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# Australia's Engineering Capability: How the last ten years will influence the future

**Cover image:**
Australian Engineering Excellence Awards, RMIT New Academic Street, Arup

Australia's Engineering Capability: How the last ten years will influence the future

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# Executive Summary

This report analyses and presents statistics describing the characteristics and size of Australia's engineering profession over the period 2006 to 2016. It is the first report covering the three population censuses over the boom and bust cycle during these years.

The report and its results are important because the services of engineers are embodied in practically all goods and services provided in a modern economy like Australia's. Without engineers to implement, technological progress and innovation would be just wishful thinking.

The skills and expertise of engineers cannot be substituted with those of other professions. However, engineering qualifications and expertise are highly prized in many lines of work beyond engineering. This complexity is not widely understood: something that gives rise to simplistic policies that reinforce boom-bust cycles rather than ameliorate them.

**This report goes beyond simply counting people with engineering qualifications and takes a closer look at who is actually working in engineering.**

This is necessary because engineers are defined by three factors:

- their secondary education
- their post-education professional formation
- the kind of work they do.

In other words, the common practice of just counting the number of people with formal qualifications in engineering can be misleading. It can result in counts that overstate the number of people with engineering qualifications that actually work in engineering.

It is no surprise to find that official statistics do not directly deal with all these attributes. Most official labour market statistics were designed to assist macroeconomic management and not the requirements of specialised (and comparatively small) professions like engineering.

To overcome this problem, the report uses a surrogate measure developed by Engineers Australia that approximates the three attributes of the profession.

**The statistics used throughout the report are from the Australian Bureau of Statistics Population Censuses conducted in 2006, 2011 and 2016.**

In a number of publications, the Bureau spells out the differences between census statistics and statistics from its Labour Force Survey. The latter are the best statistics to use for national labour market analyses, and even for such analyses at State and Territory level.

By their nature, survey techniques encompass standard error issues, and these are especially a problem when studying a group of individuals that make up just over 2% of the national labour force.

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The advantage of census statistics is the degree of disaggregation possible. This permits sensible study of the labour market and the occupational, industry, ethnic and geographic characteristics of relatively small cohorts of people. These characteristics matter to a profession that is represented in every jurisdiction, nearly every industry, and which depended heavily on skilled migration.

**The first chapter of the report sets the context for the study by describing important attributes of the engineering profession in Australia.** It also:

- discusses in greater detail the advantages and disadvantages of census statistics and statistics from the Labour Force Survey
- outlines details of other groups in the Australian labour market used to establish comparative benchmarks to assist in evaluating results relating to engineers
- covers the important issue of terminology; which may be boring but is absolutely essential when a body of qualified people satisfies demands from two directions.

**Chapter 2 is an analytical review of national statistics.** Reviews of this type are not always comfortable for engineers, because they treat engineers as a homogeneous group instead of recognising the numerous specialisations they are justifiably proud of.

However, whether we like it or not, this type of review is the basis of national policy deliberations. Accordingly, we follow suit to ensure relevant facts are brought to the fore.

**Chapter 2 begins with a review of baseline statistics, examining:**

- the relative size of the engineering labour market in Australia
- the ethnic composition and how it has changed as a result of skilled migration
- the gender composition.

The report also includes, for the first time, statistics on Aboriginal and Torres Strait Islander engineers.

**This chapter shows that the ten years of the study comprised a story in two parts.**

**From 2006 through to about 2012, boom conditions prevailed, which manifested in extraordinary high demand for engineers.** Although universities responded by encouraging more students to undertake entry level engineering courses, this course of action produced results around about the time that the demand for engineers collapsed.

As a result, Australia currently produces more engineering graduates than ever before, but the jobs have dried up. The main government policy response was skilled migration, both permanent and temporary.

Temporary migration was ramped up rapidly with the increase in demand for engineers and fell almost as quickly once demand collapsed. Permanent migration also rapidly increased within the government's high migration policy, and large numbers of migrant engineers continue to secure permanent visas.

**The second part of the story is the adjustment from boom conditions to those prevailing in 2016.**

Chapter 2 shows that there were several aspects of the adjustment process. First, labour force participation has fallen. Despite this, the supply of qualified engineers has continued to grow rapidly, resulting in increased unemployment.

More importantly, opportunities for people with engineering qualifications to work in engineering have slowed dramatically, resulting in large numbers accepting jobs in endeavours beyond engineering.

Many will not come back to the profession.

**Next, Chapter 2 explores the structure of engineering employment in some detail.** It finds that the incidence of restricted employment in engineering has fallen most severely on younger engineers.

Most of those who left the engineering labour force were older individuals, and the structure of surviving engineering employment is weighted towards these groups. With fewer younger engineers able to work in the profession, the pre-conditions for future problems with insufficient engineering capability are well and truly present.

**The balance of Chapter 2 examines the characteristics of migrant engineers.** It lists the countries and regions of the world from which Australia sources its migrant engineers, including the top ten source countries.

**Chapter 3 explores the implications of these statistics, reviewing how the attributes of the engineering profession covered in Chapter 2 differ between States and Territories.** We show that while the demand for engineers was higher in the resources States, it was not that different to demand in other jurisdictions.

The picture that emerges was that engineers were in high demand everywhere, not just in the resources areas. The corollary is that the severe adjustment that has occurred on a national level is also present in individual jurisdictions throughout the country.

**The final section of Chapter 3 examines the distribution of each jurisdiction's engineering labour force.** It focuses especially on the differences between capital cities and the balance of the jurisdiction.

We also consider where migrant engineers have chosen to locate, and what influence the resources boom had on these distributions. We find that a disproportionate share of recently arrived migrants locate in capital cities. This fact helps to explain the high rates of unemployment for this cohort, and the low proportions employed in engineering occupations.

## Companion study

A companion study titled *Engineers and Industry: A Decade of Change* looks at which industries engineers work in. The main theme of this report is that opportunities in 'core' engineering industries have dried up. Because of this, more people with engineering qualifications are working in industries with little, if any association with engineering.



# 1. Engineers and Engineering Capability

## 1.1 Understanding Australia's Engineering Capability

**KEY POINTS**

- **Without engineers to implement technical initiatives, innovation – which is recognised as critical to the Australian economy – cannot happen.**
- **New areas of practice mean engineering cannot be regarded as a homogenous discipline, so any statement of capability must recognise this complexity.**

**Innovation has been widely recognised as critical to the future of the Australian economy.** Innovation and technological growth are seen as the sources for further improvements in Australia's standard of living; and are enshrined in Australia's formal innovation and science agenda. This agenda has four pillars[1]:

- culture and capital with new tax breaks designed to remove the bias against businesses that take risks and innovate
- collaboration with changed funding incentives designed to redistribute research funding to partnerships between universities and industry
- talent and skills with encouragement to all Australian students to embrace the digital age; and changes to migration visas to attract more entrepreneurial and research talent from overseas
- government as an exemplar through the provision of better data to the public, and through making it easier for start-ups and innovative small businesses to do business with government.

It is difficult to argue with these principles; but new innovative and technological initiatives must also be implemented. And this implementation will often be by engineers, albeit in many instances in collaboration with other professionals. The skills and expertise of engineers cannot be substituted with other professionals. Without the contribution of engineers, Australia's capacity to innovate is severely impaired.

### ENGINEERS ARE NOT A HOMOGENOUS GROUP

**Engineers make things happen by solving complex real-world problems.** As the United Kingdom's Royal Academy of Engineering puts it, *"Engineering is the knowledge required, and the process applied, to conceive, design, make, build, operate, sustain, recycle or retire something of significant technical content for a specific purpose."*

The engineering profession has responded with new areas of practice, such as:

- digital technologies
- robotics
- nanotechnology
- mechatronics
- new advanced materials
- medical engineering
- additive engineering involving 3D technologies

1. Australian Government, Department of Industry, Innovation and Science, "National Innovation and Science Agenda Report". Available at www.innovation.gov.au/page/agenda.

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- artificial intelligence
- distributed manufacturing.

Some of these areas will intersect with contemporary areas of engineering practice. These include civil and environmental engineering, in the continued development of liveable cities to cater for population expansion and improvements in quality of life.

**The range covered by these developments mean that it is no longer sufficient to think about the engineering profession as a homogeneous body of knowledge.** Nor is it sufficient to see the development of the profession simply in terms of new graduates, because this completely ignores engineering practice.

The engineering profession is the aggregation of engineering professionals in an expanding range of practice reflecting technological advances. It also reflects the fact that knowledge has expanded beyond the capacity of any one individual to master, and now requires new specialisations and collaboration between specialisations.

New graduates become part of this landscape by successfully completing their engineering qualifications, then a period of professional formation in which they become experienced in their chosen area of engineering practice.

**Australia's engineering capability is an indispensable input for Australia to achieve its ambition of becoming an innovative, globally competitive nation.** It must be valued by policy makers and the community for this reason. It comprises men and women:

- who have recognised qualifications in engineering
- who, following graduation, have satisfactorily completed a period of professional formation in engineering practice
- who are employed in a wide range of occupations that apply engineering practice for the benefit of all Australians.

This means any statement of capability must recognise the complexity of current and developing practice.

## 1.2 The composition of Australia's Engineering Capability

**KEY POINTS**

- **Without engineers to implement technical initiatives, innovation – which is recognised as critical to the Australian economy – cannot happen.**
- **New areas of practice mean engineering cannot be regarded as a homogenous discipline, so any statement of capability must recognise this complexity.**

Engineers Australia is responsible for engineering standards in Australia. It accredits Australian university courses in engineering and sets the standards for engineering practice consistent with international standards.

**Practising engineers are then organised into 'the engineering team', which comprises Professional Engineers, Engineering Technologists and Engineering Associates.** These categories depend upon the engineer's qualifications and the nature of professional formation undertaken.

The roles of the three groups are:

- ***Professional Engineers*** apply lifelong learning, critical perception and engineering judgment to the performance of engineering services. They challenge current thinking and conceptualise alternative approaches, often engaging in research and development of new engineering principles, technologies and materials.

Professional Engineers apply their analytical skills and well-developed grasp of scientific principles and engineering theory to design original and novel





solutions to complex problems. They exercise a disciplined and systematic approach to innovation and creativity, and comprehension of risks and benefits. They also use informed professional judgment to select optimal solutions and to justify and defend these selections to clients, colleagues and the community.

Professional Engineers require at least the equivalent of the competencies in a four-year full-time Bachelor's Degree in engineering.

- ***Engineering Technologists*** exercise ingenuity, originality and understanding in adapting and applying technologies, developing related new technologies or applying scientific knowledge within their specialised environment.

The education, expertise and analytical skills of Engineering Technologists equip them with a robust understanding of the theoretical and practical application of engineering and technical principles. Within their specialisations, Engineering Technologists contribute to the improvement of standards and codes of practice and the adaptation of established technologies to new situations.

Engineering Technologists require at least the equivalent of the competencies in a three-year full time Bachelor's Degree in engineering.

- ***Engineering Associates*** apply detailed knowledge of standards and codes of practice to select, specify, install, commission, monitor, maintain, repair and modify complex assets such as structures, plant, equipment, components and systems.

The education, training and experience of Engineering Associates equip them with the necessary theoretical knowledge and analytical skills for several roles. These include testing, fault diagnosis and understanding the limitations of complex assets in familiar operating situations.

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.

In some countries, the professional status and practice of engineering is legally defined and protected by law. Supporting arrangements vary and include regulation through government bodies and self-governing bodies granted powers through legislation. However, in Australia, only Queensland has similar legislation. Although some other Australian jurisdictions are actively considering legislated regulation of engineers, at present most current Australian arrangements are voluntary.

### GRADUATE NUMBERS DO NOT ACCURATELY REFLECT ENGINEERING CAPABILITY

**Engineers Australia's National Engineering Register (NER) is the uniform national benchmark standard of professionalism in engineering practice.** The NER is a compliance benchmark that corresponds to the standards of competence required in legislated systems, and identifies individuals who satisfy the following criteria:

- recognised academic qualifications in engineering
- cumulative (five years in the past seven years) and current experience in their chosen area of engineering practice
- commitment to and practice of ethical standards in engineering practice
- commitment to and practice of an appropriate standard of continuing professional development
- having the benefit of professional indemnity insurance and demonstrating that they can maintain this benefit throughout the provision of engineering services.

The NER is a publicly searchable database that provides a voluntary national system of registration for the engineering team in both the private and public sectors in Australia. The NER is open to both members and non-members of Engineers Australia, and aims to provide consistency in standards of engineering practice across states and territories and to facilitate any new legislated approaches.

The voluntary nature of these arrangements means that statistical investigations must encompass the wider economy as well as Engineers Australia's membership.

**In this report, our starting point is statistics about Australians who hold recognised engineering qualifications for inclusion in the engineering team.** However, there is a tendency among the community at large (and among engineers) to presume that graduates from engineering courses become practising engineers.

This is the case for many engineering graduates. However, increasing numbers are instead gaining their engineering qualifications and then training in alternative jobs that draw on their analytical and problem-solving capabilities. Sometimes this happens by choice, but also through circumstance.

There are many factors driving this shift, including:

- improved salaries
- location of work
- type of work
- shift to limited-tenure contract employment and associated employment intermittency
- career advancement opportunities
- the simple desire for change.

However, the importance of each factor and how they work together are generally poorly understood. When engineering jobs are not available, many engineers have little choice but to accept employment that is available.

Whatever the reasons, when qualified engineers accept jobs that do not involve engineering practice, they effectively leave Australia's engineering capability.

**As a result, we need a second set of statistics: the number of qualified engineers in the economy who actually work in engineering.** Since 2010[2], Engineers Australia has used the number of qualified engineers employed in engineering occupations both for this purpose and as a measure of Australia's Engineering Capability.

Engineering occupations were identified by systematically applying three criteria to the 358 four-digit occupations in the ABS Australian and New Zealand Standard Classification of Occupations (ANZSCO). The criteria were:

- that the individual possesses recognised qualifications in engineering
- that the work undertaken by the occupation satisfies Work Skill Levels 1 or 2 in the ABS classification of skill
- that their 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.

Fifty-one occupations were identified as satisfying these criteria, and were designated as engineering occupations. However, this process was not without some subjectivity and the consequence of this was tested using sensitivity analysis that added or deleted marginal occupations. The testing process showed a minor variation in the total number of qualified engineers employed in engineering occupations, but this did not affect conclusions about changes over time.

**To ensure clarity throughout the report, additional terminology is important.**

- We refer to individuals who hold recognised engineering qualifications as **"qualified engineers".** These individuals have met the first of the three NER criteria set out above, but not necessarily the other two. They may be employed as engineers, but many are employed in a wide range of work other than engineering.
- Throughout the report, we also refer to the **"engineering labour market"**. This is the labour market for **"qualified engineers"**.
- **Australia's Engineering Capability** is then a subset of the engineering labour market that comprises **"qualified engineers"** who satisfy all three of the criteria discussed above, and so are employed in an **engineering occupation**.

**"Qualified engineers"** not employed in an **engineering occupation** contribute to the Australian economy through other means, but not through the practice of engineering.

2. Engineers Australia, The Engineering Profession in Australia, A Profile from the 2006 Population Census, September 2010, available from publicaffairs@engineersaustralia.org.au





## 1.3 Important statistical considerations

**KEY POINTS**

- **This report uses ABS Population Census statistics rather than Labour Force Survey statistics.**
- **While these statistics have some limitations, they make it possible to study changes in characteristics like diversity, hours worked, income distribution, etc.**

**Ideally, a study of the engineering profession should draw on both stock and flow statistics, that is, statistics taken at both a point in time and over time.** However, comprehensive flow statistics that describe important aspects of professions in Australia (including engineering) are simply not available. Engineers Australia has overcome this deficiency by compiling a mosaic of available statistics in its annual Statistical Overview. This compendium included a mixture of flow and stock statistics.

