a decline in their share of the qualified engineering labour force.

The diversity of the engineering labour force is summarised in Tables 3 and 4 for qualified engineers and those working in engineering occupations. 81,995 of the additional 115,953 qualified engineers added to 2021 were born overseas (70.71 per cent of the total). This includes 13,821 additional engineers not in the labour force (and not captured in the table below). A proportion of these will be international students and many will be older skilled migrants retiring or leaving the workforce for other reasons.

Table 3: Distribution of the engineering qualified labour force between men, women and birth location and change between censuses.

Census Year	2016		2021		2016-2021	
Component of Labour Force	Number	% of LF	Number	% of LF	Growth	% Growth of LF
Male, Indigenous Australian	648	0.2%	1,086	0.3%	438	67.6%
Male, born Australia	126,045	37.1%	146,779	33.9%	20,734	16.4%
Male, born overseas	167,893	49.4%	217,375	50.2%	49,482	29.5%
Male total	293,938	86.4%	364,154	84.0%	70,216	23.9%
Female, Indigenous Australian	46	0.0%	82	0.0%	36	23.9%
Female, born Australia	13,366	3.9%	17,979	4.1%	4,613	34.5%
Female, born overseas	32,802	9.6%	51,220	11.8%	18,418	56.1%
Female, total	46,168	13.6%	69,199	16.0%	23,031	49.9%
Indigenous Australian total	694	0.2%	1,168	0.3%	474	68.3%
Australian total	139,411	41.0%	164,758	38.0%	25,347	18.2%
Overseas born total	200,695	59.0%	268,595	62.0%	67,900	33.8%
Total	340,106	100.0%	433,353	100.0%	93,247	27.4%

Table 4: Distribution of the qualified engineer population working in engineering occupations between men, women and birth location and change between censuses.

Census Year	2016		2021		2016-2021	
Employed in Engineering Occupations	Number	% of EO	Number	% of EO	Growth	% Growth of EO
Male, Indigenous Australian	344	0.2%	638	0.3%	294	85.5%
Male, born Australia	77,546	43.4%	95,775	39.4%	18,229	23.5%
Male, born overseas	80,638	45.1%	112,730	46.4%	32,092	39.8%
Male total	158,528	88.8%	209,143	86.0%	50,615	31.9%
Female, Indigenous Australian	20	0.0%	63	0.0%	43	215.0%
Female, born Australia	7,439	4.2%	10,985	4.5%	3,546	47.7%
Female, born overseas	12,654	7.1%	23,029	9.5%	10,375	82.0%
Female, total	20,093	11.2%	34,014	14.0%	13,921	69.3%
Total, Indigenous Australian	364	0.2%	701	0.3%	337	92.6%
Total, born Australia	84,985	47.6%	106,760	43.9%	21,775	25.6%
Total, born overseas	93,292	52.2%	135,759	55.8%	42,467	45.5%
Total	178,621	100.0%	243,157	100.0%	64,536	36.1%

Age structure of the engineering profession

The age structure of the engineering profession is shown in Table 5 for qualified engineers by five-year age band and labour force status.

Table 5: The engineering qualified labour force by status and five-year age bands

Age	Employed, worked full-time	Employed, worked part-time	Employed, away from work	Unemployed, looking for full-time work	Unemployed, looking for part-time work	Not in the labour force	Not stated	Total	Total Labour Force	% of qualified labour force
20-24	9,898	4,530	753	736	443	2,674	44	19,078	16,360	3.80%
25-29	43,382	11,649	2,654	1,886	845	5,865	159	66,440	60,416	13.90%
30-34	51,572	9,107	3,287	1,551	598	4,919	135	71,169	66,115	15.20%
35-39	55,008	7,930	2,974	1,352	393	3,938	112	71,707	67,657	15.60%
40-44	46,375	6,521	1,921	1,134	301	3,202	88	59,542	56,252	13.00%
45-49	39,751	5,479	1,554	1,068	250	3,176	53	51,331	48,102	11.10%
50-54	31,578	4,730	1,483	980	252	3,566	40	42,629	39,023	9.00%
55-59	26,534	5,389	1,683	1,044	298	6,114	52	41,114	34,948	8.10%
60-64	15,825	5,342	1,444	927	434	11,131	52	35,155	23,972	5.50%
65-69	6,787	4,469	780	381	315	17,865	41	30,638	12,732	2.90%
70-74	2,059	2,699	320	88	169	19,782	42	25,159	5,335	1.20%
75-79	536	1,144	104	14	60	14,290	55	16,203	1,858	0.40%
80-84	126	330	40	5	18	8,998	48	9,565	519	0.10%
85-89	26	90	14	6	3	4,550	30	4,719	139	0.00%
90-94	4	18	9	0	0	1,821	16	1,868	31	0.00%
95-99	0	3	0	0	0	446	17	466	3	0.00%
100+	0	0	0	0	0	26	0	26	0	0.00%
Total	329,507	69,434	19,028	11,199	4,380	112,369	983	546,809	433,548	100.00%

Figure 3 provides a visual indication of relative population sizes per five-year age band by status in the labour force. The ongoing retirement of the engineering qualified Baby Boomer generation is evident (elaborated on further below under Retiring engineers).

Figure 3: Distribution and employment status of qualified engineers in the labour force by five-year age bands in 2021

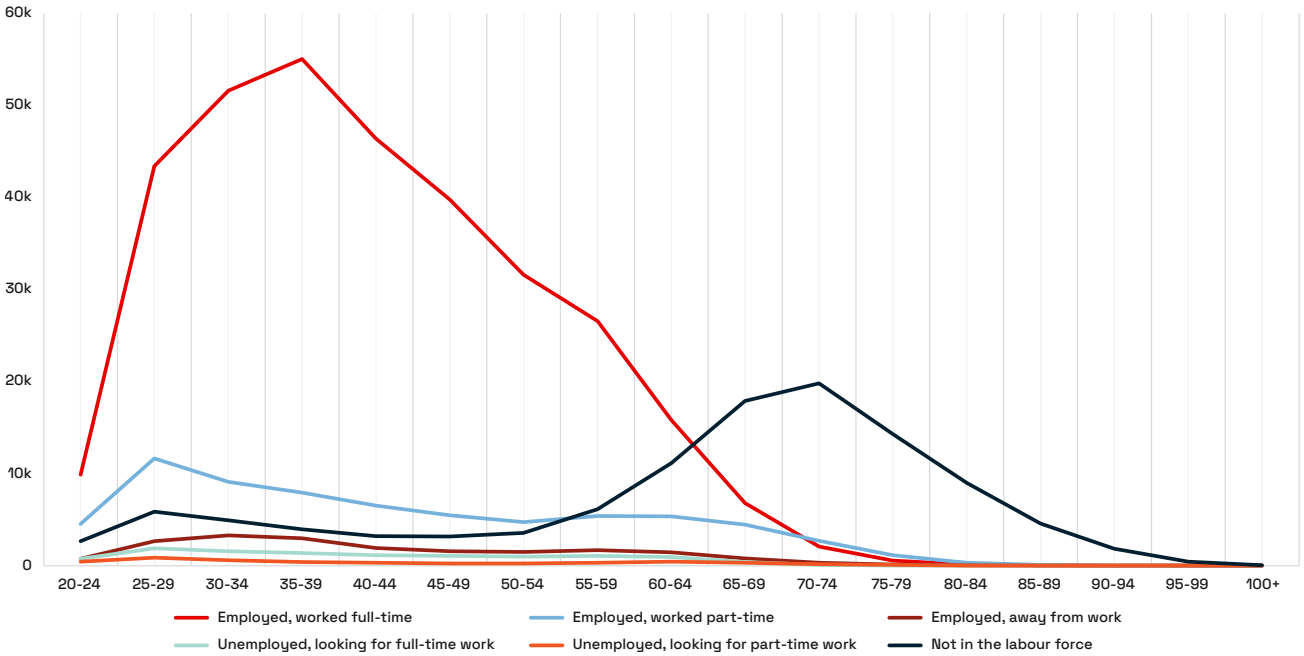
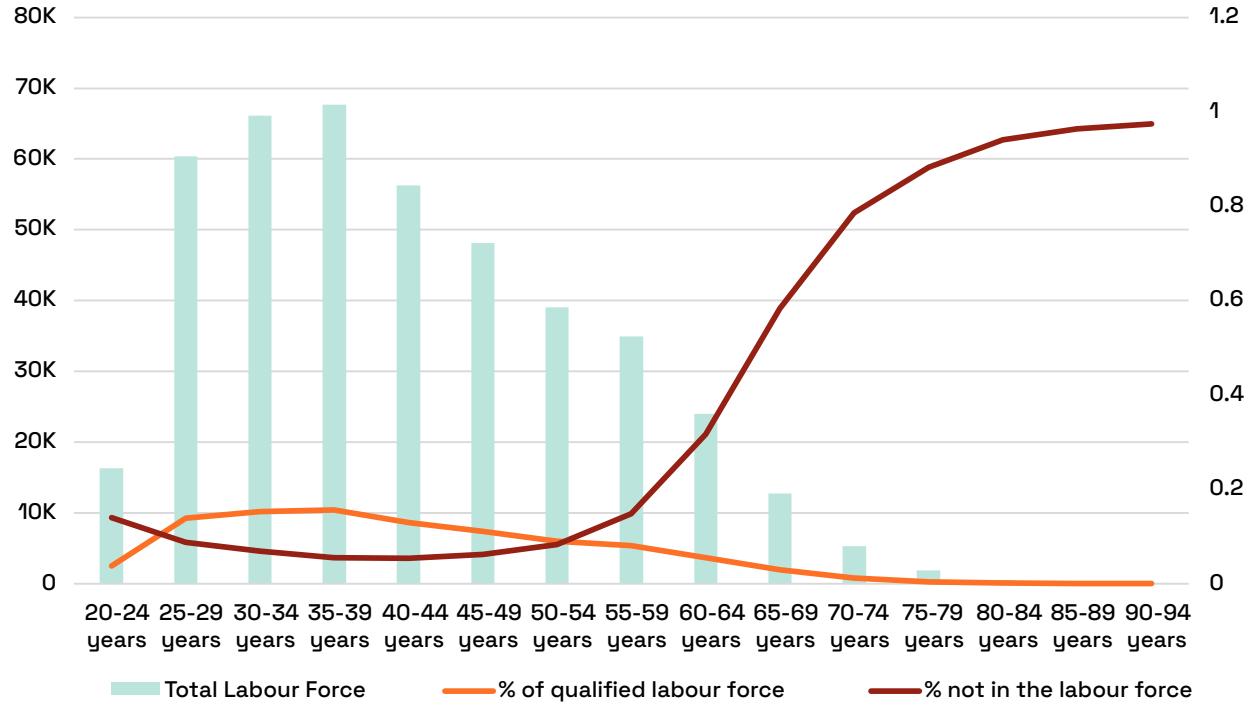


Figure 4 shows the number and per centage of each age bracket as a component of the labour force. Nearly 50 per cent of Australia's qualified engineers in the labour force is under 40 years of age.

Figure 4: Distribution of qualified engineers by five-year age brackets and per centage of total qualified engineer population



The distribution of the population, 'not-in-the-labour-force', is also shown in Figure 4. The proportion of those 'not in the labour force' falls consistently from 20-24 years, reaching a low at ages 40-44 before rising again, sharply from the age of 55. It rises steadily from 50 years, accelerating heavily from 59 years, peaking at 70-74 years. By then, 90 per cent of the workforce in that age bracket is not in the labour force, declining swiftly

thereafter. As would be expected, there is a larger share of part time employment from 70-74 years (see where the graphs cross over). Of those not in the labour force, 70.5 per cent were over the age of 60.

It is worth noting this segment of the population (qualified engineers not in the labour force) does not solely represent engineers retiring from the labour force. It also represents students (both international and domestic) and people on holiday in Australia, or those experiencing long term illness, disability, home duties/caring for children, or another scenario[10]. Approximately 7.6 per cent of those not in the labour force were aged 29 years and under.

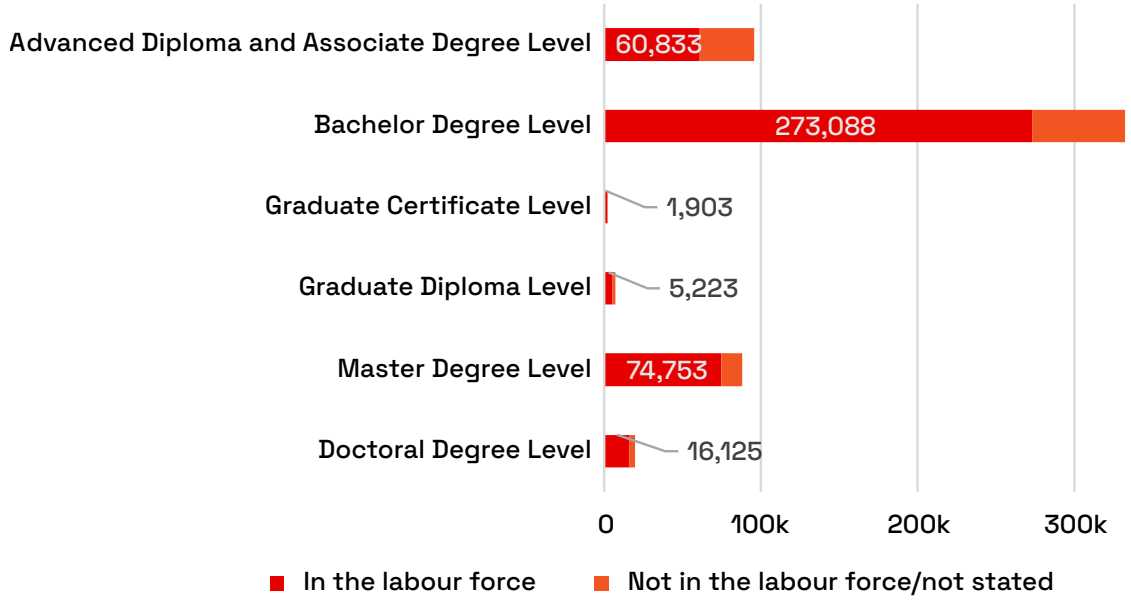
Since 2016, there was a recorded increase of 22,400 qualified engineers 'not-in-the-labour-force'. Those leaving the labour force are doing so at a reduced rate (two thirds the increase between 2011 and 2016). At its most extreme this could represent a maximum of 4,480 engineers leaving the labour force each year.

Today just over 20 per cent of Australia's qualified engineers are not in the labour force.

Distribution of qualifications by level of study

The distribution of qualifications at different levels held by the Australian qualified engineering population is shown in Figure 5. The majority hold a bachelor's degree or higher qualification. The minority hold advanced diplomas and associate degrees.

Figure 5: Distribution of engineering qualifications in Australia by level of study



10 Not in the labour force, Labour Statistics: Concepts, Sources and Methods, 2022, https://www.abs.gov.au/statistics/detailed-methodology-information/concepts-sources-methods/labour-statistics-concepts-sources-and-methods/2021/concepts-and-sources/not-labour-force#:~:text=Persons%20not%20in%20the%20labour%20force%20are%20persons%20who%20were,those%20permanently%20unable%20to%20work

The distribution of engineering qualifications in Australia by highest level of study and labour force status is recorded in Table 6.

Table 6: Distribution of engineering qualifications in Australia by highest level of study

LFSP Labour Force Status	Doctoral Degree Level	Master Degree Level	Graduate Diploma Level	Graduate Certificate Level	Bachelor Degree Level	Adv. Diploma & Assoc. Degree	Total
Employed, worked part-time	2,256	11,408	973	269	42,747	11,533	69,181
Employed, worked full-time	12,744	57,332	3,873	1,486	209,709	43,103	328,245
Employed, away from work	448	2,881	217	104	11,295	4,030	18,972
Unemployed, looking for full-time work	543	2,440	118	28	6,553	1,461	11,143
Unemployed, looking for part-time work	134	692	42	16	2,784	706	4,378
Not in the labour force	3,340	13,107	1,908	419	58,645	34,666	112,082
Not stated	28	174	0	5	553	220	980
Total	19,481	88,036	7,130	2,329	332,290	95,724	544,982
Total Labour Force	16,125	74,753	5,223	1,903	273,088	60,833	431,919

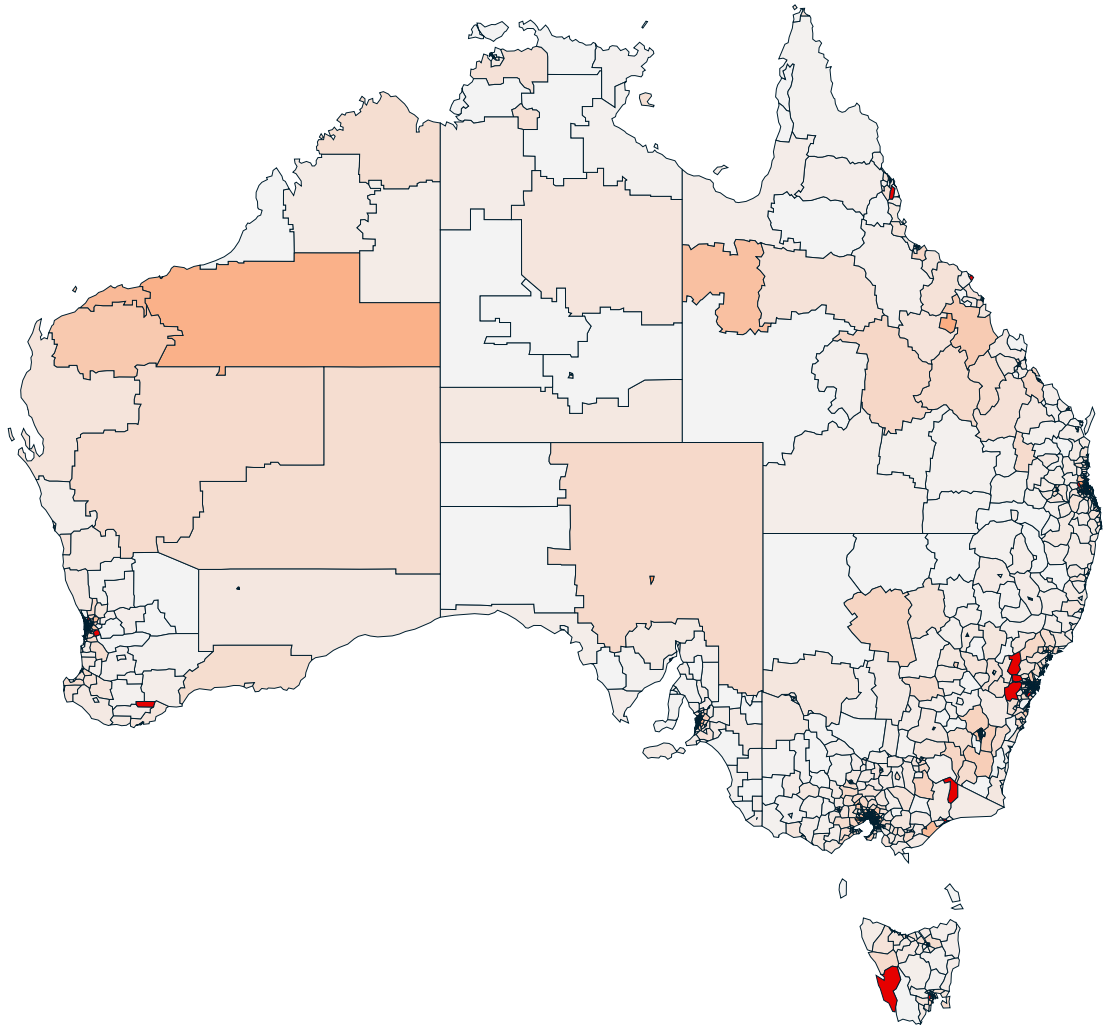
Geographical distribution

Like most of the Australian population[11], engineers live in urban areas, in and around capital cities. The concentration of qualified engineers in Australia is shown in the heat map at Figure 6 for all Statistical Area 2 (SA2) regions [12] :

Figure 6: Heat map indicating concentration of population of qualified engineers working in engineering occupations across Australia at the statistical level 2 distribution of regions on a per capita basis (darker shading indicates higher population, red shading indicates non-populated areas including all national parks)

11 Calculated as 90% of Australian's living in urban areas in 2016 by the ABS, https://www.abs.gov.au/statistics/people/population/sort

12 The suburb/rural locality level of the Australian Statistical Geography Standard (ASGS) Edition 3, see https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/main-structure-and-greater-capital-city-statistical-areas/statistical-area-level-2



The top 20 regions (at an SA4 level[13]) containing qualified engineers in the major urban areas in mainland Australia, specifically Melbourne, Sydney, Perth, Brisbane, and Canberra. These are shown in Table 7.

Table 7: Top 20 SA4 regions with qualified engineers by order of population

Region	State	Number
Melbourne - South East	Victoria	24,565
Melbourne - Inner	Victoria	22,852
Melbourne - West	Victoria	22,472
Sydney - Parramatta	New South Wales	18,330
Sydney - North Sydney and Hornsby	New South Wales	17,755
Perth - South East	Western Australia	17,588
Perth - North West	Western Australia	15,342
Sydney - Inner South West	New South Wales	15,303
Melbourne - Inner East	Victoria	14,917
Melbourne - Inner South	Victoria	13,700
Melbourne - Outer East	Victoria	13,576
Melbourne - North East	Victoria	13,052

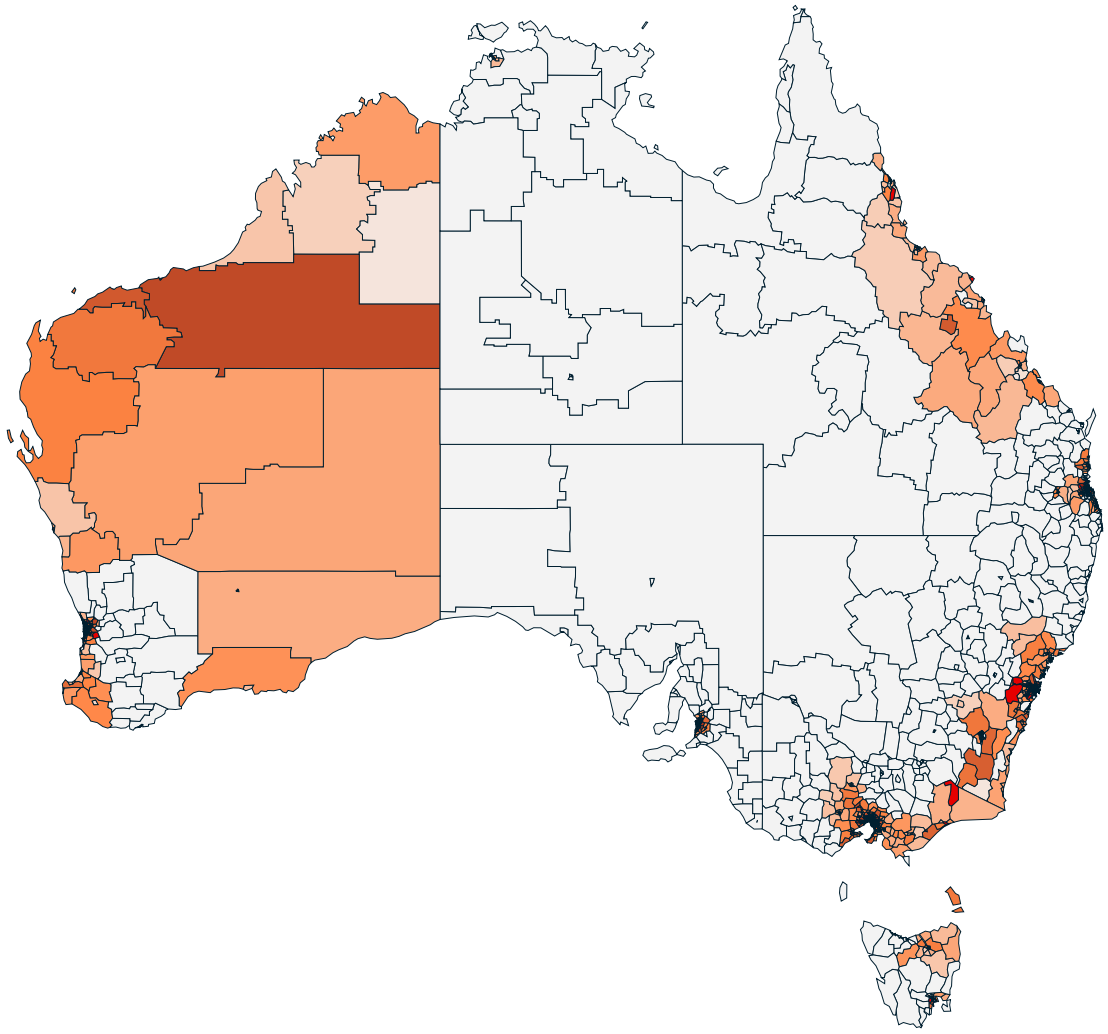
13 The largest sub-state regions in the ASGS, SA4 boundaries represent labour markets and the functional area of Australian capital cities respectively, see https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/main-structure-and-greater-capital-city-statistical-areas/statistical-area-level-4

Region	State	Number
Sydney - Blacktown	New South Wales	12,653
Brisbane - South	Queensland	12,437
Brisbane Inner City	Queensland	12,140
Perth - South West	Western Australia	12,043
Sydney - City and Inner South	New South Wales	11,702
Australian Capital Territory	Australian Capital Territory	10,566
Sydney - Inner West	New South Wales	10,255
Sydney - Ryde	New South Wales	10,044

Tasmania, Darwin, and South Australia are not in the top 20 regions primarily due to their relatively small populations. However, Canberra does feature in the top 20 due to its smaller relative size in area.

When shown on a per-capita basis, as in Figure 7, the regional areas of the Pilbara, North Queensland, Hunter Valley, Bendigo, Ballarat, Shepparton, and the Capital Region etc. become more evident.

Figure 7: Heat map indicating concentration of population of qualified engineers for the top 20 sa4 regions in Australia on a per-capita basis.



The engineering profession in the states and territories

The breakdown of the population of qualified engineers by state and labour force status is presented in Table 8. The states with highest numbers of qualified engineers (as with general population) are Queensland, Victoria, NSW and Western Australia.

Table 8: Count of qualified engineers by location and labour force status (Other territories total 7 qualified engineers, 4 working in engineering occupations, 3 not in labour force)

2021	ACT	NSW	QLD	NT	SA	TAS	VIC	WA	Total
Employed, away from work	293	7,942	3,090	104	744	200	4,296	2,158	18,831
Employed, worked full-time	6,707	104,327	54,722	2,158	18,536	3,515	95,532	44,121	329,618
Employed, worked part-time	1,246	21,230	10,931	388	4,449	1,247	21,469	8,332	69,292
Not in the labour force	2,161	40,995	18,360	372	6,344	1,895	30,711	11,699	112,540
Not stated	19	380	148	6	41	4	302	112	1,012
Unemployed, looking for full-time work	143	3,905	1,694	39	634	150	3,412	1,236	11,213
Unemployed, looking for part-time work	67	1,447	665	15	257	88	1,418	442	4,399
Total Labour Force	8,456	138,851	71,102	2,704	24,620	5,200	126,127	56,289	433,353
Total	10,636	180,226	89,610	3,082	31,005	7,099	157,140	68,100	546,905
Working in Engineering Occupations	4,812	78,396	42,071	1,388	13,348	2,587	67,195	33,356	243,157

The distribution of engineers working in engineering occupations by state and territory is shown in Figure 8, which illustrates the dominance of NSW, Queensland, Victoria, and WA in employing the majority of Australia's engineers.

Figure 8: Distribution of those working in engineering occupations between states and territories

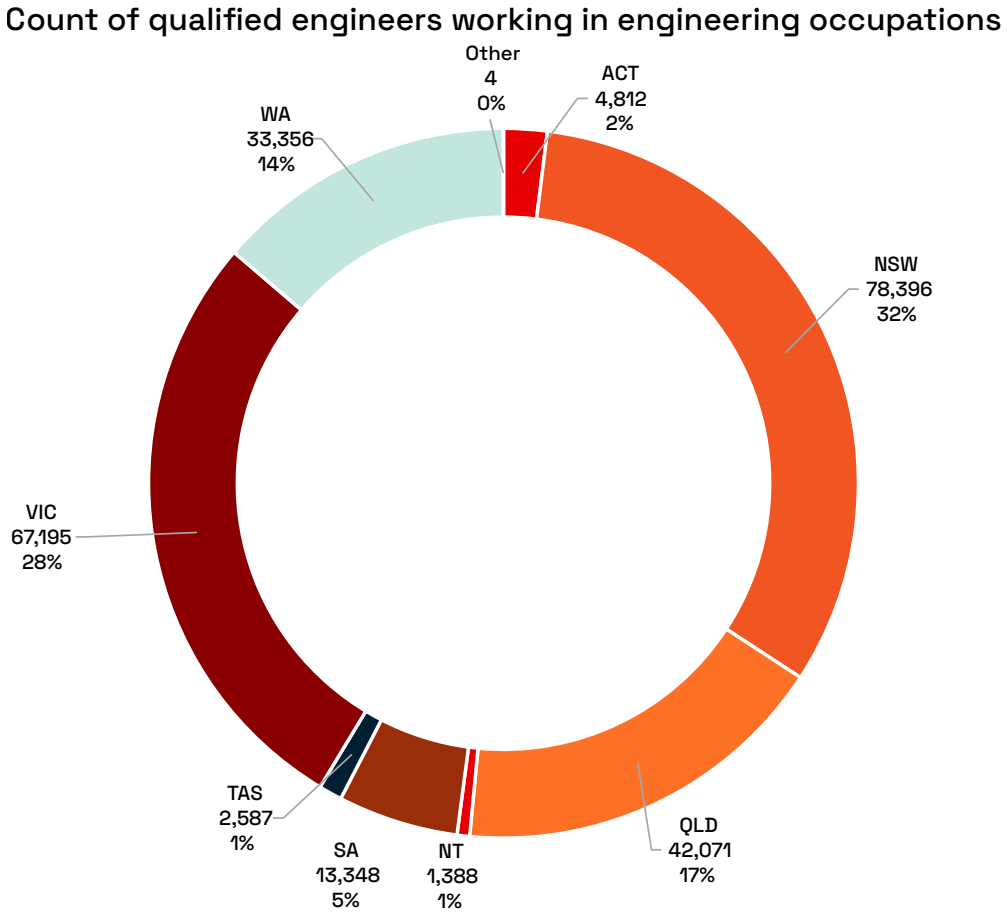
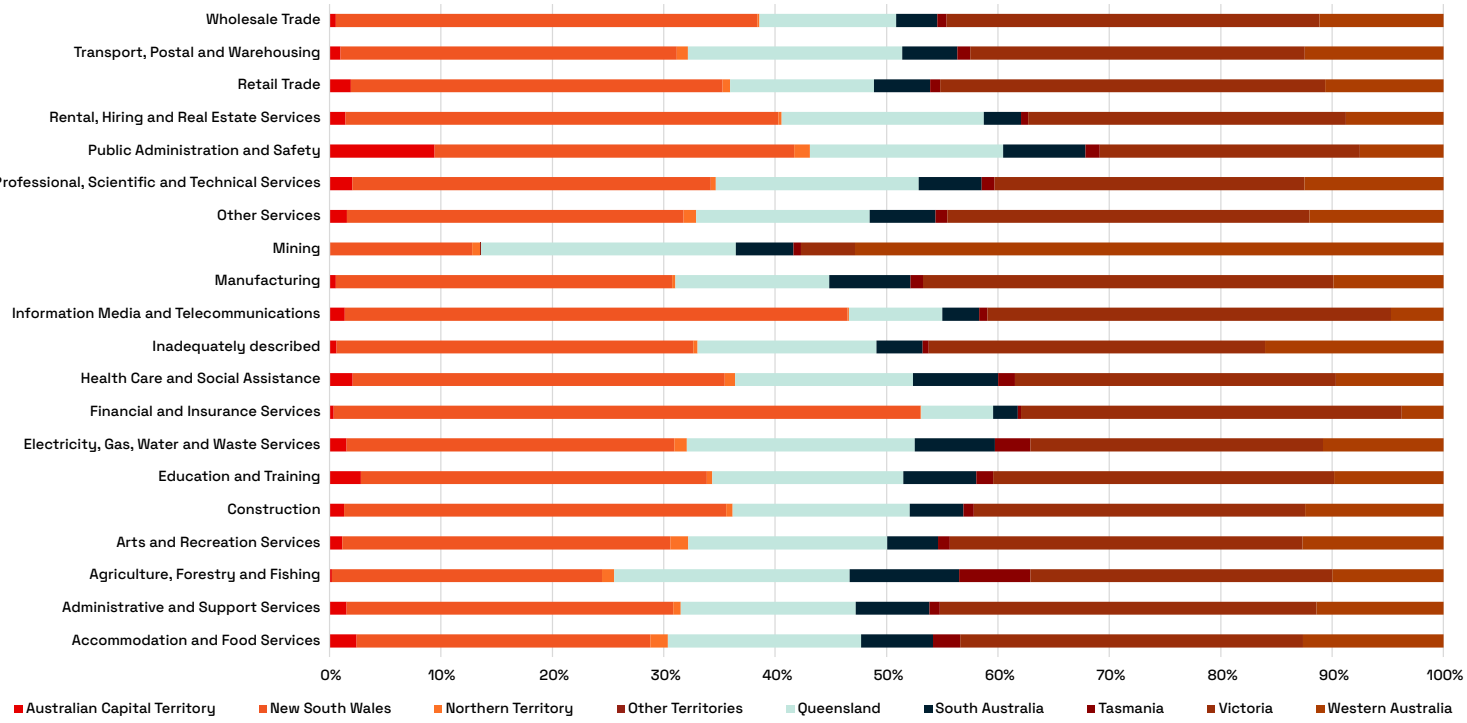


Figure 9 shows the distribution of engineers employed in each primary industries by state or territory as a per centage of the qualified engineer population within each industry.

Figure 9: Distribution of qualified engineers in primary industries by state/territory



In the following section we map out the distribution of engineers in each state covering primary industries, labour force statistics and engineering occupations.

Australian Capital Territory

Figure 10: Heat map of the ACT indicating concentration of qualified engineers (note, shading is relative to the total population of the territory, not nationally)

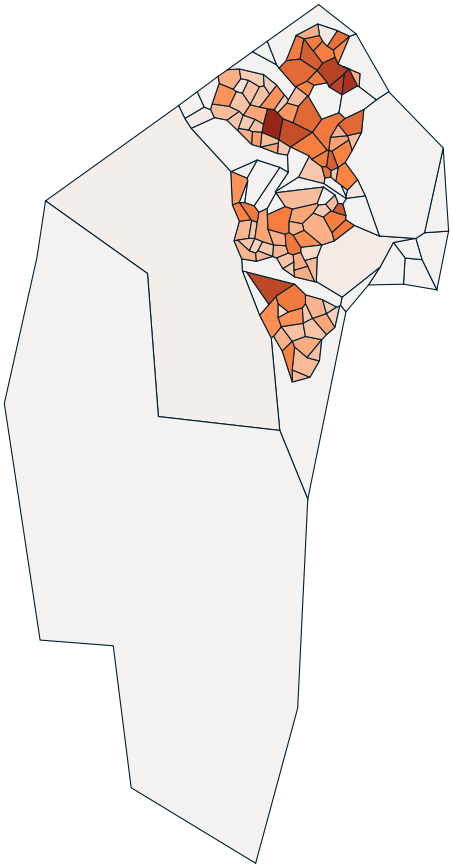


Figure 11: Distribution of qualified engineers in primary industries in the ACT

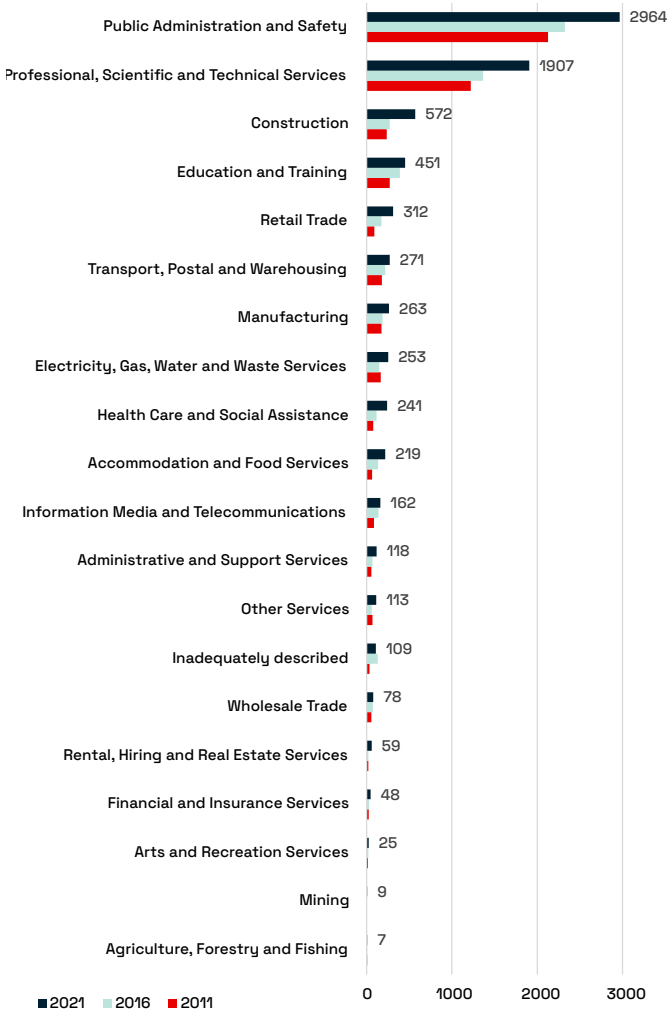


Table 9: Statistics for the qualified engineering workforce in the ACT

Census year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	205	3.2%	243	3.0%	293	2.8%
Employed, worked full-time	4,183	65.2%	4,878	60.5%	6,707	63.1%
Employed, worked part-time	616	9.6%	801	9.9%	1,246	11.7%
Not in the labour force	1,262	19.7%	1,861	23.1%	2,161	20.3%
Not stated	3	0.0%	19	0.2%	19	0.2%
Unemployed, looking for full-time work	101	1.6%	154	1.9%	143	1.3%
Unemployed, looking for part-time work	49	0.8%	104	1.3%	67	0.6%
Total	6,419	100.0%	8,060	100.0%	10,636	100.0%
Total Labour Force	**5,154**		**6,180**		**8,456**	
Total Working in Engineering Occupations	2,886		3,541		4,812	
% Working in engineering occupations	56.0%		57.3%		56.9%	

New South Wales

Figure 12: Heat map of New South Wales indicating concentration of qualified engineers within this state (note, shading is relative to the total population of the state, not nationally)

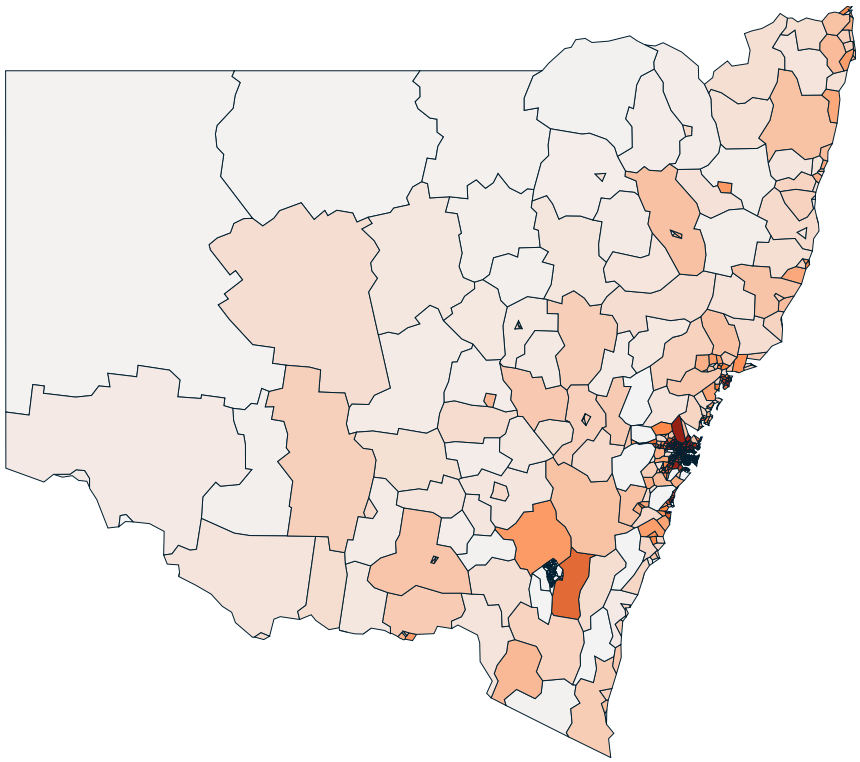


Figure 13: Distribution of qualified engineers in primary industries in NSW

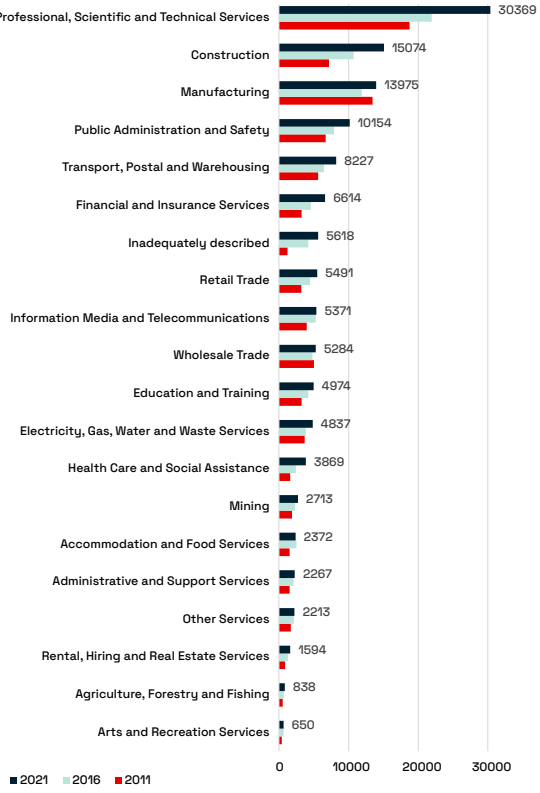


Table 10: Distribution of engineering workforce in NSW

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	3,466	3.1%	3,463	2.4%	7,942	4.4%
Employed, worked full-time	71,057	64.1%	85,504	59.9%	104,327	57.9%
Employed, worked part-time	11,143	10.1%	16,056	11.3%	21,230	11.8%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	21,467	19.4%	31,637	22.2%	40,995	22.7%
Not stated	202	0.2%	269	0.2%	380	0.2%
Unemployed, looking for full-time work	2,486	2.2%	3,919	2.7%	3,905	2.2%
Unemployed, looking for part-time work	959	0.9%	1,861	1.3%	1,447	0.8%
Total	110,780	100.0%	142,709	100.0%	180,226	100.0%
Total Labour Force	**89,111**		**108,944**		**138,851**	
Working in Engineering Occupations	47088		58,339		78,396	
% Working in Engineering Occupations	52.8%		53.5%		56.5%	

Northern Territory

Figure 14: heat map of the Northern Territory indicating concentration of qualified engineers within territory (note, shading is relative to the total population of the territory, not nationally)

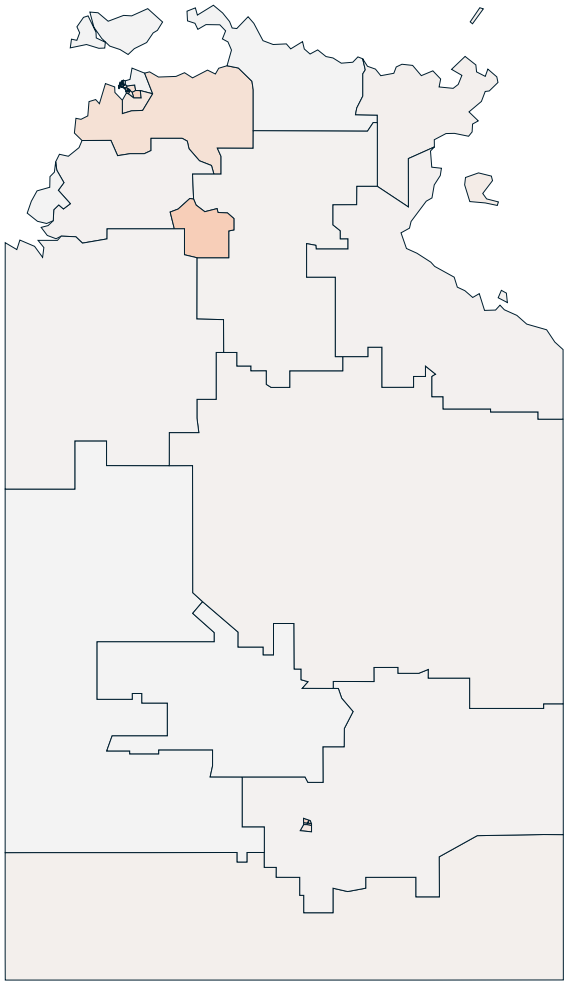


Figure 15: Distribution of qualified engineers in primary industries in the NT

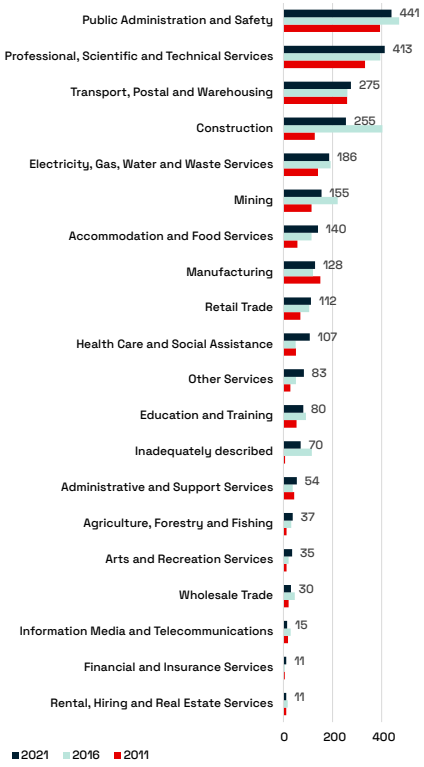


Table 11: Engineering workforce statistics for the NT

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	117	5.5%	120	3.8%	104	3.4%
Employed, worked full-time	1,566	73.1%	2,335	73.2%	2,158	70.0%
Employed, worked part-time	220	10.3%	329	10.3%	388	12.6%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	198	9.2%	314	9.8%	372	12.1%
Not stated	6	0.3%	8	0.3%	6	0.2%
Unemployed, looking for full-time work	29	1.4%	74	2.3%	39	1.3%
Unemployed, looking for part-time work	6	0.3%	11	0.3%	15	0.5%
Total	2,142	100.0%	3,191	100.0%	3,082	100.0%
Total Labour Force	**1,938**		**2,869**		**2,704**	
Working in Engineering Occupations	1043		1,544		1,388	
% Working in Engineering Occupations	53.8%		53.8%		51.3%	

Queensland

Figure 16: Heat map of Queensland indicating concentration of qualified engineers within state (note, shading is relative to the total population of the state, not nationally)

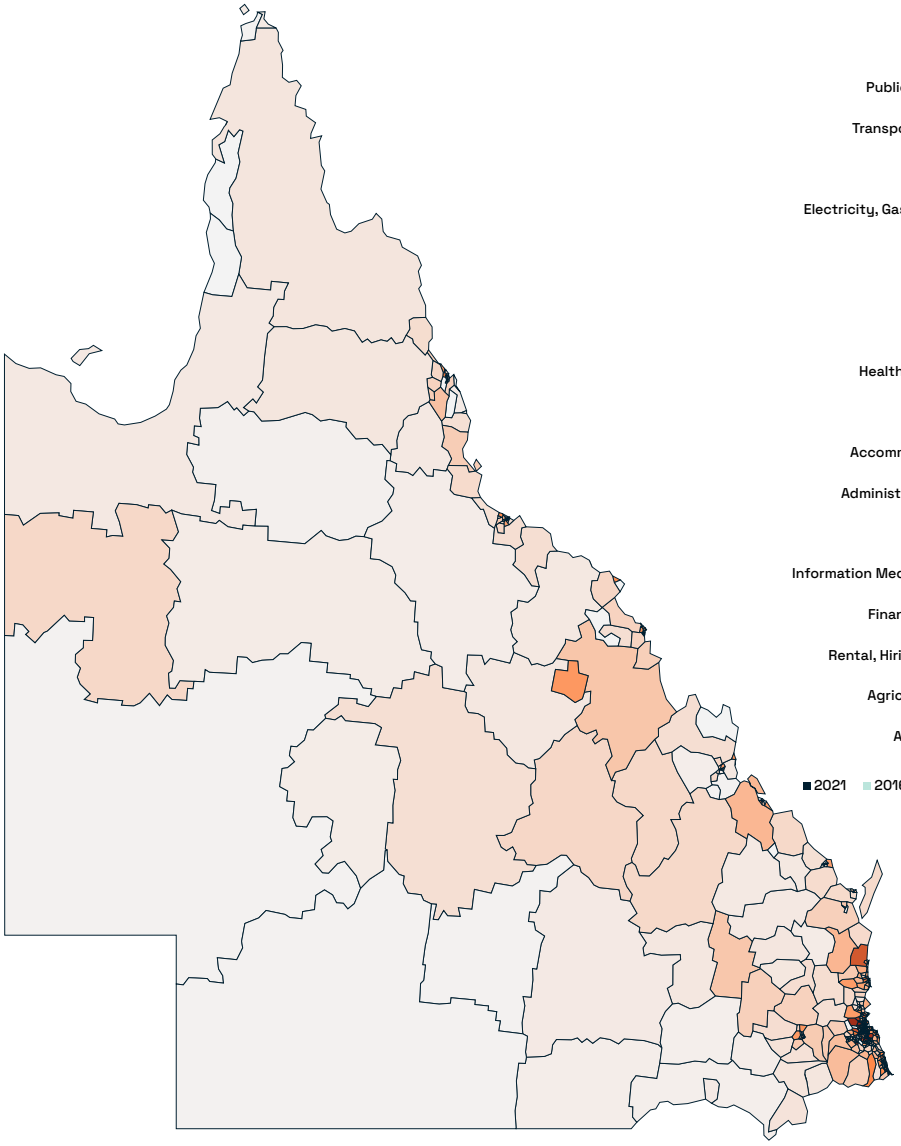


Figure 17: Distribution of qualified engineers in primary industries in QLD

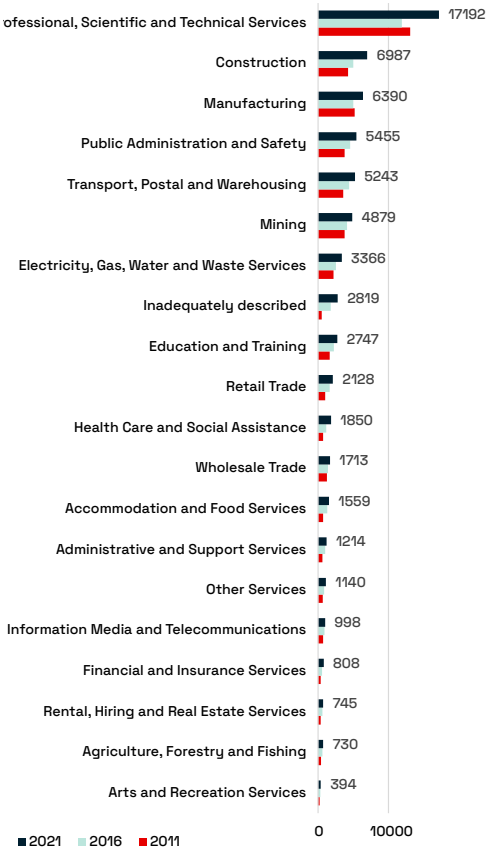


Table 12: Statistics for the engineering population in queensland

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	1,896	3.4%	1,939	2.8%	3,090	3.4%
Employed, worked full-time	38,499	68.1%	42,781	60.8%	54,722	61.1%
Employed, worked part-time	5,102	9.0%	7,848	11.2%	10,931	12.2%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	9,578	16.9%	14,277	20.3%	18,360	20.5%
Not stated	89	0.2%	100	0.1%	148	0.2%
Unemployed, looking for full-time work	1,036	1.8%	2,659	3.8%	1,694	1.9%
Unemployed, looking for part-time work	364	0.6%	768	1.1%	665	0.7%
Total	56,564	100.0%	70,372	100.0%	89,610	100.0%
Total Labour Force	**46,897**		**55,995**		**71,102**	
Working in Engineering Occupations	28,525		31,095		42,071	
% Working in Engineering Occupations	60.8%		55.5%		59.2%	

South Australia

Figure 18: Heat map of South Australia indicating concentration of qualified engineers within state (note, shading is relative to the total population of the state, not nationally)

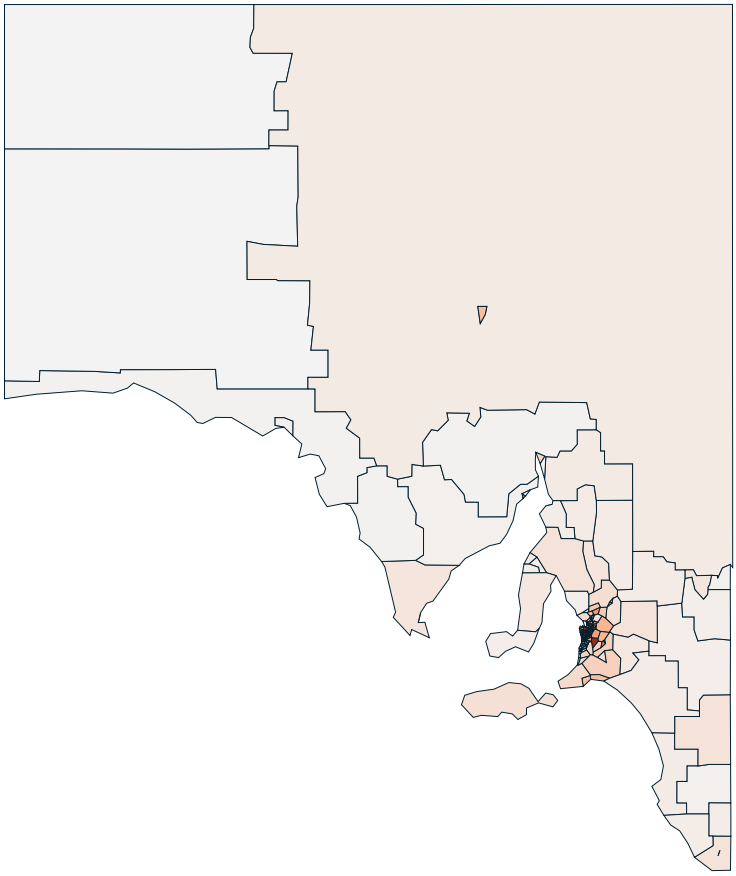


Figure 19: Distribution of qualified engineers within primary industries in South Australia

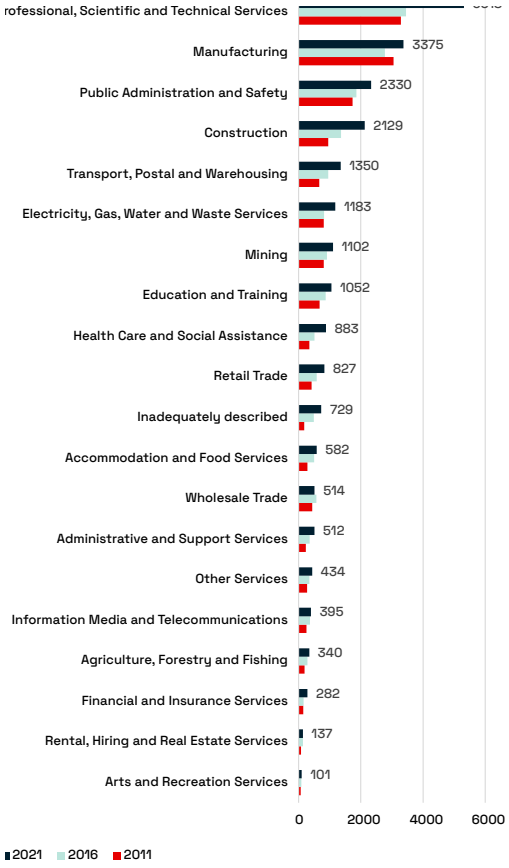


Table 13: Statistics on the population of engineers in South Australia

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	605	3.1%	632	2.6%	744	2.4%
Employed, worked full-time	12,307	63.2%	13,850	57.1%	18,536	59.8%
Employed, worked part-time	2.004	10.3%	3,004	12.4%	4449	14.3%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	3,928	20.2%	5.47	22.5%	6,344	20.5%
Not stated	29	0.1%	42	0.2%	41	0.1%
Unemployed, looking for full-time work	434	2.2%	925	3.8%	634	2.0%
Unemployed, looking for part-time work	152	0.8%	340	1.4%	257	0.8%
Total	19,459	100.0%	24,263	100.0%	31,005	100.0%
Total Labour Force	**13,500**		**18,751**		**24,620**	
Working in Engineering Occupations	8842		9719		13348	
% Working in Engineering Occupations	65.5%		51.8%		54.2%	

Tasmania

Figure 20: Heat map of Tasmania indicating concentration of qualified engineers within state (note, shading is relative to the total population of the state, not nationally)

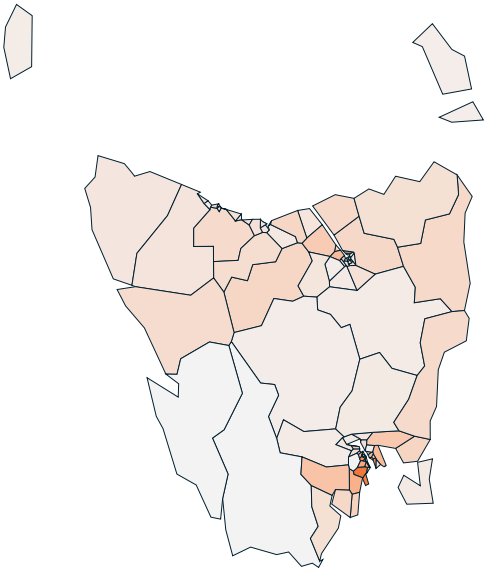


Figure 21: Distribution of qualified engineers within primary industries in Tasmania

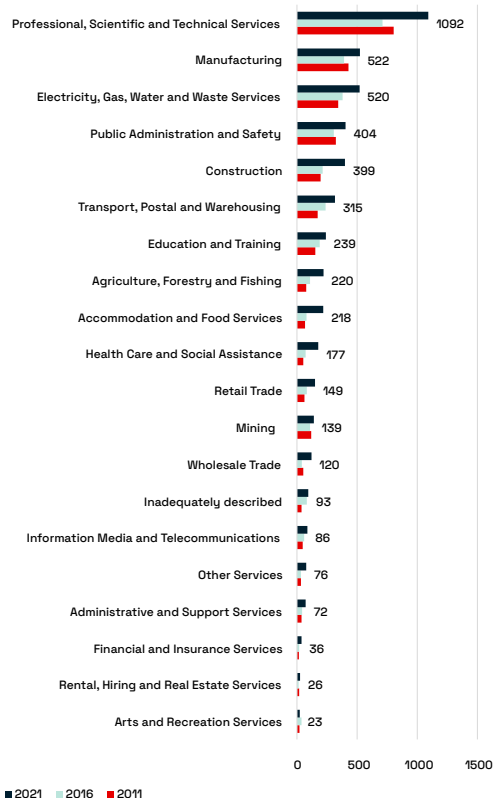


Table 14: Statistics on the population of engineers within Tasmania

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	184	4.2%	155	3.1%	200	2.8%
Employed, worked full-time	2,359	53.7%	2,403	48.7%	3,515	49.5%
Employed, worked part-time	507	11.5%	639	12.9%	1,247	17.6%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	1,221	27.8%	1,562	31.6%	1,895	26.7%
Not stated	6	0.1%	10	0.2%	4	0.1%
Unemployed, looking for full-time work	79	1.8%	124	2.5%	150	2.1%
Unemployed, looking for part-time work	38	0.9%	46	0.9%	88	1.2%
Total	4,394	100.0%	4,939	100.0%	7,099	100.0%
Total Labour Force	**3,167**		**3,367**		**5,200**	
Working in Engineering Occupations	1785		1831		2587	
% Working in Engineering Occupations	56.4%		54.4%		49.8%	

Victoria

Figure 22: Heat map of Victoria indicating concentration of qualified engineers within state (note, shading is relative to the total population of the state, not nationally)

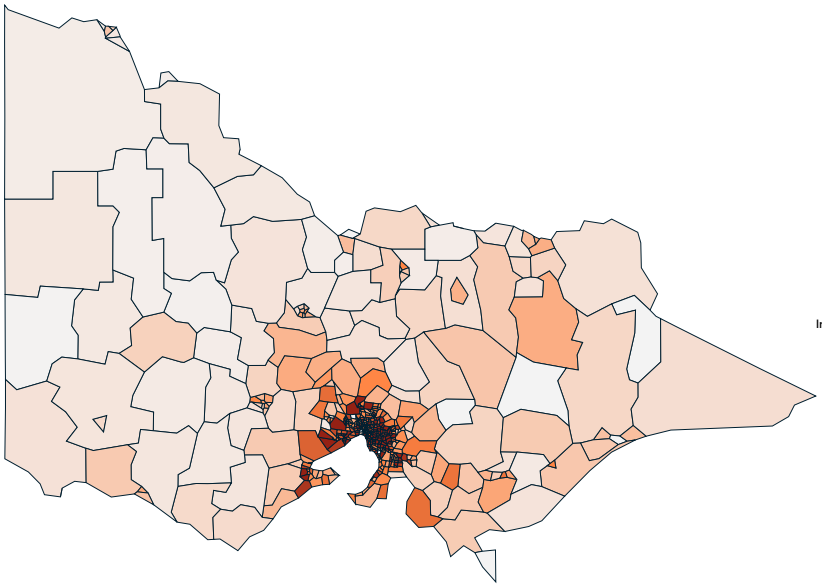


Figure 23: Distribution of qualified engineers in primary industries in Victoria

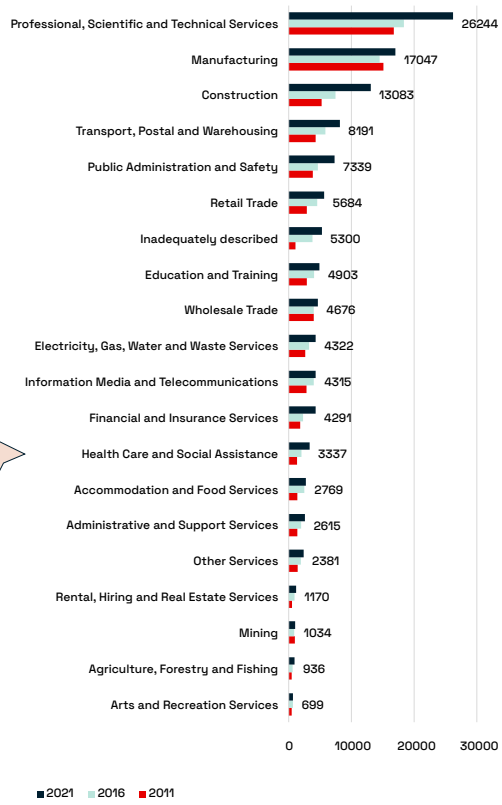


Table 15: Statistics on the population of engineers in Victoria

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	2,844	3.1%	3,121	2.6%	4,296	2.7%
Employed, worked full-time	59,001	64.3%	70,698	59.0%	95,532	60.8%
Employed, worked part-time	10,047	11.0%	15,264	12.7%	21,469	13.7%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	16,697	18.2%	25,116	21.0%	30,711	19.5%
Not stated	182	0.2%	196	0.2%	302	0.2%
Unemployed, looking for full-time work	2,184	2.4%	3,679	3.1%	3,412	2.2%
Unemployed, looking for part-time work	765	0.8%	1,770	1.5%	1,418	0.9%
Total	91,720	100.0%	119,844	100.0%	157,140	100.0%
Total Labour Force	**74,841**		**94,532**		**126,127**	
Working in Engineering Occupations	38,586		47,453		67,195	
% Working in Engineering Occupations	51.6%		50.2%		53.3%	

Western Australia

Figure 24: Heat map of Western Australia indicating concentration of qualified engineers within this state (note, shading is relative to the total population of the state, not nationally)

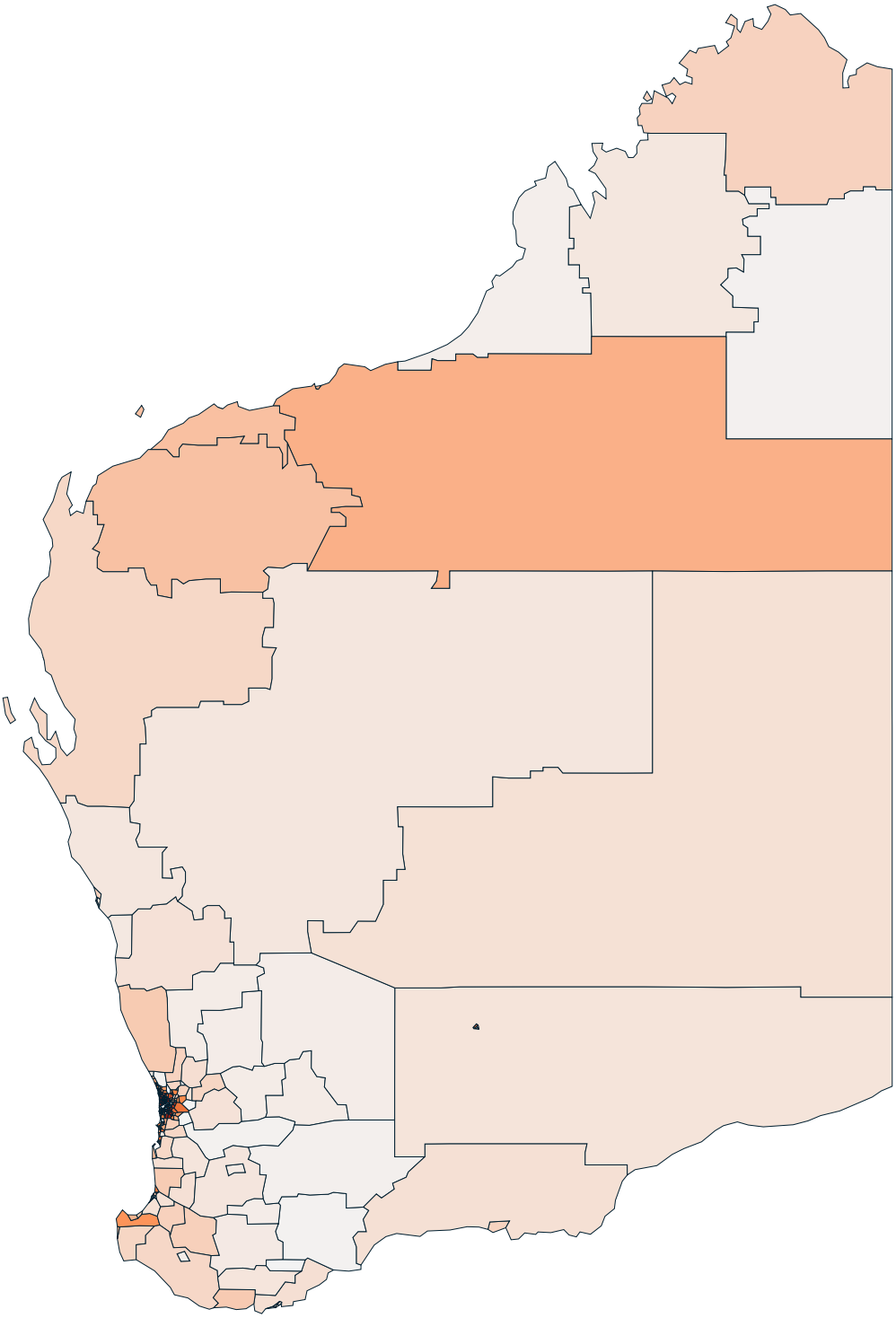


Figure 25: Distribution of qualified engineers in primary industries in WA

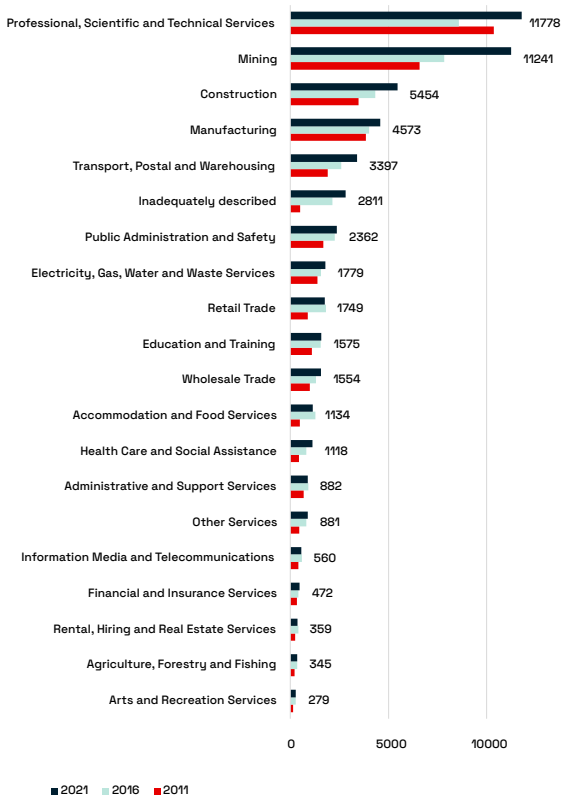
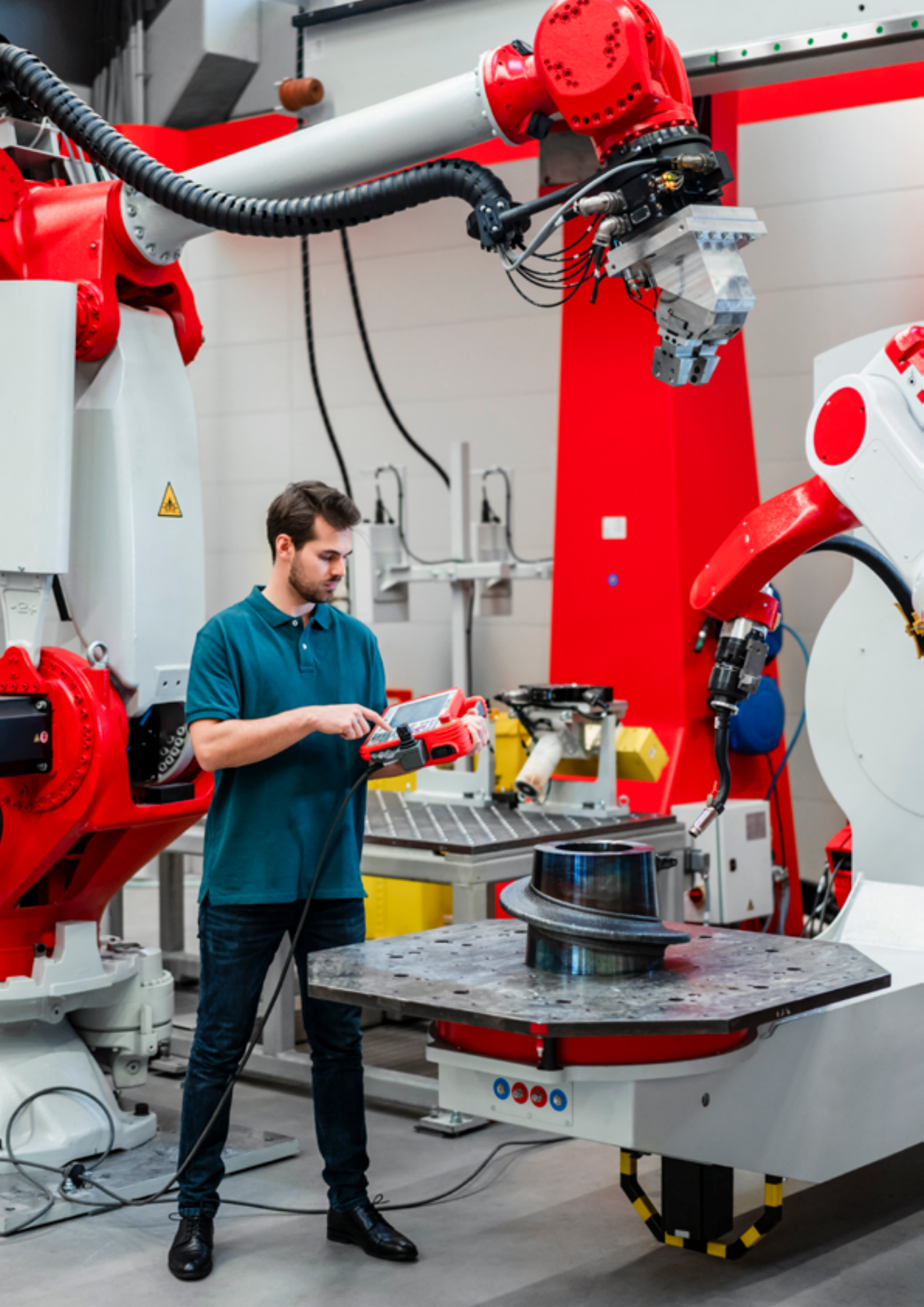


Table 16: Statistics on the population of engineers in WA

Census Year	2011		2016		2021	
	Number	Per cent	Number	Per cent	Number	Per cent
Employed, away from work	1,746	4.0%	1,776	3.1%	2,158	3.2%
Employed, worked full-time	30,504	70.5%	35035	60.9%	44,121	64.8%
Employed, worked part-time	3,990	9.2%	7,137	12.4%	8,332	12.2%
Not applicable	0	0.0%	0	0.0%	0	0.0%
Not in the labour force	6,056	14.0%	9,878	17.2%	11,699	17.2%
Not stated	58	0.1%	81	0.1%	112	0.2%
Unemployed, looking for full-time work	651	1.5%	2,816	4.9%	1,236	1.8%
Unemployed, looking for part-time work	249	0.6%	822	1.4%	442	0.6%
Total	43,254	100.0%	57,545	100.0%	68,100	100.0%
Total Labour Force	**37,140**		**47,586**		**56,289**	
Working in Engineering Occupations	22732		25,080		33,356	
% Working in Engineering Occupations	61.2%		52.7%		59.3%	



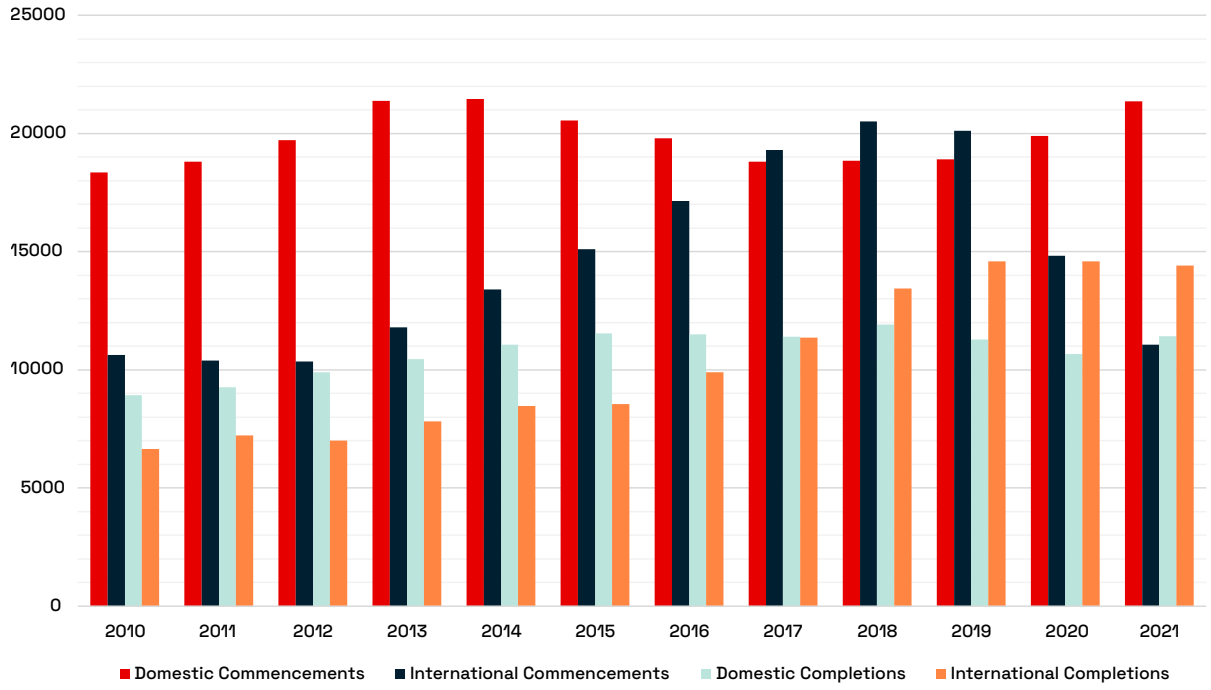
The sources of Australia's engineers

Australia's engineers are sourced either by domestic students completing their educational qualifications in Australian institutions (and occasionally through overseas institutions), or through overseas born engineers migrating to Australia. The overseas-born engineers may be international student graduates from Australian or overseas institutions, or they may arrive through the Australian Government's skilled, temporary, employer-sponsored, or humanitarian migration programs.

Higher education statistics

Education is a fundamental aspect of an engineer's development. See Figure 26 for a record of the commencements and completions of engineering programs in Australian universities from 2010 to 2021[14].

Figure 26: Commencements and completions of engineering programs in Australian higher education providers 2010 - 2021 (source - ACED, April 2022, supplemented with department of education data for 2021, Feb 2023)



Domestic commencements in engineering courses tend to be almost double completions in any given year, with increases in commencements reflected in increases in completions over later years (as we see around 2015) and the decrease in commencements reflected in declining completions a few years later (evident in the decline in student numbers to 2020).

In 2018, international completions also began and continued to exceed domestic completions. We note that international commencements exceeded domestic commencements from 2017 to 2019. The international differential in course commencements and completions was exacerbated over the COVID pandemic peaks, when borders were closed. In 2021 international students' graduations exceeded their commencements for the first time. We estimate that approximately 14,300 fewer international students commenced an engineering qualification than otherwise would have, but for the pandemic related border closures.

We know from the 2019-20 migration data records, that 7.4 per cent of in-Australia applicants for permanent migration were successfully granted to holders of temporary graduate visas[15]. However, it is difficult to establish how many international graduates overall become permanent residents or citizens over longer periods. Many will seek a temporary graduate visa and work towards the conditions of an enabling pathway to permanent residency. However, most international students do return to their home countries where they apply their Australian engineering education.

The ACED 2022 Statistics highlight the reality that engineering is a relatively long and difficult degree. Only around 25 per cent of Bachelors of Engineering (Honours) students graduate in the 'minimum time' it would take

14 Student Data, Department of Education, 2023, https://www.education.gov.au/higher-education-statistics/student-data
15 R King, Pipelines into Engineering, Dec 2021, p7

to complete a qualification with full-time study[16]. There is a five per cent attrition rate in first year, with a further 20 per cent attrition over later years.

The statistics show that 75 per cent of engineering students will graduate within six years. And that more than 75 per cent of domestic commencements will complete a degree in nine years. Five per cent remain enrolled, although not necessarily in an engineering degree.

Tables 17 and 18 report the characteristics of all commencing engineering higher education students and all graduating engineering students for the years of 2010 to 2021. The ACED data[17] is supplemented with Department of Education data[18] for the 2021 calendar year.

Table 17: All commencements

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
All commence-ments	28,975	29,199	30,065	33,179	34,864	35,639	36,935	38,121	39,360	39,030	34,730	32,419
domestic number	18,352	18,813	19,710	21,386	21,456	20,544	19,801	18,811	18,856	18,910	19,900	21,353
% domestic female	15.8%	15.3%	15.0%	15.6%	15.8%	15.8%	16.1%	16.7%	18.0%	18.4%	19.4%	19.7%
international number	10,623	10,386	10,355	11,793	13,408	15,095	17,134	19,310	20,504	20,120	14,830	11,066
% international female	18.5%	18.1%	17.8%	18.1%	18.4%	19.9%	19.9%	20.2%	19.3%	19.0%	20.7%	21.7%
% international	36.7%	35.6%	34.4%	35.5%	38.5%	42.4%	46.4%	50.7%	52.1%	51.6%	42.7%	34.1%

Table 18: All graduates

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
All graduates	15,590	16,484	16,912	18,286	19,550	20,089	21,394	22,735	25,360	25,871	25,276	25,840
domestic total	8,935	9,257	9,896	10,461	11,074	11,545	11,500	11,403	11,915	11,277	10,677	11,422
% domestic female	15.9%	15.2%	15.2%	15.5%	16.5%	15.5%	15.7%	15.6%	14.9%	17.0%	18.0%	18.3%
international total	6,655	7,227	7,016	7,825	8,476	8,544	9,894	11,360	13,445	14,594	14,599	14,416
% international female	18.3%	18.0%	18.3%	18.6%	19.2%	19.7%	19.3%	20.9%	21.6%	20.5%	20.9%	21.8%
% international	42.7%	43.8%	41.5%	42.8%	43.4%	42.5%	46.2%	50.0%	53.0%	56.4%	57.8%	55.8%

Table 19 shows the composition of graduates in 2020 by qualification level with the proportion of women in the domestic and international student cohorts provided.

16 King, R., 'Australian Engineering Higher Education Statistics 2010–20', Australian Council of Engineering Deans, (April 2022) https://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf

17 King, R., 'Australian Engineering Higher Education Statistics 2010–20', Australian Council of Engineering Deans, (April 2022) https://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf and King, R , Engineering Statistics December 2020, Australian Council of Engineering Deans http://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20Dec%202020_v2.pdf

18 Department of Education, 2023, https://www.education.gov.au/higher-education-statistics/student-data

Table 19: Graduates and participation of women, 2020

	Domestic		International	
Qualification Levels	Number	% Women	Number	% Women
Bachelor (mostly 4-year Hons)	6,918	17.2%	5,007	21.7%
Postgraduate coursework	1,986	19.8%	7,194	20.2%
Research (PhD and Masters)	691	24.7%	1,049	26.2%
Other undergraduate awards	823	11.3%	1,111	15.6%
TOTAL	10,418	17.7%	14,361	20.8%

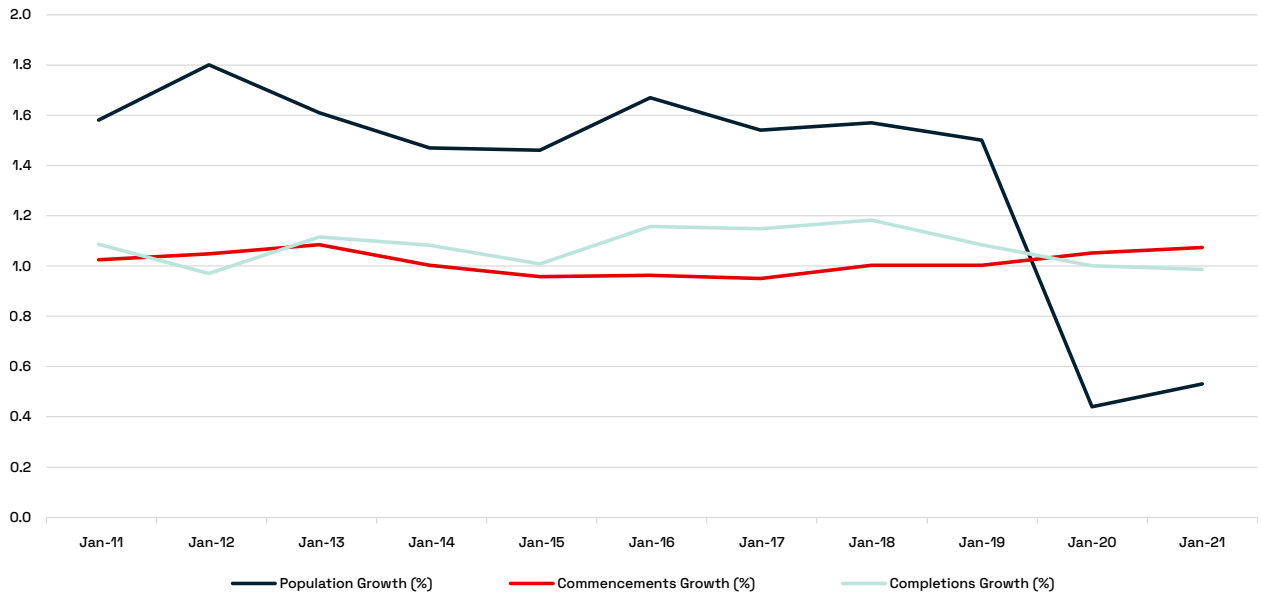
In Table 20 we see the proportion of domestic and international students in each branch of engineering, with civil & environmental, mechanical & manufacturing, and electrical & electronics making up the top three branches of engineering for both domestic and international students.

Table 20: Proportions of professional engineering degree graduates in engineering branches, 2019 (most recent available data, ACED, April 2022)

Branch of engineering	Domestic	International
Civil & environmental	33.9%	31.4%
Mechanical & manufacturing	18.8%	23.4%
Electrical & electronics	18.3%	22.7%
Chemical, mining, materials	10.1%	11.9%
Mechatronics & robotics	7.2%	4.2%
Software	3.8%	2.0%
Biomedical	3.4%	1.2%
Aerospace	3.2%	2.3%

Population growth in Australia has exceeded growth in the supply of domestically trained engineers, with the number of engineering students steady but declining relative to population, as shown in Figure 27.

Figure 27: Comparison of annual population growth[19] with annual growth in domestic engineering commencements and completions in undergraduate and postgraduate programs (population growth taken from the December quarter of each calendar year)



19 National, state and territory population, ABS, December 2022 https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release

Between 2011 and 2021 the number of engineering graduations increased by 23 per cent (well above total population growth of 14.4 per cent during the period). However, the growth in domestic commencements was 13.5 per cent. The low growth in domestic commencements relative to population will restrict potential growth in the supply of Australian engineers over the short term.

Both domestic commencements and completions increased between 2020-2021, potentially signifying an end to this period of below population growth rates. However, it is clear that Australia is reliant on skilled migrant engineers to grow its engineering workforce, and will remain so for the foreseeable future, unless there is intervention.

In 2021 approximately 1,425 people completed an engineering qualification (AQF6) at a Vocational Education and Training institution, the majority of these were at the Advanced Diploma level, with 1,350 people obtaining this qualification[20].

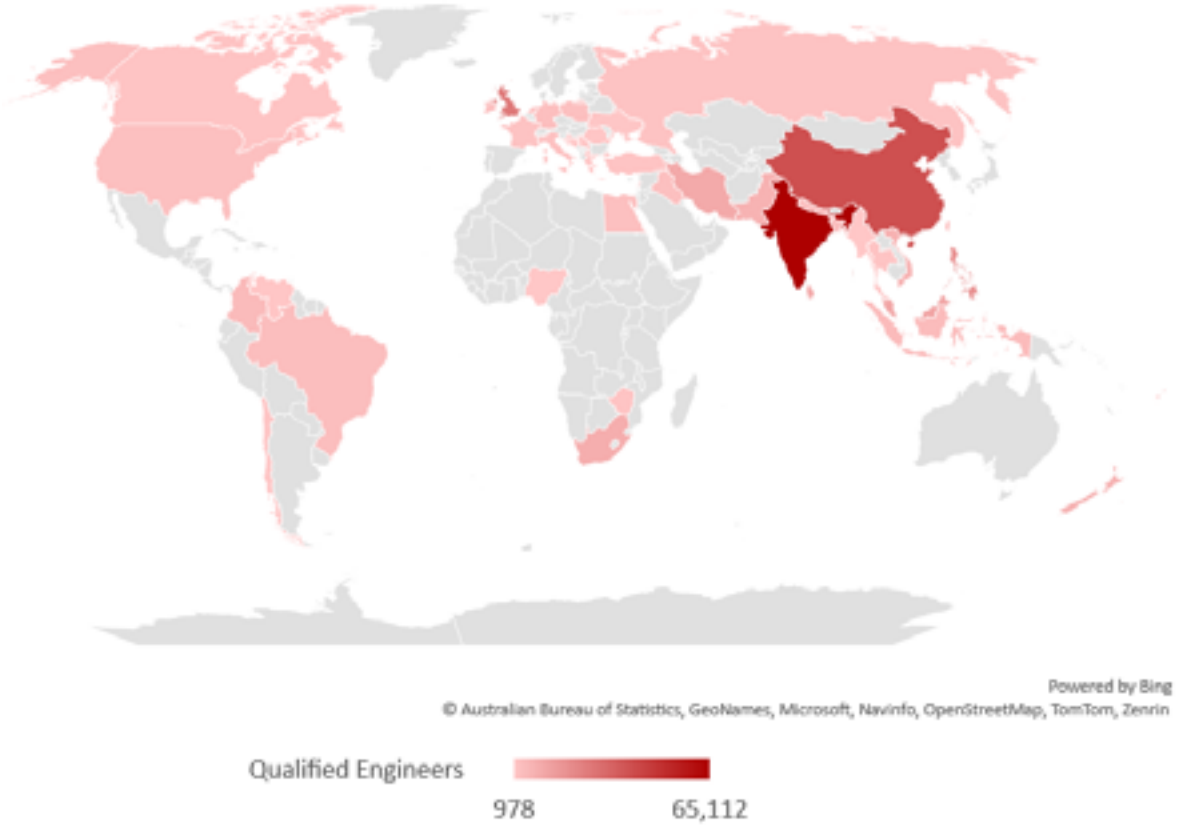
The current strategy whereby the nation relies on skilled migrant engineers has inherent risks. Clearly, there was the disruption caused by COVID-19. Any similar unforeseen events may restrict the availability of skilled migrants again in future, and for potentially longer periods. As engineers become increasingly essential to enabling global change, demand for them from both developed and developing countries is likely to increase.

Engineers born overseas

The majority of Australia's engineering workforce is born overseas. They make up over 70 per cent of the additional engineers added to Australia's population over the five years to 2021. These engineers come to Australia as international students and/or through Australia's skilled (both independent and employer-sponsored), temporary, and humanitarian migration programs. A proportion of them will have also come to Australia as the children of migrants. Others may be Australians born overseas to Australian parents.

Figure 28 illustrates the concentration of these engineers in Australia from their top 50 source countries.

Figure 28: Top 50 source countries for overseas born qualified engineers in Australia in 2021



Statistics for the top 50 countries of origin for engineers born overseas are provided in Table 21. It shows the total population from each source country in Australia. It then shows the number of qualified engineers from each source country. It also shows the numbers working in engineering occupations and the per centage of the total population in Australia of qualified engineers.

20 National Centre for Vocational Education Research, Total VET students and courses 2021: program completions, filtered for engineering and related technologies, https://www.ncver.edu.au/research-and-statistics/data/databuilder

Table 21: Statistics for top 50 source countries for overseas born engineers in Australia

Country of Birth	Total Population in Australia	Qualified Engineers	Working in Engineering Occupations	% qualified engineers
India	673,355	65,112	29,612	9.7%
China	549,616	39,190	10,903	7.1%
United Kingdom	927,488	26,009	10,492	2.8%
Philippines	293,881	19,202	6,073	6.5%
Malaysia	165,605	11,133	5,089	6.7%
Sri Lanka	131,916	10,747	5,384	8.1%
Iran	70,906	10,467	5,073	14.8%
South Africa	189,221	9,145	5,380	4.8%
New Zealand	530,502	7,730	3,876	1.5%
Pakistan	89,627	7,422	3,143	8.3%
Vietnam	258,003	7,298	2,676	2.8%
Colombia	35,036	4,836	1,385	13.8%
Hong Kong (SAR of China)	100,149	4,817	2,001	4.8%
Bangladesh	51,482	4,785	2,202	9.3%
Korea, Republic of (South)	102,093	4,414	1,205	4.3%
Indonesia	87,091	4,412	1,692	5.1%
Nepal	122,491	3,950	1,448	3.2%
Brazil	46,706	3,745	1,339	8.0%
Germany	101,281	3,664	1,362	3.6%
Scotland	118,484	3,518	1,554	3.0%
Poland	45,873	3,372	1,078	7.4%
Egypt	43,198	3,362	1,271	7.8%
Ireland	80,918	3,304	2,052	4.1%
Iraq	92,921	3,265	750	3.5%
United States of America	101,329	3,133	1,488	3.1%
Italy	163,341	2,930	1,045	1.8%
Singapore	61,042	2,849	1,208	4.7%
Taiwan	49,501	2,353	621	4.8%
Russian Federation	23,859	2,344	728	9.8%
France	36,026	2,221	1,210	6.2%
Netherlands	66,480	2,216	739	3.3%
Lebanon	87,355	2,101	834	2.4%
Zimbabwe	39,701	1,993	1,067	5.0%
Fiji	68,965	1,941	844	2.8%
Turkey	38,581	1,920	699	5.0%
Canada	50,200	1,904	1,051	3.8%
Thailand	83,779	1,800	369	2.1%

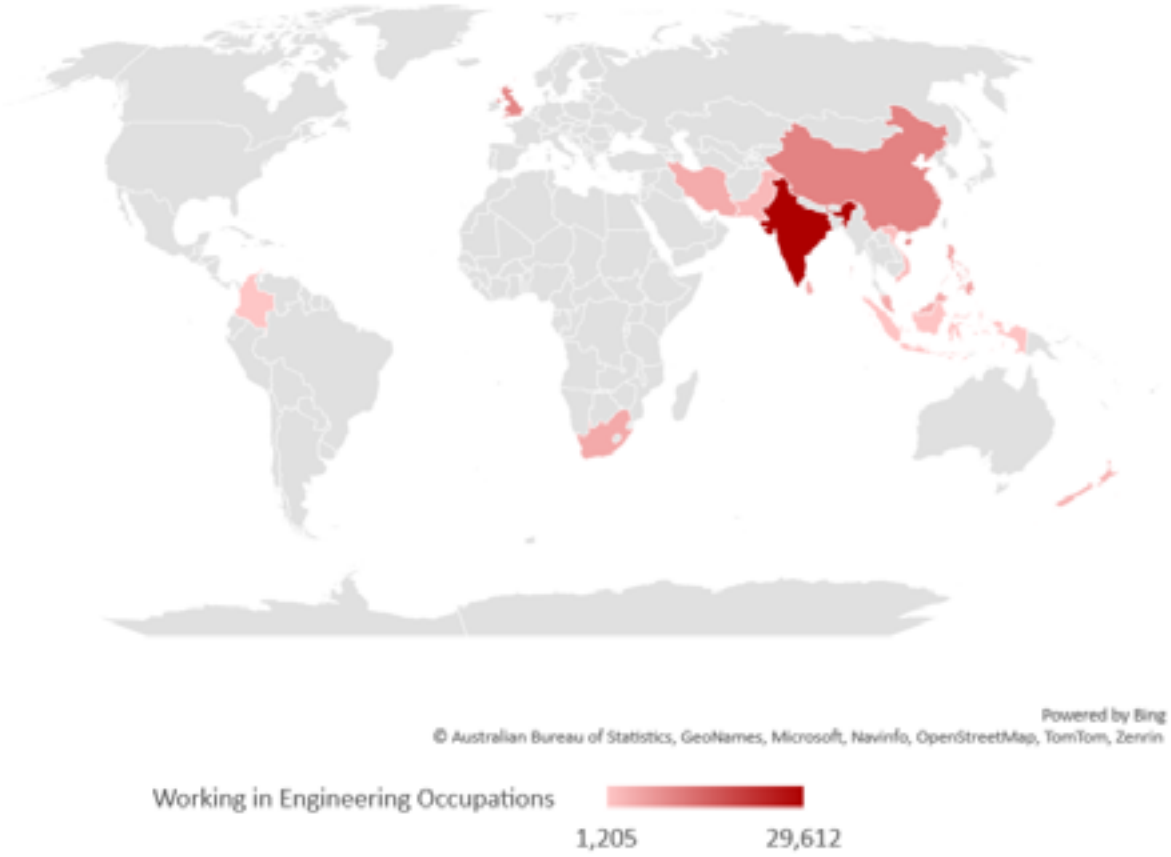
Country of Birth	Total Population in Australia	Qualified Engineers	Working in Engineering Occupations	% qualified engineers
Chile	29,883	1,515	461	5.1%
Ukraine	14,053	1,455	345	10.4%
Romania	15,271	1,308	512	8.6%
Serbia	25,427	1,191	471	4.7%
Venezuela	6,622	1,140	612	17.2%
Inadequately described	14,360	1,138	326	7.9%
Bosnia and Herzegovina	26,164	1,100	396	4.2%
Wales	29,247	1,057	442	3.6%
Croatia	43,299	1,054	371	2.4%
Greece	92,291	1,038	329	1.1%
Myanmar	39,168	1,025	345	2.6%
Nigeria	12,886	996	343	7.7%
North Macedonia	41,765	978	347	2.3%

The top 10 nations of origin of Australia's qualified engineers working in engineering occupations are shown in Table 22. Their concentration is shown on the heat map in Figure 29.