The most common source for labour market statistics in Australia is the Australian Bureau of Statistics (ABS) *Labour Force Survey*[3] (LFS) and related supplementary surveys. These time series statistics are regularly used by governments and bureaucrats to measure progress in Australia's labour market and in the labour markets of States and Territories.

These statistics are also Australia's official measures of the Australian labour market, such as the number of people employed and unemployed (stocks). Because the LFS is a regular monthly survey, changes in the number of people employed or unemployed (flows) are readily available and have contemporaneous relevance.

However, applying the LFS in investigations of specialist groups like professions poses severe limitations, including:

- ***Until two years ago, the LFS did not cover educational attainment.*** Formal qualifications are mandatory in engineering as well as in other professions. Statistics that do not include educational attainment do not provide reliable measures in these cases. While educational attainment is now collected by the LFS, just two years of statistics are available and only for some national level variables.
- ***As an alternative to the LFS, the Survey of Education and Work (SEW)[4] – an annual supplement to the LFS – does collect educational attainment statistics.*** Statistics from this source have been used by Engineers Australia to estimate the size of, and annual changes in, the national engineering labour force over time[5].
- ***For engineering, the utility of both the LFS and the SEW is limited by the size and structure of the survey sample.*** The LFS sample covers about 52,200 individuals or about 0.32% of the civilian population aged 15 years and over. The SEW sample in 2017 resulted in 40,976 interviews. Section 2.2 will show that the supply of qualified engineers increased from 2.1% in 2006 to 2.9% in 2016 of the national labour force.

In stratified, random samples (as employed by the ABS), the number of qualified engineers included reflect these representations, which means that sample size limits the amount of useful detail that can be obtained. Issues such as gender, geographic location and ethnicity cannot be reliably established.

### LIMITATIONS OF ABS POPULATION CENSUS STATISTICS

**In this report, we use statistics from the ABS population census conducted in 2006, 2011 and 2016.** Census statistics are different to those derived from the Labour Force Survey, but the trends displayed in the two data sources are consistent. The same ABS statistical classification systems and the same conventional labour market concepts are used in each collection.

3. ABS, Labour Force, Australia, Cat No 6202.0, electronic statistics, www.abs.gov.au . The most useful supplementary survey is the Survey of Education and Work, Cat No 6227.0.
4. ABS, Education and Work, Australia, Cat No 6227.0, electronic data, www.abs.gov.au
5. See Engineers Australia, The Engineering Profession, A Statistical Overview, Thirteenth Edition, February 2017, pp27-32.

However, ABS classification systems are far from ideal and have their own limitations. At times, they are cumbersome and even pedantic, but using them ensures that comparisons are as reasonable as possible. Similarly, ABS definitions for labour market variables have limitations. For example, people working just one hour per week are treated as employed. These limitations are widely known and understood, and their merits (or otherwise) are not further discussed.

**Several limitations of census statistics warrant mention.** The first is that the census is conducted every five years. Comparing the supply of qualified engineers (stock) poses no difficulties. The rate of change (flow) between census years is then estimated by calculating average annual compound growth rates. This approach gives an overview of the changes that have occurred but does not replicate the more accurate picture obtained from more frequent collections, such as the monthly LFS and the annual SEW.

Another limitation is that ABS classifications do not handle areas of engineering specialisation well. Statistics relate to the area of specialisation covered by formal education qualifications. This contrasts with the professional formation in engineering practice that typically occurs on-the-job following completion of educational qualifications.

Furthermore, coverage of specialist areas of engineering education is unhelpful, with almost half of engineers shown in the "general engineering" field. This reduces the utility of statistics for fields such as "civil engineering". Finally, field of education is defined according to an individual's highest educational attainment, which results in an undercount of qualified engineers.

**On the other hand, census statistics offer numerous advantages.** Census statistics allow detailed investigation of the engineering profession at national, State and Territory levels; as well as geographic locations within jurisdictions.

Additionally, characteristics of engineers that cannot be studied using other statistical sources can be readily investigated, including:

- diversity
- age structure
- industry composition
- hours worked
- income distribution
- occupational distribution
- impact of skilled migration.

Finally, census statistics allow us to benchmark the characteristics of engineers against other labour market groups.

Although census statistics are used to calibrate ABS survey results, the two data sources are not strictly comparable due to differences in[6]:

- ***Scope and coverage:*** the two collections differ geographically and in their target populations.
- ***Collection methodology:*** the census is self-enumerating, and there is more scope for respondents to misunderstand questions and/or to incorrectly answer them. On the other hand, the LFS is administered by trained ABS interviewers who are in a position to ask for clarifying information when confusion arises. Furthermore, the census derives labour market information from four questions, compared to seventy questions in the LFS.
- ***Sampling error:*** this has already been referred to. Commonly available statistics on engineers from the LFS do not include educational attainment and have unacceptably high standard errors.
- ***Treatment of non-response:*** in the census, some demographic characteristics are imputed for non-responding households, and there are some differences in responses to different questions. However, in the LFS, non-response is not imputed. Only fully responding households contribute to estimates, with under-enumeration compensated for by a weighting process. This issue means that labour force figures produced by the census may be lower than the LFS.

## OTHER STATISTICAL CONSIDERATIONS

**To accurately appreciate the characteristics of a specific group like qualified engineers, it is important to establish appropriate comparative benchmarks.**

For this purpose, we identify **other skilled workers** as those who have the same level of qualifications as the

6. ABS, Fact Sheet, Labour Force Survey and the Census, www.abs.gov.au/websitedbs/censushome.nsf/4a256353001af3ed4b2562bb00121564/7e658c9da9d1c029ca257aa5007f2b20!OpenDocument





engineering team in any field other than engineering. In other words, other skilled workers have at least an associate degree or an advanced diploma in any field except engineering.

We also identify **less skilled workers** as workers with trade or sub-trade qualifications, and workers with no post-school qualifications.

**The ABS has developed a technique to adjust counts to maintain confidentiality known as perturbation.** This technique makes small adjustments to all counts to prevent identifiable data about individuals being released. These adjustments result in small introduced random errors, which can mean that the rows and columns of tables do not sum to the displayed total. The technique is applied in a manner that ensures the information value of the table as a whole is not significantly affected[7].

Most tables derived through the TableBuilder facility include a "not stated" response item. In some instances, this item is sufficiently large to distort comparisons. In these cases, we handle these situations by converting raw numbers into percentages to establish the basis for subsequent discussions.

**The IT problems experienced on 2016 census night attracted considerable media attention and commentary about the impact on the quality of census results.** Census data quality was exhaustively examined by the ABS itself and by parliamentary committees.

The ABS has also undertaken a post-enumeration survey from which it estimated census under and over counts[8]. Finally, the ABS appointed an independent assurance panel comprised of Australian and international census experts to report on the quality of census statistics[9]. The finding of these reviews is that 2016 census statistics are of comparable quality to statistics from previous censuses.

**Two other important statistical time series influence growth in the supply of engineers.** Before concluding this section, it is important to briefly outline trends in these series, which include:

- statistics on domestic entry level engineering courses
- statistics on skilled migration.

Both series are collected independently from the ABS[10], and are actual counts rather than estimates derived from sample surveys.

While new graduates and new skilled migrants add to the supply of qualified engineers, retirement of existing qualified engineers and changes in labour force participation also influence overall outcomes. However, appreciating trends in new graduates and skilled migrants helps to understand how some of the results in this report have come about.

The pipeline of engineering entry level education begins with course commencements and concludes with course completions. Domestic students (that is, citizens and permanent residents who negotiate engineering education) can directly move into the engineering labour force after course completion.

**There was an increasing trend in domestic student course commencements until 2013.** Since then, however, the trend has been decreasing commencements each year. In 2016, the latest year for which statistics are available, engineering entry level course completions were still increasing, but this trend is expected to turn around as declining commencements work their way through the system.

**Overseas student engineering entry course commencements and completions were also still increasing in 2016.** So too were commencements and completions in engineering coursework Masters degrees.

This trend is important, because many graduates from these courses apply for and are granted on-shore visas in Australia's skilled migration programs. These programs also include migrant engineers who obtained their qualifications outside Australia. Permanent visas approved continue to increase each year.

In 2005-06, the beginning of the study period for this report, 4,659 permanent visas were approved. By 2015-16, the end of the study period, this had increased by 185% to 13,265. The recent budget reaffirmed the government's commitment to high permanent migration.

7. See www.abs.gov.au/ausstats/abs@.nsf/Lookup?2900.0main+features12016
8. ABS, Census of Population and Housing: Details of Overcount and Undercount, Australia, 2016, Cat No 2940.0, June 2017, www.abs.gov.au Census Independent Assurance Panel to the Australian Statistician, Report on the Quality of the 2016
9. Census Data, June 2017, www.abs.gov/websitedbs/d3310114.nsf/home Independent+Assurance+Panel?$FileCIAP+Report+on+the+quality+of+2016+Census+data.pdf
10. Statistics on engineering education are obtained from the Higher Education Division of the Department of Education and Training and skilled migration statistics are obtained from the now Department of Home Affairs.

However, the study period reflects a rise and fall in skilled migrant engineers working in Australia on temporary visas. In 2005-06, there were 4,410 migrant engineers working in Australia on temporary visas; and in 2015-16 there were 3,685. These fairly similar end-points obscure the 2011-12 peak of 10,160 migrant engineers working in Australia on temporary visas.

This rise and fall is embodied within the statistics examined for the 2011 and 2016 census. In other words, during 2006 to 2011, the statistics are enlarged by the entry of large numbers of temporary visa engineers; and between 2011 and 2016, the departure of large numbers of temporary visa engineers from Australia had the opposite effect.

## 1.4 The structure of the report

**KEY POINTS**

- **This report is unique as the first multiple-census study of engineering capability.**
- **It examines the size of the engineering labour market relative to the broader labour market, looking at both supply of and demand for qualified engineers.**
- **It also further examines changes in ethnic and gender composition, both nationally and at a regional level.**

**This report is unique because it is the first multiple census study of engineers in the Australian economy.** Chapter 2 deals with the national perspective, beginning with baseline statistics that define employment, unemployment, labour supply and employment in engineering occupations in 2006, 2011 and 2016.

**In this report, we examine the size of the engineering labour market relative to skilled workers in other fields, to less skilled workers and to the Australia labour market overall.** Australia has a long history of migration; and we show that in engineering, this has developed into a vulnerability as large-scale immigration has dramatically altered the ethnic composition of the engineering labour force.

We also examine changes in gender composition and the emergence of an Aboriginal and Torres Strait Islander component of the engineering labour force.

**The focus then turns to the changes described by the baseline statistics.** We look at how the supply of qualified engineers has changed, and the role of labour force participation in these changes. The report shows that unemployment of qualified engineers has increased despite strong employment growth. This suggests a deterioration in how Australia utilises this body of scarce resources.

By dividing employment of qualified engineers into those who work in engineering occupations and those who work in alternative jobs, we demonstrate that the underutilisation is far more serious than suggested by unemployment statistics alone. The chapter concludes with an overview of the characteristics of migrant engineers and the countries from which they originate.

**Chapter 3 expands the matters covered in Chapter 2 into States and Territories.** We examine differences in labour force participation, ethnic and gender shares and employment. We pay particular attention to differences in the utilisation of the supplies of qualified engineers available in each jurisdiction.

Much of the chapter is intended to inform readers about where qualified engineers are located, both within and between jurisdictions. We give particular attention to the location of qualified engineers in capital cities compared to the rest of the jurisdiction. We also show that migrant engineers have a much higher propensity to locate in capitals, which explains much about their comparatively high unemployment and low degree of utilisation in engineering.



# 2. The National Perspective

## 2.1 Baseline Statistics

**KEY POINTS**

- The years between 2006 to 2011 were a period of high and growing demand for engineers. This resulted from two factors: the resources sector construction boom, and the more widespread economic boom.
- Both conditions shifted dramatically from 2012, with demand for engineers collapsing and subsequent reductions in utilisation. These reductions came from increases in both unemployment and proportions of qualified engineers working outside of engineering occupations.

### THE 2006 TO 2016 DECADE WAS TURBULENT FOR ENGINEERS

**The years leading up to the 2006 census were characterised by high and growing demand for engineers.** This demand came from two sources: the resources sector construction boom and a more widespread economic boom period. These pressures were reflected in census responses. The period 2006 to 2011 was also briefly punctuated by the global financial crisis (GFC), which had severe impacts throughout the economy, but was particularly severe in the resources sector.

Immediate impacts of the GFC were short-lived, disrupting demand between 2008 and 2009, but soon after high pre-crisis demand trends had resumed[11]. By the 2011 census, the crisis appeared to be over, with most pundits suggesting that Australia had avoided the worst of the GFC. The resources construction boom resumed and government stimulus-supported infrastructure works were underway. However, economic activity was generally more subdued than before the crisis; and for engineers, indications of problems ahead were already evident.

**Late in 2012, the demand for engineers collapsed, with vacancies experiencing 30 months of continuous falls.** Two changes coincided with this collapse:

- The resources construction boom peaked and then rapidly fell as existing projects were completed and were not replaced by new ones.
- Infrastructure investment in Australian cities abruptly slowed as stimulus activity came to an end and governments became more fiscally cautious.

Economic growth after the GFC has been slower than the long-term average, and by the 2016 census, these factors appeared entrenched. In contrast to the short, sharp shock of the GFC, a steady decline in the engineering labour market had set in.

11. See Engineers Australia, The Engineering Profession; A Statistical Overview, Thirteenth Edition, February 2017, Table 2.1, p29, www.engineersaustralia.org.au

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**This report traces the consequences of this boom-bust cycle in the engineering labour market.** This report also examines the important factors in adjustment from the boom to subsequent conditions.

## INTRODUCTION TO STATISTICS USED

**The statistics in this report were compiled using the ABS 2006, 2011 and 2016 census data bases and the ABS TableBuilder Pro facility.** The advantage of this facility lies in its flexibility, which is essential in a study of this nature. Using TableBuilder, the baseline statistics for this chapter are presented in Table 2.1. Much of the analysis in this chapter is based on this table.

There are three panels in the table, each one covering a census. The variables in each panel are conventional labour market concepts: employment, unemployment, the labour force, persons not in the labour force, and population. Each panel presents statistics for three distinct labour markets, and each market is delineated by the type and level of formal educational qualifications of its participants:

- ***The first labour market (first three columns) covers "qualified engineers".*** The participants in this labour market hold engineering qualifications recognised for membership of the engineering team as described in Chapter 1. In other words, their highest qualification is at least an associate degree or advanced diploma in engineering. These qualifications satisfy Level 6 or higher in the Australian Qualification Framework (AQF)[12] in engineering.
- ***The second labour market (second set of three columns) is the labour market for "other skills".*** We define this labour market as comprising participants who hold the same level of qualifications as "qualified engineers" in any area of skill except engineering. In other words, participants have at least an AQF level 6 qualification in any recognised area of skill except engineering. Tradespeople are not included in this definition because their qualifications are at certificate level 3 (AQF level 3) or 4 (AQF level 4) and sometimes diploma level (AQF level 5).
- **The third labour market (the third set of three columns) is everybody else.** It comprises workers with trades qualifications, sub-trades qualifications (AQF levels 1 and 2) and unskilled workers, irrespective of whether any qualifications are in engineering or another field. We refer to this labour market as the market for "other workers".
- **The last three columns cover the entire Australian labour force, irrespective of skill level.** This information is important because it establishes the benchmarks that are frequently discussed in general commentary about the Australian economy and its labour market.