Table 22: Top 10 source countries for overseas born engineers working in engineering

Country of Birth	Working in Engineering Occupations
India	29,612
China	10,903
United Kingdom	10,492
Philippines	6,073
Sri Lanka	5,384
South Africa	5,380
Malaysia	5,089
Iran	5,073
New Zealand	3,876
Pakistan	3,143
Vietnam	2,676
Hong Kong (SAR of China)	2,001
Indonesia	1,692
Colombia	1,385
Korea, Republic of (South)	1,205

Figure 29: Top 10 countries of origin for overseas born engineers working in engineering occupations



Migration statistics

Migration statistics provide an additional lens for considering the available data to identify qualified engineers. The main challenge in comparing migration data to census data is that migration data, although more recently publicly available, lacks the ability to filter by qualification level or area of study. Skill levels are available, but do not provide the same level of detail as census data.

Migration data is also incomplete. Migration skill assessments are conducted for many, but not all permanent and temporary migrants to Australia. They exclude the humanitarian migration program. Exemptions may apply in cases where the individual has a relevant Australian qualification or has been nominated for an occupation that doesn't require a skills assessment due to holding certain licenses or registrations, or their work experience.

Migration data uses ANZSCO to record occupations to the most detailed level (six-digit). The data provided in this section is at the four-digit level (middle) of ANZSCO, to allow for a broader capture of qualified engineers.

The four-digit ANZSCO occupations used for examining migration data for the engineering profession are in Table 23.

Table 23: ANZSCO Unit groups for migration statistics

Unit Groups	Title
1332	Engineering Managers
2331	Chemical and material engineers
2332	Civil Engineering Professionals
2333	Electrical Engineers
2334	Electronics Engineers
2335	Industrial, Mechanical and Production Engineers
2336	Mining Engineers
2339	Other Engineering Professionals
2613	Software and applications programmer
2633	Telecommunications Engineer
3122	Civil Engineering Draftsperson
3123	Electrical Engineering Draftsperson
3124	Electronic Engineering Draftsperson
3125	Mechanical Engineering Draftsperson
3129	Other Building and Engineering Technicians

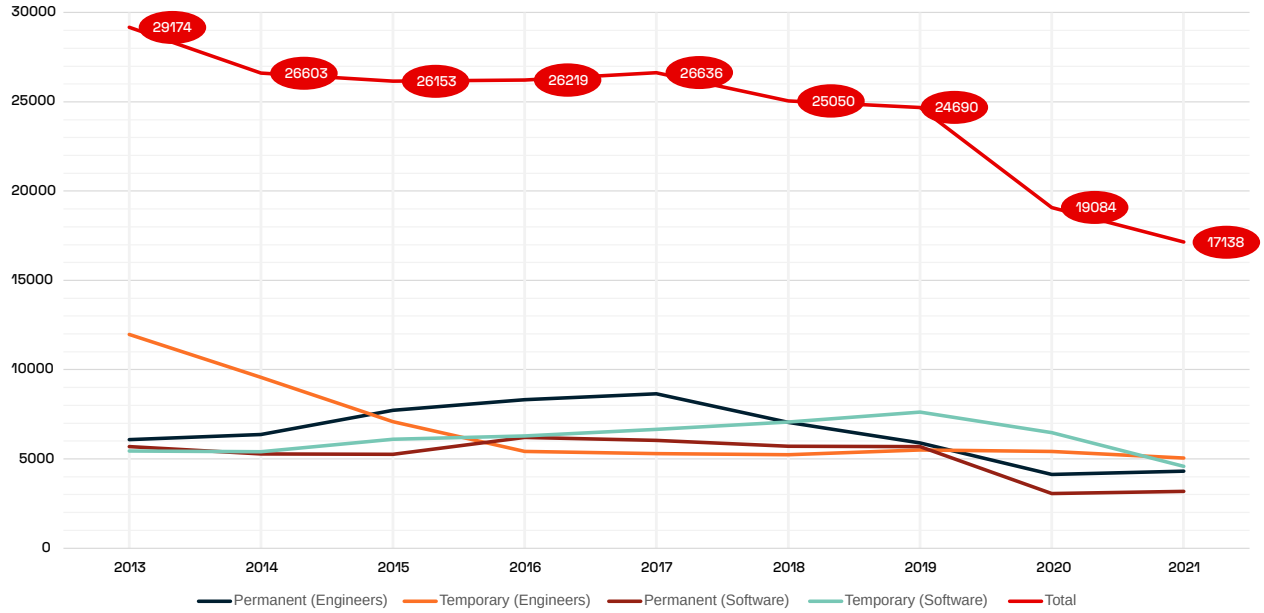
Comparisons between migration and census data are also complicated because the permanent settlement outcome statistics are provided in different program years to the quarterly totals for temporary visa holders in Australia. For the overview, we selected the program year end for permanent migration outcomes, and the third quarter of each calendar year for temporary visa holders in Australia.

Migration statistics for the years 2013 to 2021 are provided in Table 24 and shown in Figure 30. This data provides permanent migration skilled visa outcomes and temporary skilled visa holders in Australia (rather than visas granted).

Table 24: 2013-2021 permanent settlement outcomes and temporary visa holders in Australia

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Permanent Visas (Engineers)	6,074	6,355	7,722	8,314	8,635	7,035	5,894	4,133	4,315
Temporary Visas (Engineers)	11,972	9,572	7,079	5,428	5,295	5,237	5,503	5,421	5,053
Permanent Visas (Software)	5,681	5,273	5,247	6,195	6,045	5,708	5,677	3,063	3,181
Temporary Visas (Software)	5,447	5,403	6,105	6,282	6,661	7,070	7,616	6,467	4,589
Total	29,174	26,603	26,153	26,219	26,636	25,050	24,690	19,084	17,138

Figure 30: Temporary visa holders and permanent migrants for a selection of engineering occupations at the four-digit level, note this figure is indicative only and is likely an undercount, data for temporary visa holders was taken at the third quarter[21] of each program year to align with the calendar year for permanent migrants (Source, Department of Home Affairs[22]).



When comparing these figures to census data, 81,995 additional overseas-born engineers have come to Australia over the five years to 2021. However, there are only 67,900 additional overseas-born engineers in the labour force (see Table 3). Many of the overseas-born engineers new to Australia, have travelled here as international students and may be captured as 'not in the labour force'. Others will have replaced retiring overseas born engineers in Australia, who are no longer in the labour force.

If we take the sum of permanent migrants identified as 'Software' and 'Engineers' in Table 24, there are 77,837 additional permanent migrants to 2021. If we add the 9,642 temporary visa holders at the 2021 census, we get 87,479 additional overseas-born engineers.

This indicates that it is likely there is an overestimate from the migration statistics of permanent and temporary qualified engineering migrants in Australia. This is likely due to the difficulty in separating software engineers from software and applications programmers. But it does provide a useful indication of the scale of migration of qualified engineers to Australia over the 2013 to 2021 period. It also shows the downward trend due to the COVID-19 border closures.

Since then, there has been a slight and slow recovery in migration. With temporary migration for engineers rebounding to 5,656 in September 2022. Migration figures are expected to rebound considerably in 2023. Data for permanent migration was not available for 2022 at the time of writing.

Finally, it is challenging to arrive at a definitive figure for the proportion of international students who complete their studies and stay in Australia permanently. Census data does not record these statistics.

ACED analysis of 2019-20 migration data shows that 7.4 per cent of successful in-Australia applicants for permanent migration were granted to holders of Temporary Graduate vias[23]. Others may attain permanent residency or citizenship via other visa types. As far as we are aware, data on longitudinal tracking of international students and eventual migration outcomes is not currently available for the engineering profession, but it may be in future.

21 Taken at the third quarter as the final quarter of each year is significantly lower than the earlier quarters, possibly due to people travelling overseas or employment contracts ending with the calendar year. The average of all four quarters in a calendar year tends to be lower than the first three quarters count.

22 Department Of Home Affairs, Migration Program, Expert Panel (Family) And Child Outcomes Since 2011-12 Pivot Table Aad Temporary Resident (Skilled) Visa Holders In Australia At 2022-23 To December 2022 – Comparison With Previous Years, available at data.gov.au

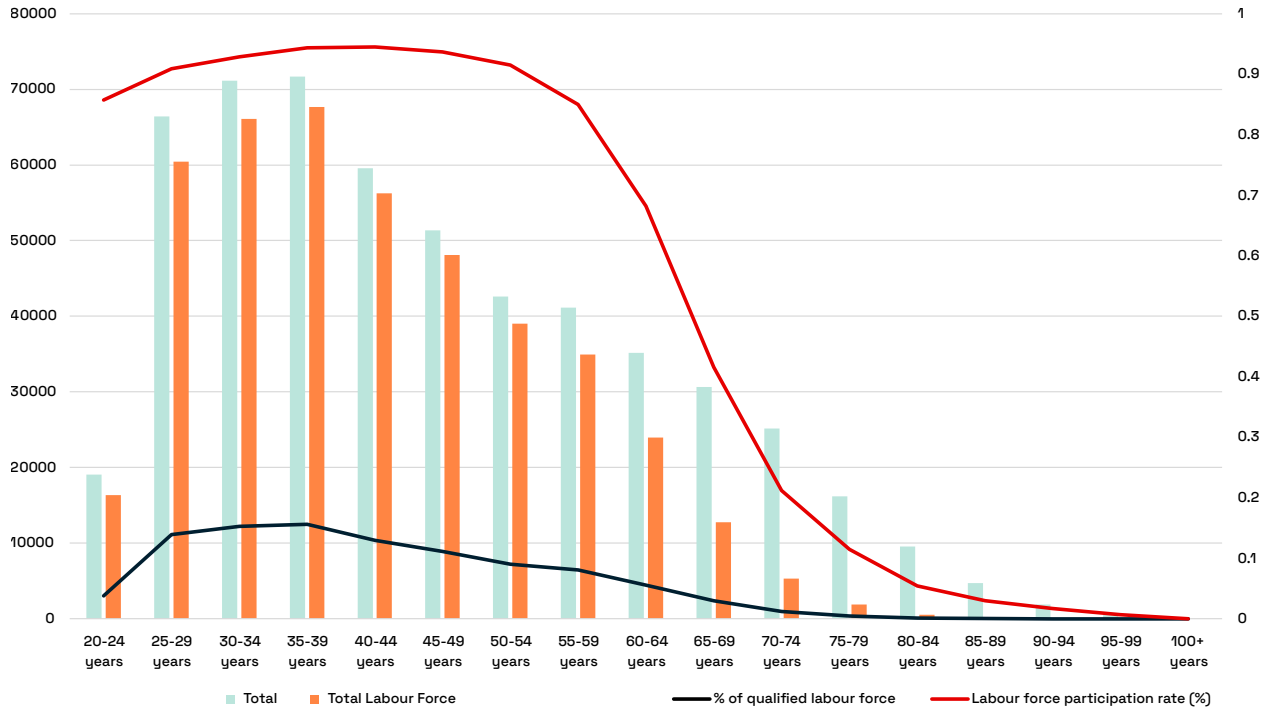
23 Pipelines into Engineering, R King, Australian Council of Engineering Deans, Dec 2021, p7

The engineering labour market

Labour force participation

To illustrate the drop-off in labour force participation as age increases, in Figure 31 and Table 25 we have provided a comparison chart plotting the total population, the population in the labour force, the per centage of the qualified engineer labour force, and the labour force participation rate per five-year age bracket.

Figure 31: Proportion of population and proportion in the labour force by age bracket for qualified engineers



Labour force participation peaks at 40-45 years at 94.5 per cent. We see the decline in labour force participation from 45-49 years of age, that is more prominent at 50-54 years, and declines faster from the 60-64 age bracket.

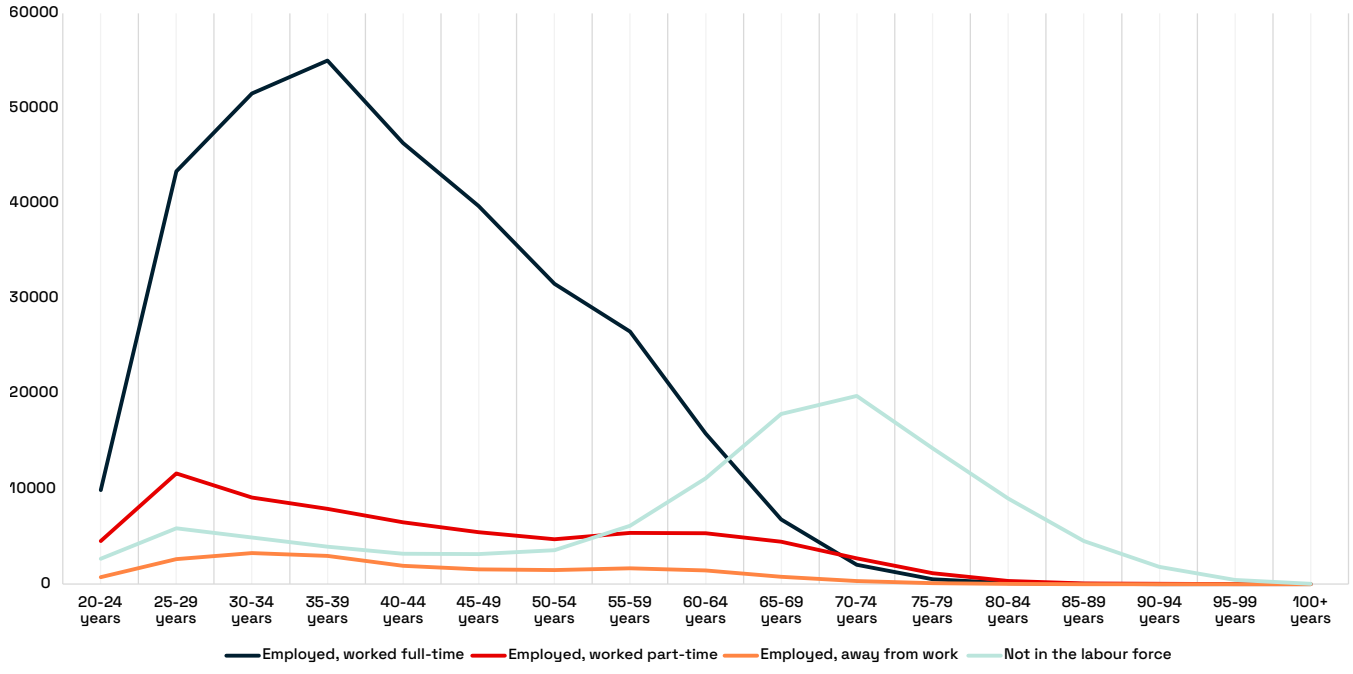
Table 25: Distribution of labour force and participation by age band

Age	Total	Total Labour Force	Proportion of engineering qualified labour force (%)	Labour force participation rate (%)
20-24	19,078	16,360	3.80%	85.80%
25-29	66,440	60,416	13.90%	90.90%
30-34	71,169	66,115	15.20%	92.90%
35-39	71,707	67,657	15.60%	94.40%
40-44	59,542	56,252	13.00%	94.50%
45-49	51,331	48,102	11.10%	93.70%
50-54	42,629	39,023	9.00%	91.50%
55-59	41,114	34,948	8.10%	85.00%
60-64	35,155	23,972	5.50%	68.20%
65-69	30,638	12,732	2.90%	41.60%
70-74	25,159	5,335	1.20%	21.20%
75-79	16,203	1,858	0.40%	11.50%
80-84	9,565	519	0.10%	5.40%
85-89	4,719	139	0.00%	2.90%
90-94	1,868	31	0.00%	1.70%
95-99	466	3	0.00%	0.60%
100+	26	0	0.00%	0.00%
Total	546,809	433,548	100.00%	79.30%

Retiring engineers

Figure 32 provides the employed components of the labour force for clearer comparison with those not in the labour force. It demonstrates the impact on the labour force of the large numbers of qualified Baby Boomer engineers reaching retirement.

Figure 32: Distribution of qualified engineers employed in the labour force and those not in the labour force.



Between 2016 and 2021, 22,419 qualified engineers exited the labour force. That is about 6.5 per cent of the 2016 engineering labour force. The crossover between full-time employment and qualified engineers not in the labour force, occurs between the ages of 60-69, the typical retirement age.

Based on 2021 census data in Table 25, the proportion of qualified engineers in the labour force halves between 55 and 69 years, it then approximately halves again for each five-year age bracket thereafter. By the ages of 80-84 years, there will likely be 5.4 per cent qualified engineers in this age bracket remaining in the workforce.

As of 2021, there were 71,652 qualified engineers between ages 55-69 in the labour force. The drop-off in qualified engineers in the work force from age 65 is dramatic. It then halves to 69 years, and more than halves again from 70-74 years. Based on the figures in Table 4 we predict that 88.5 per cent of engineers will retire by age 75. This means we could reasonably expect up to 68,133 engineers to retire over the next 15 years. More than 60 per cent of the domestic graduations, at current rates, will be required to work in the engineering workforce, to replace these engineers in the workforce.

NOTE: In Table 26 we calculate the proportion and raw numbers of qualified engineers, aged 55 to 74 years, who we anticipate will retire over the next five years. This is an indication to policymakers and workforce planners of the rate of change within the profession over the short to medium term.

Table 26: Possible population of retiring engineers over the next 5 years

Age Group	Population in Labour Force	% who may retire in next 5 years	Number who may retire in 5 years
55-59	34,948	19.8%	6,919
60-64	23,972	39.1%	9,373
65-69	12,732	49%	6,238
70-74	5,335	45.9%	2,448

On these calculations we anticipate that approximately 25,000 qualified engineers will retire from the labour force over the next five years alone. Considering current domestic graduations, and to maintain current workforce levels, we will require 66.6 per cent of graduating domestic engineers to join the labour force in their engineering capacity over the next five years. If we only rely on the domestic supply of newly trained engineers, we will limit the opportunities for economic growth and for realising many national priorities for the nation.

Graduate outcomes

The Australian Government surveys graduate outcomes using both the Graduate Outcomes Survey and the Employer Satisfaction Survey among others. Table 27 shows a summary of key takeaways from each of these two surveys for the most recent data available (2022).

Pleasingly, Table 27 shows that engineering was the field of education with the highest overall employer (supervisor) satisfaction (89.9 per cent). This is the third year in a row in which engineering graduates have had the highest overall satisfaction among employers. Employers rate engineering graduates above the 'All field' averages in 'foundation', 'collaborative', 'technical' and 'employability' skills, as well as in 'overall satisfaction'. Engineering graduates are marginally above the 'All field' rate for 'adaptive skills'.

Engineering also ranks competitively for full-time employment rates and median salary. However, engineering rates poorly for overall graduate satisfaction when it comes to obtaining their qualifications when compared to other fields. Engineers rank their experience at almost 72 per cent vs. all fields at almost 78 per cent. There needs to be some effort put into improving the student experience to lift this ranking and stem any drop-offs.

Table 27: Approximately six months after graduation, employed graduates of undergraduate awards had (GOS & ESS 2022 results[24])

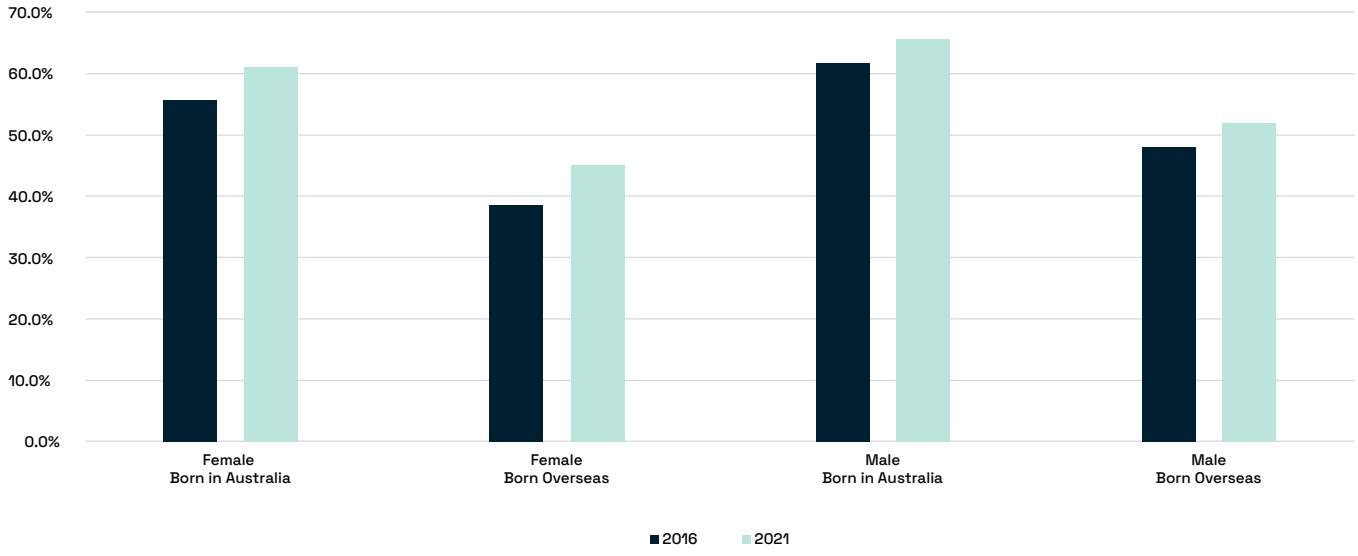
Survey outcome in 2021-22	Engineering	All fields
Median salary	$71,500 (ranked 5/21)	$68,000
Full-time employment rate	87.5% (ranked 4/21)	78.5%
Graduate overall satisfaction	71.9% (ranked 19/21)	77.9%
Employer overall satisfaction	90.2% (ranked 1/10)	84.1%

Outcomes for migrant engineers

Figure 33 shows the proportion of each gender of engineers born in Australia and overseas, working in an engineering occupation. We note the proportion of engineers working in engineering occupations in all segments of the engineering population, has increased over the last five years. However, there is still a considerable gap when compared to the proportion of Australian-born engineers. Female engineers born overseas, are the least likely to be working in an engineering occupation.

Nevertheless, overseas born female engineers have had the largest increase in the proportion of their population segment working in engineering occupations (6.4 per cent). This is similar for male overseas born engineers (almost 4 per cent). However, there is still effort and work required to improve employment outcomes for migrant engineers by addressing the barriers to their employment[25].

Figure 33: Proportion of qualifed engineers working in engineering occupations by gender and location of birth



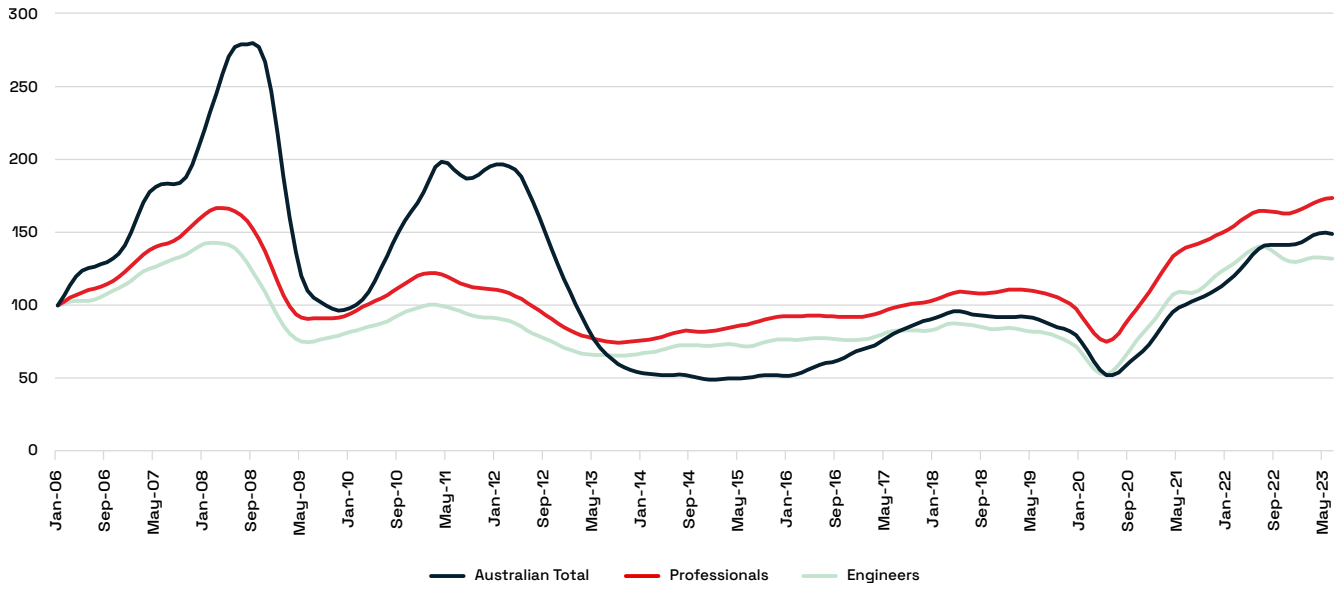
24 Graduate Outcomes Survey 2022, Department of Education 2023, https://www.qilt.edu.au/docs/default-source/default-document-library/2022-gos-national-report.pdf?sfvrsn=c5d342c8_2
Employer Satisfaction Survey 2022, Department of Education 2023, https://www.qilt.edu.au/surveys/employer-satisfaction-survey-(ess)

25 Romanis, J. "Barriers to Employment for Migrant Engineers; Research Report' Engineers Australia, October 2021 https://engineersaustralia.org.au/sites/default/files/resource-files/2021-10/barriers-employment-migrant-engineers.pdf

Engineering employment vacancies over the last decade

Employment vacancies for Engineers, Professionals, and the total Australian population, indexed from January 2006 to the June 2023 quarter, are provided in Figure 34[26].

Figure 34: Australian Vacancy Trends, January 2006 – June 2023 (indexed)



Employment vacancies are at a decade high, but still far below the mining boom (2007/08) or during the post GFC years (2010-2012). Between March 2013 and May 2021, demand for engineers was below the indexed rate set at January 2006.

Before the COVID-19 pandemic (2020-2022), there were eight years and three months of below index vacancies for engineers. Following the introduction of the COVID-19 stimulus measures (and a prolonged period of closed borders that heavily curtailed migration), the vacancy rate for engineers rose to a peak that had not been seen since September 2012.

Unemployment

Table 28 shows unemployment statistics over the decade to 2021. There are fewer unemployed engineers now than in 2016, in total numbers and as a proportion of the labour force. With an unemployment rate 20 per cent lower in 2021 than in 2016.

Table 28: Unemployment statistics for the engineering profession between 2011 and 2021

	2011	2016	2021
Unemployment Rate (% of labour force unemployed)	3.3%	4.2%	3.4%
Population unemployed, seeking fulltime work	7,000	14,350	11,213
% of total pop unemployed seeking fulltime work	2.1%	3.3%	2.1%
Population unemployed, seeking part-time work	2,582	5,722	4,399
% of total pop unemployed seeking part-time work	0.8%	1.3%	0.8%

26 Data sourced from Jobs and Skills Australia, https://www.jobsandskills.gov.au/work/internet-vacancy-index

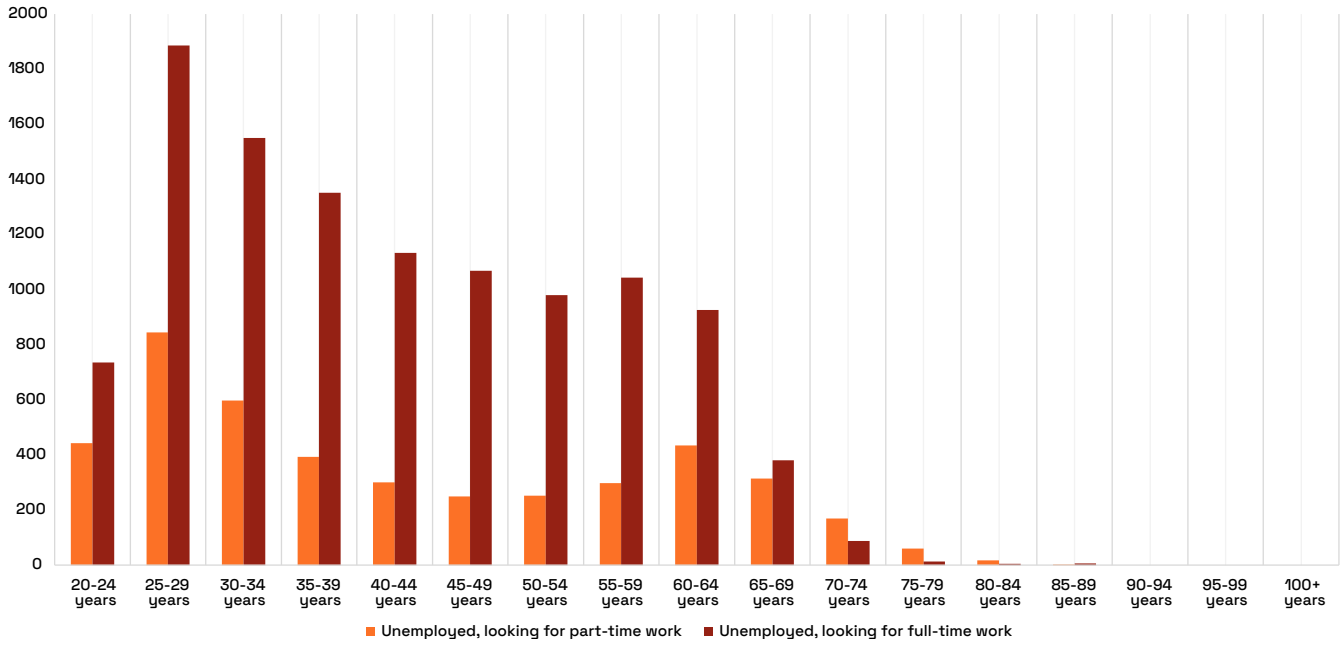
Table 29 shows unemployment data of qualified engineers by age.

Table 29: Population of unemployed qualified engineers by age bracket

LFS	Unemployed, looking for full-time work	Unemployed, looking for part-time work
20-24	736	443
25-29	1,886	845
30-34	1,551	598
35-39	1,352	393
40-44	1,134	301
45-49	1,068	250
50-54	980	252
55-59	1,044	298
60-64	927	434
65-69	381	315
70-74	88	169
75-79	14	60
80-84	5	18
85-89	6	3
Total	11,172	4,379

The unemployed components of the engineering profession are shown in Figure 35. They provide greater detail as to how unemployment changes with age. We should note the very small proportion of the engineering labour force represented in these labour force statistics. There is a rise in those seeking part-time employment at 25-29 years (perhaps indicating that they have childcare responsibilities and/or are changing careers). And again, starting between 60-64 years, there is the transition from employment to retirement.

Figure 35: Age structure of qualified engineers seeking full-time or part-time employment



Skills shortages

The data on vacancies and unemployment above confirms that employers and the wider economy experienced a skills shortage at the time of the 2021 census. Given elevated vacancies into 2023, this continues. Figure 34 shows that vacancies in June 2021 exceeded the January 2006 indexed level for the first time since February 2013.

In August 2021 there were only 15,551 unemployed qualified engineers in Australia. With 4,847 engineering vacancies recorded by Jobs & Skills Australia for that month. That is equivalent to 3.2 potential applicants per vacancy. In raw numbers that means 4,460 fewer engineers were seeking employment in 2021, than there were in 2016. At census time, the unemployment rate for engineers was 3.4 per cent, nearly 25 per cent lower than the unemployment rate for the entire workforce reported by the ABS for August 2021 at 4.5 per cent.[27]

Anecdotally we understand there are challenges in recruiting experienced engineers in the following sectors:

- Defence
- Clean energy
- Power systems
- Construction
- Software engineering
- Systems engineering
- Mining
- Railway signalling
- Civil (highway, bridge design)
- Transport
- Structural
- Electrical and control systems
- Nuclear engineering
- Space engineering

Engineers Australia members, engineering organisations and other stakeholders have reported skills shortages and recruitment difficulties since the second quarter of 2021. This triggered an investigation into the dynamics of engineering skills supply and demand in Australia. The results of which are published in the *Strengthening the Engineering Workforce in Australia report - August 2022*.

The report outlines the findings from extensive consultation and research. It identifies various improvement actions including ways to improve attracting young people to engineering; improved employment outcomes for migrant engineers; and suggestions as to how to retain engineers within the profession.

In the first half of 2023, Australia experienced significant growth in the demand for labour. Unemployment levels were at a near-record low of 3.6 per cent (April 2023[28]). Recruitment company Hays[29] reports that:

- 91 per cent of businesses say they struggle to find suitable workers
- Construction, engineering, manufacturing, technology, and mining employers have higher levels of skill shortages, with 92-95 per cent reporting difficulties
- 82 per cent of engineering employers believe that the current skills shortages will impact operations and growth
- Most of these businesses attributed their struggles to applicants not having the required skills (44 per cent), increased competition from other employers (67 per cent), fewer people entering the market (37 per cent), and current lack of overseas talent (37 per cent).
- The inability to find workers is not sector-specific, with the shortage affecting every industry.
- Overall, 22 per cent of businesses describe their skills shortage as 'extreme', 47 per cent 'moderate', and 22 per cent 'minor'.
- 61 per cent of employers intend to permanently increase their headcount in 2023.

The skill shortage problem is structural and multi-faceted and is exacerbated by:

- Closed borders from 2020 to early 2022
- Australia's infrastructure-led recovery
- New national priorities including
  - net zero emissions, clean energy transition and circular economy/sustainability requirements
  - the need to strengthen supply chains and sovereign manufacturing capabilities
  - The need to strengthen Defence capabilities
  - strong growth in 'new' sectors such as the civil space industry and nuclear-powered submarines

27 Labour Force Australia, August 2021 https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia/aug-2021#:~:text=Media%20releases-,Key%20statistics,Employment%20decreased%20to%2013%2C022%2C600.

28 Labour Force, Australia, April 2023, Australian Bureau of Statistics, https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia/latest-release

29 Hays Salary Guide, January FY2023*

- a priority on cyber security
- a trend towards digital and smart 'everything' including a general, fast-paced trend to integrate technology into most aspects of our daily lives.

Without undertaking corrective action, the skills shortage is likely to continue, certainly over the short term and likely into the medium-term. Some forecasts predict a chronic shortage over the next two decades.

Demand signals/demand forecasting

Numerous government bodies, engineering organisations, and recruitment firms recognise the current skills shortage in Australia and are acutely aware of the ongoing shortage of engineers. They share varying predictions as to the scale and duration of these shortages. Infrastructure Australia recognised the skills shortage in its October 2021 report *Infrastructure workforce and skills supply A report* from Infrastructure Australia's Market Capacity Program. It predicted the engineers' skills shortage would peak in 2023. And estimated the country would need an additional 41,000 civil, geotechnical, structural and materials engineers, to meet the demands of infrastructure projects planned and in progress to 2025[30].

An updated report on Infrastructure Market Capacity was published in December 2022, which noted severe shortages of engineers, scientists and architects. It projected the shortage to peak at more than 115,000 (inclusive of engineers, scientists and architects) towards the end of 2022 and ease towards the end of 2025[31].

Professionals Australia predicted a shortage of 200,000 engineers in Australia by 2040 if new measures and additional measures are not put in place to grow the workforce[32].

The Australian Council of Engineering Deans in December 2021[33] used projections from the **National Skills Commissions** and other sources to model workforce supply and demand and concluded that considerable efforts were required to increase the number of domestic completions by 2030, to offset workforce attrition and facilitate modest growth. It predicted that 70,000 engineers would retire over the decade.

Despite the difficulty in forecasting labour market requirements, there is a consensus among these bodies that Australia will continue to experience a skills shortage over the short term to 2025. And that this shortage is predicted to extend into the medium and longer term (2040).

30 Infrastructure workforce and skills supply A report from Infrastructure Australia's Market Capacity Program, Infrastructure Australia 2021, p34 https://www.infrastructureaustralia.gov.au/sites/default/files/2021-10/Infrastructure%20Workforce%20and%20Skills%20Supply%20report%20211013.pdf

31 Infrastructure Market Capacity, Infrastructure Australia, December 2022 , p63 https://www.infrastructureaustralia.gov.au/sites/default/files/2022-12/20221219_IA_Market-Capacity-Report.pdf

32 Engineering a Better Future Australia's Growing Crisis in Engineering Skills, The Insight Centre for Professionals Australia, March 2023, p5 https://www.voced.edu.au/content/ngv:96618

33 King, R, Engineer Shortages and Projections Working Paper, Australian Council of Engineering Deans, December 2021, p15 https://www.aced.edu.au/downloads/Engineer%20Shortages%20and%20Projections%20Dec%202021.pdf

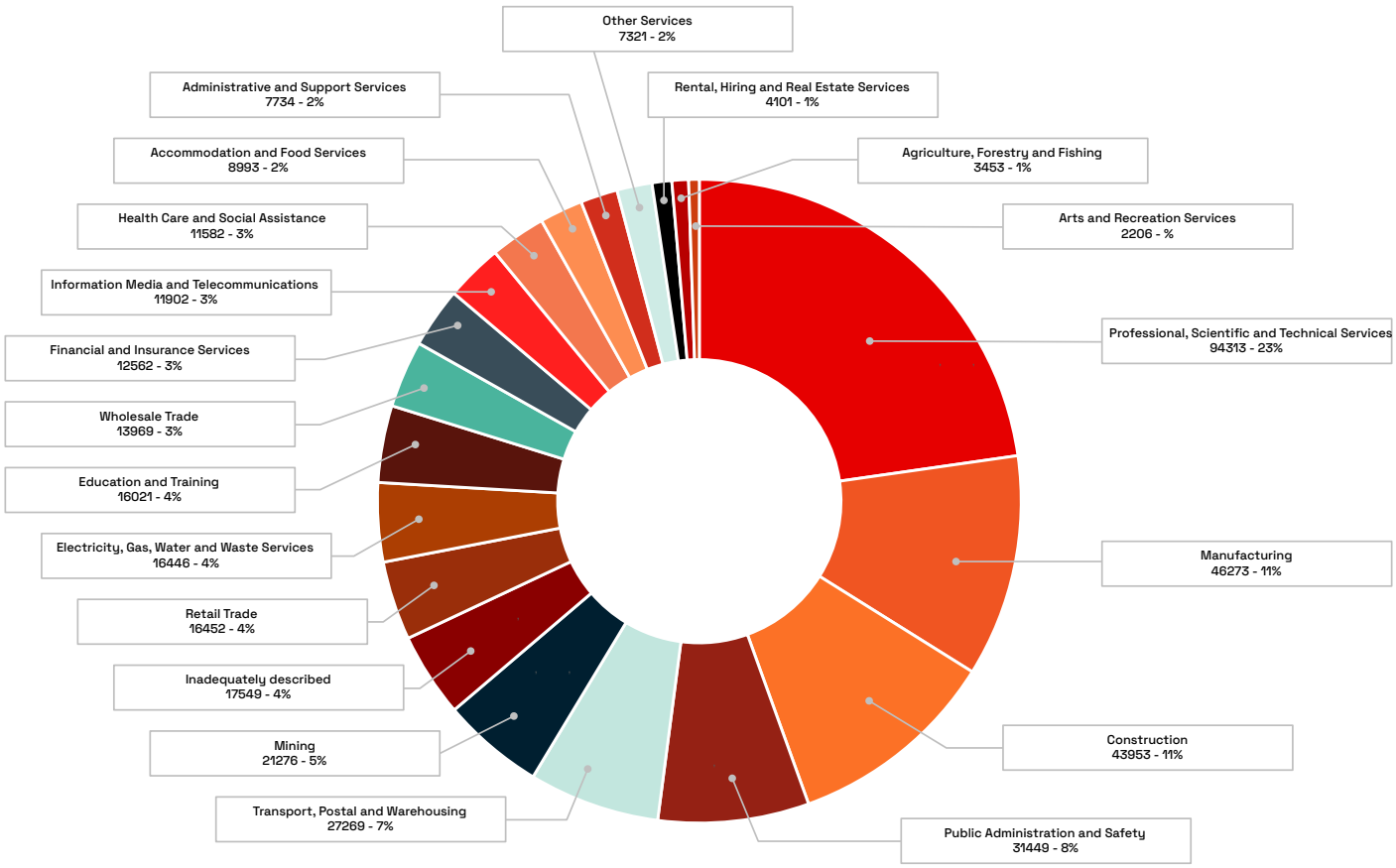
Industry

This section provides statistics on the industry distribution of engineers to the most detailed level in the ANZSIC classification scheme. That is where a 'business entity' is assigned to an industry based on its predominant activity. The term 'business entity' is used in its widest sense to include any organisation undertaking productive activities, including companies, non-profit organisations, government departments and enterprises.[34]

Primary industries

The distribution of qualified engineers in primary industries is shown in Figure 36 for the entire Australian economy[35]. The largest six industry groupings are Professional, Scientific and Technical Services; Manufacturing; Construction; Public Administration & Safety; Transport, Postal & Warehousing; and Mining.

Figure 36: Distribution of qualified engineers in primary industries 2021



Some four per cent (17,541) of the qualified engineer labour force were unable to be classified to a primary industry of employment based on their census responses. Accordingly, the ABS encoded these responses as 'Inadequately described'[36]. This indicates the limitations of ANZSIC and/or the quality of the data supplied based on the respondent's understanding of these classifications.

34 See https://www.abs.gov.au/statistics/classifications/australian-and-new-zealand-standard-industrial-classification-anzsic/2006-revision-2-0/introduction

35 Primary industries are the highest level of ANZSIC and are referred to within the scheme as Divisions.

36 Understanding supplementary codes in Census variables, retrieved 24 November 2022, https://www.abs.gov.au/statistics/detailed-methodology-information/information-papers/understanding-supplementary-codes-census-variables

Figure 37 shows the changes in primary industries for qualified engineers over the last decade.

Figure 37: qualified engineers in primary industries since 2011

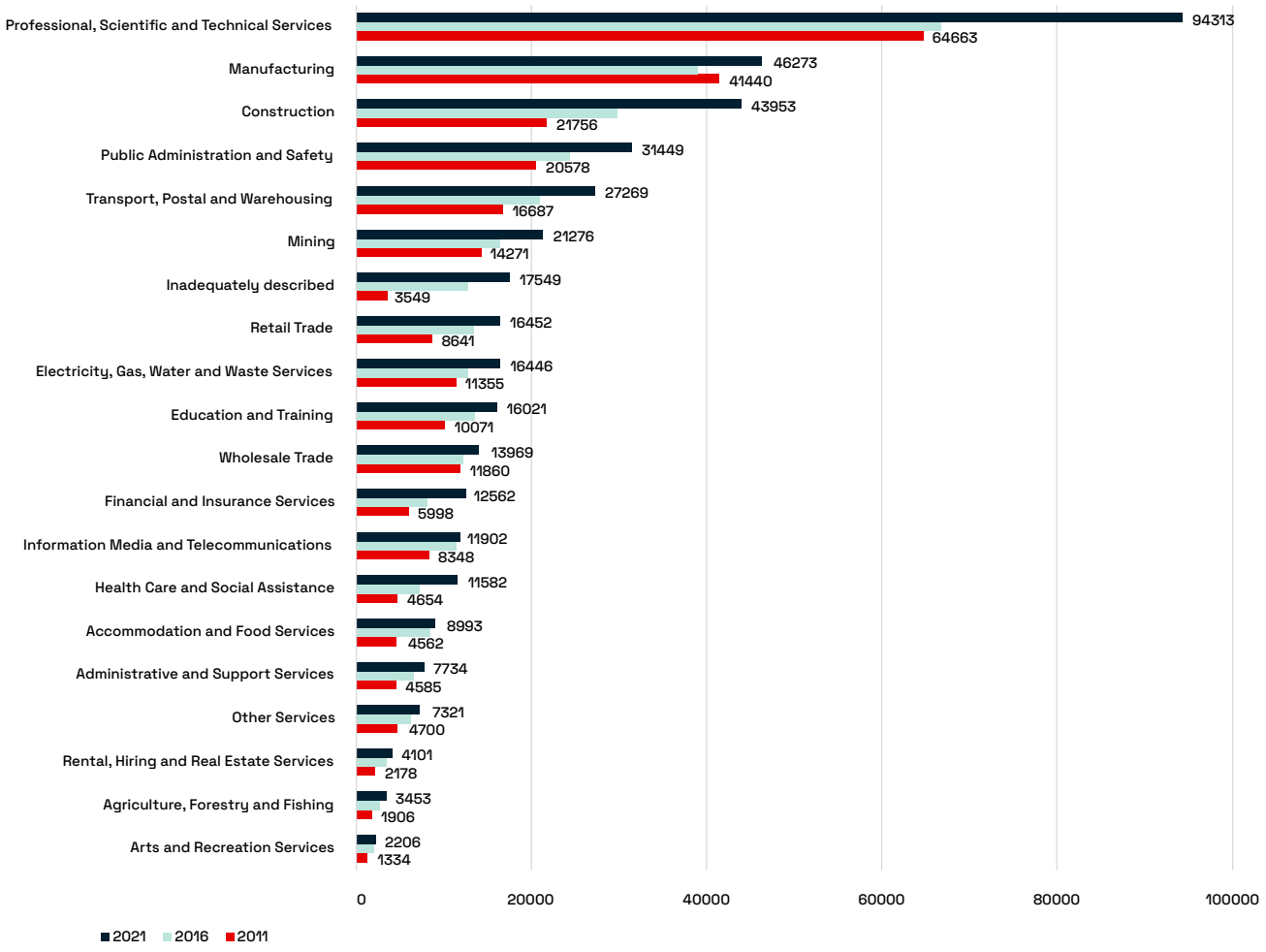


Table 30 shows the change in the numbers of qualified engineers between 2011 and 2021. It broadly indicates higher growth in engineer employment in most industries. There is however slowing growth in those industries that employ engineers in non-engineering roles. These include retail trade, accommodation and food services, administration, and support services.

Table 30: Qualified engineers by primary industry 2011 - 2021

Primary Industry	2011	2016	%	2021	%
Professional, Scientific and Technical Services	64,663	66,764	3.2%	94,313	41.3%
Manufacturing	41,440	38,920	-6.1%	46,273	18.9%
Construction	21,756	29,800	37.0%	43,953	47.5%
Public Administration and Safety	20,578	24,399	18.6%	31,449	28.9%
Transport, Postal and Warehousing	16,687	20,982	25.7%	27,269	30.0%
Mining	14,271	16,412	15.0%	21,276	29.6%
Inadequately described	3,549	12,799	260.6%	17,549	37.1%
Retail Trade	8,641	13,430	55.4%	16,452	22.5%
Electricity, Gas, Water and Waste Services	11,355	12,750	12.3%	16,446	29.0%
Education and Training	10,071	13,574	34.8%	16,021	18.0%
Wholesale Trade	11,860	12,277	3.5%	13,969	13.8%

Primary Industry	2011	2016	%	2021	%
Financial and Insurance Services	5,998	8,087	34.8%	12,562	55.3%
Information Media and Telecommunications	8,348	11,400	36.6%	11,902	4.4%
Health Care and Social Assistance	4,654	7,166	54.0%	11,582	61.6%
Accommodation and Food Services	4,562	8,414	84.4%	8,993	6.9%
Administrative and Support Services	4,585	6,557	43.0%	7,734	18.0%
Other Services	4,700	6,253	33.0%	7,321	17.1%
Rental, Hiring and Real Estate Services	2,178	3,410	56.6%	4,101	20.3%
Agriculture, Forestry and Fishing	1,906	2,713	42.3%	3,453	27.3%
Arts and Recreation Services	1,334	2,082	56.1%	2,206	6.0%

There was a significant resurgence in qualified engineers in manufacturing. The increase of close to 7,000 qualified engineers since the last census, was likely due to COVID-19 pandemic supply chain issues and an increased government focus on building sovereign manufacturing capability.

The total rate of growth of each industry over the last five years is shown in descending order in table 31.

Table 31: Growth rates of primary industries

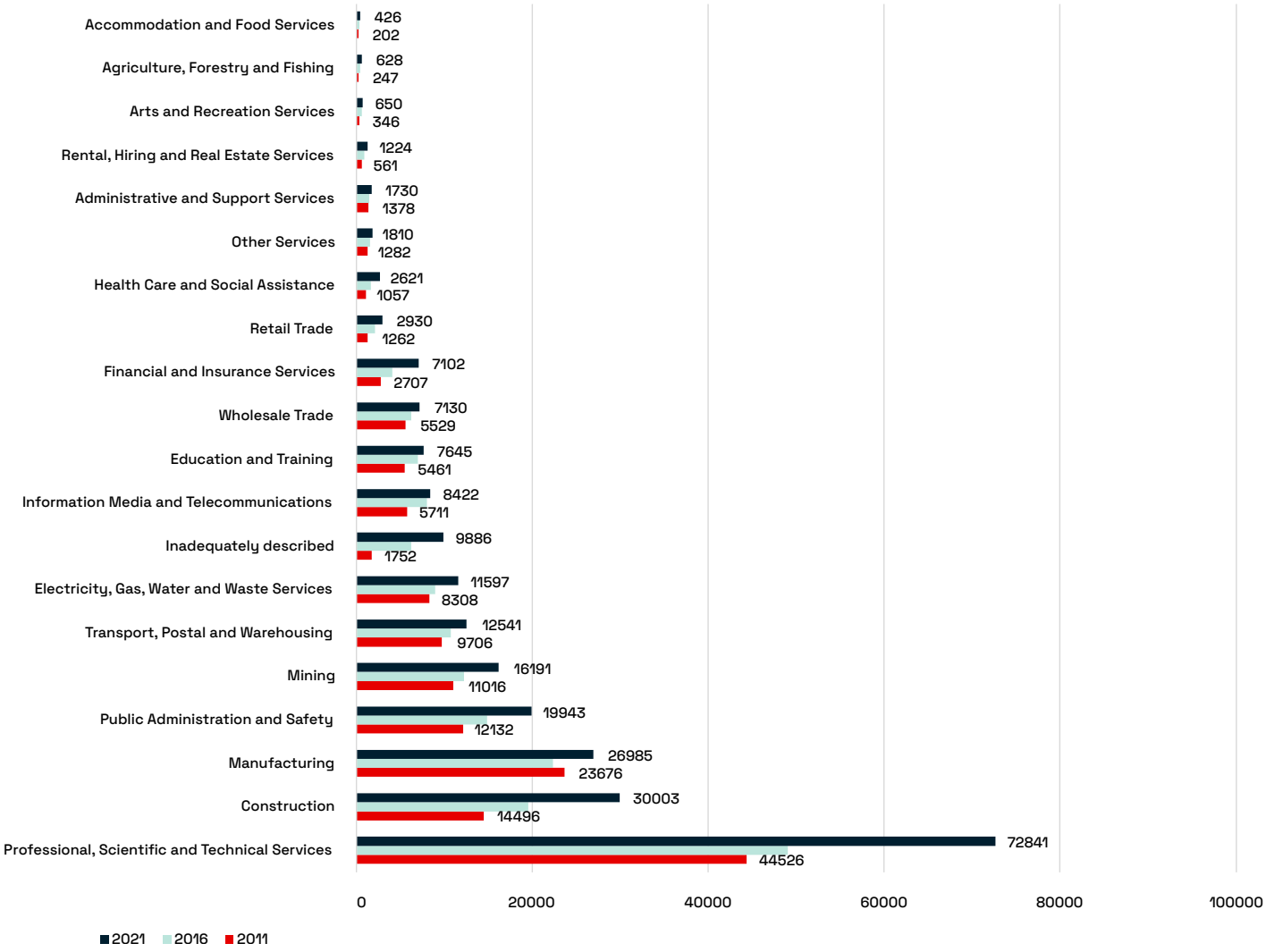
Primary Industry	% growth
Health Care and Social Assistance	61.6%
Financial and Insurance Services	55.3%
Construction	47.5%
Professional, Scientific and Technical Services	41.3%
Inadequately described	37.1%
Transport, Postal and Warehousing	30.0%
Mining	29.6%
Electricity, Gas, Water and Waste Services	29.0%
Public Administration and Safety	28.9%
Agriculture, Forestry and Fishing	27.3%
Retail Trade	22.5%
Rental, Hiring and Real Estate Services	20.3%
Manufacturing	18.9%
Education and Training	18.0%
Administrative and Support Services	18.0%
Other Services	17.1%
Wholesale Trade	13.8%
Accommodation and Food Services	6.9%
Arts and Recreation Services	6.0%
Information Media and Telecommunications	4.4%

Figure 38 shows the distribution of engineers working in engineering occupations in primary industries. Note the change in the ordering of primary industries between the qualified engineers and those working in engineering occupations. Manufacturing, for instance, is the second biggest industry for qualified engineers and is third for those working in engineering occupations. The top six industries nevertheless remain the same. They diverge thereafter.

There are relatively fewer engineering occupations in the smaller primary industries employing engineers.

Engineering occupations don't feature heavily in Arts & Recreation Services or Rental Hiring and Real Estate Services for example.

Figure 38: Distribution of qualified engineers working in engineering occupations in primary industries since 2011



The number of qualified engineers, or those working in engineering occupations, did not decrease in any primary industry. The growth over the last five years for the population of engineers in engineering occupations is in Table 32.

Table 32: Working in engineering occupations 2011 - 2021

INDP Industry of Employment	2011	2016	2021	% Growth ('16-'21)
Professional, Scientific and Technical Services	44,526	49,172	72,841	48.1%
Construction	14,496	19,549	30,003	53.5%
Manufacturing	23,676	22,361	26,985	20.7%
Public Administration and Safety	12,132	14,867	19,943	34.1%
Mining	11,016	12,242	16,191	32.3%
Transport, Postal and Warehousing	9,706	10,757	12,541	16.6%
Electricity, Gas, Water and Waste Services	8,308	8,945	11,597	29.6%
Inadequately described	1,752	6,225	9,886	58.8%
Information Media and Telecommunications	5,711	8,019	8,422	5.0%
Education and Training	5,461	6,955	7,645	9.9%

INDP Industry of Employment	2011	2016	2021	% Growth ('16-'21)
Wholesale Trade	5,529	6,231	7,130	14.4%
Financial and Insurance Services	2,707	4,096	7,102	73.4%
Retail Trade	1,262	2,119	2,930	38.3%
Health Care and Social Assistance	1,057	1,617	2,621	62.1%
Other Services	1,282	1,514	1,810	19.6%
Administrative and Support Services	1,378	1,395	1,730	24.0%
Rental, Hiring and Real Estate Services	561	858	1,224	42.7%
Arts and Recreation Services	346	545	650	19.3%
Agriculture, Forestry and Fishing	247	422	628	48.8%
Accommodation and Food Services	202	345	426	23.5%

Growth rates for the numbers of qualified engineers working in engineering occupations are provided in descending order in Table 33. The fastest growing industries were Financial and Insurance Services, Health Care and Social Assistance, 'Inadequately described', and Construction. There remains growing demand (and lucrative incentives) for engineers working in the financial and insurance sector to apply their engineering problem solving and analytical skillsets.

Table 33: Growth in industry populations for those working in engineering occupations over the five years to 2021

INDP Industry of Employment	% Growth
Financial and Insurance Services	73.4%
Health Care and Social Assistance	62.1%
Inadequately described	58.8%
Construction	53.5%
Agriculture, Forestry and Fishing	48.8%
Professional, Scientific and Technical Services	48.1%
Rental, Hiring and Real Estate Services	42.7%
Retail Trade	38.3%
Public Administration and Safety	34.1%
Mining	32.3%
Electricity, Gas, Water and Waste Services	29.6%
Administrative and Support Services	24.0%
Accommodation and Food Services	23.5%
Manufacturing	20.7%
Other Services	19.6%
Arts and Recreation Services	19.3%
Transport, Postal and Warehousing	16.6%
Wholesale Trade	14.4%
Education and Training	9.9%
Information Media and Telecommunications	5.0%

Commentary on primary industries (in order of population size in 2021)

Professional, Scientific and Technical Services

The number of qualified engineers grew from 66,764 in 2016, to 94,313 in 2021 (41.3 per cent growth). The number working in engineering occupations increased from 25,953 in 2016, to 40,637 in 2021 (56.6 per cent growth).

These services consistently have the highest proportion of engineers 'working in engineering occupations', across all three census years. This highlights the sector's strong demand for engineering expertise. It substantially increased from 2011 to 2021, from 64,663 engineers to 94,313. The lion's share of this increase was primarily in the last five-year period (2016 and 2021) numbering 27,549 engineers (41.3 per cent)).

Manufacturing

The number of qualified engineers in manufacturing grew by 18.8 per cent from 38,920 in 2016 to 46,273 in 2021. While the number of engineers 'working in engineering occupations' increased by 28.6 per cent (from 11,685 in 2016, to 15,033 in 2021). This was following the decline in the number of engineers in the sector between 2011 and 2016.

Construction

As stated, there was rapid growth in the number of engineers 'working in engineering occupations' in the construction sector between 2016 and 2021, growing from 19,549 to 30,003. This strong demand for engineering skills in the sector (53.5 per cent increase over five years) was likely driven by infrastructure projects, urban development, and advances in construction technologies.

The number of 'qualified engineers' in the industry increased by a significant 47.4 per cent (from 29,800 in 2016 to 43,953 in 2021) due to the ever-expanding infrastructure projects and their increasing complexity requiring more engineering expertise.

Public Administration and Safety

The number of engineers 'working in engineering occupations' within the Public Administration and Safety sector grew by 34.1 per cent between 2016 and 2021 (from 14,867 to 19,943). This indicates an increased need for engineers with specialised skills in environmental and safety regulation, policy development, and public infrastructure projects. Having said that, the declining share of engineers employed in the public sector relative to the entire workforce indicates that this growth is being driven by population growth, rather than an increase in engineering capability within the public sector.

Transport, Postal and Warehousing

Again, there was significant growth in the Transport, Postal, and Warehousing sector. The number of 'qualified engineers' in this sector increased from 16,687 in 2011, to 27,269 in 2021. This in turn reflects the growing importance of logistics, transportation, and warehousing in an increasingly globalised and interconnected economy.

Interestingly, less than half of the qualified engineers in this industry were in engineering occupations. There are sizeable cohorts employed in the sub-industries of 'Postal and Courier Pick-up and Delivery' and 'Road Passenger Transport' (3,633 and 3,426 respectively). Combined they represent 1.6 per cent of the entire qualified engineering labour force in Australia.

Mining

After a period of slower growth between 2011 and 2016, the Mining industry experienced a resurgence, and increased its qualified engineers' numbers by 29.6 per cent (from 16,412 in 2016, to 21,276 in 2021). The number of engineers working in engineering occupations also increased by 32.3 per cent (from 12,242 in 2016, to 16,919 in 2021).

Inadequately described

From 2016 to 2021, the number of qualified engineers working in an industry classified as 'Inadequately described' increased by just over 37 per cent (4,750 engineers). This was on top of the sharp growth from 2011 (3,549 in 2011, to 17,549 in 2021) of almost 500 per cent. This suggests an increasing number of engineers working in emerging or interdisciplinary fields that are not yet well defined within the classification system. ANZSIC was published in 2006 with only minor amendments since then. It is due to undergo an update prior to the 2026 census, which may decrease the number of inadequately described responses.

Retail Trade

The retail trade industry has relatively few engineers working in engineering occupations, just 17.8 per cent. This indicates that the engineers working in this industry primarily do so in non-engineering roles such as management, sales, or logistics. The distribution of engineers in sub-industries appears to confirm this, with 4,184 people working in supermarkets and grocery stores, and 1,907 working in fuel retailing. In 2021 there were 1,981 engineers working in engineering occupations (a 39.1 per cent increase). And for qualified engineers in 2021, 16,452 (22.5 per cent increase from 2016).

Electricity, Gas, Water and Waste Services

This industry has a higher proportion of engineers working in engineering occupations at 70.5 per cent, reflecting the sector's technical nature and demand for specialised skills. There was a 29 per cent increase in qualified engineers from 12,750 in 2016,

to 16,446 in 2021. And a 29.6 per cent increase in those working in engineering occupations from 8,945 in 2016, to 11,597 in 2021.

Education and Training

Growth in education and training slowed between 2016 and 2021 when compared to 2011–2016 (26.8 per cent and 18 per cent respectively). This is likely due to plateauing domestic commencements in the latter half of the decade. As well as a considerable drop in international student commencements in 2020 and 2021, attributable to the COVID-19 induced border closures, and stagnant funding levels for research.

Wholesale Trade

While there is an increase in both categories, the proportion of engineers working in engineering occupations remains relatively low (6,231 in 2016 and 7,130 in 2021 (14.4 per cent increase). This suggests that engineers may be working in roles such as sales, management, or supply chain logistics. The number of qualified engineers increased by 13.8 per cent between 2016 and 2021 to 13,969.

Financial and Insurance Services

As mentioned, the number of engineers working in engineering occupations in the Financial and Insurance Services sector increased by 73.4 per cent between 2016 and 2021, to 7,102. This is the fastest growing primary industry employing people in engineering occupations. The number of qualified engineers (12,562 in 2021) increased by 55.3 per cent over the same period. This indicates an increasing demand for engineers with specialised knowledge in areas such as risk management, cost engineering, and data analysis for financial systems and services. It also points to their value in non-engineering roles like finance, trading, investment, banking, auditing, compliance, contract management, and consulting.

Information Media and Telecommunications

This sector experienced significant growth between 2011 and 2016, but a much slower rate between 2016 and 2021, with an increase of just 502 qualified engineers (4.4 per cent growth) to 11,902. This suggests a stabilisation in demand for engineers given the completion of NBN work. However, looking ahead, given the ongoing rollout of 5G, there will be demand for engineers with expertise in network engineering, cybersecurity, and telecommunications infrastructure over the next five years. The number working in engineering occupations increased by five per cent to 8,422 in 2021.

Health Care and Social Assistance

The Health Care and Social Assistance sector was Australia's fastest growing sector for qualified engineers in 2021 (61.6 per cent). Between 2011 and 2021, the number of qualified engineers in the sector more than doubled, from 4,654 to 11,582. While the modest number of engineers working in engineering occupations increased by 62.1 per cent to 1,652 in 2021 from 2016. This is likely attributed to the rising demand for healthcare services and facilities arising from COVID-19 and aged care, as well as the growing need for engineers to support the development of medical technologies and equipment, such as medical devices, telemedicine, and healthcare informatics, which require specialised engineering skills. It is worth noting the significant proportion of engineers not in 'engineering occupations' in this industry, indicating an occupational mismatch.

Accommodation and Food Services

These industries have a low proportion of engineers working in engineering occupations (with only 291 people working in engineering occupations out of nearly 9,000 qualified engineers employed in this industry), suggesting limited specialised roles and/or engineers working in non-engineering positions. There were 8,993 qualified engineers in 2021 an almost seven per cent increase from 2016. The majority (6,358) of these qualified engineers, are employed in Café, Restaurants and Takeaway Food Services.

Administrative and Support Services

Again, there are relatively few engineers and engineers working in engineering occupations in this sector, 7,734 and 1,730 respectively. The majority (3,870) are employed in the sub-industries of Building Cleaning, Pest Control, and Gardening Services, with a sizeable component working in Employment Services (2,012).

Other Services

The same goes for 'Other Services', with 7,321 qualified engineers and 1,810 working in engineering occupations in 2021, respectively. There was growth however, in both groups.

Rental, Hiring and Real Estate Services

There is a similar story in the Rental, Hiring and Real Estate Services, with 4,101 qualified engineers in 2021 (56.6 per cent) growth and 1,224 in engineering occupations (42.7 per cent growth between census).

Agriculture, Forestry and Fishing

This industry is similarly a small employer of both qualified engineers (3,453 in 2021) and those working in engineering occupations (628 in 2021). Both populations grew between 2016 and 2021.

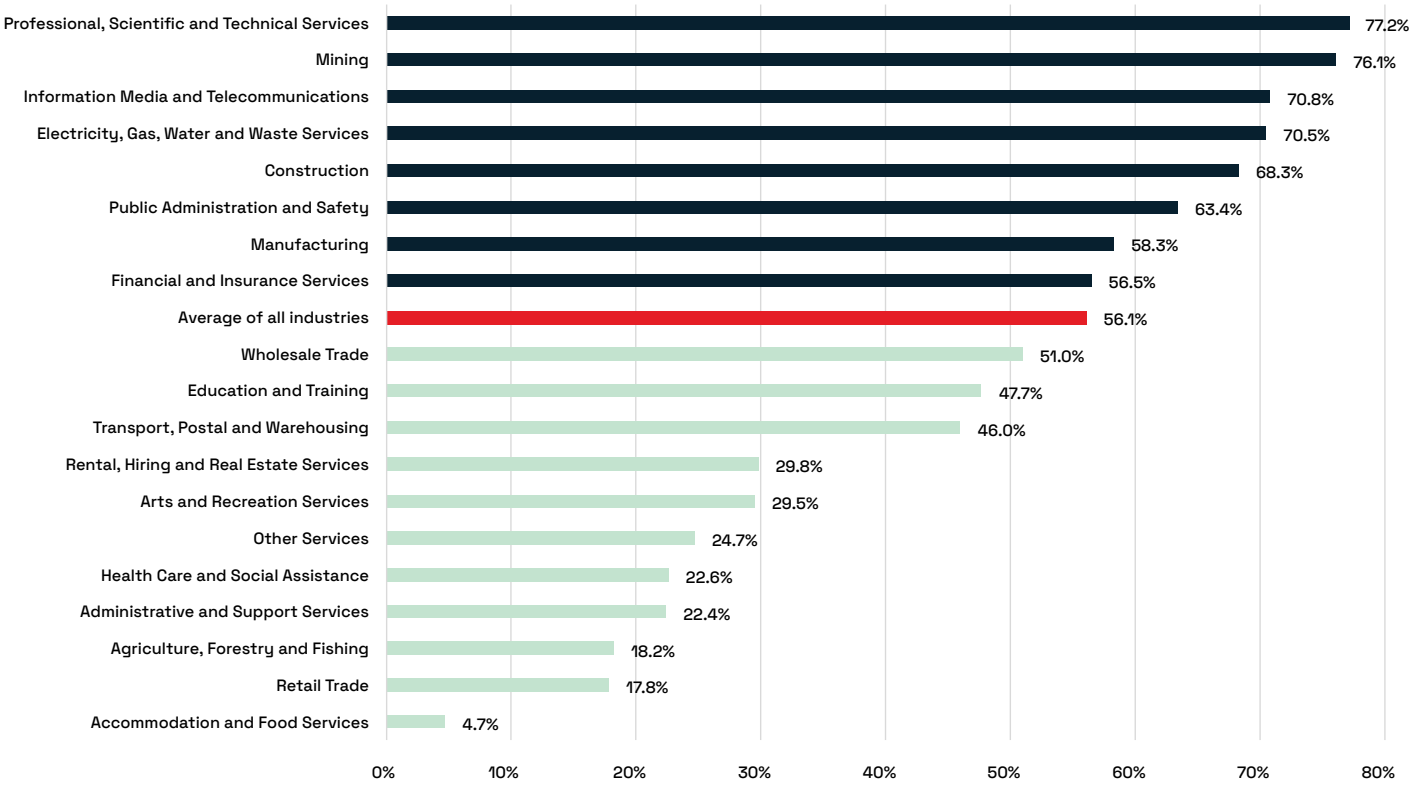
Arts and Recreation Services

Arts and Recreation Services is the smallest industry employing qualified engineers (2,206 in 2021) with 650 working in engineering occupations.

Core/none-core industries

Core industries are those in which the proportion of qualified engineers working in engineering occupations is higher than across all industries (calculated by dividing the population working in engineering occupations, by the population of qualified engineers in the labour force). Figure 39 shows core industries in 2021 in blue.

Figure 39: Core and non-core industry distribution, those above the average of all industries are core engineering primary industries, those below are non-core engineering industries



The proportion of qualified engineers working in engineering occupations in core industries is unchanged from the last census except for Financial & Insurance Services. It became a core industry by a slim margin. However, the order of the non-core industries has changed. Wholesale Trade overtook Transport, Postal & Warehousing and Education & Training.

We should also note that the ANZSIC definition of Financial & Insurance Services[37] has little relation to engineering activities or the practice of engineering.

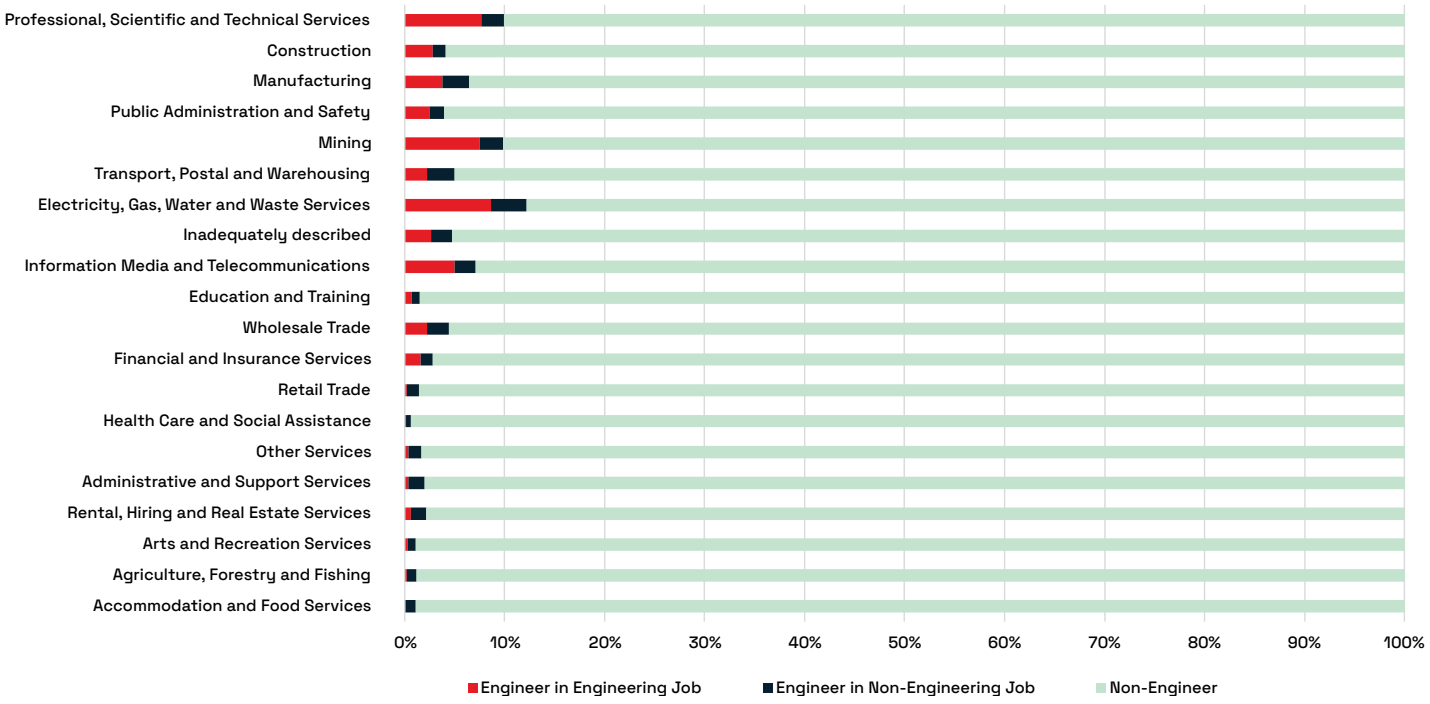
This development indicates that the definition of what a 'core' engineering industry is, should be revisited with regard to the definitions within ANZSIC for a particular primary industry and the connection to engineering practice and activities. This will take place in tandem with the review of ANZSIC scheduled by the ABS to commence prior to the 2026 census.

37 https://www.abs.gov.au/statistics/classifications/australian-and-new-zealand-standard-industrial-classification-anzsic/2006-revision-2-0/division-definitions#division-k-financial-and-insurance-services

The engineering workforce component of primary industries

The core industries are those where engineers are found in the greatest proportions. The proportion of engineers per primary industry is shown in Figure 40.

Figure 40: Proportion of industries with per centages of engineering qualified workforce



Professional, Scientific & Technical Services remain the largest industry of employment for qualified engineers. This is followed by Manufacturing; Construction; Public Administration & Safety; Transport Postal & Warehousing; Mining; Electricity, Gas, Water & Waste Services; and Education & Training.

The populations of engineers in engineering occupations, other occupations and non-engineers per primary industry are shown in Table 34.

Table 34: Qualified engineers in engineering and other occupations and non-engineers per primary industry

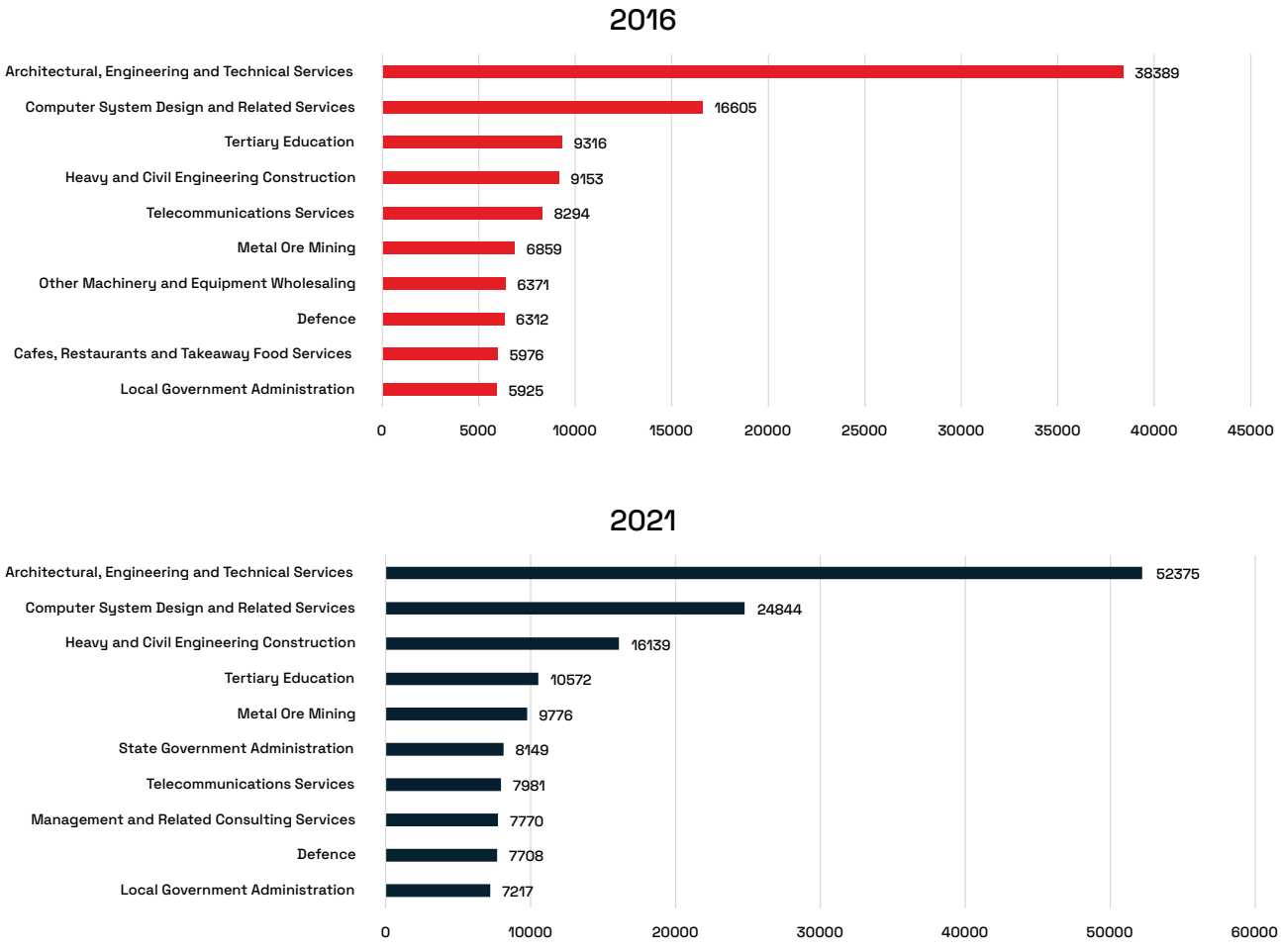
INDP Industry of Employment	Engineer in Engineering Occupation	Engineer in Non-Engineering Occupation	Non-Engineers
Accommodation and Food Services	426	8,567	774,728
Agriculture, Forestry and Fishing	628	2,825	278,558
Arts and Recreation Services	650	1,556	186,116
Rental, Hiring and Real Estate Services	1,224	2,877	183,333
Administrative and Support Services	1,730	6,004	380,433
Other Services	1,810	5,511	427,940
Health Care and Social Assistance	2,621	8,961	1,740,010
Retail Trade	2,930	13,522	1,082,980
Financial and Insurance Services	7,102	5,460	432,387
Wholesale Trade	7,130	6839	297,817
Education and Training	7,645	8,376	1,045,189

INDP Industry of Employment	Engineer in Engineering Occupation	Engineer in Non-Engineering Occupation	Non-Engineers
Information Media and Telecommunications	8,422	3,480	154,842
Inadequately described	9,886	7,663	352,358
Electricity, Gas, Water and Waste Services	11,597	4,849	117,707
Transport, Postal and Warehousing	12,541	14,728	518,911
Mining	16,191	5,085	193,470
Public Administration and Safety	19,943	11,506	765,384
Manufacturing	26,985	19,288	668,338
Construction	30,003	13,950	1,023,509
Professional, Scientific and Technical Services	72,841	21,472	850,636

Sub-industries

Sub-industries provide a greater level of detail on industrial activity in ANZSIC (the second level of the classification scheme, referred to as a Subdivision). Figure 41 shows the top 10 sub-industries for 2016 and 2021 for qualified engineers. The distribution of qualified engineers within the top 10 sub-industries is available for all primary industries on the Dashboard and at Appendix 2 (link).

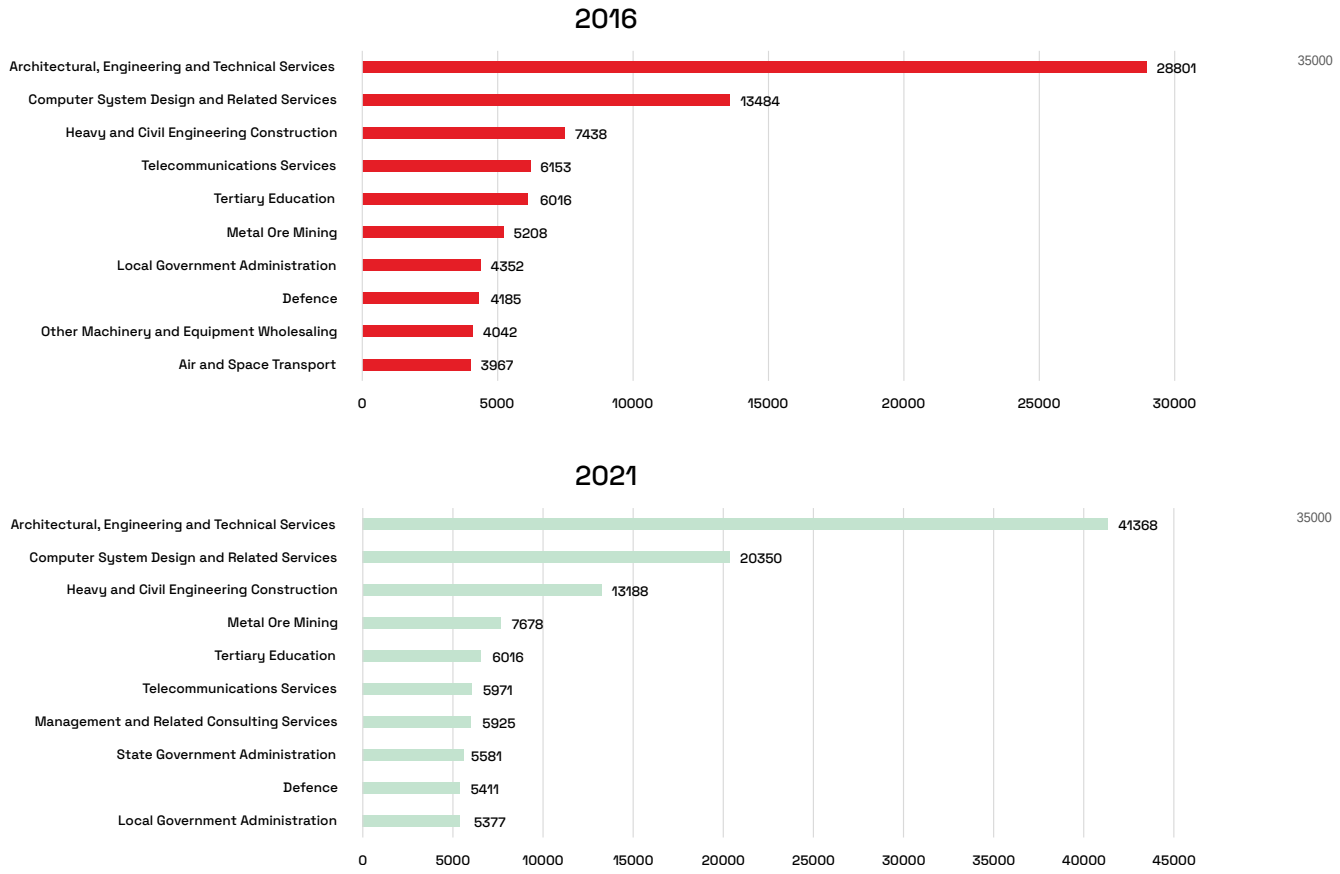
Figure 41: Top 10 sub-industries for qualified engineers (note 2021 totals 152,531 and 2016 totals 113,200 in the top 10 sub-industries)



The top 10 sub-industries for the population working in engineering occupations for 2016 and 2021 is shown

in Figure 42. We note the increasing proportion of engineers working in management and related consulting services, including state government administration. There is also considerable growth in the numbers of engineers working in Architectural, Engineering & Technical Services (46 per cent growth), Computer Systems Design & Related Services (54 per cent growth), and Heavy Civil Engineering Construction (73 per cent growth).

Figure 42: Top 10 sub-industries for engineers working in engineering occupations (note 2021 totals 83,646, 2016 totals 117,369 in top 10 sub-industries)



The top 10 sub-industries for qualified engineers and those working in engineering occupations in non-core industries are shown in Figure 43. Excluding those in tertiary education, these engineers are more likely to have an occupational skills mismatch, or find their skills underutilised. Figure 44 shows the proportions of those working in engineering occupations within non-core industries, indicating that they are more likely to be undertaking engineering activities within these sub industries. Note the inclusion of two sub-industries from Financial & Insurance Services (despite being technically a core industry).

Figure 43: Distribution of qualified engineers in top-10 sub industry sub industries in non-core industries

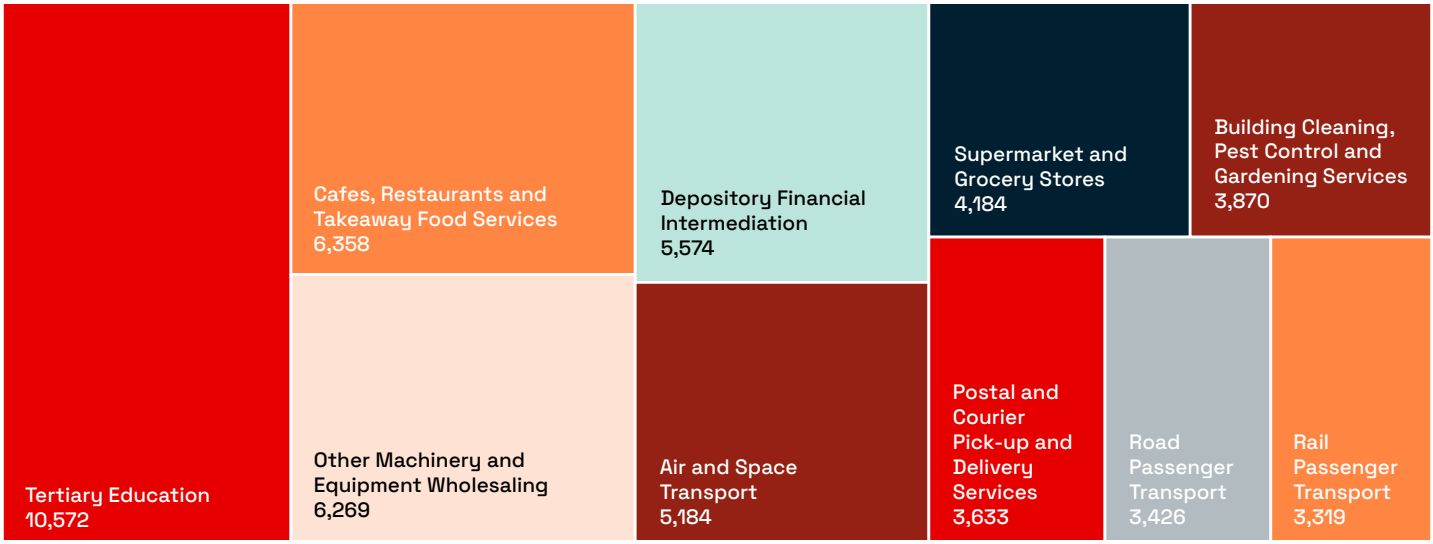
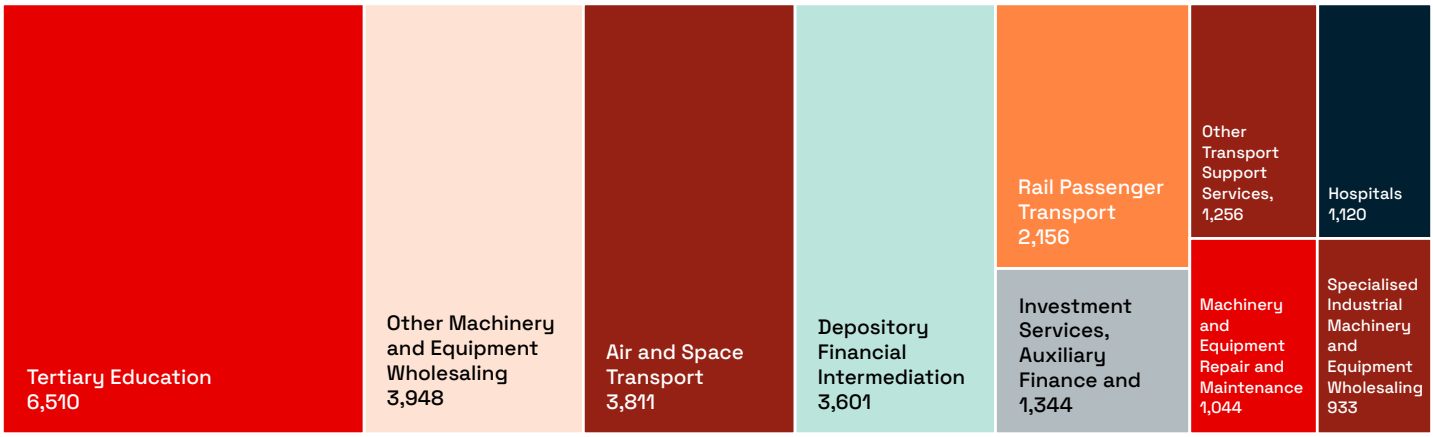


Figure 44: Top 10 sub-industry groups and classes for those in engineering occupations in non-core industries



The top five sub-industries of qualified engineers across Australian states and territories are shown in figure 45. Note the dominance of the metal ore mining sub-industry in Western Australia through its enormous iron ore exports. The distribution of those in engineering occupations is shown in Figure 46.

Figure 45: Distribution of qualified engineers in the top 5 sub industries for each state/territory (represents 26.2% of the qualified engineering labour force)

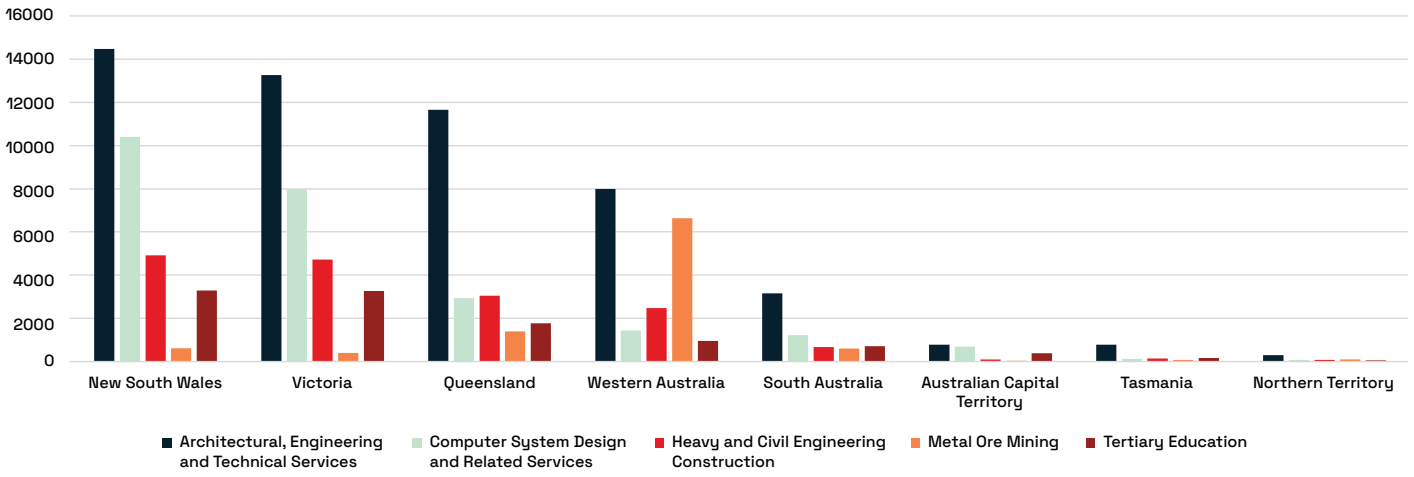
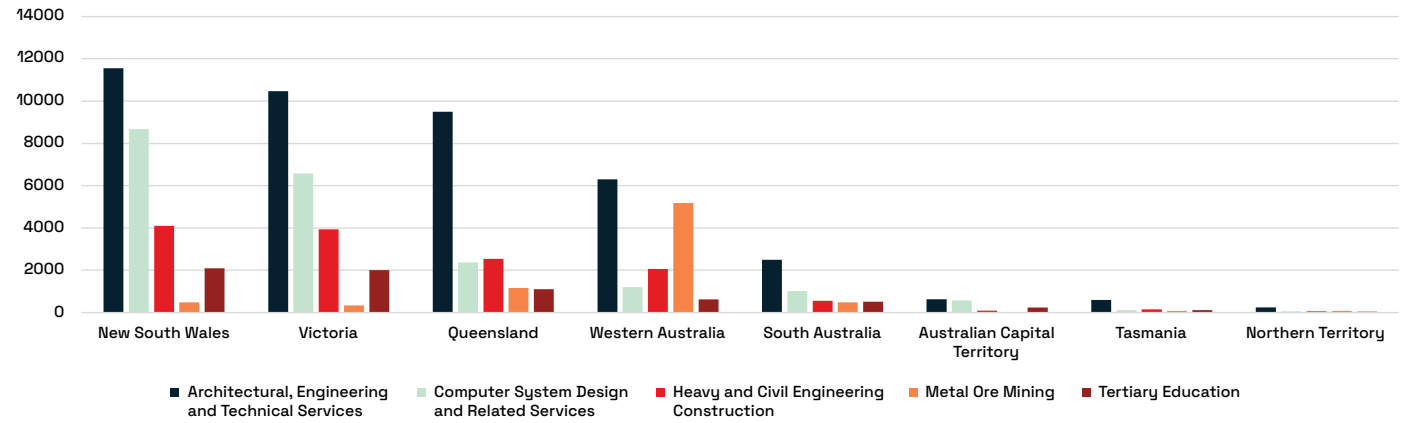


Figure 46: Distribution of engineering occupations in the top five sub-industries for each state/territory (represents 36.6% of the population of engineering occupations)



Detailed sub-industry groups and classes

The groups and classes at the lower two levels of the ANZSIC industry classification scheme could be considered as detailed sub-industries and speciality sub-industries. It is at this level of the classification scheme that we get the most insight into the specifics of what engineers actually do. At the most detailed level of the classification scheme, we are able to distinguish between those involved in providing engineering design and engineering consulting services, and architectural services.

The population of the top 10 sub-industry groups and classes for qualified engineers and those working in engineering occupations are shown in Figure 47 and 48.

Figure 47: Top 10 detailed industry groups and classes for qualified engineers in 2021 (27.1% of qualified engineer labour force)

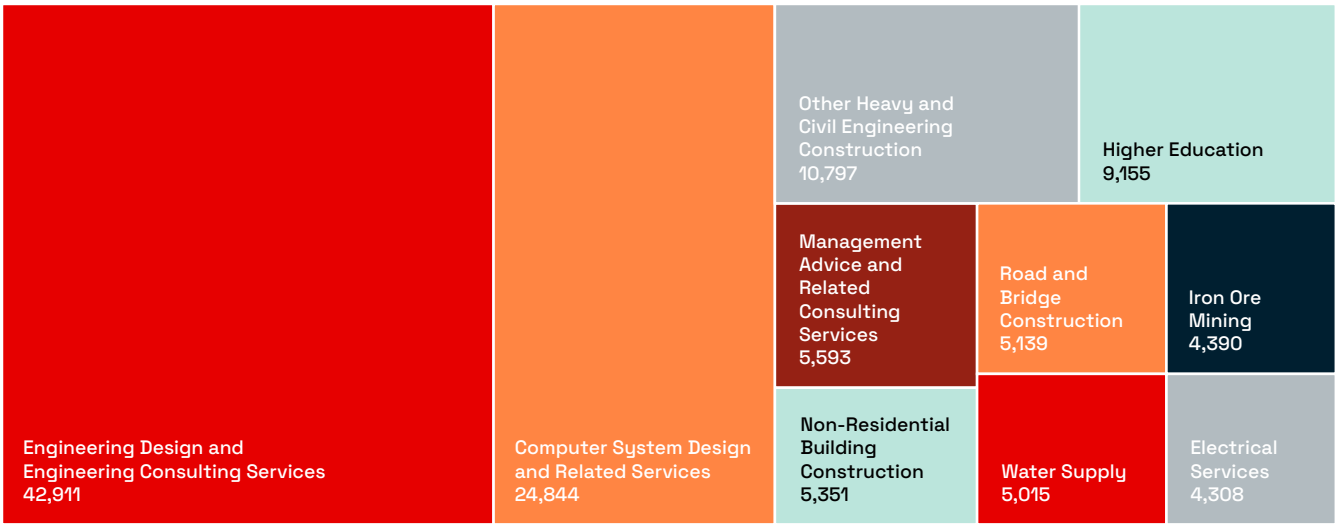
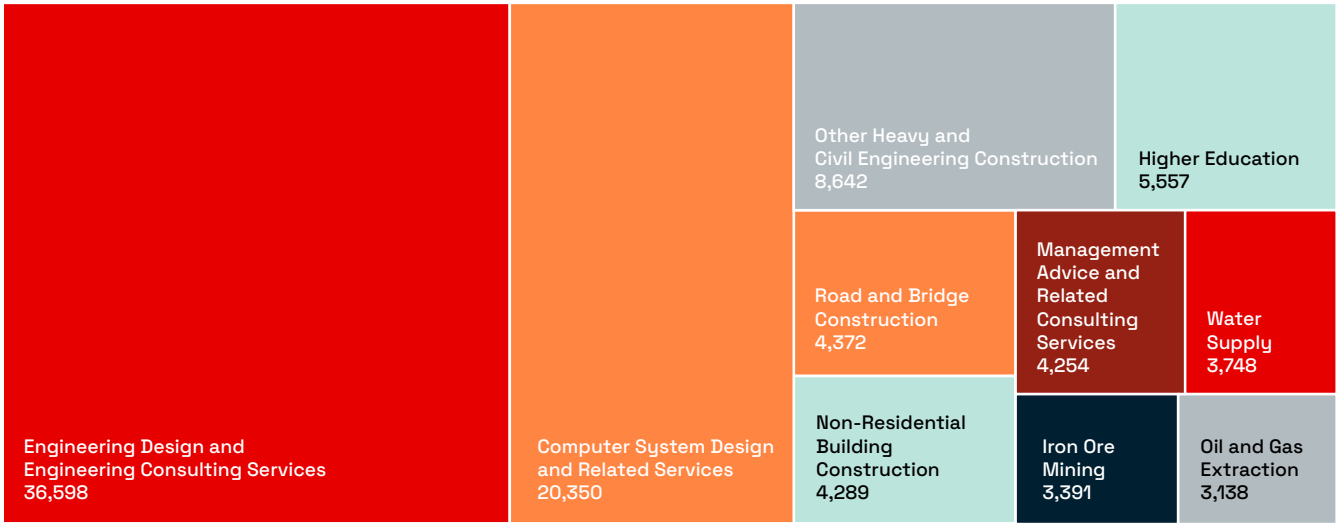
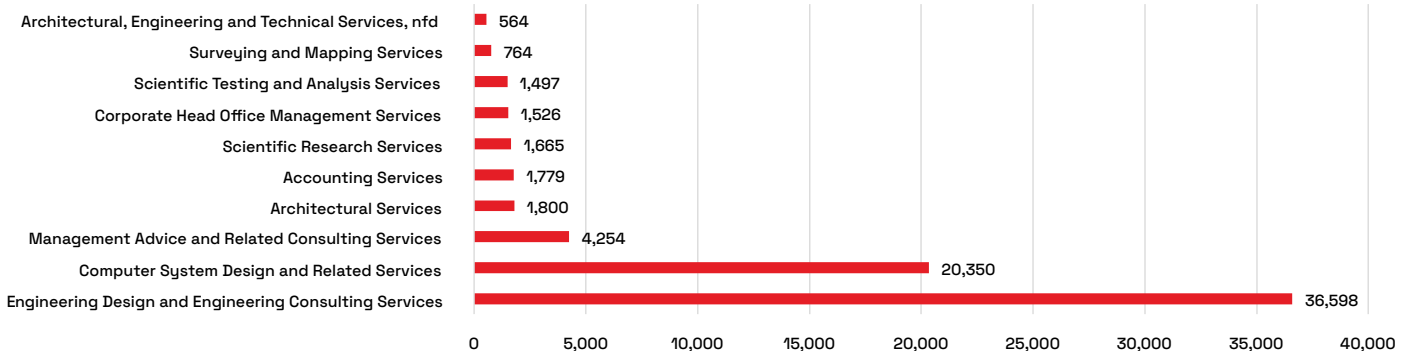


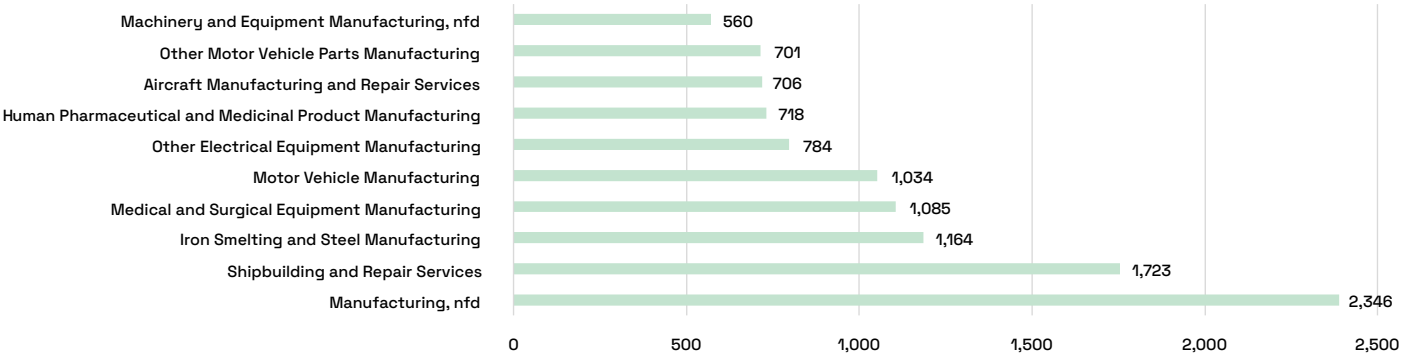
Figure 48: top 10 sub-industry groups and classes for engineering occupations in 2021 (38.8% of engineering occupations)

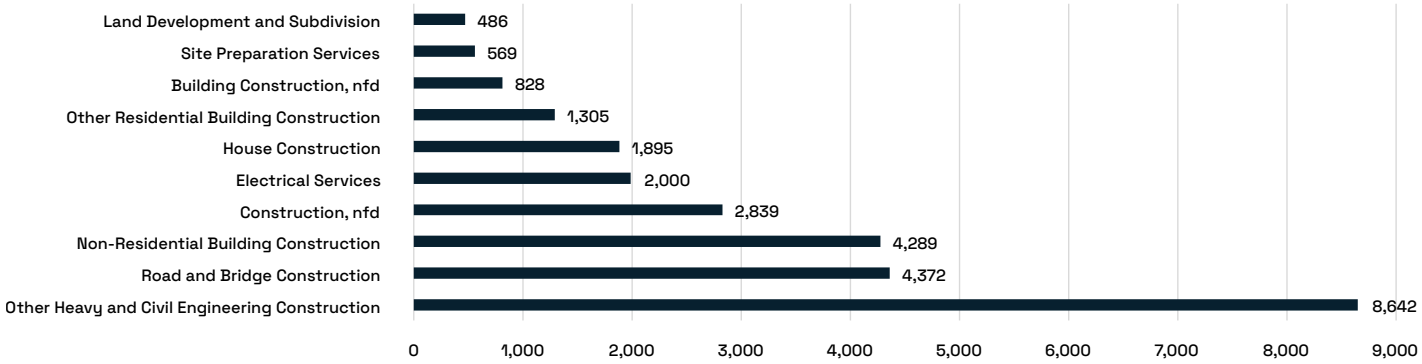


Finally, the distribution of industry classes for the primary industries of Professional, Scientific & Technical Services, Construction and Manufacturing are shown in Figure 49.