12. See Australian Qualification Framework, www.aqf.edu.au





**Table 2.1:** Engineers and other groups in the Australian labour market; 2006, 2011 and 2016

| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total | Men | Women | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | Engineers | | | Other skilled | | | Other workers | | | All workers | | |
| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total | Men | Women | Total |
| Total employed | 174490 | 20086 | 194576 | 963644 | 1239100 | 2202744 | 3773003 | 2933868 | 6706871 | 4911137 | 4193054 | 9104191 |
| Total unemployed | 4957 | 1088 | 6045 | 28809 | 34499 | 63308 | 235926 | 198531 | 434457 | 269692 | 234118 | 503810 |
| Labour force | 179447 | 21174 | 200621 | 992453 | 1273599 | 2266052 | 4008929 | 3132399 | 7141328 | 5180829 | 4427172 | 9608001 |
| Not in labour force | 37262 | 7001 | 44263 | 165365 | 362521 | 527886 | 1859583 | 2839388 | 4698971 | 2062210 | 3208910 | 5271120 |
| Not stated | 625 | 123 | 748 | 3448 | 5861 | 9309 | 530811 | 498106 | 1028917 | 534884 | 504090 | 1038974 |
| Population | 217334 | 28298 | 245632 | 1161266 | 1641981 | 2803247 | 6399323 | 6469893 | 12869216 | 7777923 | 8140172 | 15918095 |
| 2011 | Engineers | | | Other skilled | | | Other workers | | | All workers | | |
| Total employed | 225323 | 29188 | 254511 | 1205584 | 1581924 | 2787508 | 3935755 | 3080544 | 7016299 | 5366662 | 4691656 | 10058318 |
| Total unemployed | 7477 | 1892 | 9369 | 41935 | 54288 | 96223 | 270717 | 223817 | 494534 | 320129 | 279997 | 600126 |
| Labourforce | 232800 | 31080 | 263880 | 1247519 | 1636212 | 2883731 | 4206472 | 3304361 | 7510833 | 5686791 | 4971653 | 10658444 |
| Not inlabourforce | 47834 | 10243 | 58077 | 221469 | 477810 | 699279 | 2035656 | 2936295 | 4971951 | 2304959 | 3424348 | 5729307 |
| Not stated | 450 | 102 | 552 | 3062 | 4934 | 7996 | 510906 | 456472 | 967378 | 514418 | 461508 | 975926 |
| Population | 281084 | 41425322509 | | 1472050 | 2118956 | 3591006 | 6753034 | 6697128 | 13450162 | 8506168 | 8857509 | 17363677 |
| 2016 | Engineers | | | Other skilled | | | Other workers | | | All workers | | |
| Total employed | 269373 | 40897 | 310270 | 1427771 | 1956599 | 3384370 | 3910630 | 3078570 | 6989200 | 5607774 | 5076066 | 10683840 |
| Total unemployed | 15602 | 4085 | 19687 | 62497 | 83334 | 145831 | 343849 | 278088 | 621937 | 421948 | 365507 | 787455 |
| Labourforce | 284975 | 44982 | 329957 | 1490268 | 2039933 | 3530201 | 4254479 | 3356658 | 7611137 | 6029722 | 5441573 | 11471295 |
| Not in labour force | 70907 | 16009 | 86916 | 313401 | 632275 | 945676 | 2254578 | 3010432 | 5265010 | 2638886 | 3658716 | 6297602 |
| Not stated | 577 | 128 | 705 | 3380 | 5619 | 8999 | 633245 | 625433 | 1258678 | 637202 | 631180 | 1268382 |
| Population | 356459 | 61119 | 417578 | 1807049 | 2677827 | 4484876 | 7142302 | 6992523 | 14134825 | 9305810 | 9731469 | 19037279 |

## 2.2. The relative size of the engineering labour market

**KEY POINTS**

- Engineering is a small, but increasing, segment of the total Australian labour market. It grew from 2.1% to 2.9% during the 2006-2016 decade.

**An overall total of 9,608,001 workers were actively engaged in the Australian labour market in 2006.** Of this total market, 200,621 were qualified engineers who were actively engaged in the engineering labour market. 194,576 of them were employed and 6,045 were unemployed but actively looking for work.

Another 45,011 workers had the necessary engineering qualifications but were not actively engaged with the labour market[13]. They were either older workers who had retired, or younger workers who had temporarily withdrawn from the labour market to study, deal with family responsibilities or because of illness or disability. Altogether, there were 245,632 people in Australia whose highest qualification was at least an associate degree or advanced diploma in engineering.

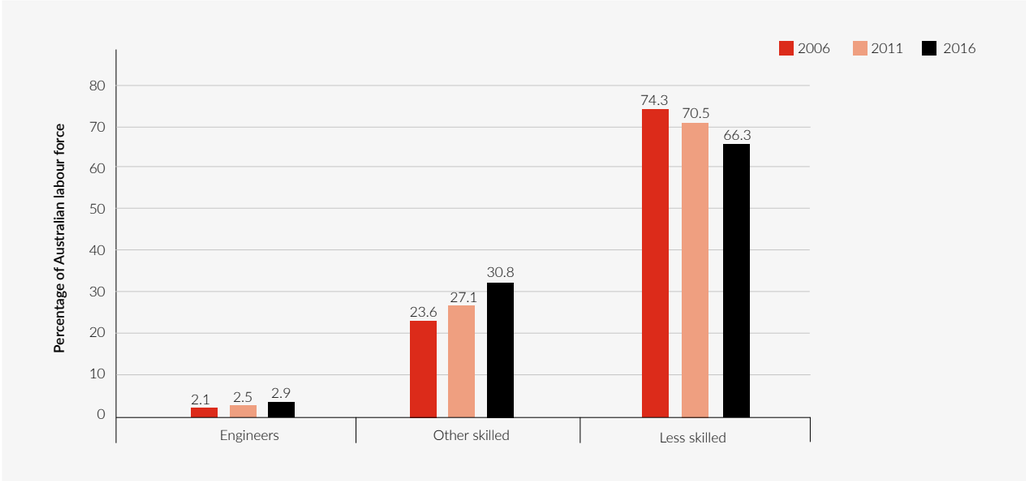
This compares with 2,266,052 people who were actively engaged in Australia's "other skills" labour market, and 7,141,328 people who were actively engaged in the labour market for "other workers".

**This means that qualified engineers active in the labour market made up 2.1% of the total labour market.** Other skilled professions made up 23.6%; and the remaining 74.3% comprised trades persons, sub-trades persons and unskilled workers.

13. This figure includes "not stated" with "not in the labour force".

These shares are illustrated in Figure 2.1.

Figure 2.1: The size of engineering labour force compared to other segments, 2006. 2011 and 2016




**By 2011, the size of the Australian labour force had increased by 10.9% to 10,658,444.** This was the product of countervailing growth in skilled and less skilled segments. The engineering labour force increased by 31.5% to 263,880 and the "other skills" labour force increased by 27.3% to 2,883,731 of the Australian labour market, increasing these segments to 2.5% and 27.1%, respectively. In contrast, the less skilled segment of the labour market grew by just 5.2% to 7,510,833, so that its share fell to 70.5%.

In the five years to 2016, the engineering labour force increased by a further 25.0% to 329,957, and the "other skills" labour force increased by a further 22.4% to 3,530,201. Growth in the "less skilled" segment of the labour force slowed to 1.3%, increasing it to 7,611,137. Overall, the Australian labour force increased by 7.6% to 11,471,295.

**As Figure 2.1 shows, the relative size of the engineering labour force increased to 2.9%.** Meanwhile, the relative size of the "other skills" labour force increased to 30.8% and the relative size of the "less skilled" labour force contracted to 66.3%. These trends illustrate the often-cited notion that skills are the future of the Australian labour force.





## 2.3. The ethnic composition of the engineering labour force

**KEY POINTS**

- In 2006, the majority of qualified engineers were Australian-born. By 2016, the majority (58.5%) were born overseas, with only 41.5% born in Australia. This increase was mostly due to skilled migration.
- Skilled migration has substantially affected the ethnic composition of the engineering labour force to a greater degree than in other skilled professions.

Skilled migration has been an established feature of Australian population policy for many decades. In this section, we consider the impact of skilled migration on the composition of the engineering labour force by distinguishing between Australian-born and overseas-born qualified engineers.

**In doing so, we acknowledge that 'skilled migrant' and 'overseas-born' are not the same.** The latter includes the young children of earlier generations of migrants who grew to adulthood and were educated in Australia. However, in Section 2.10, we show that skilled migration accounts for 95.6% of the increase in overseas-born qualified engineers between 2006 and 2016. With this background result, examining the characteristics of overseas-born qualified engineers is a satisfactory basis for initial investigations. Time of arrival in Australia is critical to many results and will be introduced in Section 2.10.

**Table 2.2:** The ethnic composition of the Australian engineering labour force, 2006 to 2016

| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2006 Census | Australian Born | | | Overseas Born | | | Engineering Team | | |
| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total |
| Employed | 93284 | 8310 | 101594 | 81206 | 11776 | 92982 | 174490 | 20086 | 194576 |
| Unemployed | 1636 | 198 | 1834 | 3321 | 890 | 4211 | 4957 | 1088 | 6045 |
| Engineering labour force | 94920 | 8508 | 103428 | 84527 | 12666 | 97193 | 179447 | 21174 | 200621 |
| Not in labour force | 18578 | 2073 | 20651 | 18684 | 4928 | 23612 | 37262 | 7001 | 44263 |
| Not stated | 290 | 35 | 325 | 335 | 88 | 423 | 625 | 123 | 748 |
| Population | 113788 | 10616 | 124404 | 103546 | 17682 | 121228 | 217334 | 28298 | 245632 |
| Employed in engineering occupations | 65975 | 4970 | 70945 | 46311 | 5001 | 51312 | 112286 | 9971 | 122257 |
| 2011 Census | Australian Born | | | Overseas Born | | | Engineering Team | | |
| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total |
| Employed | 108496 | 10382 | 118878 | 116827 | 18806 | 135633 | 225323 | 29188 | 254511 |
| Unemployed | 2374 | 273 | 2647 | 5103 | 1619 | 6722 | 7477 | 1892 | 9369 |
| Engineering labour force | 110870 | 10655 | 121525 | 121930 | 20425 | 142355 | 232800 | 31080 | 263880 |
| Not in labour force | 22674 | 2462 | 25136 | 25160 | 7781 | 32941 | 47834 | 10243 | 58077 |
| Not stated | 194 | 11 | 205 | 256 | 91 | 347 | 450 | 102 | 552 |
| Population | 133738 | 13128 | 146866 | 147346 | 28297 | 175643 | 281084 | 41425 | 322509 |
| Employed in engineering occupations | 78292 | 6640 | 84932 | 69708 | 9273 | 78981 | 148000 | 15913 | 163913 |
| 2016 Census | Australian Born | | | Overseas Born | | | Engineering Team | | |
| Variable | Men | Women | Total | Men | Women | Total | Men | Women | Total |
| Employed | 119054 | 12969 | 132023 | 150319 | 27928 | 178247 | 269373 | 40897 | 310270 |
| Unemployed | 4519 | 516 | 5035 | 11083 | 3569 | 14652 | 15602 | 4085 | 19687 |
| Engineering labour force | 123573 | 13485 | 137058 | 161402 | 31497 | 192899 | 284975 | 44982 | 329957 |
| Not in labour force | 31312 | 3087 | 34399 | 39595 | 12922 | 52517 | 70907 | 16009 | 86916 |
| Not stated | 246 | 52 | 298 | 331 | 76 | 407 | 577 | 128 | 705 |
| Population | 155131 | 16624 | 171755 | 201328 | 44495 | 245823 | 356459 | 61119 | 417578 |
| Employed in engineering occupations | 82903 | 7991 | 90894 | 82175 | 12847 | 95022 | 165078 | 20838 | 185916 |

**Skilled migration was the dominant Government response to perceived skill shortages in all skilled professions, including engineering, between 2006 and 2011.** During the early years of the shortages, the effects of skilled migration policies were mixed and led to a fundamental review that was implemented in 2010.

Temporary skilled migration became demand-driven by the requirements of employers and was not market tested. Employers simply needed to assert recruitment difficulties. There was no formal check on engineering qualifications and experience. Temporary visas were limited in duration as part of a policy design that intended temporary migration to increase when demand was high as employers experienced skill shortages. Temporary migration was then intended to decrease when demand was weak and there were no skill shortages.

The 2010 policies formalised the objective of permanent skilled migration as being supplementation of the medium-to-long-term output of Australian educational institutions in areas of skill deemed important to the future Australian economy. The mechanism instituted to guide the skills composition was the Skilled Occupation List. So far as engineers are concerned, this mechanism has remained unchanged since the new policies were implemented.[14]

**Over the past five years, Australia's annual skilled migration target has remained unchanged.** It is high in numerical terms but reflects a decreasing proportion of Australia's population. Within the aggregate target, the number of new migrant engineers granted permanent visas has rapidly increased. Just prior to the 2006 census, the number of permanent visas granted to engineers during the previous twelve months was 4,686. By 2011, the annual intake had increased to 6,220, and just prior to the 2016 census the annual intake had increased to 13,265.

**The interaction between permanent and temporary migration is important.** The number of engineers working in Australia on temporary visas ranging for periods up to four years peaked at 13,181 in the 2012-13 financial year after experiencing a one-year lull in 2009-10 at the height of the GFC impact[15].

With the exception of this short disruption, the period 2006 to 2011 was characterised by an increasing number of foreign engineers working in Australia on temporary visas, combined with a trend of increasing permanent migration. Conversely, the period from 2012 to 2016 was characterised by falling numbers of engineers working in Australia on temporary visas, but with a continuing trend of increasing permanent migration.

**The key point is that census statistics give the net outcome of these changes.** Although temporary skilled migration of engineers has fallen substantially, there are still several thousand working in Australia in this capacity. The decline in temporary migrants has been offset by the continuing increase in the number of permanent migrants. This means that the numerical increase in the last five years has been substantially higher than in the years before the collapse in demand for engineers.

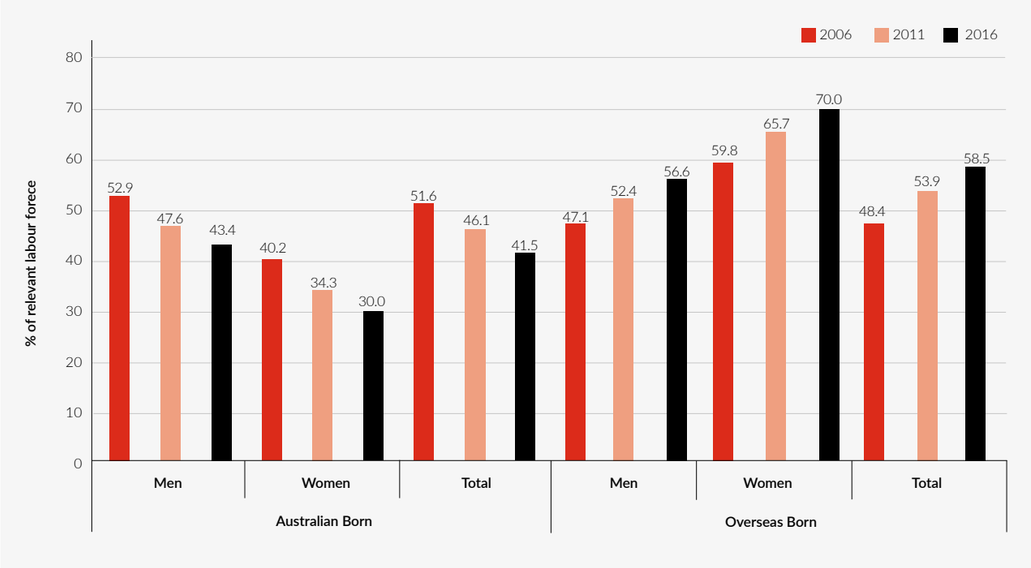
14. Since the census, the SOL has been renamed as the Medium to Long Term Strategic Skills List or MLTSSL.