Figure 49: Distribution of qualified engineers within professional, scientific, and technical services (top), Construction (middle), and Manufacturing (bottom), primary industries in 2021.







The population of qualified engineers in each of the top 10 sub-industry groups and classes for a selection of primary industries in 2021, is provided in Table 35. The more detailed groups and classes provide a better understanding of an engineer's activity in each industry.

Table 35: 2021 count of qualified engineers in top 10 sub-industry detailed groups and classes for selection of primary industries

Professional, Scientific and Technical Services	Qualified Engineers	Construction	Qualified Engineers
Engineering Design and Engineering Consulting Services	42,911	Other Heavy and Civil Engineering Construction	10,797
Computer System Design and Related Services	24,844	Non-Residential Building Construction	5,351
Management Advice and Related Consulting Services	5,593	Road and Bridge Construction	5,139
Surveying and Mapping Services	3,352	Electrical Services	4,308
Accounting Services	2,804	Construction, nfd	3,792
Scientific Research Services	2,680	House Construction	2,683
Architectural Services	2,311	Other Residential Building Construction	1,900

Scientific Testing and Analysis Services	2,273	Building Construction, nfd	1,193
Corporate Head Office Management Services	1,959	Site Preparation Services	895
Architectural, Engineering and Technical Services, nfd	1,159	Land Development and Subdivision	863
Electricity, Gas, Water and Waste Services	**Qualified Engineers**	**Information Media and Telecommunications**	**Qualified Engineers**
Water Supply	5,015	Other Telecommunications Network Operation	3,817
Electricity Distribution	4,187	Telecommunications Services, nfd	2,294
On Selling Electricity and Electricity Market Operation	1,196	Wired Telecommunications Network Operation	1,825
Electricity Transmission	1,135	Internet Service Providers and Web Search Portals	1,203
Fossil Fuel Electricity Generation	1,044	Data Processing and Web Hosting Services	6,92
Electricity Supply, nfd	873	Software Publishing	350
Gas Supply	564	Free-to-Air Television Broadcasting	284
Electricity, Gas, Water and Waste Services, nfd	445	Electronic Information Storage Services	199
Other Electricity Generation	410	Motion Picture and Video Production	162
Hydro-Electricity Generation	384	Information Media and Telecommunications, nfd	148
Public Administration and Safety	**Qualified Engineers**	**Manufacturing**	**Qualified Engineers**
State Government Administration	8,149	Manufacturing, nfd	4,028
Defence	7,708	Shipbuilding and Repair Services	2,292
Local Government Administration	7,217	Iron Smelting and Steel Manufacturing	1,853
Central Government Administration	2,505	Medical and Surgical Equipment Manufacturing	1,561
Investigation and Security Services	1,909	Motor Vehicle Manufacturing	1,457
Fire Protection and Other Emergency Services	1,045	Human Pharmaceutical and Medicinal Product Manufacturing	1,305
Police Services	827	Aircraft Manufacturing and Repair Services	1,296
Regulatory Services	801	Other Electrical Equipment Manufacturing	1,135
Correctional and Detention Services	429	Other Motor Vehicle Parts Manufacturing	1,109
Public Administration, nfd	354	Machinery and Equipment Manufacturing, nfd	810
Mining	**Qualified Engineers**		
Iron Ore Mining	4,390		
Oil and Gas Extraction	4,160		
Coal Mining	3,466		
Gold Ore Mining	2,552		
Other Mining Support Services	1,227		
Mining, nfd	1,197		

Copper Ore Mining	1,065
Mineral Exploration	629
Silver-Lead-Zinc Ore Mining	506
Other Metal Ore Mining	365

Diversity in primary industries

Statistics on female qualified engineers and those working in engineering occupations are shown over three censuses in Table 36. Note the different ordering in terms of size of industries compared to the industry totals presented previously.

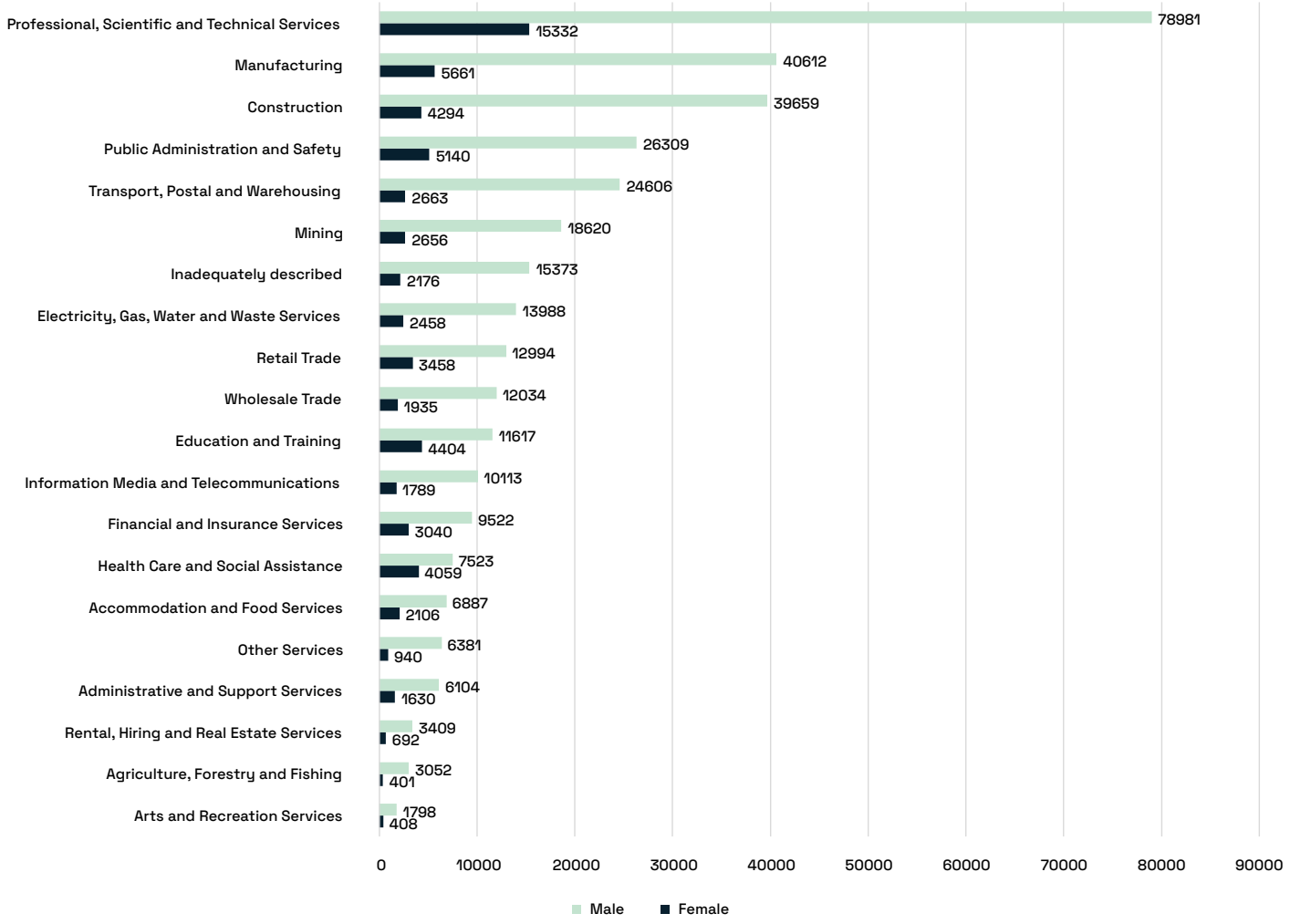
Table 36: Population of female qualified engineers and those working in engineering occupations

Women qualified engineers	2011	2016	2021	Women in engineering occupations	2011	2016	2021
Professional, Scientific and Technical Services	7,244	8,602	15,332	Professional, Scientific and Technical Services	4,808	6,032	11,413
Manufacturing	3,988	4,149	5,661	Manufacturing	1,967	2,144	2,977
Public Administration and Safety	2,575	3,400	5,140	Public Administration and Safety	1,426	2,023	3,191
Education and Training	1,868	3,073	4,404	Construction	1,004	1,520	3,082
Construction	1,449	2,214	4,294	Mining	1,103	1,328	2,102
Health Care and Social Assistance	1,467	2,411	4,059	Electricity, Gas, Water and Waste Services	869	1,116	1,778
Retail Trade	1,552	2,463	3,458	Education and Training	734	1,096	1,496
Mining	1,370	1,688	2,656	Transport, Postal and Warehousing	675	896	1,390
Financial and Insurance Services	1,066	1,604	3,040	Financial and Insurance Services	434	727	1,645
Transport, Postal and Warehousing	1,226	1,680	2,663	Information Media and Telecommunications	543	992	1,207
Electricity, Gas, Water and Waste Services	1,202	1,595	2,458	Wholesale Trade	460	627	868
Accommodation and Food Services	877	1,687	2,106	Inadequately described	142	498	951
Wholesale Trade	1,247	1,460	1,935	Retail Trade	149	282	504
Information Media and Telecommunications	854	1,437	1,789	Health Care and Social Assistance	163	245	510
Inadequately described	323	1,293	2,176	Administrative and Support Services	137	167	272
Administrative and Support Services	727	1,169	1,630	Other Services	87	130	180
Other Services	432	663	940	Rental, Hiring and Real Estate Services	34	91	176
Rental, Hiring and Real Estate Services	251	501	692	Arts and Recreation Services	41	80	87
Arts and Recreation Services	214	356	408	Agriculture, Forestry and Fishing	8	31	38
Agriculture, Forestry and Fishing	173	280	401	Accommodation and Food Services	10	20	44

The distribution of primary industries for qualified engineers by gender is shown in Figure 50.

The proportion of women in smaller industries is higher, with the largest share of female qualified engineers in Health Care & Social Assistance, Education & Training, Financial & Insurance Services, Arts & Recreation, and Accommodation and Food Services.

Figure 50: Distribution of qualified engineers in primary industries by gender in 2021



The proportion of primary industries by location of birth for qualified engineers is shown in Figure 51.

Figure 51: Distribution of qualified engineers by Australian/overseas born in 2021

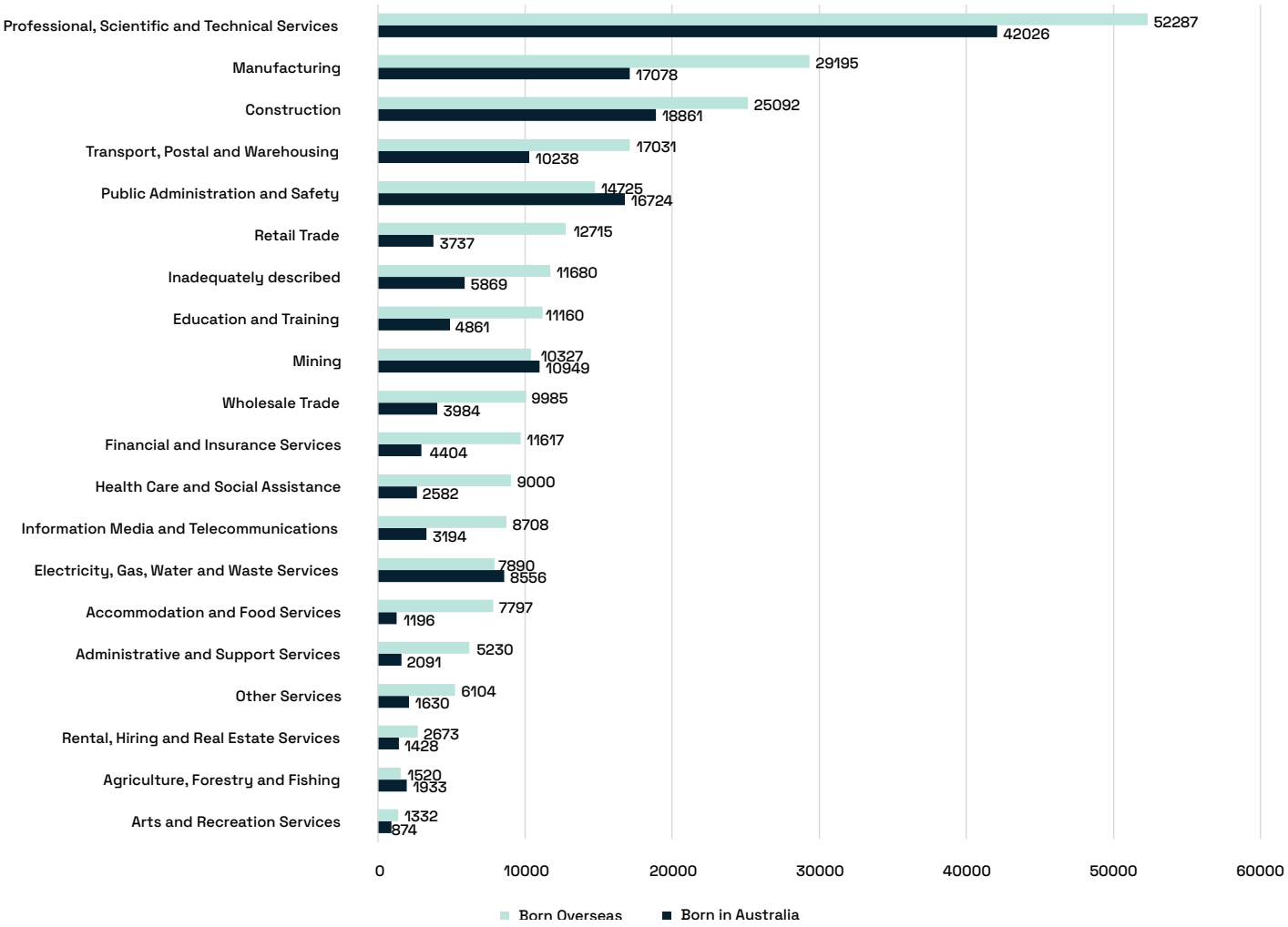


Table 37 provides the population of qualified engineers by location of birth and primary industry in 2021 and 2016. Overseas born engineers feature more heavily in non-core industries, indicating sub-optimal employment outcomes.

Table 37: Populations of qualified engineers by location of birth and primary industry (the columns labelled total indicate the per centage of the total Australian or overseas born qualified population)

Australian born qualified engineers	2016	% 2016 total	2021	% 2021 total	Overseas born qualified engineers	2016	% 2016 total	2021	% 2021 total
Professional, Scientific and Technical Services	31,905	23.8%	42,026	26.2%	Professional, Scientific and Technical Services	34,859	19.0%	52,287	20.6%
Construction	14,069	10.5%	18,861	11.7%	Manufacturing	23,130	12.6%	29,195	11.5%
Manufacturing	15,790	11.8%	17,078	10.6%	Construction	15,731	8.6%	25,092	9.9%
Public Administration and Safety	14,089	10.5%	16,724	10.4%	Transport, Postal and Warehousing	11,518	6.3%	17,031	6.7%
Mining	8,946	6.7%	10,949	6.8%	Public Administration and Safety	10,310	5.6%	14,725	5.8%
Transport, Postal and Warehousing	9,464	7.1%	10,238	6.4%	Retail Trade	9,939	5.4%	12,715	5.0%

Australian born qualified engineers	2016	% 2016 total	2021	% 2021 total	Overseas born qualified engineers	2016	% 2016 total	2021	% 2021 total
Electricity, Gas, Water and Waste Services	7,125	5.3%	8,556	5.3%	Education and Training	8,898	4.8%	11,160	4.4%
Inadequately described	4,722	3.5%	5,869	3.7%	Inadequately described	8,077	4.4%	11,680	4.6%
Education and Training	4,676	3.5%	4,861	3.0%	Wholesale Trade	8,627	4.7%	9,985	3.9%
Wholesale Trade	3,650	2.7%	3,984	2.5%	Mining	7,466	4.1%	10,327	4.1%
Retail Trade	3,491	2.6%	3,737	2.3%	Information Media and Telecommunications	7,814	4.2%	8,708	3.4%
Information Media and Telecommunications	3,586	2.7%	3,194	2.0%	Financial and Insurance Services	5,642	3.1%	9,629	3.8%
Financial and Insurance Services	2,445	1.8%	2,933	1.8%	Accommodation and Food Services	7,138	3.9%	7,797	3.1%
Health Care and Social Assistance	1,827	1.4%	2,582	1.6%	Health Care and Social Assistance	5,339	2.9%	9,000	3.5%
Other Services	1,928	1.4%	2,091	1.3%	Electricity, Gas, Water and Waste Services	5,625	3.1%	7,890	3.1%
Agriculture, Forestry and Fishing	1,591	1.2%	1,933	1.2%	Administrative and Support Services	5,064	2.8%	6,206	2.4%
Administrative and Support Services	1,493	1.1%	1,528	1.0%	Other Services	4,325	2.4%	5,230	2.1%
Rental, Hiring and Real Estate Services	1,258	0.9%	1,428	0.9%	Rental, Hiring and Real Estate Services	2,152	1.2%	2,673	1.1%
Accommodation and Food Services	1,276	1.0%	1,196	0.7%	Agriculture, Forestry and Fishing	1,122	0.6%	1,520	0.6%
Arts and Recreation Services	909	0.7%	874	0.5%	Arts and Recreation Services	1,173	0.6%	1,332	0.5%

Table 38 indicates the population of qualified engineers in engineering occupations by location of birth and primary industry in 2021 and 2016.

Table 38: Population of engineers working in engineering occupations by primary industry (the columns labelled total indicate the % of the total Australian or overseas born qualified population in engineering occupations)

Australian born working in engineering occupations	2016	% 2016 total	2021	% 2021 total	Overseas born engineers in engineering occupations	2016	% 2016 total	2021	% 2021 total
Professional, Scientific and Technical Services	23,219	27.2%	32,204	30.0%	Professional, Scientific and Technical Services	25,953	27.9%	40,637	30.1%
Construction	9,947	11.7%	13,906	13.0%	Manufacturing	11,685	12.6%	15,033	11.1%
Manufacturing	10,676	12.5%	11,952	11.2%	Construction	9,602	10.3%	16,097	11.9%
Public Administration and Safety	8,962	10.5%	11,146	10.4%	Public Administration and Safety	5,905	6.3%	8,797	6.5%
Mining	6,682	7.8%	8,372	7.8%	Mining	5,560	6.0%	7,819	5.8%

Australian born working in engineering occupations	2016	% 2016 total	2021	% 2021 total	Overseas born engineers in engineering occupations	2016	% 2016 total	2021	% 2021 total
Transport, Postal and Warehousing	6,585	7.7%	7,034	6.6%	Information Media and Telecommunications	5,508	5.9%	6,152	4.6%
Electricity, Gas, Water and Waste Services	4,997	5.9%	6,004	5.6%	Education and Training	4,571	4.9%	5,251	3.9%
Inadequately described	2,666	3.1%	3,881	3.6%	Transport, Postal and Warehousing	4,172	4.5%	5,507	4.1%
Information Media and Telecommunications	2,511	2.9%	2,270	2.1%	Inadequately described	3,559	3.8%	6,005	4.4%
Education and Training	2,384	2.8%	2,394	2.2%	Electricity, Gas, Water and Waste Services	3,948	4.2%	5,593	4.1%
Wholesale Trade	2,011	2.4%	2,273	2.1%	Wholesale Trade	4,220	4.5%	4,857	3.6%
Financial and Insurance Services	1,072	1.3%	1,300	1.2%	Financial and Insurance Services	3,024	3.3%	5,802	4.3%
Retail Trade	695	0.8%	949	0.9%	Retail Trade	1,424	1.5%	1,981	1.5%
Health Care and Social Assistance	671	0.8%	969	0.9%	Health Care and Social Assistance	946	1.0%	1,652	1.2%
Other Services	615	0.7%	714	0.7%	Administrative and Support Services	868	0.9%	1,162	0.9%
Administrative and Support Services	527	0.6%	568	0.5%	Other Services	899	1.0%	1,096	0.8%
Rental, Hiring and Real Estate Services	400	0.5%	529	0.5%	Rental, Hiring and Real Estate Services	458	0.5%	695	0.5%
Agriculture, Forestry and Fishing	258	0.3%	338	0.3%	Arts and Recreation Services	311	0.3%	400	0.3%
Arts and Recreation Services	234	0.3%	250	0.2%	Accommodation and Food Services	228	0.2%	291	0.2%
Accommodation and Food Services	117	0.1%	135	0.1%	Agriculture, Forestry and Fishing	164	0.2%	290	0.2%

Table 39 shows the distribution of Aboriginal and Torres Strait Islander qualified engineers in primary industries in 2021. The largest employers are Construction, Mining, and Professional, Scientific & Technical Services.

Table 39: Primary industries population of Aboriginal and Torres Strait Islander qualified engineers (other primary industries have 0 population)

Industry	Number
Construction	167
Mining	155
Professional, Scientific and Technical Services	141
Public Administration and Safety	130
Electricity, Gas, Water and Waste Services	82
Manufacturing	66
Transport, Postal and Warehousing	55
Inadequately described	52
Health Care and Social Assistance	29
Education and Training	19
Agriculture, Forestry and Fishing	10
Wholesale Trade	10
Financial and Insurance Services	7
Other Services	3

Public/private industry distribution

Figure 52 shows the distribution of qualified engineers in the public and private sectors in 2021.

Figure 52: distribution of qualified engineers in public/private sectors

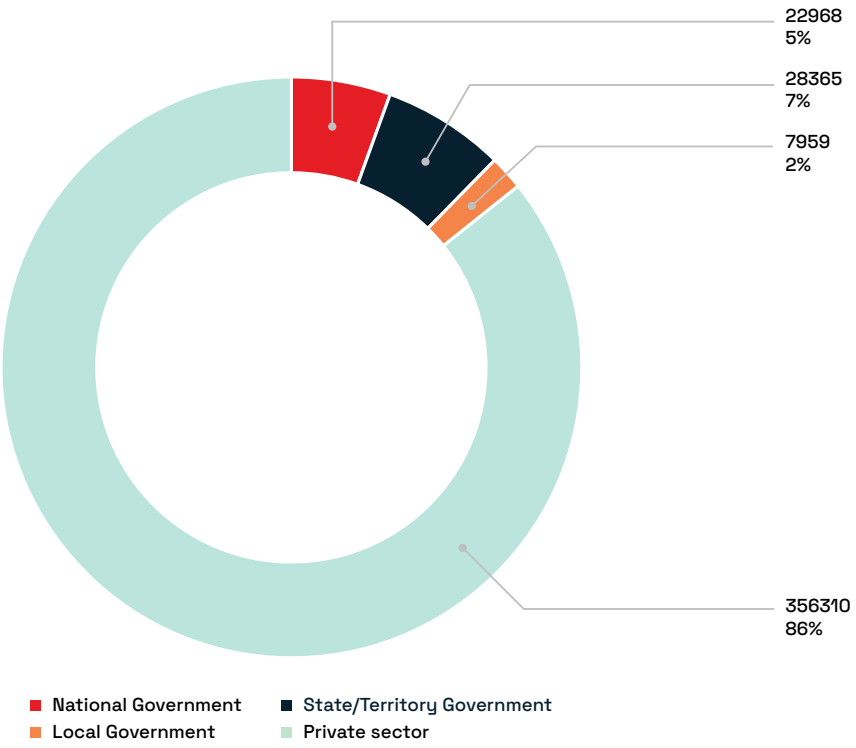


Figure 53 shows the proportion of public sector qualified engineers per primary industry. Given their industry definitions, it is expected that the public sector would dominate in these industries.

Figure 53: proportion of public sector qualified engineers per primary industry

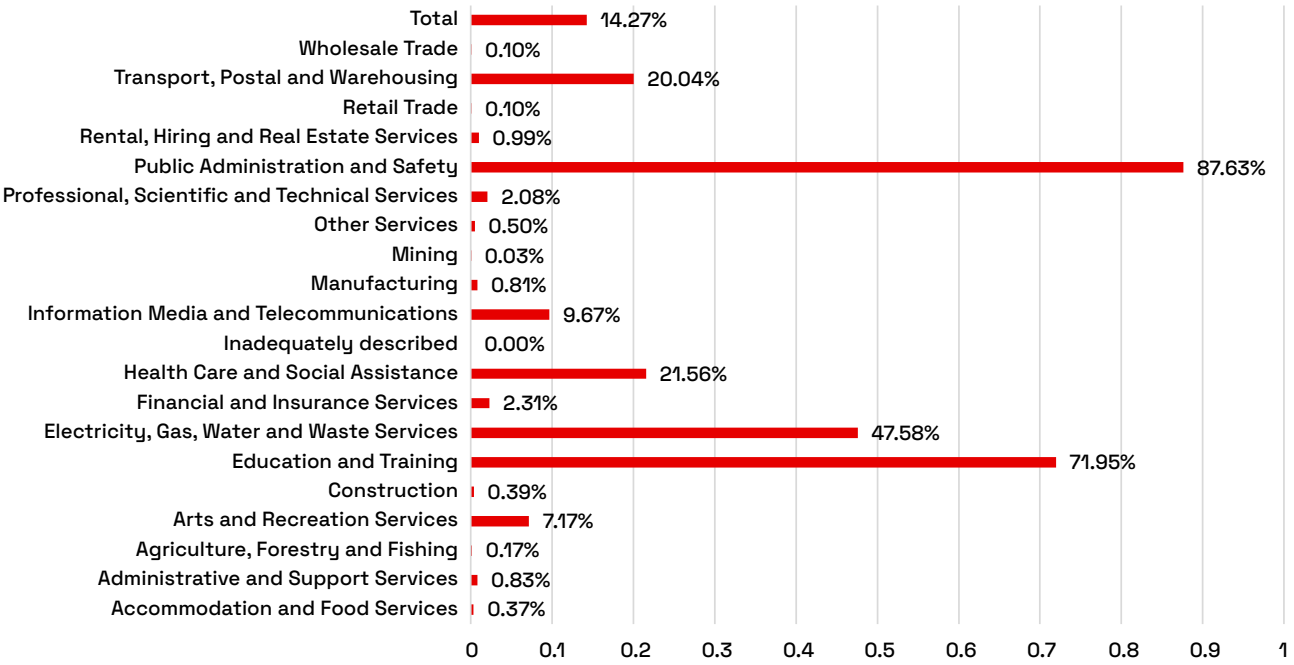


Table 40 below provides a statistical comparison of qualified engineers employed at various levels of government and within the private sector. This insight shows the dominance of the private sector in all industries barring Education & Training, and Public Administration & Safety. In total 14.27 per cent of Australia's engineers work in the public sector.

Table 40: Distribution of publicly employed engineers per primary industry 2021

Primary Industry	National Government	State/ Territory Government	Local Government	Private sector	Industry Total	% of public sector engineers by industry
Accommodation and Food Services	3	30	0	8,974	9,007	0.37%
Administrative and Support Services	0	65	0	7,726	7,791	0.83%
Agriculture, Forestry and Fishing	0	6	0	3,518	3,524	0.17%
Arts and Recreation Services	14	142	3	2,059	2,218	7.17%
Construction	0	65	108	43,821	43,994	0.39%
Education and Training	8,343	3,213	0	4,505	16,061	71.95%
Electricity, Gas, Water and Waste Services	0	7,463	389	8,652	16,504	47.58%
Financial and Insurance Services	127	165	0	12,324	12,616	2.31%
Health Care and Social Assistance	82	2,429	0	9,138	11,649	21.56%
Inadequately described	0	0	0	17,568	17,568	0.00%
Information Media and Telecommunications	1,128	22	3	10,774	11,927	9.67%

Primary Industry	National Government	State/ Territory Government	Local Government	Private sector	Industry Total	% of public sector engineers by industry
Manufacturing	331	43	0	45,959	46,333	0.81%
Mining	0	7	0	21,293	21,300	0.03%
Other Services	9	28	0	7,341	7,378	0.50%
Professional, Scientific and Technical Services	1,390	548	25	92,377	94,340	2.08%
Public Administration and Safety	9,744	10,477	7,342	3,890	31,453	87.63%
Rental, Hiring and Real Estate Services	8	25	8	4,109	4,150	0.99%
Retail Trade	0	16	0	16,468	16,484	0.10%
Transport, Postal and Warehousing	1,789	3,621	67	21,852	27,329	20.04%
Wholesale Trade	0	0	14	13,962	13,976	0.10%
Sector Total	22,968	28,365	7,959	356,310	415,602	14.27%

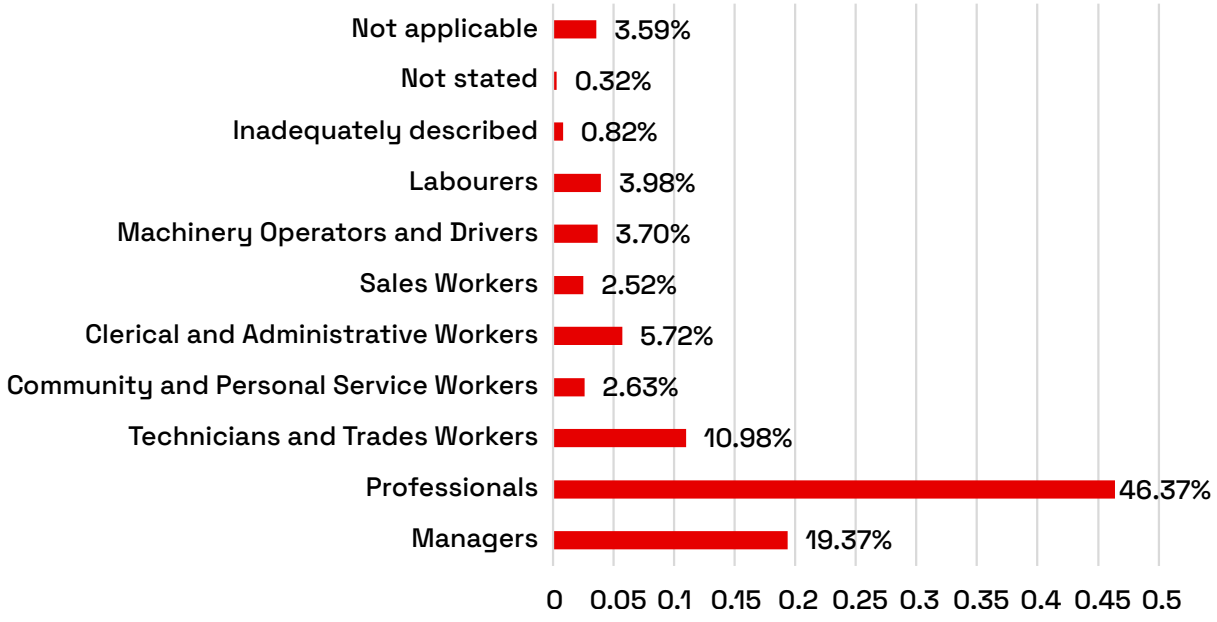
Occupations

The statistics on occupations gives us an understanding of both what engineers are employed to do within the Australian economy, and in what proportions.

Major group distribution (occupations at the highest level of ANZSCO)

Figure 54 shows the distribution of qualified engineers in the labour force by Major Unit Group within the ANZSCO classification scheme. Professionals, Managers, Technicians & Trade Workers, and Clerical and Administrative Workers, account for 81.3 per cent of qualified engineers employed in Australia. The remainder are employed as Labourers, Machinery Operators & Drivers, Community & Personal Service Workers, or 'not applicable'.

Figure 54: Distribution of qualified engineers in the labour force by major group



Engineering Occupations (occupations within the unit group level of ANZSCO)

Table 41 presents the 2021 distribution of qualified engineers working in engineering occupations by State and Territory for each of the 50, four-digit unit group level occupations within ANZSCO that we reasonably expect an engineer to be employed in. This was assessed on their skill base, its transferability, requisite knowledge, and problem-solving ability. The occupations were assessed on their attachment to the practice of engineering. Each needed to be rated at least three out of five to qualify as an engineering occupation. There are 364 ANZSCO occupations at the four-digit level.

ANZSCO is due to be updated before the next census in 2026. Engineers Australia is actively contributing to the ANZSCO update consultation process and will review the list of engineering occupations when the consultation is completed. The revised classification will be revisited for accuracy, currency, and completeness. Our criteria to determine an engineering occupation may need revision in parallel.

Table 41: Distribution of qualified engineers working in engineering occupations by State or Territory in 2021

Engineering Occupation	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Total	% of Total
Actuaries, Mathematicians and Statisticians	9	65	0	12	7	0	44	14	151	0.1%
Air Transport Professionals	65	1,152	182	1,456	308	67	987	717	4,934	2.0%
Architectural, Building and Surveying Technicians	56	1,494	29	610	208	42	1,318	437	4,194	1.7%
Chemical and Materials Engineers	12	709	11	594	168	17	769	844	3,124	1.3%
Chief Executives and Managing Directors	66	1,620	23	832	256	62	1,377	631	4,867	2.0%
Civil Engineering Draftspersons and Technicians	28	635	13	901	132	46	527	369	2,651	1.1%
Civil Engineering Professionals	460	12,183	238	8,508	1,782	527	10,279	4,370	38,347	15.7%
Commissioned Officers (Management)	138	272	23	199	66	8	144	60	910	0.4%
Computer Network Professionals	170	1,359	19	323	203	22	1,084	226	3,406	1.4%
Construction Managers	178	4,251	89	1,812	537	132	3,317	1,124	11,440	4.7%
Contract, Program and Project Administrators	224	3,330	64	1,192	517	95	2,528	1,024	8,974	3.7%
Database and Systems Administrators, and ICT Security Specialists	156	1,137	15	286	125	21	933	165	2,838	1.2%
Electrical Engineering Draftspersons and Technicians	13	485	14	410	123	32	410	332	1,819	0.7%
Electrical Engineers	221	4,510	110	3,030	883	250	3,490	2,288	14,782	6.1%
Electronic Engineering Draftspersons and Technicians	24	235	9	104	76	7	180	82	717	0.3%
Electronics Engineers	124	1,064	18	524	424	45	1,056	521	3,776	1.6%
Engineering Managers	185	3,538	58	2,257	851	142	3,396	1,950	12,377	5.1%
Environmental Scientists	15	326	13	221	54	23	321	141	1,114	0.5%
General Managers	138	1,070	24	665	195	46	982	519	3,639	1.5%
Geologists, Geophysicists and Hydrogeologists	20	74	4	79	25	9	80	154	445	0.2%
ICT Business and Systems Analysts	148	1,707	6	332	127	14	1,337	190	3,861	1.6%
ICT Managers	266	3,556	19	711	256	35	2,591	448	7,882	3.2%

Engineering Occupation	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Total	% of Total
ICT Sales Professionals	37	650	3	124	37	4	433	69	1,357	0.6%
ICT Support and Test Engineers	45	983	3	174	96	3	661	82	2,047	0.8%
ICT Support Technicians	74	1,161	19	317	192	23	959	204	2,949	1.2%
Industrial, Mechanical and Production Engineers	232	5,964	114	4,427	1,558	248	7,013	4,783	24,342	10.0%
Intelligence and Policy Analysts	69	66	0	43	25	6	104	26	339	0.1%
Management and Organisation Analysts	145	1,862	3	596	145	26	1,482	491	4,750	2.0%
Manufacturers	0	202	0	94	37	6	288	48	675	0.3%
Marine Transport Professionals	35	459	58	523	123	152	286	546	2,182	0.9%
Mechanical Engineering Draftspersons and Technicians	6	269	9	237	74	21	327	269	1,212	0.5%
Mining Engineers	8	677	29	1,727	349	38	380	3,378	6,586	2.7%
Other Building and Engineering Technicians	12	754	30	711	195	23	483	908	3,116	1.3%
Other Education Managers	9	92	0	41	20	0	77	27	266	0.1%
Other Engineering Professionals	171	1,999	27	1,149	476	61	1,950	516	6,349	2.6%
Other Natural and Physical Science Professionals	13	183	6	142	131	18	197	432	1,122	0.5%
Other Specialist Managers	81	1,754	25	810	243	59	1,489	560	5,021	2.1%
Policy and Planning Managers	215	723	9	281	125	31	576	200	2,160	0.9%
Production Managers	14	1,576	27	1,200	384	83	1,733	1,543	6,560	2.7%
Research and Development Managers	28	471	0	173	119	12	461	99	1,363	0.6%
Safety Inspectors	3	127	8	94	16	4	111	112	475	0.2%
Senior Non-commissioned Defence Force Members	29	96	10	58	23	0	29	40	285	0.1%
Software and Applications Programmers	631	8,525	30	2,235	966	88	6,411	1,107	19,993	8.2%
Supply, Distribution and Procurement Managers	22	882	8	282	99	9	784	178	2,270	0.9%
Technical Sales Representatives	12	749	0	338	91	7	713	286	2,196	0.9%
Telecommunications Engineering Professionals	87	1,532	3	332	117	25	1,312	269	3,677	1.5%
Telecommunications Technical Specialists	18	370	13	109	49	11	289	74	933	0.4%
University Lecturers and Tutors	118	1,111	21	605	276	65	1,066	326	3,588	1.5%
Urban and Regional Planners	0	241	5	127	39	5	201	54	672	0.3%
Vocational Education Teachers (Aus) / Polytechnic Teachers (NZ)	10	211	7	123	57	17	247	148	820	0.3%
Total	4,840	78,461	1,448	42,130	13,385	2,687	67,212	33,381	243,553	100.0%

As mentioned in Section One, we present the population of qualified engineers encoded to the Engineering Professionals 'NFD' category within the four-digit engineering professionals' minor group in Table 42 by level of qualification. Nearly 10,000 engineers provided responses that were unable to be classified to a detailed occupation within the minor group. We have no further detail about their activity.

Table 42: Distribution of engineering professionals nfd by qualification level

	Doctoral Degree Level	Master Degree Level	Grad Cert & Grad Dip	Bachelor Degree Level	Adv. Dip. & Assoc. Degree Level	Total
Engineering Professionals, nfd	481	2,075	165	6,623	476	9,823

We should note that the ABS defines these occupations as having Skill Level 1, which itself is defined as *"Occupations at Skill Level 1 have a level of skill commensurate with a bachelor degree or higher qualification. At least five years of relevant experience may substitute for the formal qualification. In some instances, relevant experience and/or on-the-job training may be required in addition to the formal qualification*[38].

The distribution of professional engineering occupations at the four-digit level by level of educational attainment is shown in Table 43, with the proportions of those working in these occupations having qualifications below the level of advanced diploma or associate degree (AQF6) or below the level of a bachelors degree. See Appendix 2 Table 51 (link) for the breakdown of these occupations by highest reported level of educational attainment.

We note that approximately 8.7 per cent of this segment of professional engineers hold qualifications at the level of Certificate IV and below. This includes more than 4,700 who recorded having no post-secondary education. This is one issue that statutory registration of engineers should address over time because suitable underpinning qualifications are required to practice as a professional engineer. However it is worth noting that only some engineering titles are protected by legislation.

Table 43: Professional engineering occupations by highest level of educational attainment

	Secondary Education - Years 9 and below	Certificate I & II Level	Secondary Education - Years 10 and above	Certificate III & IV Level	Advanced Diploma and Diploma Level	Bachelor Degree Level	Grad. Dip & Grad Cert Level	Postgraduate Degree Level	Total
Chemical and Materials Engineers	0	0	104	76	94	2,250	74	1,150	3,751
Civil Engineering Professionals	30	0	2,030	934	1,981	31,575	853	11,412	48,808
Electrical Engineers	0	0	483	864	1,525	10,532	314	4,291	18,004
Electronics Engineers	7	0	210	232	471	2,566	85	1,406	4,966
Industrial, Mechanical and Production Engineers	37	0	1,187	2,366	2,398	18,207	527	7,076	31,800
Mining Engineers	7	0	254	310	401	4,933	236	2,149	8,290
Other Engineering Professionals	3	0	363	372	564	4,678	240	2,686	8,914
Total	84	0	4,631	5,154	7,434	74,741	2,329	30,170	124,533
% of Total	0.1%	0.0%	3.7%	4.1%	6.0%	60.0%	1.9%	24.2%	100.0%

38 See https://www.abs.gov.au/statistics/classifications/anzsco-australian-and-new-zealand-standard-classification-occupations/2022/conceptual-basis-anzsco

Professional engineering occupations at the most detailed level

We examine the most detailed level of the Professional Engineer Minor Group in Table 44. This allows us to answer questions like how many electrical engineers are there in the Northern Territory for instance.

We note that overall, there are 106,699 qualified engineers working within these professional engineering occupations. We also note that in the qualified total, there are 3,881 individuals with an Advanced Diploma or associate degree. The breakdown of qualifications in these occupations is not shown in Table 44. However, 142,078 people recorded these occupations on their census response. The individual State totals represent qualified engineers, rather than all those in the particular occupation, as shown in the right-side column.

This means the balance of 35,379 people who recorded themselves working in an engineering occupation, could hold a higher non-engineering qualification, or lower, or no engineering qualification. Nevertheless, approximately a quarter (24.6 per cent) of Australia's qualified engineers work in these Professional Engineering occupations.

The distribution of highest level of educational attainment by people working in 6-digit engineering occupation is included at Appendix 2, Table 52 for completeness, which is congruent with the distribution in professional engineering occupations by highest level of educational attainment as shown in Table 51.

Table 44: Population of qualified engineers in professional engineering occupations by state or territory

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Other	Total Qualified	Total in occupation
Aeronautical Engineer	286	335	267	118	22	0	7	81	0	1,121	1,399
Agricultural Engineer	4	12	21	4	4	0	0	0	0	51	126
Biomedical Engineer	339	295	132	49	65	6	4	11	0	905	1,326
Chemical and Materials Engineers nfd	0	0	0	0	7	0	0	0	0	8	13
Chemical Engineer	584	642	499	137	708	14	14	4	0	2,603	3,114
Civil Engineer	7,607	6,254	5,437	1,035	2,446	333	218	335	0	23,664	29,363
Civil Engineering Professionals nfd	55	50	39	19	14	3	0	3	0	169	241
Electrical Engineer	4,478	3,452	3,021	871	2,287	256	125	223	0	14,707	18,349
Electronics Engineer	1,060	1,040	531	431	514	47	19	123	0	3,755	5,115
Engineering Professionals nec	805	755	368	167	195	34	0	58	0	2,391	3,778
Engineering Professionals nfd	2,454	2,699	1,747	785	1,619	124	83	279	5	9,788	15,356
Engineering Technologist	36	116	31	16	10	0	0	8	0	217	366
Environmental Engineer	427	376	277	61	124	6	10	11	0	1,304	1,631
Geotechnical Engineer	610	440	467	77	431	34	16	16	0	2,072	2,487
Industrial Engineer	878	1,143	411	255	337	37	5	30	0	3,112	4,732

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Other	Total Qualified	Total in occupation
Industrial, Mechanical and Production Engineers nfd	38	31	20	12	16	0	0	0	0	126	188
Materials Engineer	134	121	102	32	112	0	0	0	0	518	675
Mechanical Engineer	4,287	4,983	3,338	1,106	3,587	178	79	174	3	17,717	22,911
Mining Engineer (excluding Petroleum)	601	204	1,301	220	2,096	38	39	6	0	4,515	5,896
Mining Engineers nfd	0	5	14	6	28	0	0	0	0	57	94
Naval Architect	73	40	50	39	83	12	5	6	0	312	399
Other Engineering Professionals nfd	10	8	0	3	0	0	0	0	0	23	43
Petroleum Engineer	68	142	408	124	1,237	6	14	0	0	1,981	2,447
Production or Plant Engineer	733	783	667	184	819	46	38	19	0	3,296	4,618
Quantity Surveyor	136	102	60	10	50	0	3	0	0	361	3,450
Structural Engineer	2,567	2,136	1,602	498	1,048	110	44	63	0	8,094	9,013
Transport Engineer	1,136	1,220	872	156	358	35	7	29	0	3,832	4,936
Total	29,406	27,384	21,682	6,415	18,217	1,319	730	1,479	8	106,699	142,078

In a narrower selection of the qualified engineering population, that is those most likely to be in the occupational category of Professional Engineers with a Bachelor's degree or higher qualification, we can examine the number of qualified engineers per age bracket and the number working in professional engineering occupations. This unit group does not include Engineering Managers or Software Engineers, which often have Professional Engineers undertaking professional engineering work in these occupations.