15. Engineers Australia, The Engineering Profession; A Statistical Overview, Thirteenth Edition, February 2017, www.engineersaustralia.org.au . Statistics sourced from the Department of Immigration and Border Protection.





**Figure 2.2:** Ethic shares in the Australian engineering labour force, 2006 to 2016



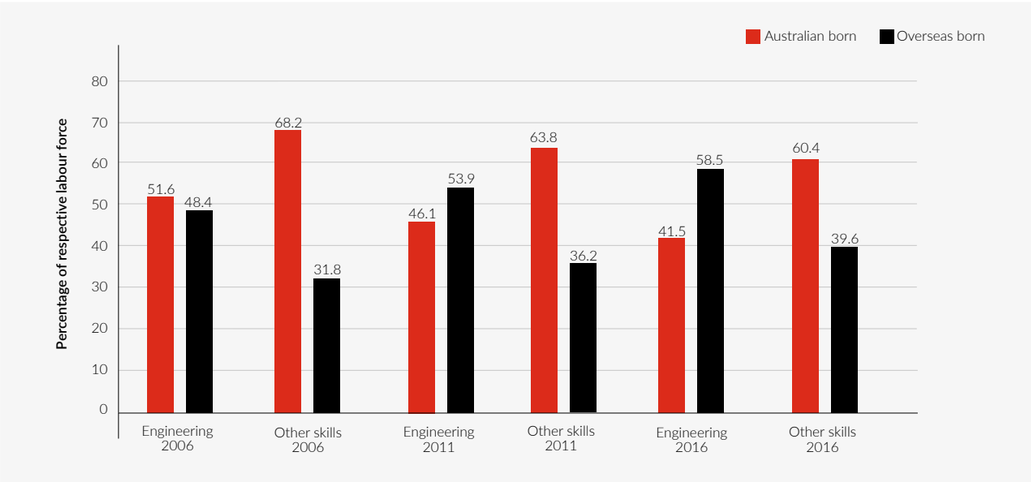

**This skilled migration has had a profound impact on the ethnic composition of the engineering labour force.** In 2007, there were 97,193 migrant qualified engineers – 84,527 men and 12,666 women – in the engineering labour force. Figure 2.2 shows these figures as proportions of the engineering labour force overall; 48.4% were overseas-born qualified engineers, and 51.6% were Australian-born.

Segmented by gender, overseas-born men were 47.1% and overseas-born women were 59.8% of overall men and women respectively. This meant Australian-born men were 52.9% and Australian-born women were 40.2% of men and women respectively.

By 2011, skilled migration had increased the overseas-born component of the engineering labour force by 45,162 or 46.5%. The corresponding increase in the Australian-born component was 18,097 or 17.5%. The result was that the Australian-born component of the engineering labour force fell from 51.6% to 46.1% and the overseas-born component increased from 48.4% to 53.9%.

**In other words, between 2006 and 2011, the engineering labour force switched from being majority Australian-born to majority overseas-born.** This change affected both genders, with overseas-born men becoming the majority and entrenching the existing majority for overseas-born women.

**Figure 2.3**: Ethnic shares in Australia's skilled labour forces; qualified engineers compared to other skills, 2006 to 2016




Between 2011 and 2016, the increase in overseas-born qualified engineers was larger than in the earlier period; 50,544 compared to 45,162. The increase in Australian-born qualified engineers was smaller; 15,533 compared to 18,097. The result was to further entrench overseas-born qualified engineers as the majority. Their share increased to 58.5% while Australian-born qualified engineers' share fell to 41.5%. The change was particularly strong in this period for women: in 2016, Australian-born women were 30.0% and overseas-born women were 70.0% of female qualified engineers.

**Skilled migration to Australia encompasses a wide range of skills, not just qualified engineers.** Therefore, it is important to compare the changes in the engineering labour force to the labour force for other skills. This comparison is illustrated in Figure 2.3. There are two points to note from this diagram:

- ***As intended, skilled migration has substantially contributed to the development of Australia's skilled labour force.*** In the process, it has changed the labour force's ethnic composition.
- ***The engineering labour force is far more dependent on skilled migration than the labour force for other skills collectively.*** The overseas-born component of the engineering labour force has grown from 48.4% to 58.5% of the engineering labour force, compared to a change from 31.8% to 39.4% for the other skills labour force.





## 2.4. The gender composition of the engineering labour force

**KEY POINTS**

- Between 2006-2016, women's share of the engineering labour force increased from 10.6%-13.6%; and their share of employment in engineering occupations increased from 8.2%-11.2%.
- These increases are substantially lower than in other skilled professions and the labour force as a whole, and do not reflect strong increases in the number of qualified women engineers.

In 2006, 10.6% of the engineering labour force was composed of women. Since then, the number of women in the Australian engineering labour force has more than doubled, increasing from 21,174 to 44,982 in 2016. This change lifted the women's share to 11.8% in 2011 and subsequently to 13.6% in 2016.

In Section 2.9, we discuss employment in engineering occupations. This concept distinguishes between qualified engineers who work in engineering occupations and qualified engineers who work in occupations with little or no engineering content.

**The proportion of female qualified engineers employed in engineering occupations has generally been lower than the proportion of women in the engineering labour force.** Figure 2.4 shows that in 2006 when the women's share of the engineering labour force was 10.6%, their share of employment in engineering occupations was 8.2%. Similarly, in 2011, the comparison was 11.8% compared to 9.7% in engineering occupations and in 2016, 13.6% compared to 11.2% in engineering occupations. This comparison is illustrated in Figure 2.4.

**Figure 2.4:** Labour force gender shares, qualified engineers compared to other groups in the labour market, 2006, 2011 and 2016

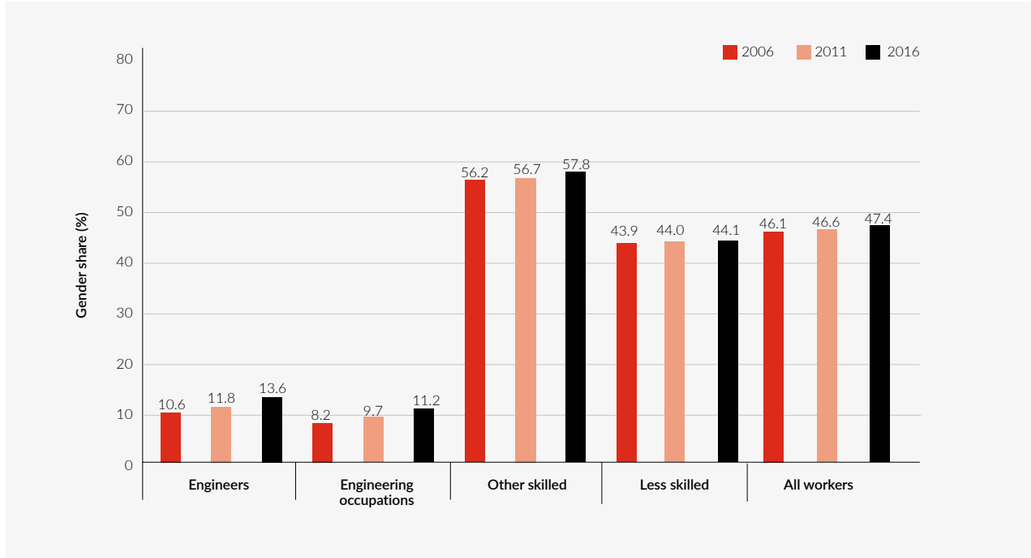
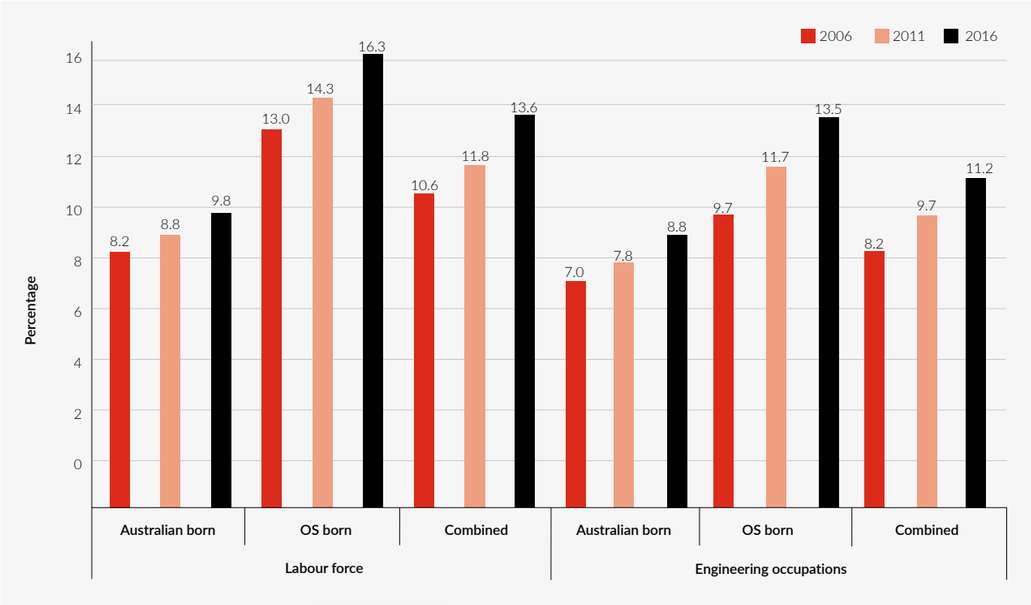


**Figure 2.5:** The proportion of women in the engineering labour force, Australian and overseas born segments, 2006 to 2016




The gender composition of the engineering labour force is more skewed towards men than other elements of skills and the labour force as a whole. The women's share of the engineering labour force has clearly increased, but the rate of progress is slow.

**The main reason that the women's share of the engineering labour force has increased is skilled migration of women.** We observe from Figure 2.5 that the women's share of the overseas-born segment is higher and has increased faster than the Australian-born share.

In the engineering labour force, the Australian-born women's share has increased from 8.2% in 2006 to 9.8% in 2016 compared to an increase from 13.0% to 16.3% for the overseas-born share. Similarly, in engineering occupations, the Australian-born women's share of engineering occupations increased from 7.0% to 8.8% while the overseas-born women's share increased from 9.7% to 13.5%.

## 2.5. Participation in the labour force

**KEY POINTS**

- Labour force participation by qualified engineers is higher in aggregate than participation is for other skilled workers. In both skill groups, labour force participation has been higher for men than for women.
- The exceptions to this generalisation are that the participation of Australian-born qualified women engineers has remained high, while that of Australian-born men fell substantially.

Australian Engineering Excellence Awards, Byron Bay Railroad Company World's First Solar Train
Byron Bay Railroad Company, Lithgow Railway Workshop, Nickel Energy, Elmofo

**Labour force participation measures the proportion of the population that is actively engaged in the labour market.** This can either be through being employed, or if unemployed, by actively searching for work.

Historically, participation was seen as a measure of the working age population, which was typically defined to be the age range 15 to 64 years. However, this definition is now outdated because many workers continue in the labour force well beyond historical retirement ages. To accommodate this trend, we adopt a more open-ended definition: the working age population is at least 15 years of age.

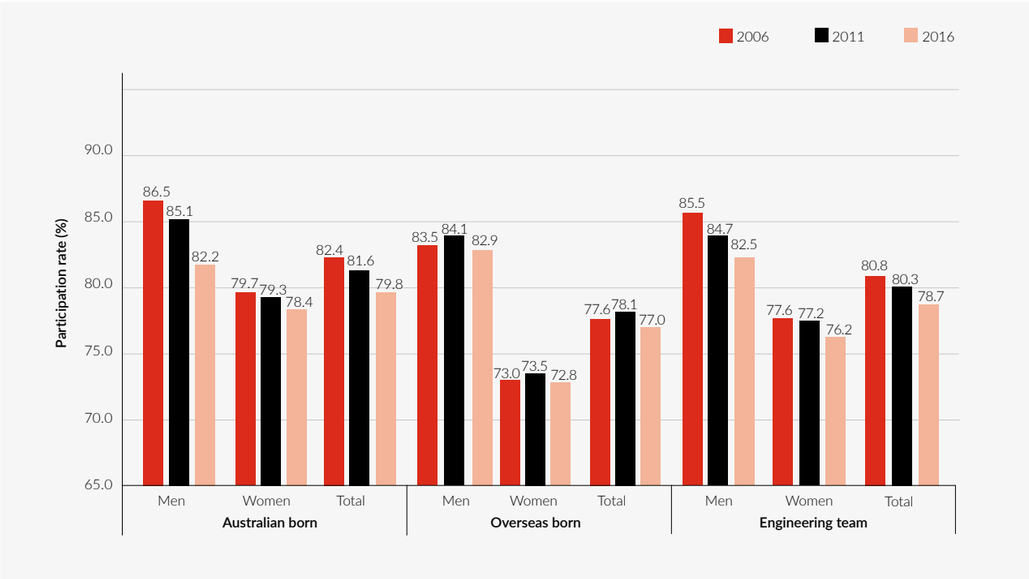
**The participation rate is therefore the proportion of the relevant population actively engaged in the labour market.** There are numerous reasons why people do not participate in the labour market, including:

- full time education
- attending to family responsibilities
- long-term debilitating illness
- age retirement.

Participation rates are important because they give perspective to other common labour market measures (like the employment and unemployment rates) by reflecting social changes and reactions to labour market conditions. High labour force participation is one of the three "Ps" regarded by the Treasury as the key to future increases in the standard of living. The other "Ps" are productivity and population[16].

**Qualified engineers are typically associated with high rates of labour force participation.** However, to accurately evaluate the situation, we need to compare ethnic and gender groups and to compare qualified engineers to other skilled workers. These comparisons are undertaken using Figure 2.6, which illustrates the participation rates for other skilled workers, and Figure 2.7, which illustrates the corresponding participation rates for qualified engineers[17].

**Figure 2.6:** Labour force participation rates for other skilled workers, 2006 to 2016

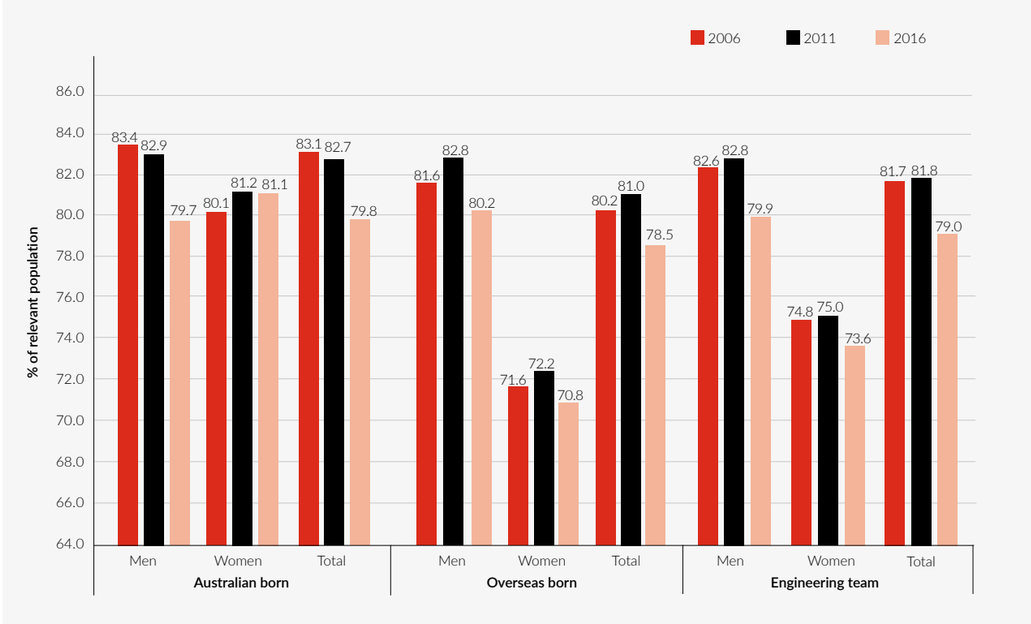



16. See archive.treasury.gov.au/igr/
17. We calculated participation rates by discounting "not stated" from population estimates. The numbers who responded this way were small for engineers, but were much larger for other labour market segments. Including them in population figures meant that estimates of the participation rate were understated.





**Figure 2.7:** Labour force participation rates for the Australian engineering labour force, 2006 to 2016




If we focused only on aggregate labour force participation rates, we would compare the last three columns of each of the two diagrams. This shows that labour force participation for qualified engineers has been higher than for other skilled workers. In 2006, participation by qualified engineers was 81.7% compared to 80.8% for other skilled workers. By 2011, participation for qualified engineers had increased slightly to 81.8% while for other skilled workers it fell to 80.3%. Labour market conditions changed between 2011 and 2016 and as a result participation by both groups fell; for qualified engineers to 79.0% and for other skilled workers to 78.7%.

**Despite the changes, labour force participation by qualified engineers was higher than for other skills.** However, disaggregating into ethnic and gender groups shows a more complex picture.

Consider Australian-born workers first. **Men with other skills had higher labour force participation rates than qualified engineers in each census year.** In 2006, the comparison was 86.5% for other skilled men compared to 83.4% for male qualified engineers. In 2011, both participation rates had fallen, and the comparison was 85.1% for other skilled men and 82.9% for qualified engineers. Both groups experienced strong discouraged worker effects during 2011 to 2016; and in 2016, the comparison was 82.2% for other skilled workers and 79.7% for qualified engineers.

**Meanwhile, the participation rates for Australian-born female qualified engineers was higher than for Australian-born women with other skills: the opposite result to men.** Furthermore, participation by women with other skills steadily fell, while participation by female qualified engineers increased and did not fall between 2011 and 2016. In 2006, the comparison was 80.1% for female qualified engineers compared to 79.7% for women with other skills. In 2011, participation for female qualified engineers increased to 81.2% while it fell to 79.3% for women with other skills. In 2016, female qualified engineers maintained participation at 81.1% while there was a further fall in participation to 78.4% for

women with other skills. The large gender imbalance for qualified engineers in favour of men produced an overall result that showed higher participation by Australian-born qualified engineers than Australian-born other skilled workers. However, by 2016 the two groups had the same rate of participation.

**In general, labour force participation by overseas-born workers has been lower than by Australian-born workers**. It has also been lower for overseas-born qualified engineers than overseas-born other skilled workers.

Consider the two groups of men. In 2006, overseas-born qualified male engineers had a participation rate of 81.6% compared to 83.4% by Australian-born qualified male engineers and 83.5% for overseas-born other skills workers. While participation fell for Australian-born men between 2006 and 2011in both skills groups, it increased for overseas-born men. Despite the increase however, participation by overseas-born workers remained lower than for Australian-born counterparts.

**Between 2011 and 2016, participation fell for both qualified male engineers and men with other skills, with the fall for the former much larger than the latter.** Participation by overseas-born qualified engineers was well below that for overseas-born other skilled workers. With the changes described in 2016, participation rates between Australian-born and overseas-born men was similar within each skills group but was lower for qualified engineers than other skilled workers.

**Overseas-born women in both skills groups had markedly lower labour force participation rates than Australian-born women.** An important difference has also developed between qualified female engineers and other skilled women. Consider Australian-born women. In 2006, the comparison was 80.1% participation by qualified engineers compared to 79.7% by Australian-born women with other skills. By 2011, the participation rate for Australian-born qualified engineers had increased to 81.2%, and essentially remained unchanged through to 2016. In contrast, participation by Australian-born women with other skills fell steadily and by 2016 was 78.4%.

**There has been a substantial gap in participation between Australian-born and overseas-born women.** Participation by overseas-born female qualified engineers has been lower than participation by overseas-born other skilled women. In 2006, the participation rate for Australian-born female qualified engineers was 80.1% compared to 79.7% for Australian-born women with other skills. By 2011, participation for qualified engineers had increased to 81.2% and it remained essentially unchanged at this level through to 2016. In contrast, participation by Australian-born women with other skills steadily fell to 79.3% in 2011 and 78.4% in 2016, suggesting evidence for a discouraged worker effect.

**In both skill groups, labour force participation rates for Australian-born women has been substantially higher than for overseas-born women.** For overseas-born female qualified engineers, participation rates were 71.6% in 2006, 72.2% in 2011 and 70.8% in 2016. For overseas-born women with other skills the corresponding rates were 73.0%, 73.5% and 72.8%, respectively. These rates were each higher than recorded for qualified engineers.

*Overseas-born women in both skills groups had markedly lower labour force participation rates than Australian-born women.*





## 2.6. Aboriginal and Torres Strait Islander engineers

**KEY POINTS**

- The number of Aboriginal and Torres Strait Islander engineers has increased strongly since 2006. Despite this, in 2016, just 0.3% of the engineering labour force identified as Aboriginal or Torres Strait Islander.

**In 2011, Engineers Australia adopted a Reconciliation Action Plan as its contribution to the Government's "closing the gap" program.** An element was to actively encourage more Aboriginal and Torres Strait Islander people into engineering careers. Progress towards this objective is outlined in Table 2.3. However, the small numbers in this Table require some caution, especially in respect to derived estimates.

**Table 2.3:** Aboriginal and Torres Strait Islander engineers in Australia

| 2006 Census | | | |
|---|---|---|---|
| Variable | Men | Women | Total |
| Total employed | 281 | 31 | 312 |
| Total unemployed | 17 | 3 | 20 |
| Engineering labour force | 298 | 34 | 332 |
| Not in labour force | 42 | 7 | 49 |
| Population | 340 | 41 | 381 |

| 2011 Census | | | |
|---|---|---|---|
| Variable | Men | Women | Total |
| Total employed | 410 | 41 | 451 |
| Total unemployed | 10 | 0 | 10 |
| Engineering labour force | 420 | 41 | 461 |
| Not in labour force | 72 | 13 | 85 |
| Population | 492 | 54 | 546 |

| 2016 Census | | | |
|---|---|---|---|
| Variable | Men | Women | Total |
| Total employed | 722 | 80 | 802 |
| Total unemployed | 45 | 5 | 50 |
| Engineering labour force | 767 | 85 | 852 |
| Not in labour force | 170 | 22 | 192 |
| Population | 937 | 107 | 1044 |

**In 2006, the labour force of Aboriginal and Torres Strait Islander engineers was 332, of which 10.2% were women.** At 87.1% the labour force participation rate was very high, but it was accompanied by an unemployment rate of 6.0% at a time of high demand for engineers.

By 2011, the Aboriginal and Torres Strait Islander engineering labour force had increased by 38.9% to 461. Labour force participation was lower at 84.4%, but unemployment was mainly frictional (that is, unemployment consistent with workers moving between jobs) with a rate of just 2.2%.

**By 2016, the Aboriginal and Torres Strait Islander engineering labour force had increased by a further 84.8% to 852.** This was an overall increase of 157% since 2006; evidence of significant progress. Labour force participation fell to 81.6%, reflecting the difficult circumstances in the engineering labour market, however, participation was higher than for the engineering team overall. The unemployment rate increased to 5.9%, which was broadly consistent with the unemployment rate for the engineering team.

## 2.7. Growth in the supply of qualified engineers

**KEY POINTS**

- The Summary: The supply of qualified engineers has experienced stronger growth than the supply of other skilled workers. This was primarily due to skilled migration and part of a broader phenomenon in which skills have been the driving force.
- The overseas-born component of the engineering labour force grew faster than the Australian-born component. The supply of qualified women engineers grew faster than the supply of male qualified engineers.

The supply of qualified engineers increases when:

- new graduates join the labour force
- existing graduates not in the labour force re-join it
- permanent or temporary skilled migrants join the labour force.

Conversely, the engineering labour force decreases when qualified engineers:

- retire due to age
- leave the labour force to undertake family responsibilities or because of illness
- temporary migrants return to home countries.

**Supply is therefore influenced by government higher education and migration policies, and by the choices made by individuals to study engineering.** The discussion in section 2.5 also showed that the supply of qualified engineers is influenced by labour market conditions. In this section, we turn our attention from participation in the labour force to how the balance of these factors affects the numerical size of supply.

**The supply of qualified engineers has grown faster than other segments of the Australian labour market.** Between 2006 and 2011, the supply of qualified engineers grew by an average 5.6% per year, well above the average 4.9% per year growth in the supply of other skills. This relationship was maintained between 2011 to 2016, although both growth rates slowed somewhat to average 4.6% per year for qualified engineers and 4.1% per year for other skilled workers.

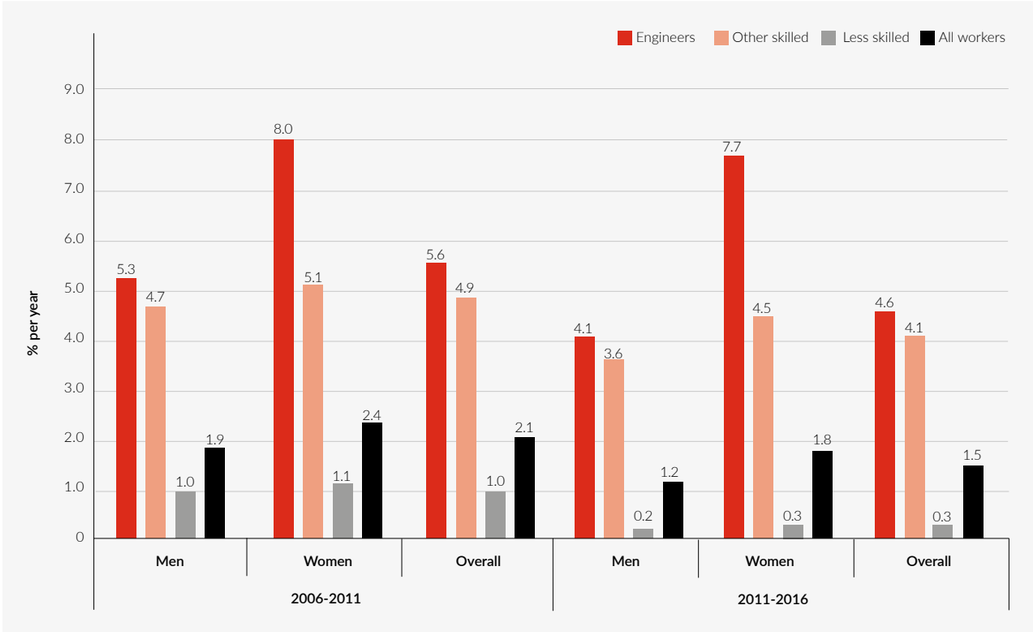
The supply of skilled workers, whether qualified engineers or in other areas, has grown several multiples faster than the supply of workers with lower level qualifications or no qualifications in both periods. In Figure 2.1, we observed that this group's share of the Australian labour force overall has fallen over time. This is due to a combination of slow growth for this group: an average of 1.0% per year between 2006 and 2011, and an average of 0.3% per year between 2011 and 2016, with substantially higher growth in the two skills groups. These results are illustrated in Figure 2.8.





**The highest growth rates have been achieved by skilled women.** Between 2006 and 2011, the supply of female qualified engineers increased by an average of 8.0% per year compared to average 5.3% per year for men. Growth in supply for other skills was also high with an average of 5.1% per year for women and 4.7% for men, but there was a clear gap between these rates and those for qualified engineers. In comparison, the largest segment of the labour force (other workers) experienced more muted growth, averaging just 1.1% per year for women and 1.0% per year for men. The combined outcome for Australia's labour supply was an average of 2.4% per year growth for women, 1.9% per year for men, and 2.1% per year overall.

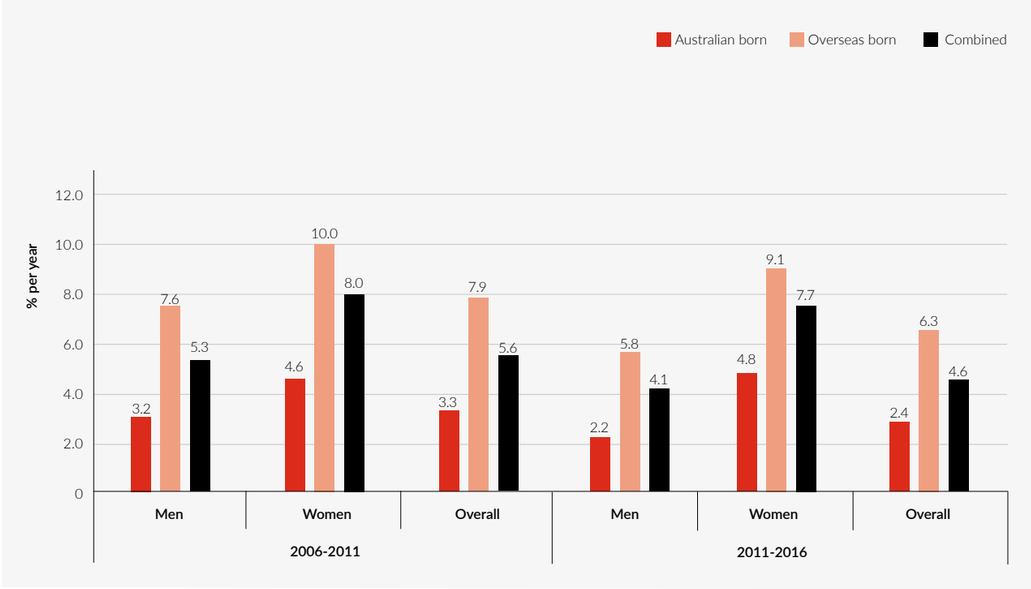
**Figure 2.8:** Average annual growth in the Australian labourforce, qualified engineers, other skills and other workers, 2006 to 2016




**The dominance of skills was again evident in the pattern of growth in the labour force between 2011 and 2016.** Most growth rates slowed: qualified engineers averaged 7.7% per year for women, and 4.1% per year for men. For other skilled workers, rate slowed to an average of 4.5% per year for women and 3.6% per year for men. The most obvious change during this period was the extraordinary slowdown in growth for less skilled workers.

**We conclude from these figures that growth in the supply of qualified engineers is part of a broader phenomenon in which skills have been the driving force in the growth of labour supply.** The recent resources boom and the prominence given to shortages of engineers at the time is most likely an important factor explaining the difference in growth between the two skilled groups. What is indisputable is the large gulf between growth in the skilled labour force and the less skilled labour force.