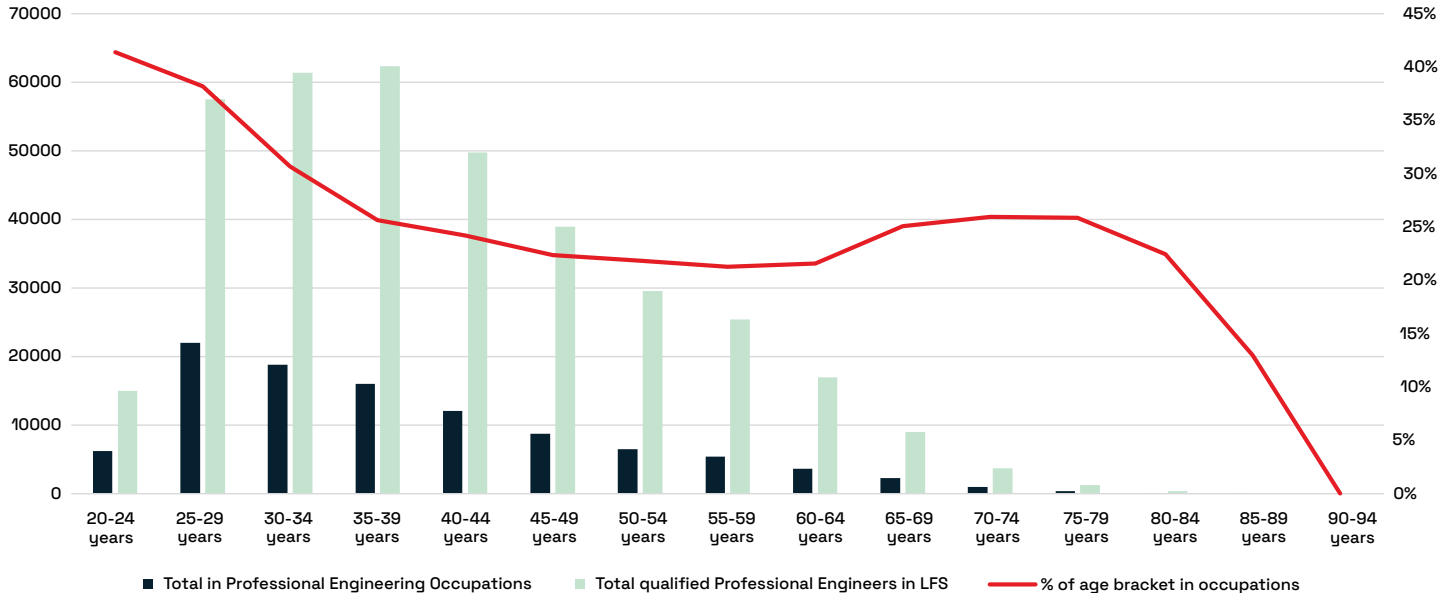
There are 27 professional engineering occupations out of 1,076 six-digit ANZSCO occupations. These are the occupations that are most related to engineering disciplines, qualifications, professional engineering practice and technical engineering.

Many people associate engineering with these professional engineering occupations. However, many engineers practice in leadership and management. As well as a range of other technical roles that use their engineering problem-solving skillsets, knowledge and experience that are not captured within the narrow selection of occupations presented here.

There are 106,699 qualified engineers in occupations within the Engineering Professionals Minor Group, there are 371,092 qualified engineers in the labour force with a Bachelor's degree or higher qualification in engineering (see figure 5).

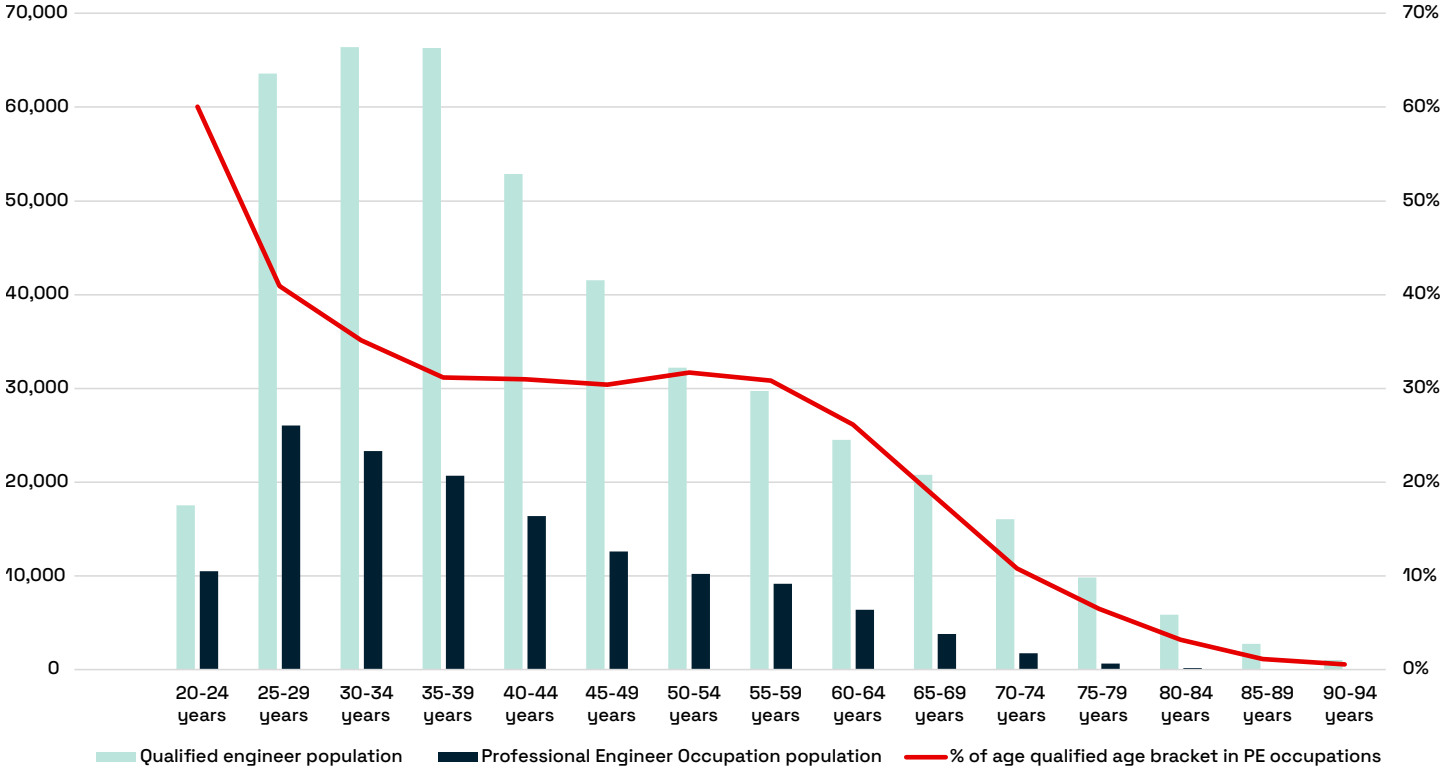
The proportion of qualified engineers by age group in professional engineering occupations is shown in Figure 55. Note the decrease in age in an increasing proportion in engineering occupations, indicating that graduate engineers (20-24 years old) are in high demand (or were at the time of census night).

Figure 55: Qualification utilisation rates by five-year age bands (bachelor's degree and postgraduate qualifications) in limited selection of professional engineering occupations – with only qualified engineers in these professional engineering occupations



For the sake of completeness Figure 56 shows the proportion of qualified engineers by age bracket and the population of those in professional engineering occupations (without filtering these occupations for those with engineering qualifications). As noted earlier, the Census excludes engineers with a higher qualification in a non-engineering field. In any event, the participation rate for each age bracket follows a similar trajectory.

Figure 56: Qualification utilisation rates by five-year age bands (bachelor's degree and postgraduate qualifications) in limited selection of professional engineering occupations – with the population of those in professional engineering occupations not limited to those with engineering qualifications.



The high utilisation rate of 20–24-year-olds indicates a resurgent demand for professional engineers. Shortages have been reported since mid-2021. There are now more qualified engineers aged 20-24 years working in professional engineering occupations (all six-digit occupations within the Engineering Professionals Minor Group)

than those aged 55-59 (10,512 vs 9,160), with 50 per cent of qualified engineers less than 40 years of age.

The drop in utilisation rates of the 25-39 age group accords with the experience of graduates over the last decade. In general, it was more challenging for graduates to find engineering jobs between 2013-2021.To alleviate skills shortages, employers should consider opening graduate programs to older age groups (i.e.35-39 age groups).

This analysis replicates earlier findings from Engineers Australia[39] and academic analysis by Palmer and Campbell[40] of earlier census data. Over multiple census it shows decreasing proportions of Australia's qualified engineers working in professional engineering occupations as they increase in age. These earlier studies noted a decline in the proportion of younger graduates working as engineers as at the 2016 census compared with the same cohort in 2006 and 2011.

An earlier analysis of census data by Trevelyan and Tilli in 2010[41] found that 40 per cent of engineering graduates (and up to 70 per cent or more of migrants from certain regions) were not working in engineering-related occupations at the time of the 2006 Census.

Note: More research is needed to understand the reasons for this situation.

The BeLongEng Project is undertaking a longitudinal study to track the practices and contexts of a cohort (panel) of individual engineers over time. It is anticipated that this project will provide evidence into how and why engineering practice is changing, and so lead to a more responsive and productive learning and workplace ecosystem[42].

The findings of this study will provide insights as responses are collected over the survey period to 2042.

Occupational outcomes by five-year age bands

Table 46 indicates the per centage of people who responded in the census that they were working in a particular occupation versus the number of people qualified to do so. That qualification is measured by educational attainment. That is those with an associate degree, advanced diploma, or higher qualification in that field. See Appendix 2 for table 53 which has the mapping of occupation codes to fields of education between respective classification schemes. See Appendix 2 for supplementary tables 54 and 55 used to calculate these per centages. The mapping of occupations to fields of education is imperfect, due to the breadth of engineering qualifications, which is not fully captured by the classification schemes, and this should be kept in mind when examining the statistics below.

The results highlight some anomalies. These include the per centages recorded in transport engineering and mining engineering, geotechnical, structural, and industrial engineering. This is partly due to the broad useability of an engineering degree. Many engineering organisations view an 'engineer' as an 'engineer', rather than specifying the role according to the engineer's initial qualifications in a particular discipline.

The large per centages in Table 45 are also due to the small numbers involved. For instance, in transport engineering, there are only three qualified engineers between the ages of 20-24 and yet 377 respondents recorded themselves as having that occupation. This speaks to the limitations in using census data, as transport engineers can have a background in civil engineering or others, and they are not limited to those with specific transport engineering qualifications.

The figures presented can be influenced by a range of other factors, including that as stated previously, an 'engineer' is not a legally protected title. Employers can include 'engineer' in the job title whether the individual is a practicing engineering or not. It may also be due to a mismatch with qualifications held at a lower level, or people's engineering qualifications not being captured because they have a higher qualification. Similarly, people may work in engineering occupations which are not captured by ANZSCO individually and are encoded to the Engineering Professionals nec occupation[43]. When encoding a census response to a particular occupation the ABS have regard to the answers provided for the census question as to the tasks performed in a person's usual occupation, as well as the occupation nominated by the respondent.

39 Australia's Engineering Capability: How the last ten years will influence the future, Engineers Australia, 2019, p43-49

40 Palmer, Stuart and Campbell, Malcolm 2018, Using census data to better understand engineering occupational outcomes, in AAEE 2018: Proceedings of the 29th Australasian Association for Engineering Education Annual Conference, Engineers Australia, [Hamilton, N.Z.], pp. 1-7.

41 J P Trevelyan & S Tilli (2010) Labour Force Outcomes for Engineering Graduates in Australia, Australasian Journal of Engineering Education, 16:2, 101-122, DOI: 10.1080/22054952.2010.11464047, https://doi.org/10.1080/22054952.2010.11464047

42 BeLongEng Project, University of Canterbury, https://www.belongeng.org/about

43 Not elsewhere classified (nec) categories are used for responses where there isn't a specific category in the classification, see https://www.abs.gov.au/statistics/detailed-methodology-information/information-papers/understanding-supplementary-codes-census-variables

Table 45: Per centage of people in select professional engineering six-digit ANZSCO occupations of total the number of qualified engineers in relevant ASCED detailed educational field of study by five-year age bands (Div/o indicates 0 population of qualified engineers in that age band)

Age bracket	Aerospace Engineering	Biomedical Engineering	Chemical Engineering	Civil Engineering, nfd	Electrical Engineering	Electronic Engineering	Environmental Engineering	Geotechnical Engineering	Industrial Engineering	Materials Engineering	Mechanical Engineering	Mining Engineering	Structural Engineering	Transport Engineering
20-24	51.9	50.6	31.7	114.3	113.2	217.3	110.1	DIV/0	715.8	92.1	90.1	202.8	423.4	12,566.70
25-29	43.2	39.9	26	84.5	73.4	92.7	52.8	1,104.20	136.9	34.9	65.5	102.6	260.2	2,325.00
30-34	37.1	37.2	20.7	73.4	70.2	47.6	42.6	465.5	96.1	16.4	67.6	85.2	229	987.5
35-39	43.5	36.1	22.8	68.5	70.7	41.8	48.3	300.7	88.9	14.4	62.9	82.6	203.9	587.9
40-44	47.8	50.2	20.1	61	64.7	46.1	44.3	267	90	11.9	57.5	77.5	226.8	613.5
45-49	37.7	78	23.6	55.3	52.4	44.8	46.4	251.8	118.7	10.1	52.9	72	214.1	698.3
50-54	47.4	146	23.2	52.9	48.2	50.1	44.6	292	139.6	8.3	53.1	70	185.7	753.2
55-59	37.8	138.9	23.8	50.4	48.5	55	51	146.2	156.7	7.8	49.3	54.9	188.2	770
60-64	44.5	148.9	22.2	49.5	48.1	61.2	61	162.2	109.8	5.6	51.7	53.1	173.9	800
65-69	62.3	147.8	23.4	52.1	48.8	55.5	44.8	156	103.7	9.1	54.7	52.3	170.6	816.7
70-74	10.3	78.6	21	47.6	40.6	64.5	72.2	262.5	130.6	11.3	57	55.9	179.1	527.3
75-79	0	100	27.3	54.1	44	100	DIV/0	233.3	55.6	0	70.5	56.3	166.7	100
80-84	0	0	18.8	38.5	52.5	50	75	75	0	0	84.8	160	160	0
85-89	0	0	0	65	0	0	0	0	0	0	46.2	0	0	DIV/0
Total	43	51.2	23.4	69.2	62.2	53.5	48.9	375.1	114.4	13.7	60.6	79.4	222.5	902.4

Occupations by gender by five-year age band

Table 46 shows the proportion of female qualified engineers per occupation.

Table 46: Per centage (ratio) of qualified engineer women to men in engineering occupations by five-year age band, Red text indicates above 10%, Green text above 20% (Div/o indicates 0 population of qualified engineers in that age band)

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years
Chief Executives and Managing Directors	0.0%	12.9%	8.7%	9.5%	11.1%	8.9%	6.6%	5.1%	4.7%	1.2%
General Managers	0.0%	13.0%	10.0%	11.8%	10.8%	13.3%	8.8%	3.4%	1.0%	0.0%
Policy and Planning Managers	DIV/0	40.0%	42.3%	31.3%	39.1%	30.4%	15.4%	14.0%	6.7%	0.0%
Research and Development Managers	0.0%	41.9%	37.7%	29.7%	31.8%	26.7%	18.4%	8.2%	12.9%	0.0%
Construction Managers	22.9%	15.9%	11.4%	10.7%	9.9%	8.2%	5.3%	2.9%	2.7%	0.8%
Engineering Managers	37.8%	19.1%	17.6%	13.1%	11.5%	9.0%	6.6%	3.8%	0.9%	0.0%
Manufacturers	50.0%	26.5%	20.7%	16.7%	16.1%	10.8%	0.0%	0.0%	0.0%	7.5%
Production Managers	12.5%	24.6%	15.5%	14.5%	12.9%	9.5%	4.8%	4.0%	4.5%	0.0%

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years
Supply, Distribution and Procurement Managers	30.8%	23.4%	19.8%	29.0%	22.9%	17.6%	14.8%	4.1%	4.2%	5.5%
Other Education Managers	DIV/0	75.0%	100.0%	52.9%	38.9%	26.5%	37.9%	34.3%	56.3%	0.0%
ICT Managers	0.0%	30.6%	37.1%	22.3%	16.5%	10.8%	9.8%	7.3%	9.2%	2.9%
Commissioned Officers (Management)	24.5%	13.6%	9.5%	5.5%	5.3%	3.2%	0.0%	3.0%	0.0%	0.0%
Other Specialist Managers	68.0%	61.8%	47.1%	39.4%	33.7%	30.4%	21.6%	14.7%	10.6%	4.4%
Senior Non-commissioned Defence Force Members	DIV/0	DIV/0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Actuaries, Mathematicians and Statisticians	0.0%	33.3%	50.0%	68.8%	23.1%	19.0%	0.0%	100.0%	83.3%	DIV/0
Intelligence and Policy Analysts	120.0%	39.5%	86.7%	110.5%	43.8%	46.2%	69.2%	66.7%	0.0%	0.0%
Management and Organisation Analysts	49.3%	45.3%	55.8%	53.0%	41.3%	26.6%	21.5%	14.6%	6.8%	6.1%
ICT Sales Professionals	60.0%	31.9%	31.7%	17.1%	17.4%	8.7%	0.0%	6.5%	0.0%	0.0%
Technical Sales Representatives	38.1%	16.0%	18.2%	12.4%	11.3%	7.0%	1.3%	7.9%	4.5%	0.0%
Air Transport Professionals	13.6%	15.9%	11.5%	9.7%	9.7%	6.2%	8.3%	1.2%	1.8%	0.0%
Marine Transport Professionals	16.1%	12.9%	6.6%	6.4%	2.8%	2.5%	0.0%	1.0%	0.0%	4.5%
Urban and Regional Planners	100.0%	42.6%	30.3%	41.8%	49.4%	18.5%	23.3%	12.8%	19.0%	0.0%
Engineering Professionals, nfd	27.2%	23.1%	19.5%	20.8%	17.5%	13.5%	7.7%	3.3%	2.2%	1.5%
Chemical and Materials Engineers	61.1%	45.4%	41.7%	36.5%	28.1%	28.5%	15.4%	13.5%	8.8%	5.2%
Civil Engineering Professionals	27.6%	22.9%	18.6%	20.0%	16.7%	13.5%	9.8%	8.5%	4.6%	2.8%
Electrical Engineers	21.6%	18.6%	15.1%	12.4%	9.4%	8.1%	4.3%	3.6%	2.3%	0.9%
Electronics Engineers	12.0%	13.0%	16.8%	8.3%	9.9%	8.6%	4.6%	3.0%	3.2%	0.0%
Industrial, Mechanical and Production Engineers	17.9%	13.0%	12.5%	10.6%	9.4%	7.7%	5.2%	3.9%	3.1%	2.1%
Mining Engineers	44.2%	30.4%	24.3%	18.5%	17.3%	12.2%	8.3%	3.1%	0.0%	0.0%
Other Engineering Professionals	39.4%	29.2%	22.3%	26.8%	19.9%	18.6%	9.5%	5.4%	2.0%	0.0%
Environmental Scientists	50.0%	81.3%	74.3%	97.6%	85.5%	86.2%	60.5%	37.5%	19.5%	0.0%
Geologists, Geophysicists and Hydrogeologists	100.0%	0.0%	43.4%	48.3%	22.9%	22.9%	13.7%	22.6%	15.0%	0.0%
Other Natural and Physical Science Professionals	68.0%	44.1%	34.5%	27.9%	14.0%	22.2%	20.5%	19.5%	0.0%	0.0%
University Lecturers and Tutors	27.7%	37.6%	36.1%	38.5%	18.9%	22.1%	18.3%	20.6%	9.8%	7.1%
Vocational Education Teachers (Aus) / Polytechnic Teachers (NZ)	0.0%	77.8%	17.5%	36.1%	38.7%	14.5%	29.1%	13.3%	6.0%	3.5%
ICT Business and Systems Analysts	85.0%	46.5%	66.2%	41.7%	19.8%	24.2%	14.5%	11.6%	7.3%	8.2%
Software and Applications Programmers	22.3%	24.7%	40.2%	31.8%	17.9%	10.3%	10.2%	7.6%	7.0%	1.5%

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years
Database and Systems Administrators, and ICT Security Specialists	35.5%	28.2%	27.0%	24.8%	13.7%	9.8%	5.8%	8.9%	7.0%	0.0%
Computer Network Professionals	31.6%	23.7%	13.9%	11.8%	7.7%	5.4%	4.5%	6.0%	6.8%	0.0%
ICT Support and Test Engineers	28.0%	43.0%	46.5%	51.3%	16.8%	15.5%	6.7%	17.9%	6.7%	0.0%
Telecommunications Engineering Professionals	51.2%	36.8%	16.8%	16.8%	12.2%	8.1%	6.2%	3.2%	3.3%	0.0%
Architectural, Building and Surveying Technicians	12.4%	23.2%	19.9%	23.4%	20.7%	14.8%	17.4%	7.2%	4.7%	0.0%
Civil Engineering Draftspersons and Technicians	31.3%	26.9%	27.6%	20.5%	25.4%	17.4%	13.5%	15.3%	7.8%	0.0%
Electrical Engineering Draftspersons and Technicians	15.4%	16.0%	9.7%	16.0%	8.4%	7.4%	5.0%	11.6%	0.0%	0.0%
Electronic Engineering Draftspersons and Technicians	0.0%	23.8%	10.5%	9.8%	7.8%	15.7%	7.2%	12.9%	5.4%	0.0%
Mechanical Engineering Draftspersons and Technicians	0.0%	11.2%	9.6%	9.2%	11.8%	9.3%	10.7%	9.0%	6.4%	0.0%
Safety Inspectors	0.0%	15.2%	9.1%	12.1%	6.3%	22.2%	5.9%	6.5%	0.0%	0.0%
Other Building and Engineering Technicians	23.1%	32.8%	25.8%	16.9%	9.2%	6.8%	4.9%	1.4%	3.9%	7.7%
ICT Support Technicians	23.3%	35.4%	37.7%	30.8%	21.7%	15.5%	11.0%	8.7%	4.4%	0.0%
Telecommunications Technical Specialists	0.0%	21.7%	17.0%	22.2%	9.5%	7.1%	8.0%	7.5%	13.0%	0.0%
Contract, Program and Project Administrators	28.6%	35.8%	34.1%	33.2%	23.4%	27.0%	15.5%	12.0%	6.4%	1.4%

Occupations by birth location across the five-year age bands

Table 47 shows the proportion of overseas born qualified engineers per occupation as a per centage of the total population for that occupation and age bracket.

Table 47: Proportion of overseas-born qualified engineers in the 4-digit engineering occupations expressed as a per centage. The green text indicates more than 50 per cent (Div/o indicates 0 population of qualified engineers in that age band)

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years
Actuaries, Mathematicians and Statisticians	12.5%	25.0%	56.7%	70.4%	81.3%	88.0%	100.0%	50.0%	100.0%	DIV/0	DIV/0	DIV/0
Air Transport Professionals	16.0%	38.5%	17.2%	21.9%	24.5%	20.7%	23.0%	25.5%	33.5%	14.5%	29.5%	58.8%
Architectural, Building and Surveying Technicians	43.2%	59.7%	67.0%	75.6%	69.9%	54.5%	61.7%	58.7%	53.6%	42.4%	61.4%	58.3%
Chemical and Materials Engineers	29.1%	40.9%	55.6%	59.7%	56.1%	50.9%	48.4%	49.5%	51.6%	46.9%	59.0%	66.7%

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years
Chief Executives and Managing Directors	100.0%	53.2%	51.9%	56.1%	48.6%	38.2%	42.6%	46.7%	47.8%	46.0%	41.5%	55.0%
Civil Engineering Draftspersons and Technicians	40.9%	75.5%	51.1%	53.6%	55.8%	50.0%	50.3%	58.2%	59.2%	42.6%	83.3%	61.5%
Civil Engineering Professionals	31.0%	39.1%	46.8%	58.6%	59.8%	50.6%	48.0%	56.9%	53.1%	45.8%	39.8%	30.8%
Commissioned Officers (Management)	19.7%	22.0%	18.7%	10.4%	17.5%	12.4%	7.8%	27.9%	30.4%	0.0%	0.0%	DIV/0
Computer Network Professionals	34.0%	46.2%	75.2%	84.7%	78.3%	68.7%	68.2%	66.1%	73.0%	64.2%	100.0%	DIV/0
Construction Managers	23.7%	38.9%	43.8%	50.9%	50.6%	44.2%	47.5%	52.5%	56.7%	50.4%	42.1%	44.4%
Contract, Program and Project Administrators	41.9%	51.7%	55.9%	67.8%	67.0%	55.8%	54.4%	56.3%	54.0%	52.0%	61.3%	42.9%
Database and Systems Administrators, and ICT Security Specialists	23.8%	54.1%	75.6%	84.8%	83.5%	69.9%	69.3%	63.8%	72.9%	60.0%	100.0%	DIV/0
Electrical Engineering Draftspersons and Technicians	56.7%	82.9%	38.9%	58.3%	56.1%	59.0%	64.1%	62.7%	63.4%	56.1%	100.0%	DIV/0
Electrical Engineers	39.1%	51.3%	56.9%	62.7%	60.5%	55.2%	53.5%	53.1%	48.4%	51.1%	52.3%	53.3%
Electronic Engineering Draftspersons and Technicians	30.8%	94.2%	52.4%	56.7%	70.9%	66.7%	58.4%	64.6%	67.8%	66.7%	7.1%	DIV/0
Electronics Engineers	35.7%	42.7%	64.6%	71.1%	67.0%	54.8%	56.2%	62.7%	58.8%	64.1%	58.1%	0.0%
Engineering Managers	21.0%	34.9%	42.0%	50.1%	51.0%	46.1%	46.5%	51.5%	50.2%	52.6%	43.2%	26.7%
Engineering Professionals, nfd	35.4%	42.8%	49.0%	62.3%	60.2%	53.7%	50.2%	52.2%	50.6%	40.9%	39.6%	45.2%
Environmental Scientists	40.7%	40.9%	50.8%	57.4%	52.6%	31.4%	30.4%	41.8%	65.3%	45.5%	52.9%	DIV/0
General Managers	0.0%	50.8%	51.0%	45.6%	38.3%	38.7%	41.8%	45.2%	46.6%	28.6%	43.1%	36.4%
ICT Business and Systems Analysts	45.9%	67.4%	88.3%	94.3%	83.8%	71.5%	68.7%	71.3%	67.5%	73.6%	100.0%	DIV/0
ICT Managers	60.0%	47.8%	72.4%	81.8%	78.7%	63.1%	60.2%	57.2%	61.0%	67.6%	61.9%	DIV/0
ICT Sales Professionals	37.5%	72.6%	74.7%	80.9%	72.7%	61.6%	58.3%	69.6%	50.8%	52.2%	100.0%	DIV/0
ICT Support and Test Engineers	46.9%	72.0%	89.3%	93.9%	89.7%	76.9%	78.0%	88.8%	79.7%	63.0%	100.0%	100.0%
ICT Support Technicians	43.4%	72.0%	80.5%	88.2%	84.0%	82.0%	77.5%	75.5%	63.3%	56.3%	75.0%	100.0%
Industrial, Mechanical and Production Engineers	29.5%	45.1%	51.8%	60.5%	62.9%	54.4%	53.7%	57.3%	55.7%	57.4%	58.0%	67.2%
Intelligence and Policy Analysts	27.3%	26.4%	50.0%	47.5%	23.9%	23.7%	72.7%	35.0%	75.0%	45.5%	100.0%	DIV/0
Management and Organisation Analysts	41.5%	49.3%	70.4%	78.9%	72.0%	61.3%	57.0%	53.7%	47.7%	47.9%	53.8%	54.5%

Engineering Occupations (4-digit ANZSCO)	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years
Manufacturers	66.7%	81.4%	71.4%	52.4%	56.9%	57.6%	60.2%	67.6%	58.9%	58.1%	65.7%	78.6%
Marine Transport Professionals	27.8%	45.8%	24.7%	41.5%	42.8%	40.1%	35.8%	38.9%	49.1%	54.3%	67.7%	16.7%
Mechanical Engineering Draftspersons and Technicians	64.0%	73.2%	60.6%	60.5%	73.5%	65.4%	74.6%	65.1%	71.1%	54.5%	36.4%	0.0%
Mining Engineers	35.9%	40.0%	47.1%	57.4%	59.7%	52.4%	62.0%	59.6%	59.0%	46.6%	47.5%	81.3%
Other Building and Engineering Technicians	47.9%	49.7%	49.4%	60.7%	58.7%	57.5%	53.0%	51.4%	57.8%	64.3%	66.7%	DIV/0
Other Education Managers	DIV/0	100.0%	100.0%	88.5%	56.0%	58.1%	80.0%	61.7%	44.0%	62.5%	DIV/0	DIV/0
Other Engineering Professionals	28.3%	39.4%	47.4%	49.0%	47.7%	40.3%	45.4%	51.8%	50.6%	47.6%	20.9%	15.8%
Other Natural and Physical Science Professionals	21.4%	24.7%	52.4%	57.6%	42.1%	39.4%	36.2%	46.7%	44.8%	54.3%	-6.7%	100.0%
Other Specialist Managers	42.9%	57.9%	60.3%	65.9%	58.5%	54.2%	54.6%	56.4%	63.2%	52.5%	55.0%	11.1%
1.058		45.7%	42.9%	56.1%	49.1%	44.8%	50.0%	45.6%	52.8%	48.5%	42.9%	60.0%
Production Managers	59.3%	53.6%	47.3%	55.3%	55.0%	52.4%	47.9%	59.7%	56.4%	49.4%	67.3%	27.3%
Research and Development Managers	30.0%	54.1%	51.2%	49.5%	59.2%	51.6%	48.5%	49.5%	46.8%	32.4%	0.0%	DIV/0
Safety Inspectors	0.0%	68.4%	83.3%	75.7%	51.0%	47.7%	46.3%	28.8%	50.0%	69.6%	0.0%	100.0%
Senior Non-commissioned Defence Force Members	DIV/0	DIV/0	0.0%	-4.3%	16.3%	15.8%	41.1%	28.3%	22.2%	-25.0%	DIV/0	DIV/0
Software and Applications Programmers	34.9%	56.2%	81.3%	87.7%	79.1%	69.4%	62.7%	67.2%	68.0%	62.7%	66.1%	100.0%
Supply, Distribution and Procurement Managers	29.4%	56.9%	71.0%	71.5%	64.9%	51.5%	63.6%	64.6%	60.0%	46.6%	56.3%	DIV/0
Technical Sales Representatives	72.4%	56.0%	67.6%	75.6%	70.3%	64.2%	56.7%	59.9%	57.9%	30.2%	84.0%	DIV/0
Telecommunications Engineering Professionals	37.1%	66.3%	78.2%	86.6%	80.5%	74.2%	69.3%	62.4%	58.1%	68.6%	57.1%	100.0%
Telecommunications Technical Specialists	100.0%	92.9%	79.4%	89.6%	84.0%	70.8%	60.3%	45.8%	67.3%	39.1%	DIV/0	DIV/0
University Lecturers and Tutors	59.4%	69.9%	83.3%	84.3%	80.6%	75.2%	74.2%	79.6%	75.8%	75.5%	45.6%	43.5%
Urban and Regional Planners	20.0%	41.6%	40.4%	67.4%	54.8%	44.2%	56.6%	52.3%	44.0%	71.4%	25.0%	-25.0%
Vocational Education Teachers (Aus) / Polytechnic Teachers (NZ)	100.0%	50.0%	63.8%	80.7%	73.3%	64.4%	38.2%	52.1%	51.1%	47.2%	46.4%	33.3%

Occupations at the most detailed level – What engineers do

To have a better understanding of what engineers do occupationally, it is helpful to examine the most detailed level of the ANZSCO classification scheme.

Some 81.3 per cent of qualified engineers in the labour force are in the Managers, Professionals, Technical & Trades Workers, and Clerical & Administrative Workers Major Groups within ANZSCO (Figure 54). To provide further occupational detail in this section, we examine the six-digit occupations in these major unit groups of most of Australia's qualified engineers. These occupations represent 352,416 qualified engineers out of the 433,353 in the labour force.

There are 725 six-digit occupations where qualified engineers are in the relevant unit group with non-zero cells. Some 80.8 per cent of the qualified engineering labour force are represented in 474 six-digit ANZSCO occupations in these unit groups, the remaining 251 occupations represent 0.5% of the qualified engineer labour force.

The remainder of Australia's qualified engineers (18.7 per cent) are in the Community & Personal Service Workers, Sales Workers, Machinery Operators & Drivers, and Labourers unit groups. Or their responses were classified as 'Inadequately described', 'Not stated' or 'Not applicable'.

In the following section we examine the distribution of occupations for those 352,416 engineers in the labour force whose occupations are classified at the most detailed level of ANZSCO. Figures 57–61 show the detailed occupations in which these engineers work for the top 280 occupations in which qualified engineers are found, with the remaining occupational distribution provided in Table 55 in Appendix 2.

Insight: There are some surprising results where engineers are found throughout a diverse range of occupations. The diversity of occupational outcomes demonstrates the transferability of engineering knowledge, skills, and experience. As well as the value of the engineering problem-solving skill set within the wider Australian economy.

Some of the listed occupations have little attachment to engineering, and the engineers in them may be there either by circumstance or choice.

Many emerging occupations including Cybersecurity Engineering, Quantum Engineering, Mechatronics, and a range of other disciplines, will not be captured for some time by the ANZSCO classification scheme. An update is underway in time for the 2026 census.

Note: There are different numbers of qualified engineers in occupations which are similar to those at the four-digit level. For example, of the 38,348 civil engineering professionals in Table 41, compared with 23,370 captured at the six-digit level in Figure 30, most will be classified to a more accurate six-digit occupation within the higher level four-digit unit group. In this example, the four-digit occupation group of Civil Engineering Professionals includes six-digit occupations such as civil engineer, geotechnical engineer, quantity surveyor, structural engineer, and transport engineer. Not everyone who responded to the census was able to be classified to the lowest level of ANZSCO.

Figure 57: The top 40 six-digit ANZSCO engineering occupations that qualified engineers can be found in 2021 (51% of qualified engineers in the labour force)

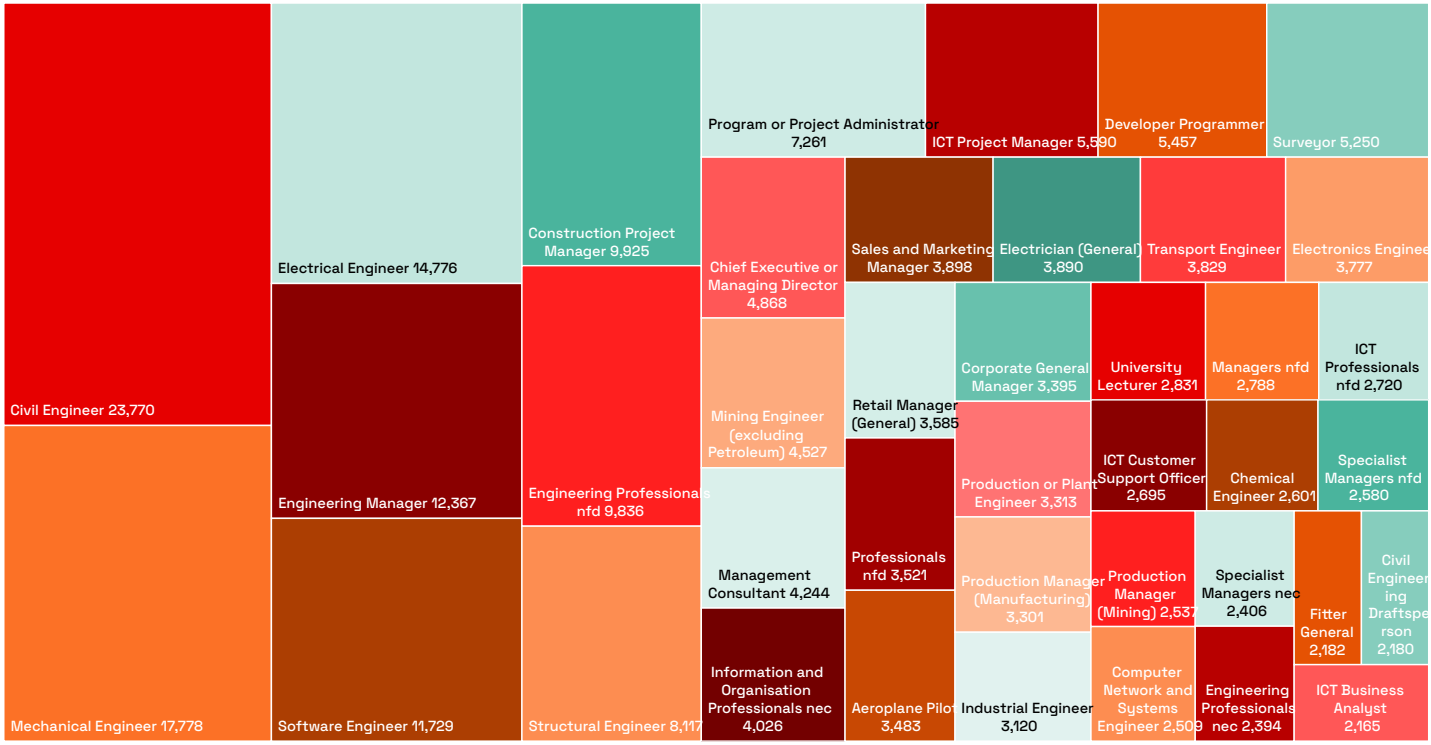


Figure 58: The next 60 six-digit ANZSCO engineering occupations that qualified engineers can be found in 2021 (17% of qualified engineers in the labour force)

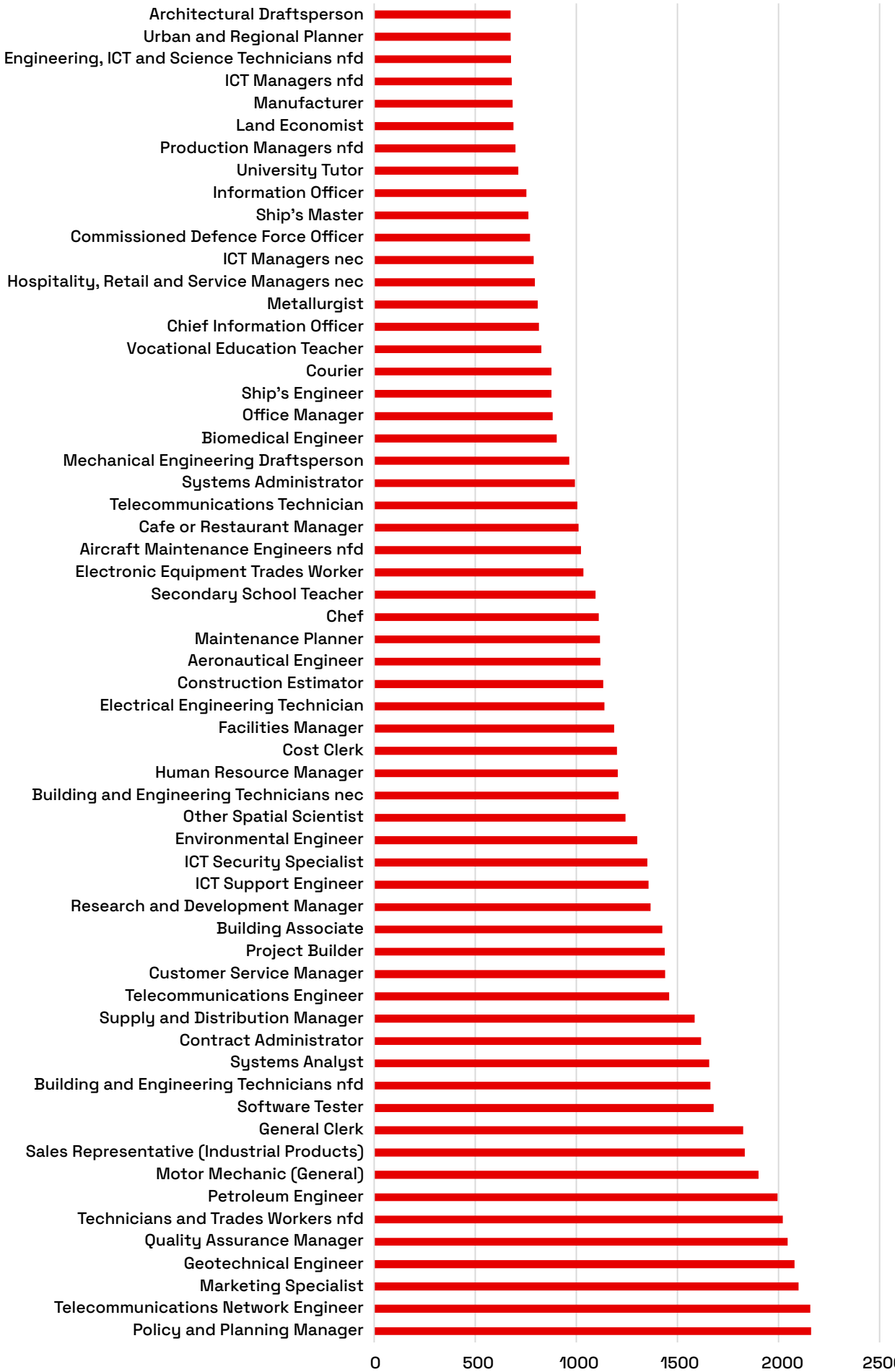


Figure 59: The next 60 six-digit ANZSCO engineering occupations that qualified engineers can be found in 2021 (6.1% of qualified engineers in the labour force)

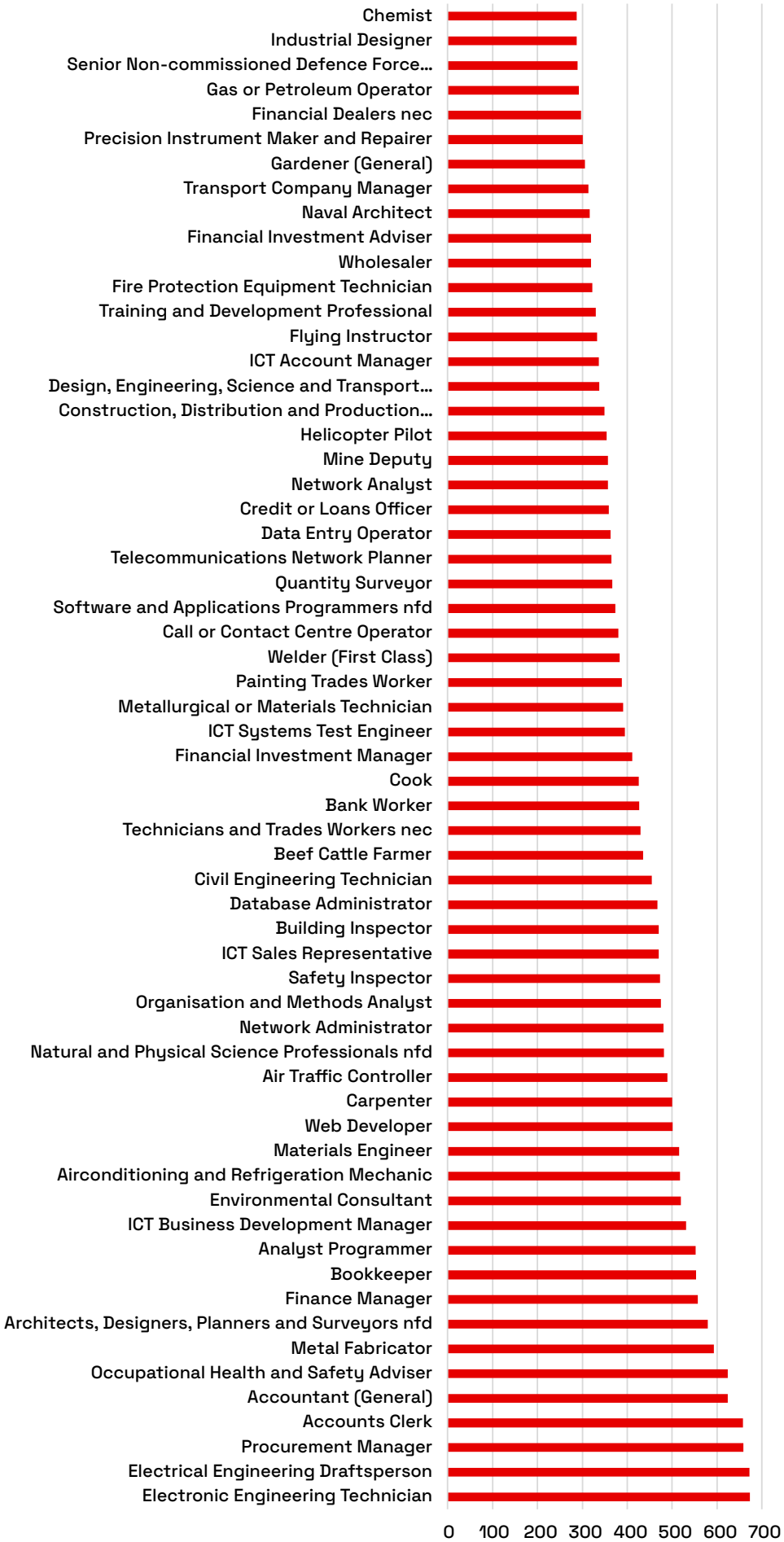


Figure 60: The next 60 six-digit ANZSCO occupations in which qualified engineers were recorded in 2021 (2.99% of the qualified engineer labour force)

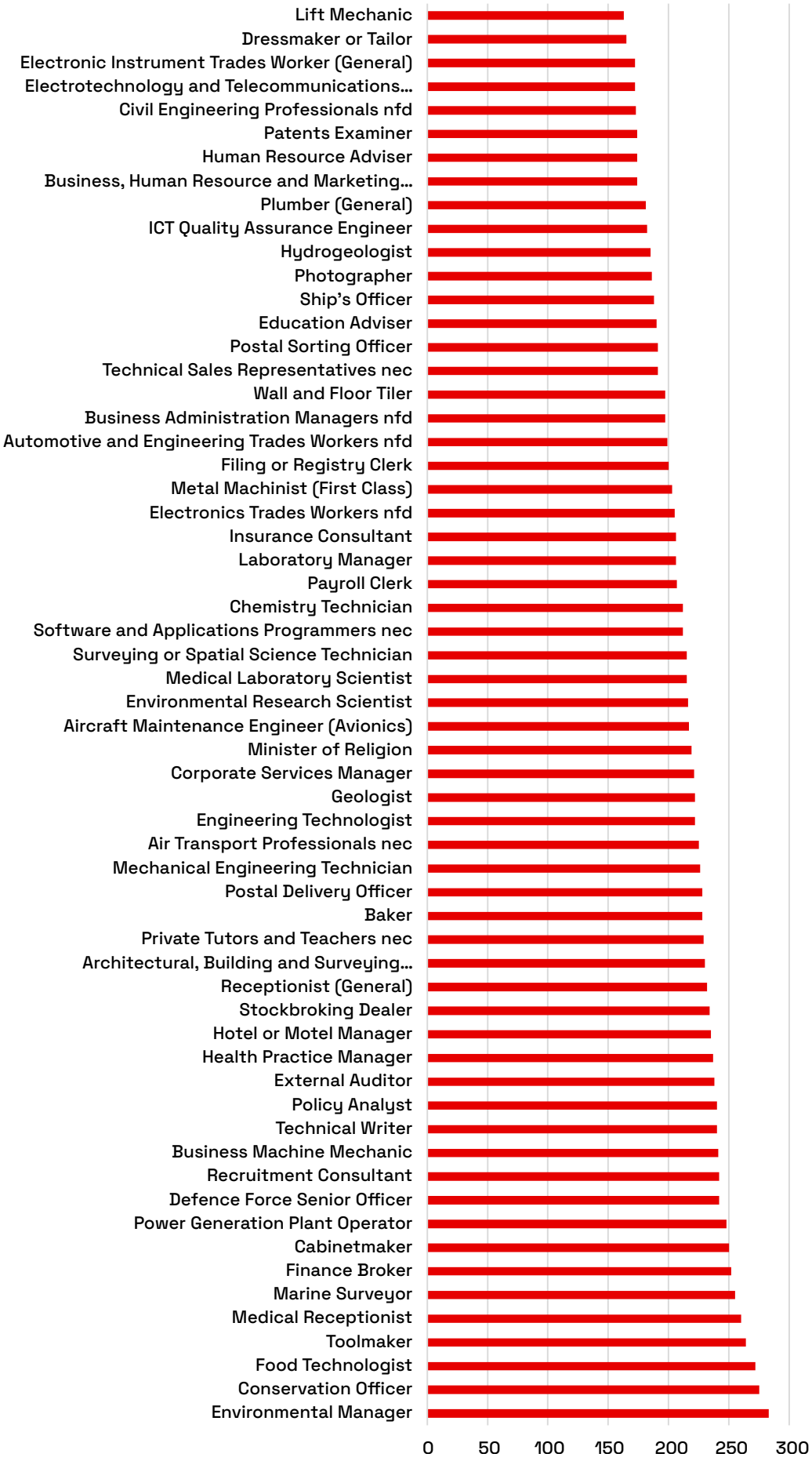


Figure 61: The next 60 six-digit ANZSCO occupations of qualified engineers 2021 (1.72% of the engineering qualified labour force)

SECTION 3
The nature of change – analysis and insights

Labour force and employment statistics

As shown in Section Two of the Overview, Australia's demand for engineering skills is outpacing supply. This is despite the increase in the number of qualified engineers between 2016 and 2021, at three times faster than the general workforce. And for those working in engineering it increased four times faster.