**Figure 2.9:** Contributions by ethnic and gender groups to the growth in the supply of qualified engineers, 2006 to 2016




In Figure 2.9, we examine the contributions of ethnic and gender groups to growth in the supply of qualified engineers. Several points emerge from this diagram:

- ***The overseas-born component of the engineering labour force has grown faster than the Australian-born component.*** Between 2006 to 2011, the overseas-born component grew by an average of 7.9% per year compared to average 3.3% per year for the Australian-born component. Both growth rates slowed between 2011 and 2016, but the substantial gap remained with the overseas-born component growing by average 6.3% per year and the Australian-born component by average 2.4% per year. These figures show that skilled migration has been the driving force behind growth in Australia's supply of qualified engineers.
- ***The supply of qualified female engineers has grown faster than the supply of men.*** Between 2006 to 2011, the number of qualified female engineers grew by an average of 8.0% per year compared to 5.3% per year for men. Once again, both rates slowed between 2011 to 2016 to average 7.7% per year for women compared to 4.1% per year for men. This rapid growth puts the gender shares illustrated in Figure 2.4 into appropriate perspective.
- ***The driving force in the increase of qualified female engineers has been skilled migration.*** This is true even though the growth in the number of Australian-born qualified women engineers has consistently exceeded growth in the number of Australian-born men.

Between 2006 to 2011, the number of Australian-born female qualified engineers grew by average 4.6% per year, less than half the average 10.0% per year for overseas-born women. The former increased to average 4.8% per year between 2011 to 2016, while the latter slowed to average 9.1% per year, demonstrating the continuation of the large gap evident in the earlier period.





## 2.8. Growth in the demand for qualified engineers

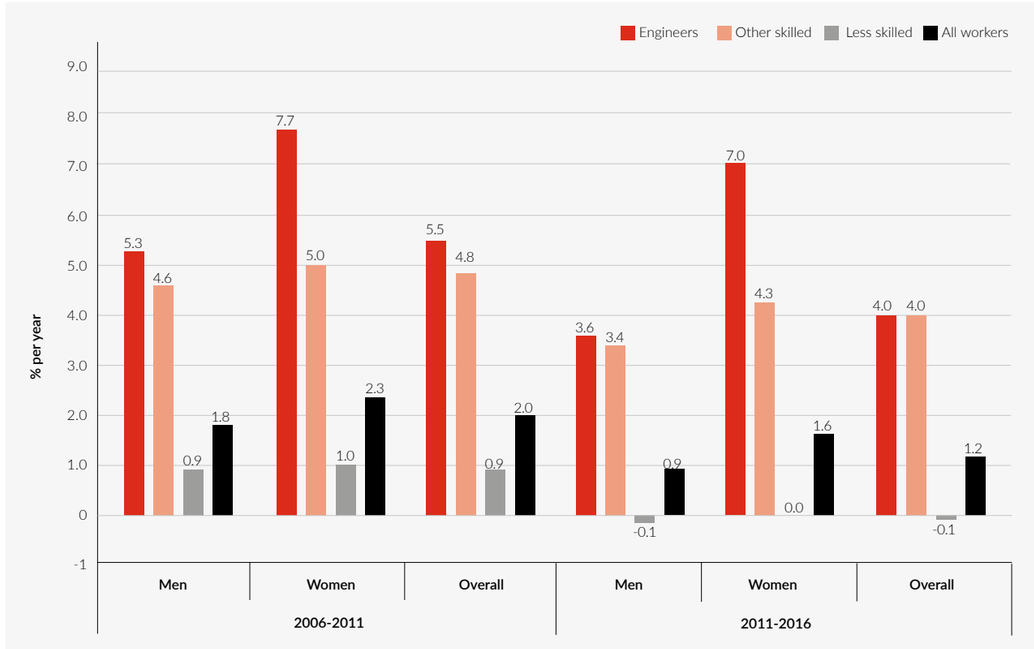
**KEY POINTS**

- Growth in demand for qualified engineers increased substantially to average 5.5% per year in the resources and infrastructure boom between 2006 to 2011. This outpaced demand growth for other skilled workers.
- This figure slowed after the boom to average 4.0% per year between 2011 to 2016, during which demand for both skill groups grew at the same rate.
- Demand growth for qualified engineers largely reflected supply growth; and again, the key driver in both periods was skilled migration.

**The demand for labour is usually measured by the number of persons employed.** Growth in the demand for qualified engineers is compared to other segments of the labour market in Figure 2.10, using the same format as in Figure 2.8.

**Growth in demand for qualified engineers increased at an average rate of 5.5% per year from 194,576 in 2006 to 254,511 in 2011.** This was faster than growth in the demand for other skilled workers which averaged 4.8% per year, reflecting the twin influences of the resources and infrastructure booms at the time. In turn, the demand for skilled workers grew over four times faster than the average 0.9% per year recorded for less skilled workers. As was the case with supply, the driver of employment growth in Australia was skills.

**Figure 2.10:** Average annual growth in demand for labour in Australia, qualified engineers, other skilled workers and other workers, 2006 to 2016

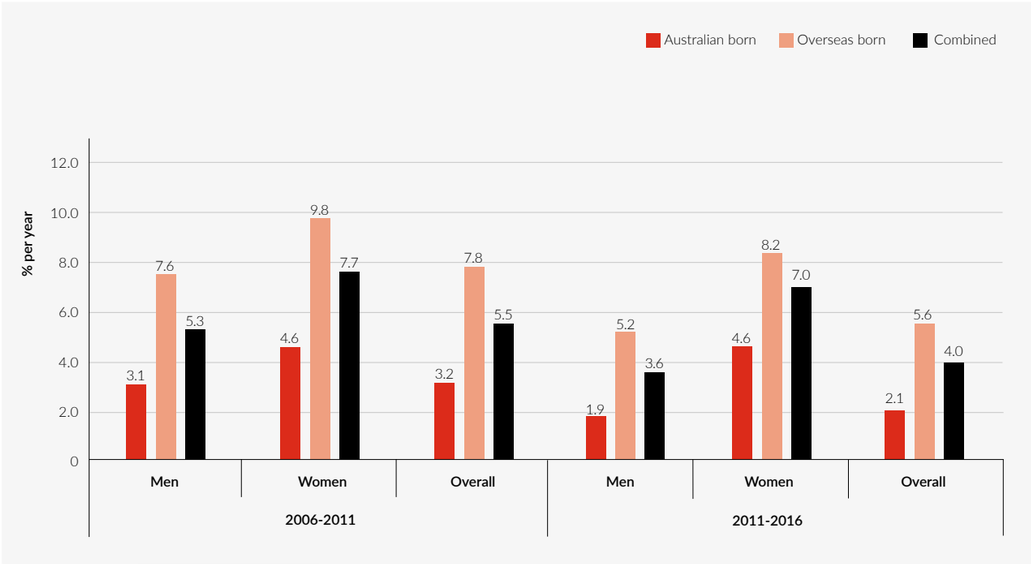


**By 2016, employment of qualified engineers had increased to 310,270, and employment growth had slowed to average 4.0% per year.** Employment growth also slowed for other labour market groups. Growth in the demand for other skilled workers fell from average 4.8% per year to average 4.0% per year. Meanwhile, employment for less skilled workers was effectively stagnant, contracting by average 0.1% per year.

Several of the changes in supply evident in Figure 2.9 are reflected on the demand side and these are illustrated in Figure 2.11:

- ***Slower growth in demand for qualified engineers in the 2011 to 2016 period affected both ethnic groups and both genders.*** It was particularly strong for Australian-born men. Employment growth slowed from an average of 7.7% per year to 7.0% per year for women, and from 5.3% per year to 3.6% per year for men. Employment growth for overseas-born qualified engineers fell from an average of 7.8% per year to 5.6% per year. Employment growth among Australian-born men was the slowest of all groups and fell from an average of 3.1% per year to 1.9% per year.
- ***Again, the driver of employment growth for qualified engineers was skilled migration.*** Between 2006 and 2011, demand for qualified engineers born overseas grew by an average of 7.8% per year compared to 3.2% per year for those born in Australian. This relationship continued between 2011 to 2016 with the demand for overseas qualified engineers growing by average 5.6% per year compared to average 2.1% per year for Australian-born engineers.
- **The highest growth rates were recorded for qualified women engineers.** An important contrast is that while growth in demand for overseas-born qualified women engineers fell between the two periods, growth in demand for Australian-born women remained constant. For both groups of women, the impact of high employment growth on overall growth was limited by the low representation of women.

**Figure 2.11:** Contributions by ethnic and gender groups to growth in demand for qualified engineers, 2006 to 2016








## 2.9. Utilisation of the supply of qualified engineers

**KEY POINTS**

- Unemployment rates for qualified engineers have substantially increased. In 2006, rates were similar in aggregate to those for other skilled workers, although rates were higher in qualified female engineers than in other skilled workers.
- By 2016, the unemployment rate for all qualified engineers had doubled to 6.0% from 3.0% in 2006. This was far more than rates for other skilled workers, and was worst in overseas-born female engineers, who had rates in double figures.
- On the basis of unemployment figures alone, Australia's utilisation of qualified engineers has deteriorated over time. However, when these figures are combined with those for qualified engineers who work outside of engineering occupations, the deterioration poses serious risks to Australia's future engineering capability.

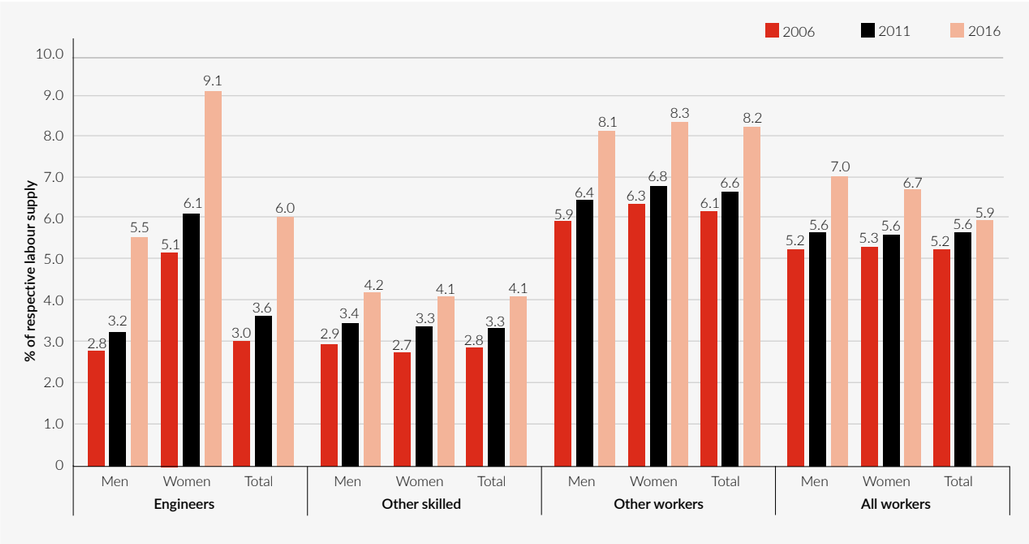
**The discussion in the previous two sections indicated that the supply of qualified engineers has grown faster than demand, so unemployment has increased.** Utilisation of the supply of labour is usually gauged by changes in the unemployment rate. An increase in the unemployment rate is associated with a deterioration in the effective utilisation of supply.

Differences in supply and demand growth for ethnic and gender groups resulted in corresponding changes in the utilisation of qualified engineers. Figure 2.12 illustrates how unemployment rates for qualified engineers have changed compared to other labour market groups.

**In 2006, the unemployment rate for qualified engineers was 3.0%, slightly higher than the 2.8% rate for other skilled workers.** Low unemployment rates like these are close to frictional rates of unemployment. A key difference between the two skilled groups related to unemployment rates for women.

**Among qualified engineers, the unemployment rate was higher for women than for men, but among other skilled workers the opposite was the case.** Unemployment rates for less skilled workers were about twice as high as for skilled workers. The exception to this generalisation was qualified women engineers, where the gap between unemployment rates was much less.

**Figure 2.12:** Unemployment rates for different labour market groups, 2006 to 2016




**By 2011, there was already evidence of slower labour demand growth in the Australian economy.** The unemployment rate for qualified engineers increased from 3.0% to 3.6% and for other skilled workers from 2.8% to 3.3%.

Once again, the impact on qualified women engineers was greater than on male colleagues. The unemployment rate for women increased from 5.1% to 6.1% compared to a change from 2.8% to 3.2% for men. In the other skills group, unemployment rates increased but with no gender difference. These changes did not garner much attention because the unemployment rates were low when compared to the rates for less skilled workers, which increased from 6.3% in 2006 to 6.8% in 2011.

**By 2016, the unemployment rate for qualified engineers had almost doubled from the 2011 rate.** This increase, from 3.6% to 6.0%, was substantially more than the change from 3.3% to 4.1% for other skilled workers. As occurred in both 2006 and 2011, the unemployment rate for qualified female engineers was higher than for male engineers, while there was no gender difference for the other skills group.

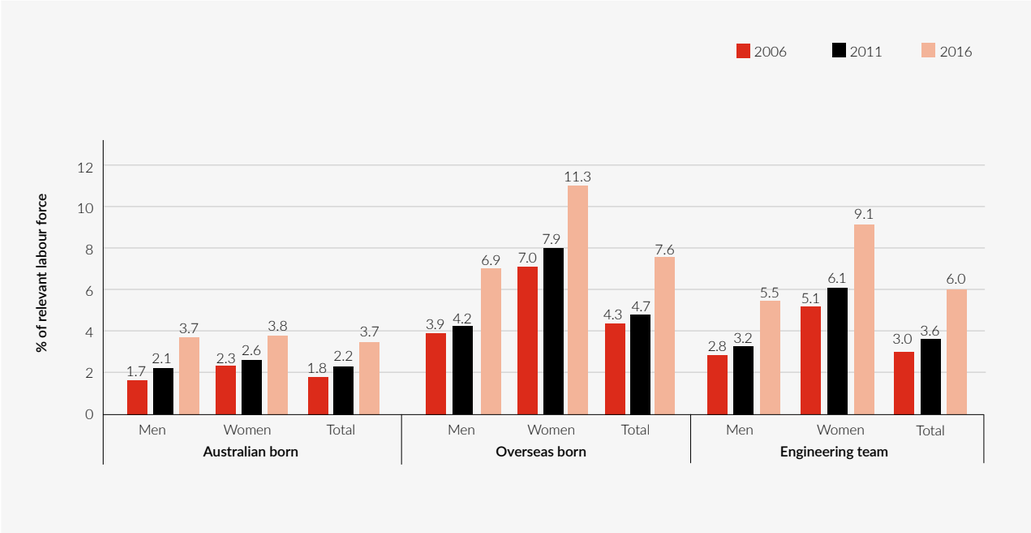
Unemployment was particularly severe for qualified female engineers, increasing from 6.1% to 9.1%. Unemployment rates for less skilled workers increased to over 8.0% with minor gender differences, and economy-wide unemployment increased from 5.6% in 2011 to 6.9% in 2016[18] putting the change for qualified women engineers into perspective.

18. Please note the points made in Chapter 1 concerning the relationship between Labour Force Survey statistics and Census statistics. The 2016 economy-wide unemployment rate in the Census was higher than in the Labour Force Survey, emphasising the importance of comparative benchmarks.





**Figure 2.13:** Unemployment rates for Australian qualified engineers, 2006 to 2016




**A substantial part of the change in unemployment of qualified engineers was borne by overseas-born individuals.** In Figure 2.13, we observe no gender difference in the change in unemployment rates for Australian-born qualified engineers between 2011 and 2016. On the other hand, when we turn to overseas-born qualified engineers, the unemployment rate for overseas-born women has been consistently higher than for men. In other words, the gender difference in unemployment among qualified engineers is mainly due to the experience of overseas-born women.