Whilst this increase of 26 per cent since the last Census (115,954 engineers) is encouraging, Australia's engineering skills and labour shortage is at its worst for more than a decade. Demand for engineering skills is outpacing supply from both supply channels, qualified engineers and those working in engineering occupations.

This shortfall is, and will remain critical for Australia's economy, as we stand on the cusp of the nation's clean energy transition. From renewables to an increasing demand for infrastructure, the need for engineers will continue to grow from now into the long term.

All indications point to the shortage getting worse before it gets better, especially if the initiatives currently planned and underway are not amplified.

Australia's track record in addressing supply challenges within its engineering workforce is not promising. A Senate Committee highlighted similar critical skill shortages in engineering in 2012[44], however the recommendations were not actioned. Many of those recommendations remain relevant today.

The 2012 inquiry followed the 2010 Australian National Engineering Taskforce which worked to address concerns of an aging workforce and engineering shortages. There were also references in Hansard to a skills shortage in engineers and related trades in the late 1980s.

The statistical reality is, we face the same shortages today. As we transition to meet the global demand for skilled engineers, particularly due to unprecedented environmental and climate change, we cannot afford not to act.

Engineers, as documented in Section 2, populate every industry in the core pursuit of the profession - to design, develop and invent new and existing processes, products, and technologies. However, the reality remains that the pipeline is constrained and will continue to worsen unless collaborative action is taken.

Some facts:

- Vacancies for engineering jobs are elevated.
- Unemployment for qualified engineers is low. There are fewer unemployed engineers now in real terms than in 2016 (despite economic and population growth).
- Migration slowed even before the pandemic and its recovery will take time.
- We compete with other advanced economies for skilled migrants.
- The shift in the age profile of the engineering labour force shows that many experienced engineers retired in the last decade.
- We anticipate a further 24,980 qualified engineers will retire from the labour force over the next five years.
- Nearly 50 per cent of Australia's qualified engineers today are under 40 years of age.

To better understand the depth of the issue we detail comparative statistics on the number, growth, genesis, employment, and demographics of Australia's population of engineers in this final Section.

Number and growth

There are 546,905 qualified engineers in Australia, of which 433,353 are in the labour force. This participation rate of 79.24 per cent is an increase of 115,953 engineers since the last census. Overall if we limit the number of engineers to those in the labour force, the profession has increased its population by 27.4 per cent since 2016.

The population of qualified engineers in the labour force represents 3.4 per cent of Australia's total labour force, and 13.66 per cent of Australia's skilled workforce[45]. This is a growth rate three times faster than the general population over the last five years — almost 27 per cent for engineers vs. 8.6 per cent for the general population. However, of the additional 115,953 engineers, only 93,427 engineers were in the labour force, a participation rate of 80.4 per cent.

44 The shortage of engineering and related employment Parliament of Australia, 2012 skillshttps://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Education_Employment_and_Workplace_Relations/Completed_inquiries/2010-13/engineering/index

45 Defined as occupations at skill level 1 and 2

Genesis

81,995 of the additional 115,953 engineers, were born overseas (70.7 per cent of the total). But only 67,900 are in the labour force. Taking an average over five years, this equates to adding around 13,580 qualified engineers born overseas each year. This indicates the scale of skilled migration. However, not everyone 'born overseas' would be considered a migrant to Australia. They may be children of Australian citizens.

Of the 33,958 additional engineers born in Australia added over the same period, 26,467 were in the labour force. The 2016 to 2021 yearly average was 5,293 engineers. The ACED data from April 2022 and December 2021, recorded a yearly average of just 7,764 engineers between calendar years 2017 and 2021. The gap of 2,471 engineers each year is due to retirement.

This of course means that Australia's engineering requirement must be filled by engineers born overseas.

Overall, the total population in the occupational group increased from 430,952 in 2016, to 546,905 in 2021, an increase of approximately 27 per cent.

Employment

Labour force participation: The total engineering labour force increased from 340,106 in 2016, to 433,353 in 2021 - an increase of approximately 28 per cent.

Reduction in unemployment: The number of people looking for full-time work decreased from 14,350 in 2016, to 11,213 in 2021, a decrease of approximately 22 per cent. Similarly, the number of people looking for part-time work decreased from 5,722 to 4,399, a decrease of approximately 23 per cent. This is an encouraging statistic, showing clearly the demand for engineers over the period.

Over the 2016-2021 period, unemployment dropped considerably for all qualified engineers, both men and women, born in Australia and overseas. By October 2022, engineering vacancies were at a 10-year high and holding steady, while vacancies for non-engineering sectors appears to have peaked.

The proportion of the engineering population looking for full-time unemployed was 2.1 per cent (down from 3.3 per cent). This is a drop of 37 per cent. And for part-time unemployed qualified engineers, it was down from 1.3 per cent, a 38 per cent reduction. There were 3,137 less unemployed engineers seeking full-time engineers in 2021 than in 2016.

Shift in full-time and part-time employment: Between 2016 and 2021, the number of people employed full-time increased by 28 per cent from 257,507 to 329,622 particularly in the 25-29, 30-34, and 35-39 age groups.

The number of people employed part-time increased approximately 36 per cent from 51,078 to 69,292. Growth was most evident in the 25-29, 30-34, and 35-39 age groups. It also re-emerged in the 55-59 and 60-64 age groups.

This may reflect the trend of increased workplace flexibility, and may also represent the desires of Millennials.[45]. Millennials are now the largest generation in the engineering profession. Meanwhile, older workers may use part-time employment to transition to retirement or reduce their working hours for health or caregiving reasons.

The growth in part-time work for older engineers also represents an opportunity, allowing them to adjust to a changing lifestyle while mentoring and developing younger engineers. For some engineers it may represent a constrained capacity for work.

Insight: The proportion of qualified engineers undertaking part time work is growing at a faster rate than those in full time work. Employers should consider offering part-time opportunities to cater to various life stages to support engineers' personal and professional growth.

Higher labour force participation in older age groups: There is an increase in labour force participation for individuals aged 55 and above between 2016 and 2021. This suggests that people in this age group may be delaying retirement or re-entering the workforce, possibly due to financial needs or a desire to remain active and engaged.

Insight: Employers could leverage this experienced workforce by offering age-friendly work environments, flexible schedules, and opportunities for mentorship and knowledge transfer.

Shifting age demographics: The census shows an increasingly ageing population, with the fastest growing age brackets being between 70 and 84 years. Sixty to 64-year-olds and above, increased to 123,799 in 2021, from 89,442 in 2016. Growth was also strong in younger cohorts. The 35 to 39-year-olds population rose 38.5 per cent. However, the population of qualified engineers aged 20-24, fell by 2,851 (just over 14 per cent), arising from reduced numbers of international students due to border closures.

Change in 'employed but away from work': From 2016 and 2021, the number of people 'employed but away from work', increased significantly. This was prominent in the 25-29, 30-34, and 35-39 age groups. The numbers increased by 7,452, rising from 11,576 to 19,028, (a growth of 64.4 per cent). This was largely driven by the COVID-19 lockdowns that were present at the time of census. They required remote work, and included COVID-related stand-downs, workers stuck interstate due to border closures, and extended leaves of absence for illness or caring responsibilities.

Resilience and adaptability of the workforce: Despite the challenges posed by the Pandemic, the engineering occupational group were resilient and adaptable. There was a significant increase in the total labour force between 2016 and 2021. This suggests many individuals were able to navigate the uncertainties and changes in the labour market. Some switched industries, or re-skilled, others pursued an entrepreneurial venture.

However, the closed borders and the pandemic impacted significantly on the numbers of overseas-born engineers of the 20-24 and 25-29 age groups who were studying engineering within Australia.

Vacancies: over the last census period, particularly between the start of COVID and the August 2021 census date, show that between February 2013 and May 2021, demand for engineers was below the indexed vacancy rate from January 2006. Before the COVID-19 pandemic it was more than eight years below index. Following the COVID-19 stimulus measures, the vacancy rate for engineers rose to a peak not seen since October 2012 and April 2009 before that.

Skills shortages

As described in **Section 2,** there is currently an engineering skills shortage in Australia. And all the predictions are that it may continue over the longer term. Skills shortages for engineering do recur in Australia and their solutions require sustained effort over the long term. We know we need to improve engineering attraction and retention rates. However, we also need to examine the broader economic conditions that influence the cyclical occurrence of skills shortages in Australia.

The need for long term stability and domestic utilisation of engineers

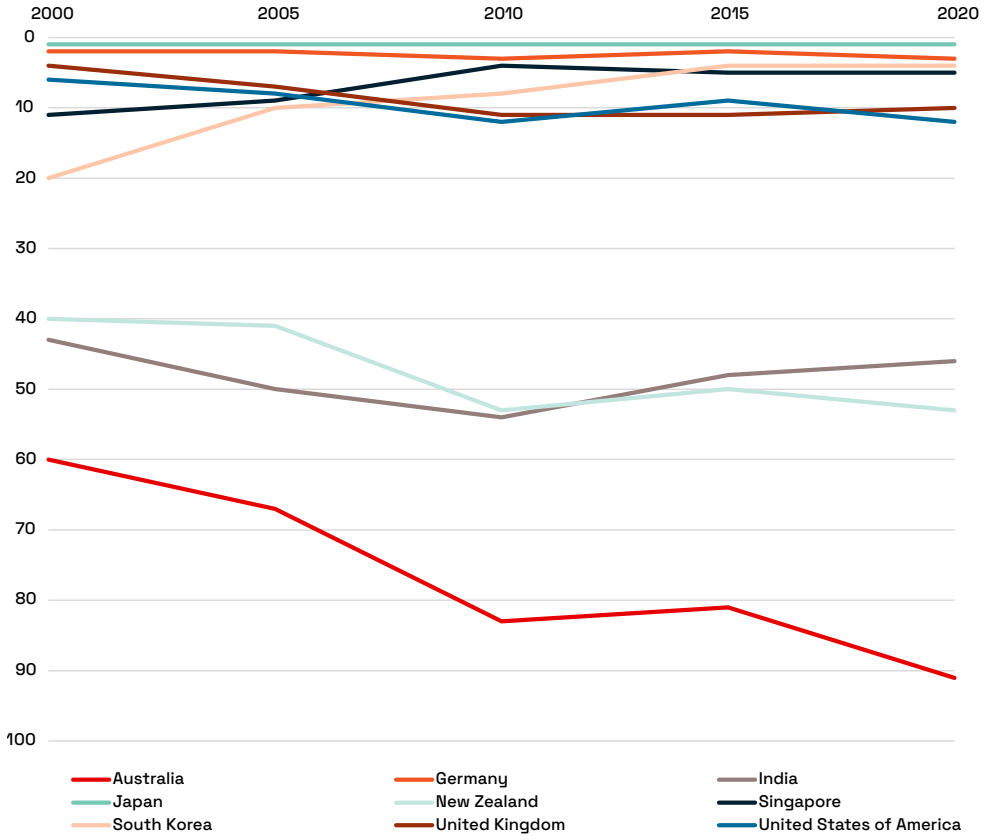
The reality is skill shortages in Australia to date have tended to be cyclical due to the nation's dependence on commodities. The commodity-boom-bust cycle is a chronic issue for Australia.

When in a bust cycle, there are few stable long-term sectors for engineers to transition to. Comparisons are frequently made with Germany, when we are often asked why we don't have an economy like Germany's. The reality is that Germany has a large manufacturing sector that maintains a more consistent demand for engineers. Consequently, the profession is not so exposed to the boom-bust commodity cycle.

Australia on the other hand lacks economic complexity. This has deteriorated over the last two decades. Ranked at a low 91 in the world for economic complexity in 2020[46], Australia falls well below many nations. Unless engineers are involved in commodity projects there just is insufficient complex engineering work in the rest of the economy to keep them busy. This stimulates engineers' move into other occupations and sectors where their skills can be used. See Figure 62 below for the economic complexity comparative rankings between Australia and eight other countries over time.

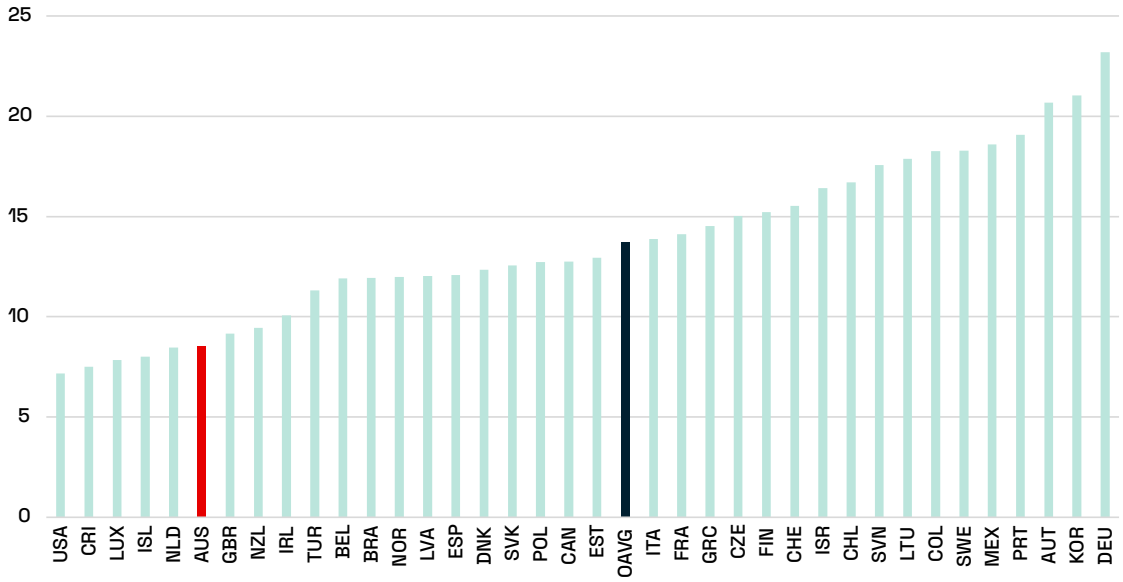
46 https://atlas.cid.harvard.edu/rankings

Figure 62: Comparative rankings of economic complexity over the period of 2000 - 2020[47]



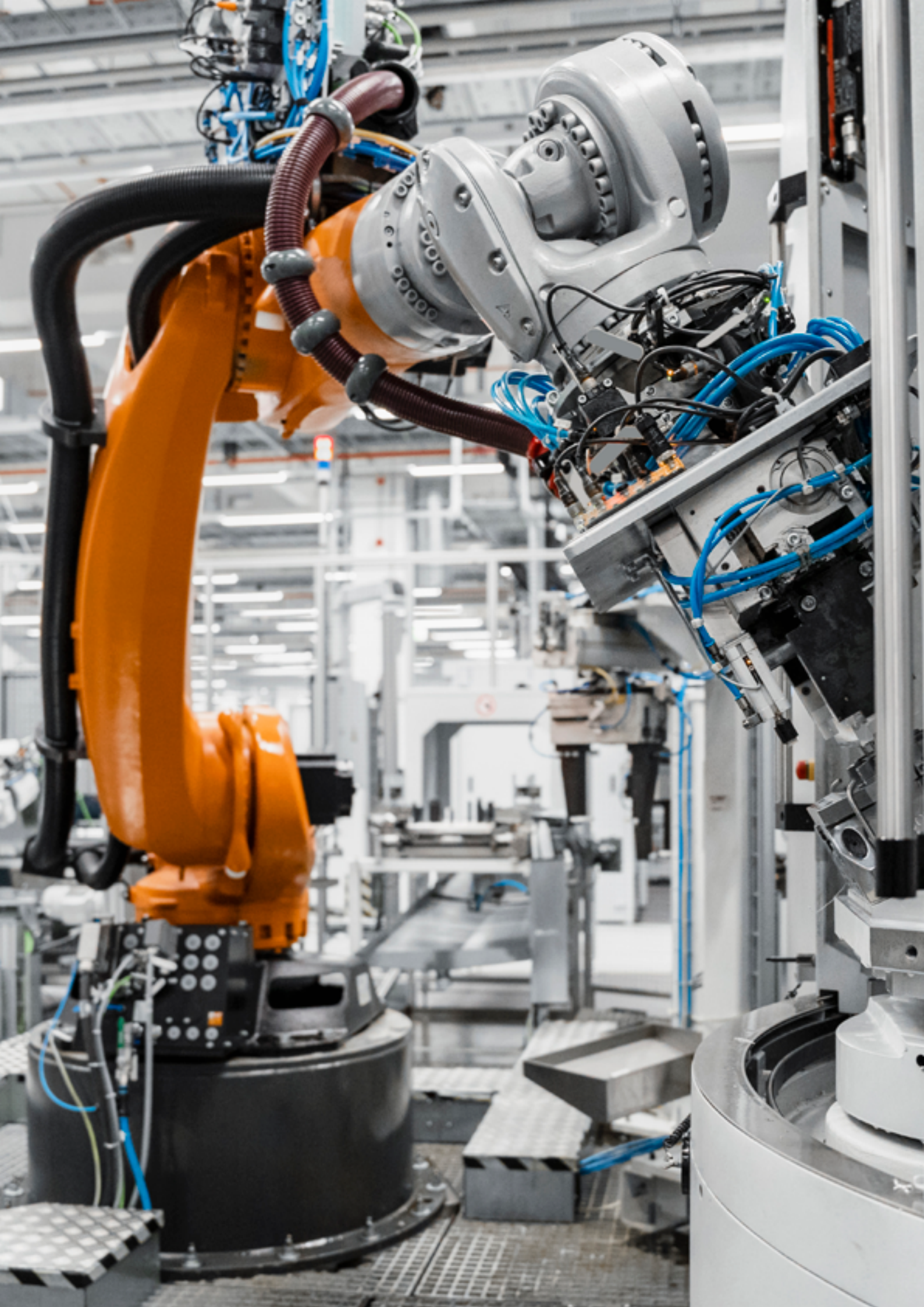
It is worth noting that Australia has the sixth lowest number of engineering graduates in the OECD countries, with only 8.2 per cent of graduates having an engineering qualification in 2020, having improved from having the second lowest number in 2019. However, despite its high economic complexity, the United States has the lowest proportion of engineering graduates (see Figure 63). The link between the proportion of engineering graduates and economic complexity is not necessarily proven but does appear correlated.

Figure 63: Comparison of tertiary engineering graduates (OECD)[48]



Take Away: To reduce the risk of engineering skills shortage shocks, we need to increase the complexity of our economy to ensure more ongoing, rather than project-based engineering work. This would also improve the ecosystem for increasing the number of engineering student graduations.

47 Data sourced from https://atlas.cid.harvard.edu/rankings
48 Source: OECD (2023), Tertiary graduates by field (indicator). doi: 10.1787/9af26c71-en (Accessed on 27 February 2023)



Industry

General observations

Most industries are experiencing, and have consistently experienced, a growing demand for engineering skills. This reflects the importance of engineering expertise in driving innovation and economic growth.

As we combat the urgent demands of climate change – whether the growth in qualified engineers in Construction (47.5 per cent), Transport (30 per cent) or Electricity, Gas, Water and Waste Services (29 per cent) – we can see the need to meet continuous demand. With increasing political and social volatility, the demand for qualified engineers in Health Care and Social Assistance (61.6 per cent), Public Administration and Safety (28.9 per cent), and Financial and Insurance Services (55.3 per cent growth), also demonstrates the importance of Australia being able to continue to meet this demand.

The statistics also suggest that some engineers might be taking up positions that use their engineering skills and background in non-engineering roles.

Between 2016 and 2021, there was a notable increase in the proportion of engineers working in engineering occupations in some industries. For instance, there was a significant rise in the number of engineers 'working in engineering occupations', in the Construction industry, growing from 19,549 in 2016 to 30,003 in 2021. A growth of 53.5 per cent over a five-year period.

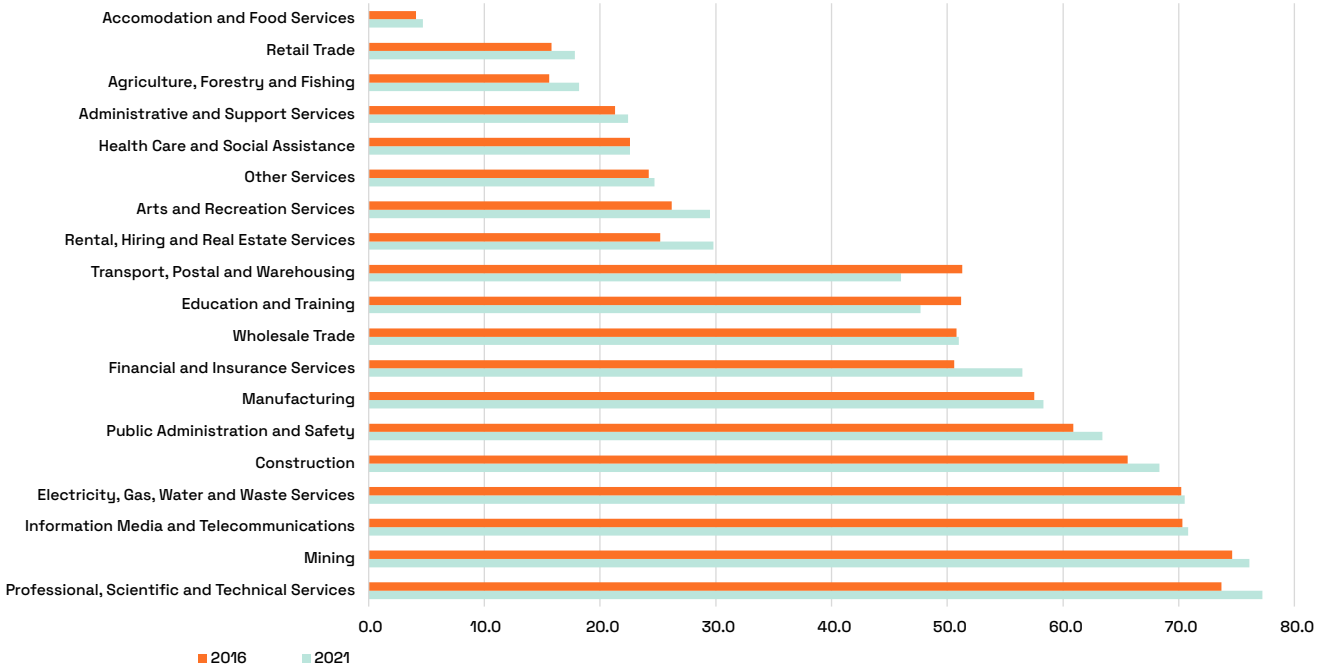
In industries such as Agriculture, Forestry and Fishing, and Arts and Recreation Services, where the total number of engineers 'working in engineering occupations' is comparatively small, there was still growth between 2016 and 2021.

The significant growth in the 'inadequately described' category is explained by the fact that the ANZSIC classification was last created nearly 20 years ago. It accurately reflected the industry distribution in 2006, but not so well in 2021.

Changes in core vs none-core industries

Figure 64 shows the proportions of qualified engineers working in engineering occupations per industry in 2016 and 2021.

Figure 64: Proportion of qualified engineers working in engineering occupations by industry in 2016 and 2021



The significant 2016-2021 census finding was a consistent demand for engineers. And a headline finding is that the core industries for engineering occupations remains unchanged from the last five-year census to 2021. Financial and Insurance Services is the exception. It became a core industry by a slim margin of 0.4 per cent, with 56.5 per cent of qualified engineers working in engineering occupations versus the average across all industries of 56.1 per cent.

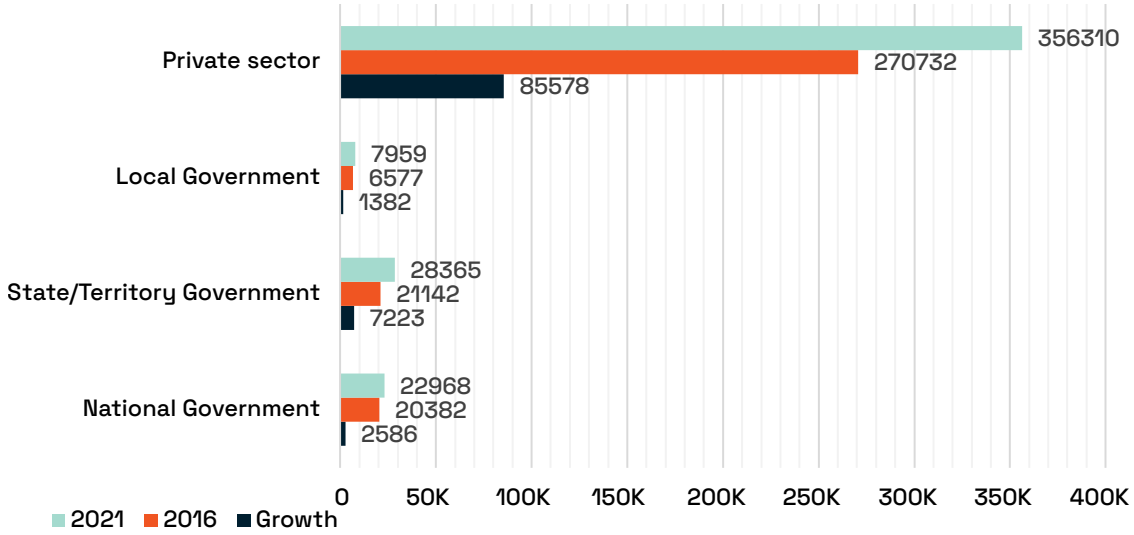
There was steady growth in the proportion of qualified engineers working in engineering occupations in the core industries of Manufacturing, and Professional, Scientific and Technical Services. It grew by 28.6 per cent and 56.6 per cent respectively, pointing to the unabated demand for specialised engineering knowledge and skills in these traditional engineering industries.

The two primary industries that experienced a decrease in the proportion of qualified engineers working within an engineering occupation were Transport, Postal & Warehousing and Education & Training. Again, this is likely due to the pandemic, remote schooling, movement, and travel.

The shifting public/private sector distribution

The changes in distribution of qualified engineers between the public and private sectors over the three census periods is shown in Figure 56.

Figure 65: Distribution between public/private sectors between 2011 and 2016 for qualified engineers



Observation: Note the growth of qualified engineers in all Government sectors as well as the Private sector over the three census periods. There was a significant increase of around 24 per cent of qualified engineers in the Private Sector in the latest 2016-2021 period. Overall, 85.7 per cent of qualified engineers are employed in the Private Sector as of 2021. The decreasing share of engineers employed by national government (despite rising overall numbers), is indicative of outsourcing public-sector engineering work to the private sector.

Table 48: Distribution of qualified engineering labour force between public/private sectors.

	2016		2021	
National Government	20,382	6.4%	22,968	5.5%
State/Territory Government	21,142	6.6%	28,365	6.8%
Local Government	6,577	2.1%	7,959	1.9%
Private sector	270,732	84.9%	356,310	85.7%

Occupation distribution and outcomes

Although only a quarter of engineers in the workforce, actually work as professional engineers in professional engineering occupations, the opportunities for engineers to work in engineering occupations have recovered.

Of the 433,353 qualified engineers in the labour force in 2021, 243,157 are working in engineering occupations (56.1 per cent, up 4.6 per cent, an increase of 64,536 from 2016). Of the close to a quarter of a million qualified engineers, 209,143 are men. The gender breakdowns of all male qualified engineers working in engineering occupations is 57.3 per cent. And for all females working in engineering, it is 49 per cent, or 34,014, women. The distribution between genders of qualified engineers working in engineering occupations is approximately 86 per cent male, and 14 per cent female.

The number of overseas-born female engineers working in engineering occupations (up 10,375 to 23,029) is increasing by 71 per cent faster than the number of Australian-born female engineers working in engineering occupations (at 10,985 in 2021, up 3,546). Their growth rates are almost 82 per cent and 47.7 per cent respectively, over the five-year census interval.

In summary the number of qualified engineers working in engineering occupations:

- has increased by 36 per cent since the 2016 census
- grew at twice the rate over the last five years than during the previous census interval (36 per cent compared to almost 18 per cent), and
- is growing at a faster rate than the population of qualified engineers, indicating increasing utilisation rates for those with engineering qualifications.

The impact of COVID-19

The COVID-19 pandemic had a significant impact on migration rates and education figures for the engineering profession. And, as to be expected, there was a significant jump (10.5 per cent CAGR) in those 'away from work', due to the impact of COVID lockdowns. Transport, Postal and Warehousing, as well as the Construction and Manufacturing industries were the most severely impacted. This makes sense as these industries mostly require a physical presence for their work to be completed.

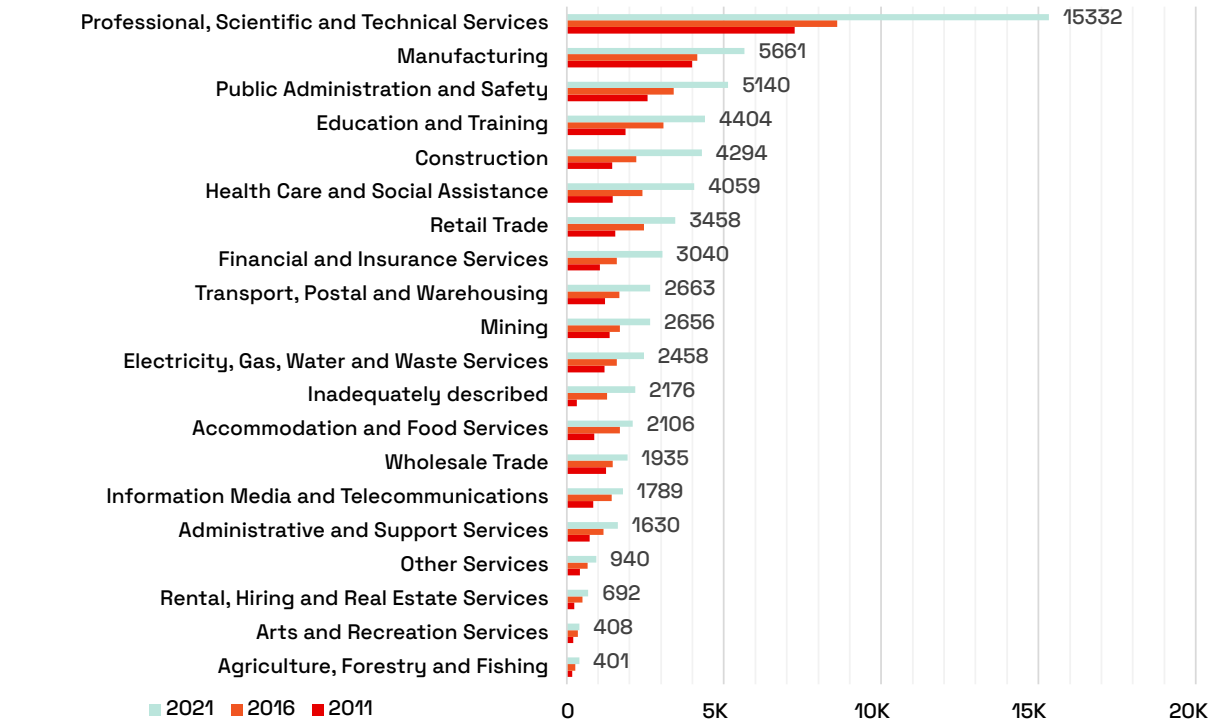
The fact that the Health Care and Social Assistance sector was one of Australia's fastest growing primary industries for qualified engineers in 2021, is also testament to the Pandemic's impact. It also shows the high proportion of engineers not in engineering occupations.

Professional diversity and occupational outcomes

Women and gender in engineering

The gender balance of the engineering profession is slowly improving. Women are now 16 per cent of the engineering qualified population (up from 13.6 per cent in 2016). They also comprise 16 per cent of the qualified engineer labour force (i.e. those in employment or seeking employment). Figure 66 shows the changes in the primary industry distribution of qualified women engineers from 2011 to 2021.

Figure 66: Female qualified engineers in primary industries 2011 – 2021

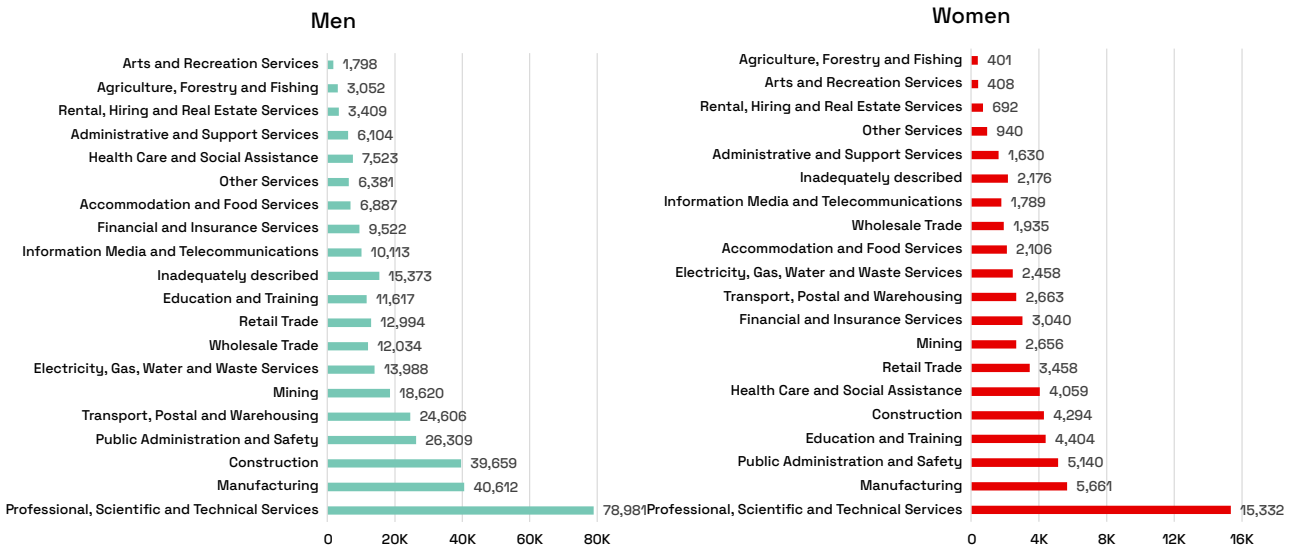


The per centage of women working in engineering occupations is also higher at 14 per cent (up from 11.2 per cent in 2016). In total there are now 87,972 women engineers in Australia, and as previously mentioned, 76.4 per cent (67,902), were born overseas.

- 16% of qualified engineers in Australia are female
- 76% of these female engineers were born overseas
- 17.7% of engineering graduates are female (18.9% enrolments)
- 14% of the engineering workforce (engineering occupations) are female.

The top industries that employ women engineers are different to men, in particular there are a great proportion of women working in Public Administration & Safety and Education and Training when compared to men, see Fig. 67. The share of women working in engineering occupations increased in all industries except for agriculture, forestry and fisheries which declined from 7.3 per cent to 6 per cent.

Figure 67: Distribution of qualified engineers in primary industries for men (left) and women (right) in 2021



However, for illustrative purposes, despite these increases in gender balance, at the current rate (women in engineering increasing by only 2.4 per cent every five years), it will take qualified female engineers, 70.8 years to be as equally distributed in the engineering profession as their male counterparts.

We know from EA's 2022 research[49] that 90 per cent of women in non-engineering fields either never, or only briefly, consider studying engineering. The most common reason cited was lack of awareness of what engineering is and what engineers do. Females who do choose to become engineers are significantly more satisfied on average than women in other careers. Their career satisfaction is on par with women in health careers.

Nevertheless, two-thirds of women who left the engineering profession reported doing so because they felt they had limited career opportunities, were harassed, bullied and/or felt not valued.

Only 14 per cent cited the work not being a good match for their skills and interests. That was half the proportion of men who cited this reason for leaving. This indicates that women aren't likely to be leaving because of the work. They are more likely to be leaving engineering because of discrimination in the workplace.

Female engineers also have a disproportionately high rate of imposter syndrome compared with men and with women in other fields. One in two female engineers report feeling like an imposter at work and so doubting their own abilities and achievements. This is compared with one in three male engineers and one in three women in other fields.

There are notable differentials in the proportion of men and women working part time in engineering occupations, Figure 68 shows that a significantly higher proportion of women in engineering occupations work part-time compared to men, at 8.6 per cent and 14.9 per cent respectively. The general trend between census is an increase in the proportion of women working full time and an increase in the proportion of men working part time.

Figure 68: Proportion of men and women working full-time or part-time in engineering occupations

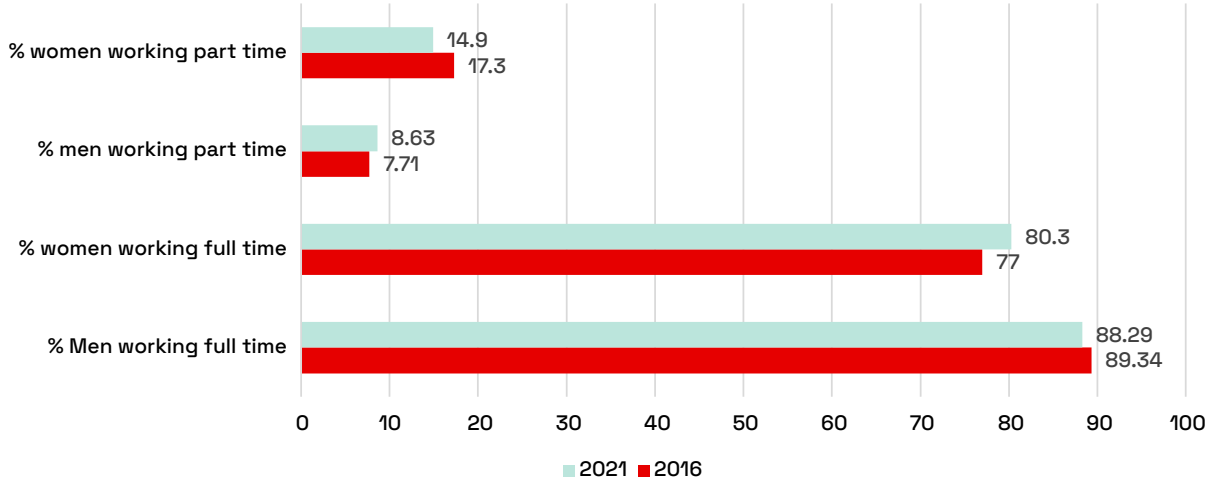
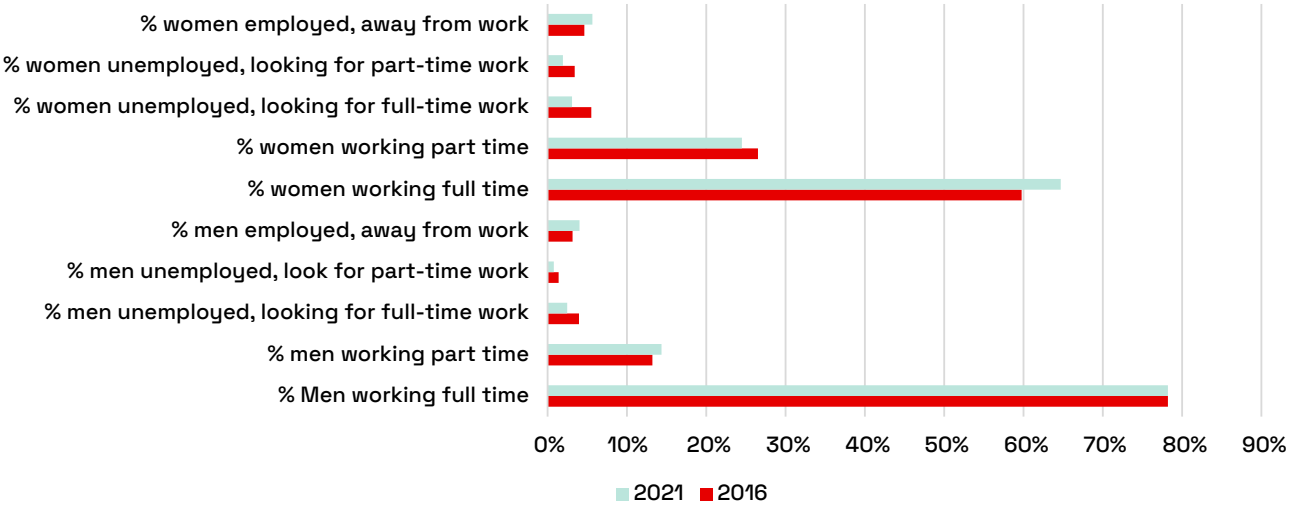


Figure 69 shows the proportion of the engineering qualified labour force by employment status. The difference is more pronounced, with women more likely to work part time in 2021 and more likely to be unemployed than their male counterparts.

As outlined earlier there has been a decrease in the unemployed components of the engineering qualified population for men and women since 2016. There has also been an increase in the proportion of female qualified engineers working full time of nearly five per cent.

49 Romanis, J. 'Women in Engineering' Engineers Australia (June 2022) https://engineersaustralia.org.au/sites/default/files/women-in-engineering-report-june-2022.pdf

Figure 69: Proportion of male and female labour force by employment status in 2016 and 2021



Aboriginal and Torres Strait Islander outcomes

The proportion of Aboriginal and Torres Strait Islander qualified engineers increased by 170 per cent since the 2016 census (1,513 vs 886)[50]. For those working in engineering occupations Aboriginal and Torres Strait Islander qualified engineers increased by 51.9 per cent compared with the 2016 census (701 vs 364). Although employment of our Aboriginal and Torres Strait Islander qualified engineers and those working in engineering occupations increased in all industries, overall, they remain a small proportion of the engineering population at just 0.3 per cent.

Overseas born engineers / migrant Outcomes

As we saw in Figure 33, higher proportions of overseas born engineers worked in engineering occupations in 2021 than they did in 2016. That is still a considerable gap when compared to Australian born engineers. We also know there is an over index in non-core industries, where there is a higher proportion of overseas-born engineers than Australian-born in non-engineering occupations in all industries[51].

Insight: To mitigate the issue of engineers working in non-engineering industries, Government and industry, need to support migrant engineers to obtain employment in engineering roles when they migrate to Australia. This cohort is critical to maintaining Australia's engineering capability.

Engineers born overseas comprise:

- 62.7% of the qualified population
- 62% of the labour force and
- 55.8% of the population in engineering occupations.
- 70% of the growth in the engineering labour force to 2021

Differing outcomes for engineers depending on country of birth

Table 49 shows the composition and outcomes for those working in engineering occupations by country of birth and gender in 2016 and 2021. The differing employment outcomes are clear:

- Men born overseas – 51.9% of qualified engineers in the labour force are in engineering occupations.
- Men born in Australia – 65.7% of qualified engineers in the labour force are in engineering occupations
- Women born overseas – 45% of qualified engineers in the labour force are in engineering occupations
- Women born in Australia 61.1% of qualified engineers in the labour force are in engineering occupations

50 For detailed analysis of the change in counts of Aboriginal and Torres Strait Islander Australians in the 2021 Census see https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/understanding-change-counts-aboriginal-and-torres-strait-islander-australians-census/latest-release

51 Romains, J Barriers to migrant employment, Engineers Australia, 2021 https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-10/barriers-employment-migrant-engineers.pdf

Table 49: Proportion in engineering occupations (engineering occupations divided by labour force)

	2016	2021
Women Born Overseas	38.6%	45.%
Women Born Australia	55.7%	61.1%
Men Born Overseas	48%	51.9%
Men Born Australia	61.8%	65.7%
Male Total	53.9%	57.4%
Female Total	43.5%	49.2%
Total	52.5%	56.1%

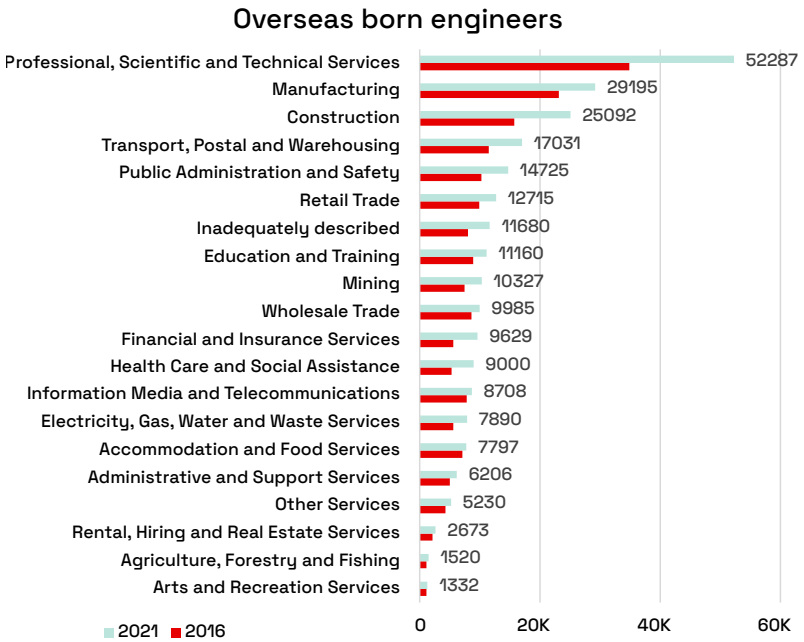
As we saw in **Section 2**, in 2021 there were 339,314 qualified engineers born overseas, of which 268,595 are in the labour force. And just 50.4 per cent (135,759) of those overseas-born qualified engineers, work in engineering. The proportion of Australia's qualified engineers who were born overseas has increased to 62 per cent (up from 59.7 per cent in 2016).

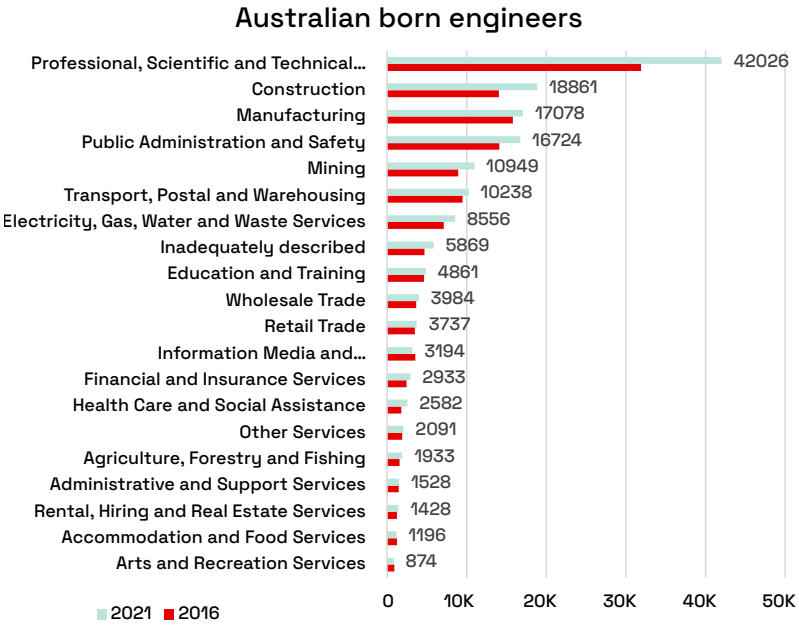
The top industries of employment differ for engineers born in Australia and overseas. Both the Retail Trade, and Transport, Postal & Warehousing industries have high numbers of qualified engineers born overseas. A small proportion of those employed in these industries actually work in engineering occupations. This indicates suboptimal employment outcomes for engineers born overseas.

The reality is that engineers born overseas continue to be employed in industries which are not using their qualifications. And the over-indexation of qualified engineers in non-engineering occupations in sectors including Warehousing, Retail Trade, Healthcare & Social Assistance, Accommodation & Food Services, Rental Hiring & Real Estate, and Arts & Recreation, indicates that migrant engineers have sub-optimal employment outcomes.

Australian born engineers on the other hand are predominantly found in core industries, see Figure 70.

Figure 70: Distribution of qualified engineers born overseas in primary industries (below) and Distribution of Australian born engineers in primary industries (right)





In summary:

- There is a small but noticeable improvement in employment outcomes for engineers born overseas.
- Migration (permanent and temporary) declined over the decade even before the COVID-19 pandemic. The rate of migration is still recovering.
- Australia is heavily dependent on skilled migrants to maintain its qualified engineering population.
- Of the additional 93,247 engineers added to the Australian labour force since 2016, 67,900 (72.8 per cent) were born overseas. Without these engineers, Australia's engineering capability would be seriously diminished.
- We still need to improve outcomes for migrant engineers. Only 45 per cent of female overseas born engineers are in engineering occupations.
- And 51 per cent of overseas born males are in engineering occupations compared with almost 61 per cent of female Australian-born engineers and 65% for males born in Australia.
- Australia is not the only country with high demand for engineers. We compete with other advanced economies for skilled migrants. This competition will increase over the coming decades as the world nears peak population and demand for engineering skills continues to rise.