Although there was an increase in unemployment among overseas-born qualified engineers between 2006 and 2011, this change was small compared to the change between 2011 and 2016. The unemployment rate for overseas-born qualified male engineers increased from 4.2% to 6.9%. For overseas-born women however, the change was from an already-exceptionally high 7.9%, to 11.3%. These figures were well above the unemployment rate for women in the less skilled segment of the labour force.

Based on unemployment rate changes, there has been **a serious deterioration in the utilisation of Australia's engineering labour force, particularly between 2011 and 2016.** This deterioration has impacted all ethnic and gender groups. The least impact occurred among Australian-born qualified engineers. For this group, there was no gender difference; and the 2016 unemployment rates experienced remained well below the economy-wide average.

**Among overseas-born qualified engineers, the situation was more severe.** Overseas-born qualified female engineers had abnormally high unemployment rates in each of the three census years, and their rates increased into double-digit territory in 2016. Furthermore, there was a substantial increase in the rate for overseas-born male qualified engineers to a level approaching twice the rate for Australian-born qualified engineers.

## CAUTION: UNEMPLOYMENT RATES ALONE DO NOT REFLECT ENGINEERING CAPABILITY

In Chapter 1 we explained the difference between the number of qualified engineers and Australia's engineering capability, which comprises the subset of qualified engineers who are employed in engineering occupations.

The supply of qualified engineers in essence satisfies two sources of demand:

- the demand for qualified engineers as part of Australia's engineering capability
- the demand for qualified engineers to undertake more general analytical work as part of Australia's other skills labour force.

In other words, the education and training of qualified engineers are transferable to a wide range of work and not confined to engineering. However, the reverse is not true: lawyers, accountants and other skills cannot undertake engineering work due to the uniqueness of engineering practice.

**This means the unemployment rate for qualified engineers offers only a limited perspective of the change in the utilisation of Australia's engineering capability.** Qualified engineers who have moved into non-engineering work can return to the profession providing they have maintained their knowledge of contemporary engineering developments and contemporary engineering practice. Furthermore, a return to engineering work may involve acceptance of a position similar to one held prior to the interruption of their previous engineering career. The longer the absence from engineering, the more difficult a return becomes, and fewer engineers actually return.

The consequences of this distinction for the utilisation of Australia's supply of qualified engineers is outlined in Table 2.4. This table shows how Australia's supply of qualified engineers is distributed between employment in engineering occupations, employment elsewhere and unemployment from 2006 to 2016.

**The proportion of qualified engineers employed in engineering occupations is lower than many suppose, and varies greatly between ethnic and occupational groups as illustrated in Figure 2.14.**

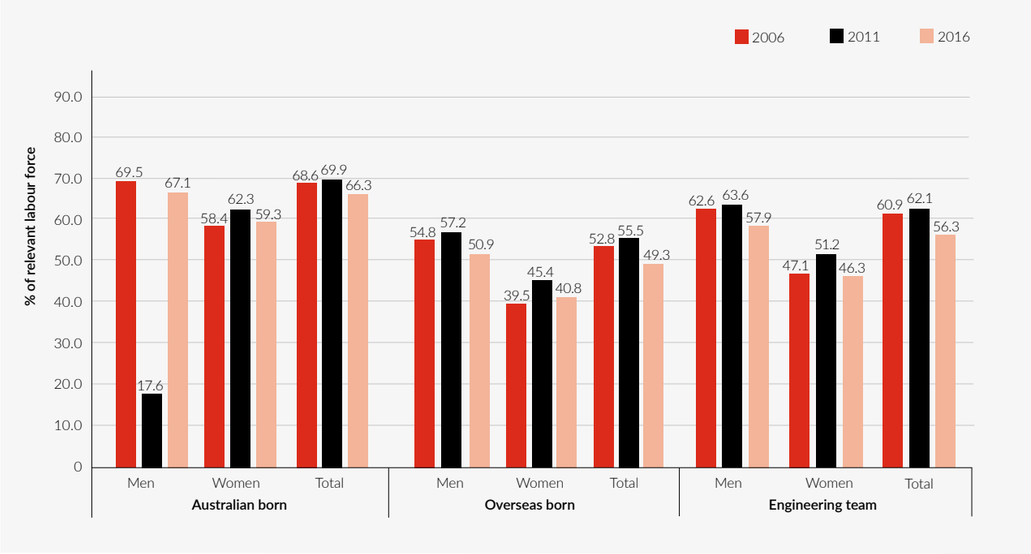
**Table 2.4:** Utilisation of Australia's qualified engineers, 2006 to 2016

| Labour market variable | Men | Women | Total | Men | Women | Total | Men | Women | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Australian born | | | Overseas born | | | Combined | | |
| Employed in engineering | 65975 | 4970 | 70945 | 46311 | 5001 | 51312 | 112286 | 9971 | 122257 |
| Employed elsewhere | 27309 | 3340 | 30649 | 34895 | 6775 | 41670 | 62204 | 10115 | 72319 |
| Unemployed | 1636 | 198 | 1834 | 3321 | 890 | 4211 | 4957 | 1088 | 6045 |
| Labour force | 94920 | 8508 | 103428 | 84527 | 12666 | 97193 | 179447 | 21174 | 200621 |
| % in engineering occupations | 69.5 | 58.4 | 68.6 | 54.8 | 39.5 | 52.8 | 62.6 | 47.1 | 60.9 |
| 2011 | Australian born | | | Overseas born | | | Combined | | |
| Employed in engineering | 78292 | 6640 | 84932 | 69708 | 9273 | 78981 | 148000 | 15913 | 163913 |
| Employed elsewhere | 30204 | 3742 | 33946 | 47119 | 9533 | 56652 | 77323 | 13275 | 90598 |
| Unemployed | 2374 | 273 | 2647 | 5103 | 1619 | 6722 | 7477 | 1892 | 9369 |
| Labour force | 110870 | 10655 | 121525 | 121930 | 20425 | 142355 | 232800 | 31080 | 263880 |
| % in engineering occupations | 70.6 | 62.3 | 69.9 | 57.2 | 45.4 | 55.5 | 63.6 | 51.2 | 62.1 |
| 2016 | Australian born | | | Overseas born | | | Combined | | |
| Employed in engineering | 82903 | 7991 | 90894 | 82175 | 12847 | 95022 | 165078 | 20838 | 185916 |
| Employed elsewhere | 36151 | 4978 | 41129 | 68144 | 15081 | 83225 | 104295 | 20059 | 124354 |
| Unemployed | 4519 | 516 | 5035 | 11083 | 3569 | 14652 | 15602 | 4085 | 19687 |
| Labour force | 123573 | 13485 | 137058 | 161402 | 31497 | 192899 | 284975 | 44982 | 329957 |
| % in engineering occupations | 67.1 | 59.3 | 66.3 | 50.9 | 40.8 | 49.3 | 57.9 | 46.3 | 56.3 |





**Figure 2.14:** The proportions of the Australian engineering labour force employed in engineering occupations, 2006 to 2016




In 2006, the supply of qualified engineers, or engineering labour force, was 200,621: 122,257 or 60.9% were employed in engineering occupations, 72,319 were employed in other occupations and 6,045 were unemployed.

The highest proportion employed in engineering occupations was 69.5% for Australian-born men, and the lowest was 39.5% for overseas-born women. There was a substantial gender difference in each ethnic group: 69.5% of Australian-born men were employed in engineering occupations compared to 58.4% for Australian-born women. There was also a similar gender gap for overseas-born qualified engineers.

Further, there was a substantial difference between ethnic groups: 68.6% of Australian-born qualified engineers were employed in engineering occupations compared to 52.8% of overseas born qualified engineers.

In other words, the unemployment rate for qualified engineers reflects the utilisation of the skilled labour force more accurately than it does the utilisation of the supply of qualified engineers in engineering work as part of Australia's engineering capability.

**A more balanced position is needed: one that takes into account what a qualified engineer does.** Such a measure combines the number of qualified engineers not employed in engineering occupations, plus the number unemployed as a proportion of the engineering labour force.

**Using this measure shows that between 2006 and 2011, utilisation of Australia's supply of qualified engineers improved. This happened even though about one third did not work in engineering.** In 2006, there were 78,364 qualified engineers in these situations, which comprised 39.1% of the engineering labour force. By 2011, the supply of qualified engineers had increased by 31.5% and employment in engineering occupations had increased by 34.1% to 163,913. The relationship between these figures explains why the proportion of qualified engineers employed in engineering occupations increased in 2011.

At the same time, the number of qualified engineers unemployed increased by 55.0% to 9,369; and the number not employed in engineering occupations increased by 25.3% to 90,598. In aggregate, 99,967 qualified engineers were either unemployed or not employed in engineering occupations. While this figure is larger than the corresponding one in 2006, high growth in the supply of qualified engineers meant that it was 37.9% of the 2011 engineering labour force.

**By 2016, utilisation of Australia's engineering labour force was below the 2006 and 2011 levels, despite a two-third increase in the supply of engineers since 2006.** In 2016, the supply of qualified engineers had increased to 329,957 and employment in engineering occupations had increased to 185,916.

The proportion employed in engineering occupations also fell to 56.3% with all groups losing ground. The proportion remained highest for Australian-born men at 67.1%, and the lowest was still overseas-born women with 40.8%. The combined total of unemployed qualified engineers and qualified engineers not employed in engineering increased to 144,041. But despite the strong growth in the supply of engineers, this figure was 43.7%, indicating a substantial fall in the utilisation of Australia's engineering labour force.

Another way to look at these changes is to examine the growth rates for the supply of qualified engineers, growth in demand for them, and growth in the demand for qualified engineers in engineering occupations. This is done in Table 2.5.

**Between 2006 and 2011, the supply of qualified engineers grew by average 5.6% per year.** Demand for qualified engineers grew slightly more slowly, averaging 5.5% per year. However, the demand for qualified engineers to work in engineering occupations was much stronger, growing by an average of 6.0% per year. The strength of the demand for qualified engineers to work in engineering occupations relative to growth in supply was the pressure felt by employers that was generally described as a shortage of engineers. It was indeed a shortage, but not of qualified engineers per se; it was a shortage of qualified engineers willing to work in engineering occupations. This shortage was evident among overseas-born qualified engineers and among Australian-born men, but not Australian-born women.

**Table 2.5:** Relative growth in the supply of qualified engineers and engineering capability

| Average annual growth in (%) | Men | Women | Total | Men | Women | Total | Men | Women | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Australian born | | | Overseas born | | | Combined | | |
| **2006 to 2011** | | | | | | | | | |
| Supply of qualified engineers | 3.2 | 7.6 | 5.3 | 4.6 | 10.0 | 8.0 | 3.3 | 7.9 | 5.6 |
| Demand for qualified engineers | 3.1 | 7.6 | 5.3 | 4.6 | 9.8 | 7.7 | 3.2 | 7.8 | 5.5 |
| Employment in engineering | 3.5 | 6.0 | 3.7 | 8.5 | 13.1 | 9.0 | 5.7 | 9.8 | 6.0 |
| **2011 to 2016** | | | | | | | | | |
| Supply of qualified engineers | 2.2 | 5.8 | 4.1 | 4.8 | 9.1 | 7.7 | 2.4 | 6.3 | 4.6 |
| Demand for qualified engineers | 1.9 | 5.2 | 3.6 | 4.6 | 8.2 | 7.0 | 2.1 | 5.6 | 4.0 |
| Employment in engineering | 0.9 | 3.8 | 1.4 | 3.4 | 6.7 | 3.8 | 2.2 | 5.5 | 2.6 |

**Between 2011 and 2016, circumstances changed dramatically as Australia's engineering capability deteriorated.** Growth in the supply of qualified engineers slowed, but at an average of 4.6% per year, it was still fairly robust. Employment growth for qualified engineers slowed even more to average 4.0% per year, which explains the large increase in unemployment.

However, the largest change was the reduction in growth in employment of qualified engineers in engineering occupations from average 6.0% per year to average 2.6% per year between 2011 and 2016. Opportunities in engineering work on average grew by 2.0% per year less than growth in the supply of qualified engineers. This provides a crude gauge of the deterioration in Australia's engineering capability.

Australian Engineering Excellence Awards, Henry Rolland Park And Boardwalk
Chincivil Pty Ltd

**Many qualified engineers who do not work in engineering occupations are employed in other skilled occupations, but this is not always the case.** For example, in 2016, there were 592 individuals with at least a Bachelor's degree in engineering employed as "occupational and environmental health professionals" and as "social professionals", clearly skilled occupations. On the other hand, there were 3,356 similarly qualified individuals employed as "car, bus, train, delivery or truck drivers". Another 7,342 were employed as "cleaners, construction workers, process workers, packers and freight handlers". Clearly, these are not professional level occupations, and they emphasise the poor utilisation of at least 8.6% of the qualified engineers not employed in engineering occupations in 2016.

The issue here is that unless an individual studies and completes a recognised qualification in engineering, they are unable to become an engineer. However, completion of this qualification is simply the first step towards becoming an engineer. Additional steps include undertaking and completing professional formation in engineering practice[19] and then building a career working in engineering. In other words, focusing policy on the number of engineering graduates addresses one important issue, but neglects other key factors.

**The approach to assessing utilisation of the supply of qualified engineers shows that retention of qualified engineers in engineering is a major issue.**

## 2.10. The structure of employment

**KEY POINTS**

- The proportion of qualified engineers employed in engineering occupations falls with age for both men and women, with the proportion of women lower for all age groups. This differential is less in Australian-born than in overseas-born engineers.
- Qualified engineers tend to have a higher proportion of full-time work and a lower proportion of part-time work than is seen in other skilled workers. This effect is magnified in the proportions of engineers in full-time work in engineering occupations.
- There is a gender gap across all skill categories, with women tending to have a greater incidence of part-time work than men. However, the gap is narrower in engineering occupations than in other skilled work.

In earlier sections, we considered the size and growth of employment for qualified engineers and other skilled workers. We now turn attention to the structure of employment. There are two aspects we consider:

- First, we examine employment of qualified engineers in engineering occupations more closely to investigate how it changes over the working life of a qualified engineer.
- Second, we consider the role of full-time and part-time work in the lives of qualified engineers.

### AGE PROFILE SHIFTS IN EMPLOYMENT OF QUALIFIED ENGINEERS

**We have already observed that the proportions of qualified engineers employed in engineering occupations have been quite low.** In 2006, it was 60.9%, in 2011 it increased to 62.1% and in 2016 it fell sharply to 56.3%. An important question is: at what stage do qualified engineers decide to leave engineering and accept work in other occupations?

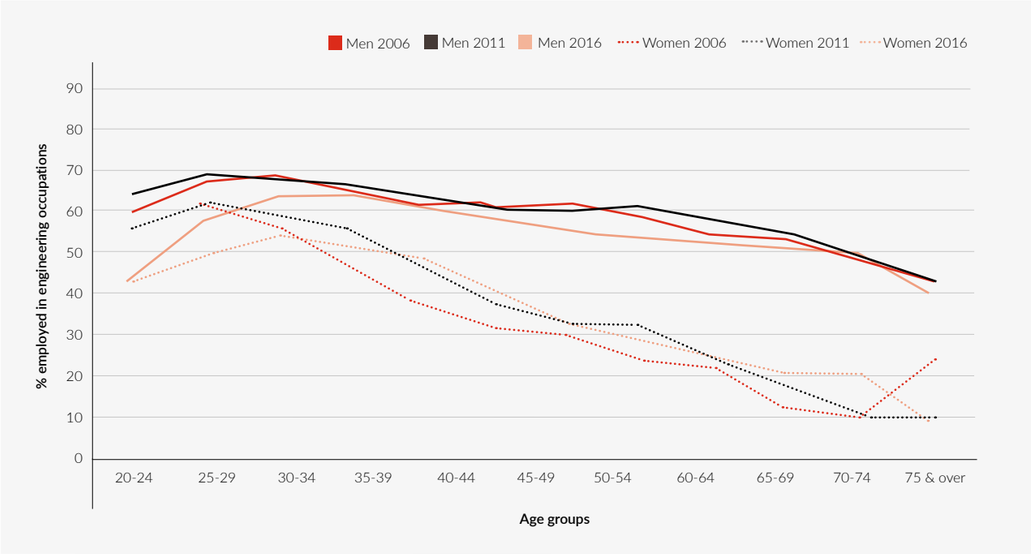
In Figure 2.15, we examine the life cycle profile for qualified engineers employed in engineering occupations. Specifically, we look at whether and how the proportions employed in engineering occupations change for qualified engineers aged from 20 years to over 75 years of age.