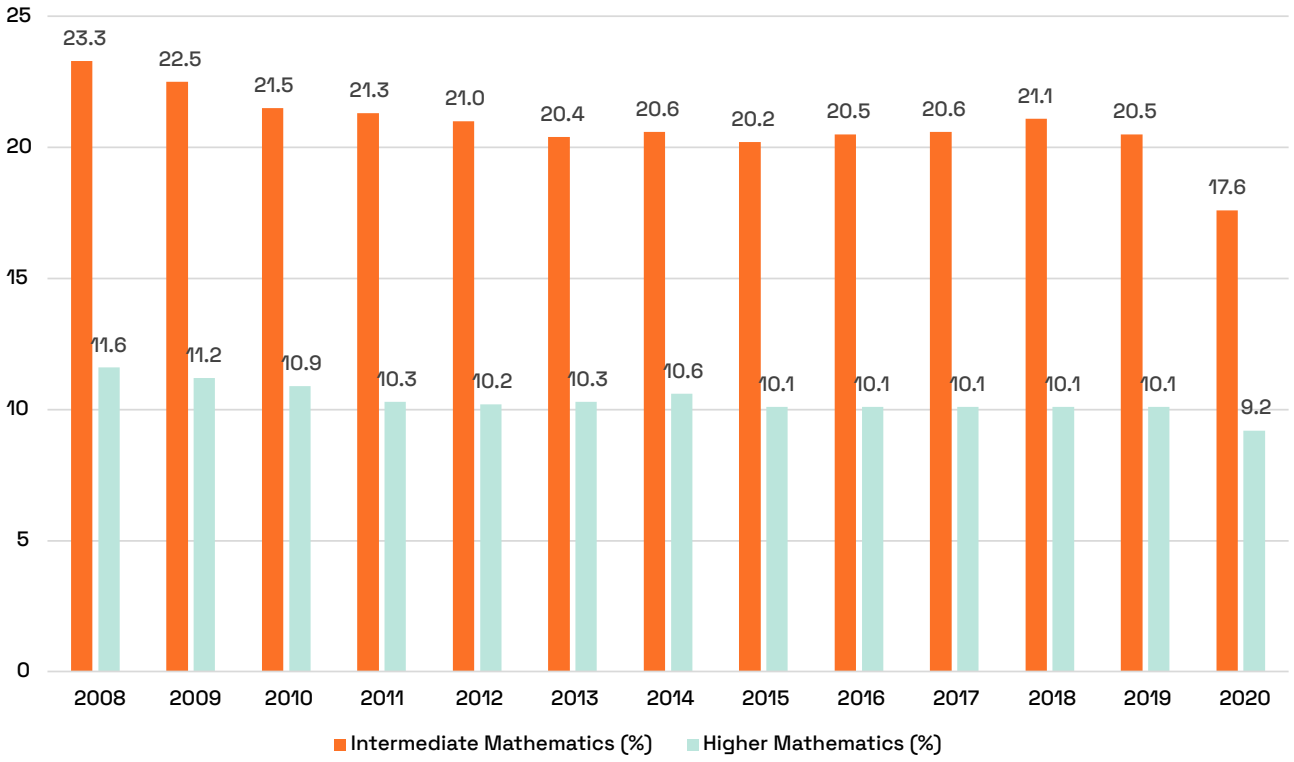
Engineering education & graduate outcomes

Concerning trends in the number of Australian students studying mathematics

Given the reality that the pipeline into an engineering degree requires competency in mathematics, the 2022 Year 12 Mathematics Participation Report Card shows that enrolments have reached an all-time low[52].

Figure 71 shows that the numbers of Australian school students studying intermediate and advanced level mathematics is declining.

Figure 71: Proportion of high school students studying mathematics in Australia (Source: AMSI, 2022[53])



Familiarity with and engagement in mathematics are essential for students pursuing an engineering qualification. Studying higher level mathematics is a pre-requisite for many institutions. Indeed, mathematical literacy is foundational knowledge in engineering education.

Similarly concerning is Australia's PISA performance in mathematics and science. Australia's performance in maths declined from ranking tenth among surveyed nations in 2003 to thirtieth in 2018[54]. **Mathematics is reported to be taught by out-of-field teachers (years 7-9) approximately 40 per cent of the time[55]. Figure 72 shows the performance of Australian students in the PISA Science and Maths tests since 2006.**

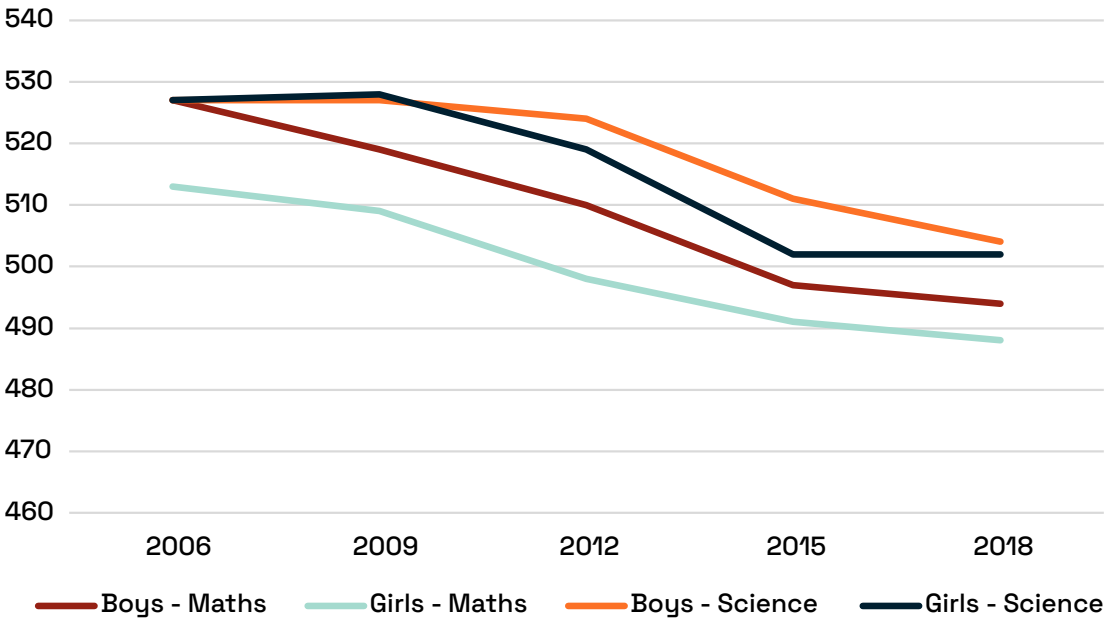
52 Australian Mathematical Sciences Institute, April 2022 https://amsi.org.au/wp-content/uploads/2022/04/year-12-participation-2022.pdf

53 Data sourced from Australian Mathematical Sciences Institute, April 2022 https://amsi.org.au/wp-content/uploads/2022/04/year-12-participation-2022.pdf

54 PISA 2018: Australian students' performance, Australian Council for Educational Research, https://www.acer.org/au/discover/article/pisa-2018-australian-students-performance

55 Australian Teacher Workforce Data: National Teacher Workforce Characteristics Report December 2021, https://www.aitsl.edu.au/docs/default-source/atwd/atwd-teacher-workforce-report-2021.pdf?sfvrsn=126ba53c_2

Figure 72: PISA results for Australian students in maths and science[56]



From a gender perspective, 37.8 per cent of those undertaking higher mathematics, were female[57]. In intermediate mathematics, the gender balance was nearly even.

Graduate outcomes

As in **Section 2**, a greater proportion of younger graduates are fully employed as professional engineers and/or in engineering occupations. These engineering graduates enjoy relative success according to the graduate outcomes survey in terms of employment and salary outcomes. And pleasingly, employers rank engineering graduates highest overall of all graduates (Australian Government's Employer Satisfaction Survey).

The Impact of COVID-19 and other emerging trends

COVID-19 and Engineering Education: The COVID-19 pandemic in Australia in March 2020 caused immediate and significant changes to both the student experience and their outcomes. It also continues to impact face-to-face, laboratory sessions etc ongoing. While all universities had to transition to online learning almost overnight, this practice was an 'emergency' response. The resultant student experience was quite different to the 'good' online learning which some institutions have had in practice for decades, which is reflected in the noticeable decline in learning engagement scores in 2020, as captured by the Student Experience Survey conducted as part of the Quality Indicators for Learning and Teaching initiative[58]. It should be noted that the shift to blended learning brought about by the pandemic response was an acceleration of many universities already extant plans to introduce these practices.

The overall student experience has recovered, but remains slightly below pre-pandemic trends. Continued monitoring of the impacts of COVID-19 and the resultant new norm of blended learning will be required over the coming years as blended learning is normalised and sound pedagogy is incorporated as online education systems mature and develop.

It has been reported that reduced income from international student enrolments has caused significant staffing redundancies at some universities, resource shortages and casual academic spending reductions., with nearly 40,000 jobs in tertiary education lost in the twelve months to May 2021[59]. It will take time for the higher education sector to adapt and recover.

The COVID-19 border closures lead to an estimated reduction of 14,300 international students commencing

56 Data sourced from Department of Industry, Science and Resources, STEM Equity Monitor, https://www.industry.gov.au/publications/stem-equity-monitor/primary-and-secondary-school-data/international-assessment-scores

57 Australian Teacher Workforce Data: National Teacher Workforce Characteristics Report December 2021, https://www.aitsl.edu.au/docs/default-source/atwd/atwd-teacher-workforce-report-2021.pdf?sfvrsn=126ba53c_2

58 Quality Indicators for Learning and Teaching, Student Experience Survey, 2022 https://www.qilt.edu.au/surveys/Data-Visualisation/ses

59 At the Crossroads: What is the post-COVID future of Australia's Public Universities?, Eliza Littleton, The Centre for Future Work at the Australia Institute , April 2022, p15 https://futurework.org.au/wp-content/uploads/sites/2/2022/04/At_the_Crossroads_-_FINAL_2.pdf

study of an engineering qualification (presuming that but for the pandemic enrolment figures would have remained largely consistent with the previous year). It is worth noting that when international students study in Australia their understanding and ability to maintain valuable professional links with Australia is increased exponentially (see Austrade figures).

With the Australian Government's Universities Accord consultation underway significant reforms have been foreshadowed for the higher education sector in the coming years.

Declining numbers of students choosing to study advanced mathematics, physics and other STEM subjects in high school61 may constrain growth in domestic students choosing to study engineering and pursue engineering as a career.

Academic Integrity and Assessment: Generative Artificial Intelligence (AI), and ChatGPT in particular, is an area of both interest and concern for all universities and the TEQSA (Tertiary Education Quality and Standards Agency) in particular. Understanding the value and threat of Generative AI is currently being explored by TEQSA, which has taken the lead in how best to respond. Banning Generative AI is not a sustainable strategy. It is important the methods of assessment are consistent with the learning outcomes being assessed. The award of a qualification should only occur when a student demonstrates the necessary learning outcomes through achieving the required level of study. Better understanding the risks, the ethics, the value, and opportunities of AI is underway across the profession and within business and the community at large. There are real opportunities for learning to be enhanced through the use of Generative AI, and developing skills in prompt engineering is critical to achieving this. It is important to note that today's students will be working with AI for the rest of their entire careers, so learning ethical and sound practice with AI is important from today.

ACED 2035 report and project(s) implementation[60]: The Australian Council of Engineering Deans (ACED) Engineering 2035 report and the ongoing project explores how the future of engineering education in Australia will be influential in ensuring Australia's engineering programs deliver engineers equipped with the skillsets needed for the future. It remains to be seen how universities will respond and implement the ACED 2035 recommendations with regard to the change in international student numbers and foreshadowed changes in higher education policy.

Challenges on the horizon

- Domestic production of engineers grew very slowly over last 20 years.
- There are challenges in the education system with declining numbers of students studying maths and declining performance in mathematics.
- We have a way to go in improve the employment outcomes for overseas-born engineers.
- It is important for the community to better understand 'what engineers do' and the breadth and depth of opportunities a career in engineering can provide.
- It is vital that the engineering community and all our stakeholders join forces to encourage and excite young people to choose the engineering profession.

The demand for engineers is likely to continue to increase significantly due to new demands from climate change, the transition to clean energy and the inherent complex infrastructure requirements among many other national priorities such as digitisation of our economy and industries through to building a nuclear-powered submarine capability. There are sizeable challenge ahead. The engineering profession remains a critical part of the workforce and arguably its importance is increasing. Governments, industry, engineering education institutions, schools and professional bodies need to work together as a priority and with urgency to ensure we have sufficient engineers to undertake the enormous amount of current and future engineering work.

Further statistics/find out more

Further publications using census data are planned for 2023 and beyond. To find out more about engineers and engineering visit www.engineersaustralia.org.au.

60 Australian Council of Engineering Deans, Engineering 2035, https://www.aced.edu.au/index.php/examples

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Appendices

Appendix 1 - Methodology, data sources and the challenge of capturing the breadth what of engineers do

Methodology and data sources

Definitions of terms for industries, occupations, fields of education and other parameters are per the ABS or where applicable, the respective entity responsible for that data.

There are limitations in using the ANZSCO (Aust and NZ Standard Classification of Occupations), ANZSIC (Aust and NZ Standard Industrial Classification) and ASCED (Australian Standard Classification of Education) schemes used in classifying census data.

They do not fully capture the breadth or depth of what engineers do, or what engineering can entail. This is particularly so in the emerging fields and disciplines, and schemes that will evolve over time. ANZSCO is undergoing a classification revision before the next census, however there will always be a challenge to capture the dynamism and breadth of engineering.

Engineers Australia defines two population subsets to assist in investigating census data:

Qualified Engineer(s): This subset of the population includes all individuals in the Australian economy with engineering qualifications. That is a qualification at least to the level or advanced diploma/associate degree level (AQF6) or higher in engineering and related technologies.

Working in engineering: This subset of the population includes qualified engineers working in an occupation that has a demonstrated degree of attachment to engineering. Of the 634 listed ANZSCO occupations, 50 were analysed to fit the criteria of an engineering occupation, being:

- work undertaken by the occupation satisfies Work Skill Levels 1 or 2 in the ABS classification of skill
- the attachment to engineering in an occupation, rated at least three in a five-point scale, where five was complete attachment and one was little attachment.

With regard to the working in engineering occupation grouping, originally devised in 2010[1], the occupations which are 'engineering related' were the subject of much debate. They will always remain debatable. However, informed decisions were made to either include or exclude certain segments of the population to indicate the proportion of qualified engineers in engineering occupations. With the 2026 review of ANZSCO we will revisit what is considered an engineering occupation under the new classification scheme.

We have taken the opportunity to review our methodology with the release of 2021 census data and made three revisions:

04. We included the narrow field of geomatic engineering within our two population sets (previously excluded), which has an impact of increasing the qualified population of engineers by approximately 3per cent (for reference in the 2016 census this equated to approximately 13,000 people not previously counted).

05. We excluded Engineering Professionals 'Not Further Defined' from the population of those working in engineering occupations, noting that the ABS specifies that *'nfd codes are designed to facilitate processing by allowing inadequately described or non-specific responses to be coded to a broader level of the classification rather than be lost altogether'.* **NFD codes are not a formal part of a classification.** This has an impact of reducing the population of those in engineering occupations by approximately 4per cent. The size of this population is provided at the appropriate place.

06. In a similar theme the 'Natural Science professionals nfd' occupation was substituted for Geologists, Geophysicists and Hydrogeologists. These populations are of the same order of magnitude (around 450). Worth noting there are many qualified engineers working in this occupation.

EA is producing statistics at the most detailed levels of the ANZSCO classification scheme for the first time, to provide a greater understanding of what engineers do in Australia.

These revisions do not invalidate previous statistics published by Engineers Australia. They complement them. Nevertheless, we remain mindful of the shifts in the data due to the slight differences in the populations being examined.

In arriving at the most accurate statistics possible we are required to exercise our judgement to best inform ourselves with the data available to us with its accompanying limitations.

We have included those with qualifications in geomatic engineering on the basis that Engineers Australia has accredited engineering programs within this narrow field.

Those coded to the occupation of Engineering

1 The Engineering Profession in Australia; A Profile from the 2006 Population Census, Andre Kaspura Engineers Australia, 2010

Professionals 'nfd' are excluded from the population of those working in engineering occupations, as these responses do not form part of the classification scheme. They are encoded to the Engineering Professionals unit group and are likely to be undertaking engineering work. But we simply cannot know from the encoding of their response.

These engineers are captured in the population of qualified engineers; however, we cannot specifically classify them to an engineering occupation. The size of the populations of Engineering Professionals 'nfd', is provided in the appropriate places for awareness and information.

The populations presented and analysed in this report are those most likely to contribute to Australia's stock of qualified engineers and those working in engineering occupations. However, there are likely to be more engineers than presented here, for reasons elaborated below.

When examining detailed statistics, it is important to keep in mind the proportion of the engineering labour force that is being examined.

A few more important definitions:

- Statistical areas are used by the ABS to define geographical areas with a given population size at various levels, while retaining meaningful names related to those areas. At the SA4 level, the largest sub-state regions, there are populations above 100,000to provide a sufficient sample size for Labour Force estimates. In regional areas, SA4s tend to have smaller populations of 100,000 to 300,000 people. In cities, SA4s tend to have larger populations of 300,000 to 500,000 people.
- Throughout this report we refer to segments of the population as being 'in the labour force' or 'not in the labour force'. This is an important distinction as Australia's engineering capability is provided by those who are either employed or seeking employment in the labour force. The 'Not in the labour force' census variable represents people who are voluntarily retired, attending an educational institution, experiencing long term illness, disability, and/or other scenarios.
- There is a 'not further defined' (NFD) code used by the ABS at lower levels of classification schemes when enough information exists to partially code a response but is insufficient for the ABS to code it to the most detailed category in the classification (or any category within that level of the classification at which it appears).
- We talk about engineers born overseas in this report. Being born overseas does not necessarily mean that a qualified engineer is a skilled migrant. All skilled migrants are born overseas. This population subset includes all skilled migrants (temporary and permanent) who were in Australia on census night. It also includes those who came to Australia as children, or were born to Australian parents overseas etc.
- We use the ASCED broad field of Engineering and Related Technologies to ensure that we have captured all of those with engineering qualifications in Australia.

It is worth noting that:

- The subsets of engineers presented here represent those most likely to contribute to Australia's engineering workforce capability.
- The census records the highest qualification attained by a respondent. The Organisation of Economic Co-operation and Development (OECD) estimates nine per cent of Australian adults held a Master's qualification in 2021. However, it is not uncommon for an engineer to obtain postgraduate qualifications (such as an MBA or Masters of International Relations).
- When examining the 2021 census, there were 1,520,007 Australians with a qualification higher than a Bachelor's degree. With a labour force of 12,692,783 almost 12 per cent of hold postgraduate qualifications, which might mean there are up to 12 per cent more engineers in Australia.
- Census data is self-reported. It relies on the judgement of respondents to answer the survey honestly and accurately.
- The person response rate of the 2021 census was excellent, at 95.8% (with a target of 95%). However, this still represents ~1 million Australians for whom answers were imputed. Given the relatively small population of engineers as a component of Australia's population, the effect of this imputation could be outsized for the engineering profession.
- There were 1,372,273 people (5.4 per cent) whose country of birth was not stated in the 2021 Census or for whom the response was unable to be coded to a country.
- We take segments (or slices) of the population at different levels of detail in the classification schemes with other census parameters. We provide the population size of engineers that these segments represent, as not all respondents are able to be encoded at all levels of detail within ANZSIC, ANZSCO and ASCED. This means that the entire population of engineers and those working in engineering are unable to be represented at lower levels of the classification scheme. Also, at the highest levels of the classification schemes, there are significant proportions of responses which are 'inadequately

described' or 'not stated'.

- Inadequately described and non-answered responses are recorded by the ABS, as there may not be sufficient detail to be encoded, fit to a category or classification, or have data to encode. At the most detailed levels of classification some of the population is essentially 'lost' from the count due to their response only being encoded to a certain level. Combinations of different census questions are adequately answered by respondents. This leads to variations in the availability of data for a particular census parameter.
- 'Engineer' is not a legally protected title within Australia (excluding statutory registration schemes which require particular types of engineering work to be undertaken by those with appropriate qualifications and experience). There is a non-trivial population of Australians who are working within engineering occupations and hold a role or job title provided to them by their employers, but do not in fact hold engineering qualifications. Engineering requires qualifications and should only be carried out by people who are duly qualified.

The challenge of capturing the breadth of what engineering is and what engineers do with the available data

Engineering is a broad profession with an enormous diversity in areas of engineering practice. This poses a challenge in capturing the breadth of what engineering is and what engineers do within the confines of statistical classification schemes and definitions.

Specialisation begins during academic studies. For example, students can choose between majors in mechanical engineering, biomedical engineering, civil, or electrical engineering, among many others. Most specialisation during an engineer's career takes place on-the-job, through training, and guidance during professional formation. For example, a graduate with a degree in civil engineering can choose to practice as a structural, geotechnical, coastal, or civil engineer. The evolution of technology has led to an increasing number of interdisciplinary specialisations, for example, the interaction between mechanical and electrical engineering and the field of mechatronics.

The ANZSCO (Aust and NZ Standard Classification of Occupations), ANZSIC (Aust and NZ Standard Industrial Classification) and ASCED (Australian Standard Classification of Education) schemes used in classifying census data do not fully capture the breadth or depth of what engineers do or what engineering can entail. This includes emerging fields and disciplines.

The schemes will evolve over time (and indeed ANZSCO is undergoing revision before the next census), However there will always be a challenge to capture the dynamism and breadth of engineering. For example, there are:

- Seven ANZSCO occupations at the 4-digit level within Engineering Professionals Minor Group 27, occupations at the 6-digit level and a further 44 specialisations within the 6-digit occupations
- 11 narrow fields within the broad ASCED field of Engineering & Related Technologies
- 357 unique disciplines, sub-disciplines, areas of practice, areas of engineering, specialities and otherwise obtained from legislation, other engineering bodies and a scan of global online literature
- 83 unique programs from EA's accredited program database
- Occupational outcomes due to less understood, choices/circumstances.

On balance there would appear to be more disciplines, and areas of practice and specialities within engineering, that are not necessarily captured by ANZSCO. We should state that this is not a criticism. ANZSCO has to capture the entire Australian economy, and there will always be limitations with any classification scheme.

All statistics have limitations imposed through definitions and classification systems that need to be understood and accounted for when evaluating conclusions. Too literal an interpretation may well be less useful than a more balanced consideration.

Appendix 2 – Supplementary tables

Table 50: Distribution of qualified engineers within top 10 sub-industries for each primary industry (note not all industries have 10 or more sub-industries)

Accommodation and Food Services	Qualified Engineers
Cafes, Restaurants and Takeaway Food Services	6,358
Accommodation	1,475
Pubs, Taverns and Bars	605
Food and Beverage Services, nfd	344
Clubs (Hospitality)	201
Accommodation and Food Services, nfd	28

Administrative and Support Services	Qualified Engineers
Building Cleaning, Pest Control and Gardening Services	3,870
Employment Services	2,012
Other Administrative Services	1,258
Travel Agency and Tour Arrangement Services	374
Packaging Services	236
Administrative Services, nfd	13
Administrative and Support Services, nfd	3
Building Cleaning, Pest Control and Other Support Services, nfd	0

Agriculture, Forestry and Fishing	Qualified Engineers
Sheep, Beef Cattle and Grain Farming	1,089
Fruit and Tree Nut Growing	427
Agriculture, nfd	381
Agriculture and Fishing Support Services	303
Mushroom and Vegetable Growing	276
Dairy Cattle Farming	246
Aquaculture	142
Poultry Farming	129
Fishing	106
Nursery and Floriculture Production	97

Arts and Recreation Services	Qualified Engineers
Gambling Activities	825
Sports and Physical Recreation Activities	507
Creative and Performing Arts Activities	354
Amusement and Other Recreation Activities	166
Parks and Gardens Operations	118
Museum Operation	95
Arts and Recreation Services, nfd	69
Horse and Dog Racing Activities	58
Sports and Recreation Activities, nfd	19
Heritage Activities, nfd	0

Construction	Qualified Engineers
Heavy and Civil Engineering Construction	16,139
Building Installation Services	6,437
Non-Residential Building Construction	5351
Residential Building Construction	4,581
Construction, nfd	3,792
Building Completion Services	1,844
Land Development and Site Preparation Services	1,771
Other Construction Services	1,363
Building Structure Services	1,257
Building Construction, nfd	1,193

Education and Training	Qualified Engineers
Tertiary Education	10,572
School Education	3,268
Adult, Community and Other Education	1,330
Education and Training, nfd	451
Preschool Education	322
Educational Support Services	70
Adult, Community and Other Education, nfd	11
Preschool and School Education, nfd	4

Electricity, Gas, Water and Waste Services	Qualified Engineers	Financial & Insurance Services	Qualified Engineers
Water Supply, Sewerage and Drainage Services	5,193	Depository Financial Intermediation	5,574
Electricity Distribution	4,187	Auxiliary Finance and Investment Services	2,852
Electricity Generation	1,906	Health and General Insurance	1,612
On Selling Electricity and Electricity Market Operation	1,196	Finance, nfd	672
Electricity Transmission	1,135	Financial Asset Investing	422
Electricity Supply, nfd	873	Superannuation Funds	303
Gas Supply	564	Auxiliary Insurance Services	297
Waste Collection Services	467	Life Insurance	275
Waste Treatment, Disposal and Remediation Services	453	Financial and Insurance Services, nfd	270
Electricity, Gas, Water and Waste Services, nfd	445	Non-Depository Financing	230
Health Care and Social Assistance	**Qualified Engineers**	**Information Media and Telecommunications**	**Qualified Engineers**
Hospitals	3,157	Telecommunications Services	7,981
Residential Care Services	2,275	Internet Service Providers and Web Search Portals	1,203
Other Social Assistance Services	2,010	Data Processing, Web Hosting and Electronic Information Storage Services	905
Medical Services	999	Television Broadcasting	370
Allied Health Services	963	Software Publishing	350
Child Care Services	668	Newspaper, Periodical, Book and Directory Publishing	293
Pathology and Diagnostic Imaging Services	488	Motion Picture and Video Activities	240
Medical and Other Health Care Services, nfd	422	Information Media and Telecommunications, nfd	148
Health Care and Social Assistance, nfd	256	Radio Broadcasting	95
Other Health Care Services	244	Internet Publishing and Broadcasting	74
Manufacturing	**Qualified Engineers**	**Mining**	**Qualified Engineers**
Other Transport Equipment Manufacturing	4,647	Metal Ore Mining	9,776
Manufacturing, nfd	4,028	Oil and Gas Extraction	4,160
Motor Vehicle and Motor Vehicle Part Manufacturing	3,415	Coal Mining	3,466
Professional and Scientific Equipment Manufacturing	2,165	Other Mining Support Services	1,227
Computer and Electronic Equipment Manufacturing	1,975	Mining, nfd	1,197
Basic Ferrous Metal Manufacturing	1,853	Exploration	831
Electrical Equipment Manufacturing	1,657	Other Non-Metallic Mineral Mining and Quarrying	286
Basic Non-Ferrous Metal Manufacturing	1,574	Construction Material Mining	251

Polymer Product Manufacturing	1,387	Non-Metallic Mineral Mining and Quarrying, nfd	35
Pharmaceutical and Medicinal Product Manufacturing	1,334	Exploration and Other Mining Support Services, nfd	4
Other Services	**Qualified Engineers**	**Professional, Scientific and Technical Services**	**Qualified Engineers**
Machinery and Equipment Repair and Maintenance	2,561	Architectural, Engineering and Technical Services	52,375
Automotive Repair and Maintenance	2,034	Computer System Design and Related Services	24,844
Other Personal Services	738	Management and Related Consulting Services	7,770
Civic, Professional and Other Interest Group Services	708	Legal and Accounting Services	3,363
Religious Services	428	Scientific Research Services	2,680
Personal Care Services	330	Other Professional, Scientific and Technical Services	965
Repair and Maintenance, nfd	277	Advertising Services	712
Other Repair and Maintenance	198	Professional, Scientific and Technical Services, nfd	543
Funeral, Crematorium and Cemetery Services	60	Professional. Scientific and Technical Services (except Computer System Design and Related Services), nfd	536
Private Households Employing Staff and Undifferentiated Goods and Service-Producing Activities of Households for Own Use	16	Market Research and Statistical Services	460
Public Administration and Safety	**Qualified Engineers**	**Rental, Hiring and Real Estate Services**	**Qualified Engineers**
State Government Administration	8,149	Real Estate Services	2,061
Defence	7,708	Property Operators	1,126
Local Government Administration	7,217	Other Goods and Equipment Rental and Hiring	459
Public Order and Safety Services	4,462	Property Operators and Real Estate Services, nfd	235
Central Government Administration	2,505	Motor Vehicle and Transport Equipment Rental and Hiring	227
Regulatory Services	801	Rental, Hiring and Real Estate Services, nfd	21
Public Administration, nfd	354	Rental and Hiring Services (except Real Estate), nfd	18
Justice	92	Non-Financial Intangible Assets (except Copyrights) Leasing	3
Public Administration and Safety, nfd	88	Farm Animal and Bloodstock Leasing	0
Government Representation	26		
Retail Trade	**Qualified Engineers**	**Transport, Postal and Warehousing**	**Qualified Engineers**
Supermarket and Grocery Stores	4,184	Air and Space Transport	5,184
Fuel Retailing	1,907	Postal and Courier Pick-up and Delivery Services	3,633
Electrical and Electronic Goods Retailing	1,594	Road Passenger Transport	3,426

Pharmaceutical and Other Store-Based Retailing	1,243
Clothing, Footwear and Personal Accessory Retailing	1,149
Motor Vehicle Retailing	1,123
Specialised Food Retailing	1,011
Retail Trade, nfd	888
Hardware, Building and Garden Supplies Retailing	818
Recreational Goods Retailing	617

Wholesale Trade	Qualified Engineers
Other Machinery and Equipment Wholesaling	6,269
Specialised Industrial Machinery and Equipment Wholesaling	1,666
Mineral, Metal and Chemical Wholesaling	1,171
Grocery, Liquor and Tobacco Product Wholesaling	1,054
Motor Vehicle and Motor Vehicle Parts Wholesaling	972
Timber and Hardware Goods Wholesaling	714
Furniture, Floor Covering and Other Goods Wholesaling	535
Pharmaceutical and Toiletry Goods Wholesaling	513
Wholesale Trade, nfd	461
Textile, Clothing and Footwear Wholesaling	248

Rail Passenger Transport	3,319
Other Transport Support Services	2,264
Road Freight Transport	1,855
Warehousing and Storage Services	1,463
Airport Operations and Other Air Transport Support Services	1,323
Water Transport Support Services	1,237
Transport, Postal and Warehousing, nfd	957

Table 51: 4-digit Professional Engineering Occupations and highest level of educational attainment

	Engineering Professionals, nfd	Chemical and Materials Engineers	Civil Engineering Professionals	Electrical Engineers	Electronics Engineers	Industrial, Mechanical and Production Engineers	Mining Engineers	Other Engineering Professionals	Total
Not stated	205	29	354	206	78	345	76	44	1,336
Secondary Education - Years 9 and below	23	0	30	0	7	37	7	3	100
Certificate I & II Level	0	0	0	0	0	0	0	0	10
Secondary Education - Years 10 and above	1,294	104	2,030	483	210	1,187	254	363	5,926
Certificate III & IV Level	1,068	76	934	864	232	2,366	310	372	6,229
Diploma Level	616	31	1,009	608	200	1,166	189	293	4,122
Advanced Diploma and Associate Degree Level	572	63	955	912	272	1,233	209	267	4,477
Advanced Diploma and Diploma Level, nfd	0	0	12	0	0	3	0	4	33
Bachelor Degree Level	7,573	2,250	31,575	10,532	2,566	18,207	4,933	4,678	82,317
Graduate Certificate Level	83	16	200	86	27	143	39	64	638
Graduate Diploma Level	187	54	543	176	49	294	188	167	1,650
Graduate Diploma and Graduate Certificate Level, nfd	38	5	117	53	15	85	15	17	344
Master Degree Level	2,888	801	10,063	3,769	1,160	6,358	1,881	2,129	29,043
Doctoral Degree Level	596	341	1,286	500	242	680	250	536	4,430
Postgraduate Degree Level, nfd	20	4	63	19	5	35	13	24	184
Total	15,177	3,780	49,165	18,215	5,040	32,147	8,365	8,954	140,846
Count of quals below AQF6	3,001	211	4,063	1,955	649	4,771	760	1,051	16,552
% Below AQF6	19.80%	5.60%	8.30%	10.70%	12.90%	14.80%	9.10%	11.70%	11.80%
Count of sub-bachelor quals	3,573	274	4,970	2,867	921	5,992	969	1,302	20,897
% of people below bachelor level	23.50%	7.20%	10.10%	15.70%	18.30%	18.60%	11.60%	14.50%	14.80%

Table 52: 6-digit professional engineering occupations by highest level of educational attainment

	Engineering Professionals nfd	Chemical and Materials Engineers nfd	Chemical Engineer	Materials Engineer	Civil Engineering Professionals nfd	Civil Engineer	Geotechnical Engineer	Quantity Surveyor	Structural Engineer	Transport Engineer	Electrical Engineer
Postgraduate Degree Level, nfd	20	0	0	0	0	50	0	0	7	3	19
Doctoral Degree Level	596	0	243	97	4	533	272	15	367	91	500
Master Degree Level	2,888	6	660	147	44	5,406	872	614	2,050	1,075	3,769
Graduate Diploma and Graduate Certificate Level, nfd	38	0	4	3	0	73	6	12	19	13	53
Graduate Diploma Level	187	0	41	11	0	315	25	43	74	82	176
Graduate Certificate Level	83	0	13	3	0	126	6	16	11	31	86
Bachelor Degree Level	7,573	11	1,916	320	150	19,463	1,175	2,091	5,847	2,849	10,532
Advanced Diploma and Associate Degree Level	572	0	46	13	5	558	10	135	96	154	912
Advanced Diploma and Diploma Level, nfd	0	0	0	0	0	12	0	0	0	4	0
Diploma Level	616	0	22	12	4	601	17	144	79	171	608
Certificate III & IV Level	1,068	0	53	21	8	476	24	117	140	168	864
Secondary Education - Years 10 and above	1,294	0	67	37	17	1,307	72	186	211	230	483
Certificate I & II Level	0	0	0	0	0	0	0	0	0	0	0
Secondary Education - Years 9 and below	23	0	0	0	0	9	0	10	3	5	0
Not stated	205	0	24	4	4	244	6	24	60	22	206
Total	15,177	13	3,096	670	235	29,183	2,482	3,408	8,961	4,893	18,215
Count of quals below AQF6	3,001	0	142	70	29	2,405	113	457	433	578	1,955
% Below AQF6	19.8%	0%	4.6%	10.4%	12.3%	8.2%	4.6%	13.4%	4.8%	11.8%	10.7%
Count of sub-bachelor quals	3,573	0	188	83	34	2,963	123	592	529	732	2,867
% of people below bachelor level	23.5%	0%	6.1%	12.4%	14.5%	10.2%	5%	17.4%	5.9%	15%	15.7%

Continued over page

Table 52: 6-digit professional engineering occupations by highest level of educational attainment

Electronics Engineer	Industrial, Mechanical and Production Engineers nfd	Industrial Engineer	Mechanical Engineer	Production or Plant Engineer	Mining Engineers nfd	Mining Engineer (excluding Petroleum)	Petroleum Engineer	Other Engineering Professionals nfd	Aeronautical Engineer	Biomedical Engineer	Agricultural Engineer	Engineering Technologist	Environmental Engineer	Naval Architect	Engineering Professionals nec	Total
5	0	4	19	6	0	7	6	0	0	3	0	0	3	0	12	184
242	9	141	454	83	4	171	76	0	63	112	5	8	120	23	197	4,430
1,160	36	1,039	4,465	817	20	1,201	664	9	316	307	17	148	450	57	830	29,043
15	0	11	72	6	0	13	6	0	3	0	0	0	4	0	4	344
49	0	62	195	31	4	159	24	0	16	10	0	7	24	4	107	1,650
27	0	22	106	14	0	28	5	0	9	3	0	3	10	3	33	638
2,566	91	2,433	12,990	2,693	43	3,498	1,398	21	788	588	39	134	932	247	1,918	82,317
272	6	179	878	169	3	152	52	3	48	56	0	18	7	17	118	4,477
0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	5	33
200	10	195	792	169	4	142	38	0	33	72	4	13	6	7	150	4,122
232	27	325	1,678	345	10	231	74	6	58	83	31	18	14	20	145	6,229
210	9	223	766	190	3	204	42	0	47	53	23	9	42	3	189	5,926
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
7	0	6	25	4	0	7	3	0	0	0	0	0	0	0	3	100
78	0	37	271	36	0	53	28	0	7	11	4	0	5	0	16	1,336
5,040	185	4,683	22,705	4,572	94	5,862	2,416	43	1,391	1,303	125	362	1,617	383	3,725	140,846
649	46	749	3,264	708	17	584	157	6	138	208	58	40	62	30	492	16,420
12.9%	24.9%	16%	14.4%	15.5%	18.1%	10%	6.5%	14%	9.9%	16%	46.4%	11%	3.8%	7.8%	13.2%	11.7%
921	52	928	4,142	877	20	736	209	9	186	264	58	58	69	47	610	20,897
18.3%	28.1%	19.8%	18.2%	19.2%	21.3%	12.6%	8.7%	20.9%	13.4%	20.3%	46.4%	16%	4.3%	12.3%	16.4%	14.8%

Table 53: Mapping of ANZSCO occupational codes to ASCED fields of education

6 Digit ANZSCO Occupation	Detailed ASCED field of education
Aeronautical Engineer	Aerospace Engineering
Biomedical Engineer	Biomedical Engineering
Chemical Engineer	Chemical Engineering
Civil Engineer	Civil Engineering, nfd
Electrical Engineer	Electrical Engineering
Electronics Engineer	Electronic Engineering
Environmental Engineer	Environmental Engineering
Geotechnical Engineer	Geotechnical Engineering
Industrial Engineer	Industrial Engineering
Materials Engineer	Materials Engineering
Mechanical Engineer	Mechanical Engineering
Mining Engineer (excluding Petroleum)	Mining Engineering
Structural Engineer	Structural Engineering
Transport Engineer	Transport Engineering

Table 54: Five-year age bands, select Professional Engineer occs, No education filters, in labour force

	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85-89 years	90-94 years	95-99 years	Total
Aeronautical Engineer	120	254	220	195	163	135	130	76	57	33	3	0	0	0	0	0	1399
Biomedical Engineer	124	262	201	172	149	103	92	100	67	34	11	4	0	0	0	0	1326
Chemical Engineer	202	573	448	428	341	343	249	232	140	86	37	18	3	0	0	0	3114
Civil Engineer	2806	7194	5433	3688	2804	2157	1580	1420	998	728	310	124	25	13	0	0	29363
Electrical Engineer	1114	2727	2836	3065	2185	1742	1510	1385	987	483	186	81	21	0	0	0	18349
Electronics Engineer	226	560	537	730	684	537	537	542	411	218	78	31	3	0	0	0	5115
Environmental Engineer	109	330	280	290	254	180	78	53	36	13	13	5	3	0	0	0	1631
Geotechnical Engineer	174	530	512	421	283	214	146	76	60	39	21	7	3	0	0	0	2487
Industrial Engineer	272	727	738	710	640	482	409	337	225	111	47	10	0	0	0	0	4732
Materials Engineer	70	117	96	92	71	62	45	49	23	25	16	0	0	0	0	0	675
Mechanical Engineer	1396	4278	3576	3272	2673	2124	1774	1518	1157	644	285	105	39	6	0	0	22911

	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85-89 years	90-94 years	95-99 years	Total
Mining Engineer (excluding Petroleum)	290	906	1132	986	739	568	433	368	237	135	62	18	8	0	0	0	5896
Structural Engineer	614	1717	1690	1291	1032	715	518	525	360	290	163	60	16	0	0	0	9013
Transport Engineer	377	930	869	682	546	412	354	308	216	147	58	3	0	6	0	0	4936

Table 55: Five-year age bands, select Professional Engineer occs, qualified AQF6 (Advanced Diploma/Associate Degree) and bove, in labour force

Detailed ASCED Field	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85-89 years	90-94 years	95-99 years	Total
Aerospace Engineering	231	588	593	448	341	358	274	201	128	53	29	9	4	4	0	0	3250
Biomedical Engineering	245	656	541	477	297	132	63	72	45	23	14	4	3	0	0	0	2588
Chemical Engineering	638	2204	2161	1876	1694	1456	1072	974	632	367	176	66	16	3	0	0	13329
Civil Engineering, nfd	2456	8511	7402	5381	4595	3898	2986	2820	2018	1397	651	229	65	20	6	0	42452
Electrical Engineering	984	3716	4042	4335	3378	3324	3133	2855	2051	989	458	184	40	10	5	0	29509
Electronic Engineering	104	604	1127	1746	1485	1200	1072	986	672	393	121	31	6	0	0	0	9558
Environmental Engineering	99	625	657	600	573	388	175	104	59	29	18	0	4	0	0	0	3334
Geotechnical Engineering	0	48	110	140	106	85	50	52	37	25	8	3	4	0	0	0	663
Industrial Engineering	38	531	768	799	711	406	293	215	205	107	36	18	3	0	0	0	4135
Materials Engineering	76	335	584	641	596	616	545	632	410	276	141	50	18	5	0	0	4924
Mechanical Engineering	1550	6528	5287	5201	4645	4018	3343	3082	2239	1178	500	149	46	13	0	0	37796
Mining Engineering	143	883	1329	1193	953	789	619	670	446	258	111	32	5	6	0	0	7428
Structural Engineering	145	660	738	633	455	334	279	279	207	170	91	36	10	4	0	0	4050
Transport Engineering	3	40	88	116	89	59	47	40	27	18	11	3	4	0	0	0	547

Table 56: Distribution of qualified engineers within 6-digit ANZSCO occupations

Occupation	Qualified Engineers	Occupation	Qualified Engineers
Primary School Teacher	94	Early Childhood (Pre-primary School) Teacher	39
Grain, Oilseed or Pasture Grower	92	ICT Support Technicians nec	39
Public Relations Professional	90	Aircraft Maintenance Engineer (Structures)	39
Taxation Accountant	89	Chief Executives, General Managers and Legislators nfd	38
Contract, Program and Project Administrators nfd	85	Caravan Park and Camping Ground Manager	38
Sound Technician	84	Architectural, Building and Surveying Technicians nfd	38
Child Care Centre Manager	83	Electronic Instrument Trades Worker (Special Class)	38
Market Research Analyst	83	Medical Technicians nfd	37
Hotel or Motel Receptionist	83	Licensed Club Manager	36
Multimedia Designer	80	Newspaper or Periodical Editor	36
Pastrycook	80	Musical Instrument Maker or Repairer	36
Financial Market Dealer	79	Practice Managers nec	36
Statistician	79	Supply, Distribution and Procurement Managers nfd	35
School Teachers nfd	79	Management Accountant	35
Hardware Technician	79	Telecommunications Cable Jointer	35
Environmental Scientists nec	78	Meter Reader	35
Boat Builder and Repairer	78	Master Fisher	34
Education Managers nec	77	Pharmacy Technician	34
Floor Finisher	77	Amusement Centre Manager	33
Telecommunications Linesworker	75	ICT Business and Systems Analysts nfd	33
Construction Managers nfd	72	Operating Theatre Technician	33
Liaison Officer	72	Construction Trades Workers nfd	33
ICT Trainer	69	Miscellaneous Hospitality, Retail and Service Managers nfd	32
Fashion Designer	69	Musician (Instrumental)	32
Grape Grower	67	Management and Organisation Analysts nfd	32
Equipment Hire Manager	67	Sales, Marketing and Public Relations Professionals nfd	32
ICT Support and Test Engineers nec	67	Local Government Legislator	31
ICT Support Technicians nfd	67	Health Professionals nfd	31
Panelbeater	67	Locksmith	31
Glazier	67	Author	30
Dairy Cattle Farmer	66	Valuer	30
Insurance Broker	66	Other Engineering Professionals nfd	30
Accommodation and Hospitality Managers nec	65	Other Building and Engineering Technicians nfd	30

Occupation	Qualified Engineers	Occupation	Qualified Engineers
Stonemason	65	Library Technician	30
Mixed Livestock Farmer	64	Camera Operator (Film, Television or Video)	30
Railway Station Manager	62	Optical Dispenser	30
Pathology Collector	62	Apiarist	29
ICT and Telecommunications Technicians nfd	62	Medical Administrator	29
Web Administrator	62	Wine Maker	29
Vehicle Body Builder	62	Dance Teacher (Private Tuition)	29
Mathematician	61	Science Technicians nfd	29
General Practitioner	61	Roof Plumber	29
Hairdresser	61	Jeweller	29
Sports Centre Manager	60	Numerical Clerks nfd	29
Cabler (Data and Telecommunications)	60	Parking Inspector	29
Vegetable Grower	59	Mixed Crop Farmer	28
Hospitality, Retail and Service Managers nfd	59	Special Needs Teacher	28
Economist	59	Electronics and Telecommunications Trades Workers nfd	28
Social Professionals nec	59	Clothing Patternmaker	28
Medical Technicians nec	59	Performing Arts Technicians nec	28
Metal Fitters and Machinists nfd	58	School Principal	27
Telecommunications Trades Workers nfd	58	Database and Systems Administrators, and ICT Security Specialists nfd	27
Judicial and Other Legal Professionals nec	57	Light Technician	27
Greenkeeper	57	Survey Interviewer	27
Marine Transport Professionals nec	56	Aquaculture Farmer	26
Mining Engineers nfd	56	Bed and Breakfast Operator	26
Registered Nurse (Aged Care)	56	Actors, Dancers and Other Entertainers nec	26
Private Tutors and Teachers nfd	55	Biotechnologist	26
Industrial Pharmacist	55	Graphic Pre-press Trades Worker	26
Telecommunications Engineering Professionals nfd	55	Picture Framer	26
Joiner	55	Shipwright	26
Butcher or Smallgoods Maker	55	Crop Farmers nfd	25
Computer Network Professionals nfd	54	Advertising, Public Relations and Sales Managers nfd	25
Agricultural Engineer	53	Arts Professionals nfd	25
Counsellors nec	53	Director (Film, Television, Radio or Stage)	25
Vehicle Painter	53	Landscape Architect	25
Hair or Beauty Salon Manager	52	Surveyors and Spatial Scientists nfd	25
Signwriter	52	Roof Tiler	25
Agricultural Technician	51	Print Finisher	25
Fitness Centre Manager	50	Diver	25

Occupation	Qualified Engineers	Occupation	Qualified Engineers
Translator	50	Call or Contact Centre Team Leader	25
Sheetmetal Trades Worker	50	Sugar Cane Grower	24
Tertiary Education Teachers nfd	49	Workplace Relations Adviser	23
Geophysicist	48	Health Information Manager	23
Social Worker	48	Cardiac Technician	23
Hydrographer	48	Motorcycle Mechanic	23
Mechanical Engineering Trades Workers nfd	48	Airconditioning and Mechanical Services Plumber	23
Livestock Farmers nfd	47	Pet Groomer	23
Air Transport Professionals nfd	47	Admissions Clerk	23
ICT Support and Test Engineers nfd	47	Education, Health and Welfare Services Managers nfd	22
Life Science Technician	47	Film and Video Editor	22
Advertising Specialist	45	Librarian	22
Meteorologist	45	Agricultural Consultant	22
Crop Farmers nec	44	Registered Nurses nec	22
Poultry Farmer	44	Student Counsellor	22
Agricultural Scientist	44	Agricultural, Medical and Science Technicians nfd	22
Multimedia Specialist	44	Arborist	22
Solid Plasterer	44	Call or Contact Centre Information Clerks nfd	22
Bricklayer	43	Transport Services Managers nfd	21
Media Producer (excluding Video)	42	Records Manager	21
Electronic Engineering Draftsperson	42	Advertising and Marketing Professionals nfd	21
Florist	42	ICT Sales Professionals nfd	21
Mail Clerk	42	Park Ranger	21
Other Specialist Managers nfd	41	Teacher of English to Speakers of Other Languages	21
Music Teacher (Private Tuition)	41	Carpenter and Joiner	21
Illustrator	40	Communications Operator	21
University Lecturers and Tutors nfd	40	Upholsterer	21


ENGINEERS
AUSTRALIA