19. In this respect, engineering has arrangements similar to other professions.





**Figure 2.15:** The proportion of qualified engineers employed in engineering occupations falls with age




**The proportion of qualified engineers employed in engineering occupations falls with age for both men and women.** The labour market circumstances when each census was taken affects its position relative to other years.

At any given census, the life cycle profile of employment in engineering occupations for men lies above that for women. In other words, irrespective of age group, the proportion of men employed in engineering occupations is higher than women. Consider 2006: 69.5% of young men aged 25 to 29 years were employed in engineering occupations, compared to 61.7% of women in that age group. The comparison was much the same in 2011, but 2016 was very different and more is said about this below.

**The rate of decline in the proportion of women employed in engineering occupations is far higher than it is for men.** By the time young men have been in the labour force ten years, the proportion employed in engineering occupations drops to 66.6% in 2006 and 2011, but the proportion of young women falls much more, to 36.8% in 2006 and 55.9% in 2011. Move on a further ten years and the proportion of men employed in engineering occupations drops to 60.8% while the proportion of women falls to between 32 and 37%.

Opportunities for employment of women in engineering occupations improved between 2006 and 2011. The 2006 and 2011 life cycle profiles for men are almost identical, with only minor differences between them. In contrast, the 2011 life cycle profile for women lies substantially above the 2006 profile with the only point of commonality the 25 to 29-year age group. What this change shows is that at every age above 29 years, the proportion of women employed in engineering occupations in 2011 was higher than in 2006.

**The severe deterioration in the engineering labour market between 2011 and 2016 had a particularly severe impact on young qualified engineers.** For both men and women under 40 years old, proportions employed in engineering occupations are substantially lower than in the earlier years.

In the 25 to 29-year age group, 57.7% of young men and 49.6% of young women were employed in engineering occupations compared to 69.5% and 61.7% respectively in 2011. In the 30 to 34-year

age group, 63.2% of young men and 53.5% of young women were employed in engineering occupations compared to 68.5% and 59.8% respectively in 2011. The difference between 2016 and 2011 diminished with age. In the case of women, from age group 40 to 44 years the 2011 and 2016 profiles were almost identical. However, in the case of men in their 50s the 2016 profile was below the 2011 profile.

**More research is needed to explain the downward slope of the profiles and the low starting values.** Movements up or down in the life cycle profiles, whether the whole trend or any part of it, can be attributed to conditions in the engineering labour market. However, the downward slopes of the profiles cannot be explained in this way. Similarly, the starting values of the profiles are comparatively low, at best about 70% in the 25 to 29-year age group.

Further research is necessary to establish definitive explanations. The most plausible explanation is that career opportunities are limited in engineering, and that there are more attractive options in other areas of work. Alternatively, working conditions in engineering may not be as attractive as elsewhere, particularly for women.

**The proportion of Australian-born male qualified engineers employed in engineering occupations has been higher than that for overseas-born males irrespective of age group.** Figure 2.16 shows that the life cycle profiles for both groups trend downwards, but the profile for overseas-born men lies well below that of Australian-born men. There was some upward movement of the profile for overseas-born men from 2006 to 2011, but not enough to challenge the substantial gap between the two groups. Another important point to note is the high values of the early career proportions of Australian-born men employed in engineering occupations: 75.4% in 2006, increasing to 78.1% in 2011, but falling to 72.7% in 2016, in each case in the 25 to 29-year age group.

In contrast, the highest proportions of overseas-born men employed in engineering occupations occur in the 30 to 34-year age group. This is determined largely by the immigration process: the most common age for migrant engineers is about 32 years. The values of these maximum proportions are low compared to Australian-born men: 60.4% in 2006, 62.4% in 2011 and 56.7% in 2016.

**Figure 2.16:** The proportion of male qualified engineers employed in engineering occupations

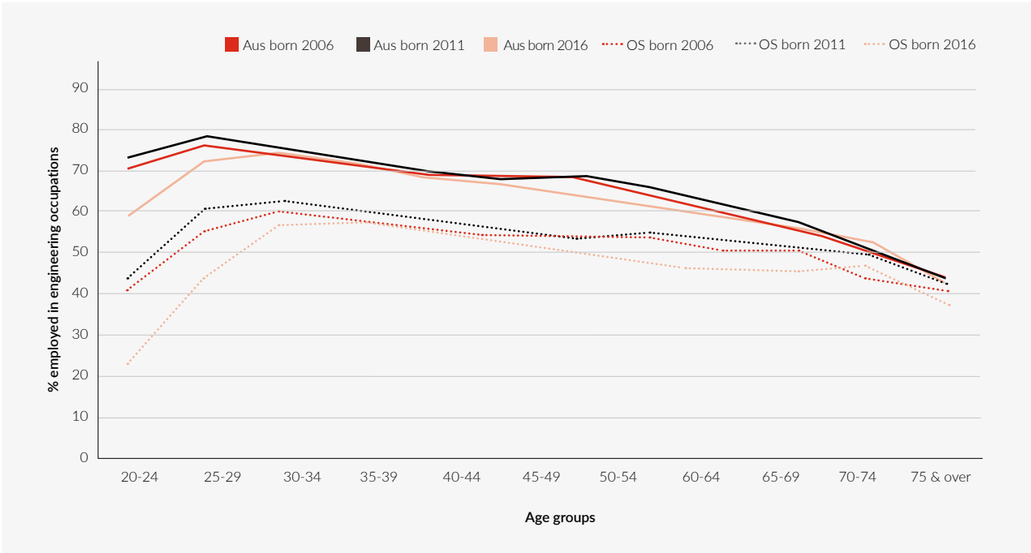
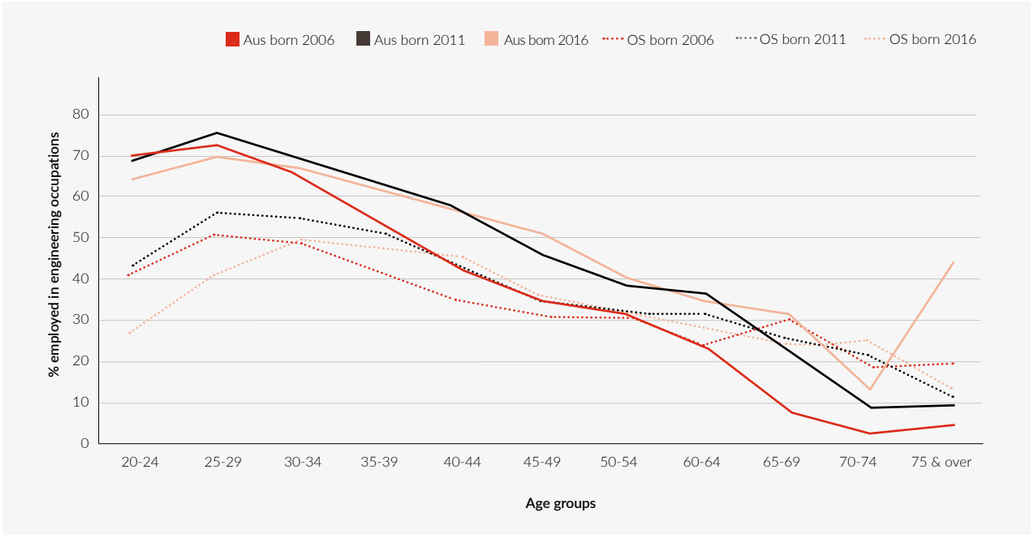







**Figure 2.17:** The proportion of women qualified engineers employed in engineering occupations




The downwards shift of parts of the 2016 profiles are clearly evident for both Australian-born and overseas-born groups, with the main incidence on young engineers and engineers in their 50s. However, the degree of change was more pronounced for the overseas-born group than the Australian-born group.

**The experience of female qualified engineers mirrors that of men in many respects, with a decline that is more severe for women.**

The highest proportions employed in engineering occupations were young Australian-born women; 71.8% in 2006, 74.1% in 2011 and 69.2% in 2016, each in the 25 to 29 years age group. These values are below the corresponding ones for Australian-born men, but are well above those for overseas-born men.

The upwards shift in the profile between 2006 and 2011 was quite pronounced for Australian-born women and more muted for overseas-born women. In 2016, both groups experienced a downwards shift in their life cycle profile in the younger age groups: for Australian-born women aged below 35 years and for overseas-born women aged below 40 years. Comparing Figure 2.16 and 2.17 shows that the decline in proportions employed in engineering occupations with age is more severe for women than men.

## PROPORTIONS OF QUALIFIED ENGINEERS IN FULL-TIME VS. PART-TIME WORK

The ABS reports employment statistics under three headings:

- full-time employment (worked 35 or more hours per week)
- part-time employment (worked less than 35 hours per week)
- away from work (people have a job but are away from work for a range of reasons).

**Using these definitions, Table 2.6 taken at face value suggests that qualified engineers undertake more full-time and less part-time work than other skilled workers.**

In 2006, 83.3% of qualified engineers worked full-time compared to 69.5% of other skilled workers. Over time, the share of full-time work fell for both

groups to 83.1% in 2011 and 80.4% in 2016 for qualified engineers; and to 68.5% in 2011 and 67.1% in 2016 for other skilled workers.

Conversely, part-time work has been more important to other skilled workers and less important to qualified engineers. In 2006, 12.2% of qualified engineers worked part-time, rising to 12.7% in 2011 and to 16.0% in 2016. The corresponding shares of part-time work for other skilled workers were 25.2%, 26.3% and 28.2%, respectively.

For both groups, a small proportion of workers were away from work on census night. For other skilled workers, the shares were 5.3% in 2006 and 2011 and 4.6% in 2016. For qualified engineers, the corresponding shares were 4.5%, 4.2% and 3.6%, respectively. No information is available to allocate these shares to either full-time or part-time employment.

**Table 2.6:** The structure of employment, qualified engineers and other skills, 2006 to 2016

| Employment status | Men | Women | Total | Men | Women | Total | Men | Women | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Australian born | | | Overseas born | | | Combined | | |
| **Other skills** | | | | | | | | | |
| Employed FT | 81.7 | 58.5 | 69.5 | 81.1 | 57.3 | 68.5 | 79.9 | 56.3 | 67.1 |
| Employed PT | 13.9 | 35.3 | 25.2 | 14.9 | 36.3 | 26.3 | 16.8 | 37.9 | 28.2 |
| Employed away | 4.3 | 6.2 | 5.3 | 3.9 | 6.4 | 5.3 | 3.2 | 5.8 | 4.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Qualified engineers** | | | | | | | | | |
| Employed FT | 84.8 | 70.5 | 83.3 | 85.0 | 68.5 | 83.1 | 82.6 | 65.7 | 80.4 |
| Employed PT | 10.8 | 23.8 | 12.2 | 11.0 | 25.5 | 12.7 | 14.0 | 29.0 | 16.0 |
| Employed away | 4.4 | 5.7 | 4.5 | 4.0 | 5.9 | 4.2 | 3.4 | 5.3 | 3.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

In part, the difference in full-time shares between other skilled workers and qualified engineers is due to the low share of qualified women engineers and the substantially higher share of other skilled women choosing to work part-time. Breaking down the figures just discussed shows this, but nonetheless does not alter the conclusion that full-time work is more important to qualified engineers.

Consider the statistics for men. **The share of full-time work for men has fallen over time, but remains the bulk of work for men, and is more important for male qualified engineers than male workers with other skills.** In 2006, 84.8% of male qualified engineers worked full-time compared to 81.7% of other skilled males. In 2011, these shares were 85.0% for qualified engineers and 81.1% for other skills and in 2016 they were 82.6% and 79.9%, respectively.

Conversely, the shares of part-time work for both groups of men have increased over time and are more important for male other skilled workers. For qualified engineers, shares increased from 10.8% in 2006 to 11.0% in 2011 and to 14.0% in 2016; for other skilled workers from 13.9%, to 14.9% and to 16.8%, respectively.

The circumstances for women were totally different. **Compared to men, the share of full-time work was lower and the share of part-time work was higher for both groups, but full-time work was far more important for female qualified engineers.** In 2006, 70.5% of female qualified engineers worked full-time compared to 58.5% of women with other skills. Like men, the share of full-time work fell over time: for qualified engineers, it fell to 68.5% in 2011 and to 65.7% in 2016. For other skilled women, the share of full-time work fell to 57.3% in 2011 and to 56.3% in 2016.

Conversely, part-time work was more important to women with other skills than to female qualified engineers, even though almost twice as many female qualified engineers as men worked part-time. In 2006, 23.8% of female qualified engineers worked part time compared to 10.8% of men. However, 35.3% of women with other skills worked part time. In 2011, these figures were 11.0% and 25.5% for qualified engineers and 36.3% for women with other





skills. In 2016, they were 14.0% and 29.0% for qualified workers and 37.9% for other skills.

**The statistics in Table 2.6 relate to qualified engineers. When the focus is on engineering occupations, full-time work is even more important and part-time work is less important.**

Figure 2.18 distinguishes between the statistics for male qualified engineers in the Table and male qualified engineers employed in engineering occupations. Figure 2.19 does the same thing for female qualified engineers.

**Figure 2.18:** The changing structure of employment, male qualified engineers employed in engineering occupations, 2006 to 2016

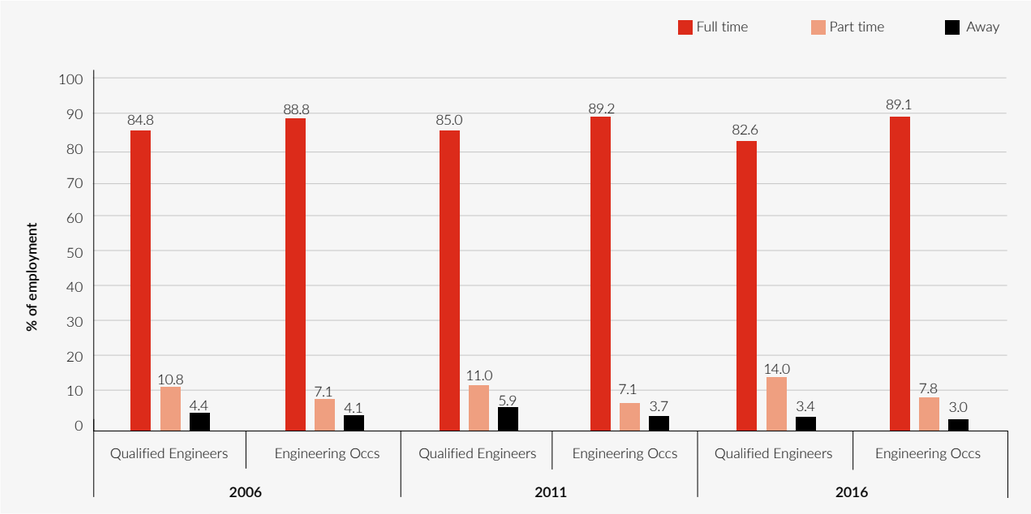
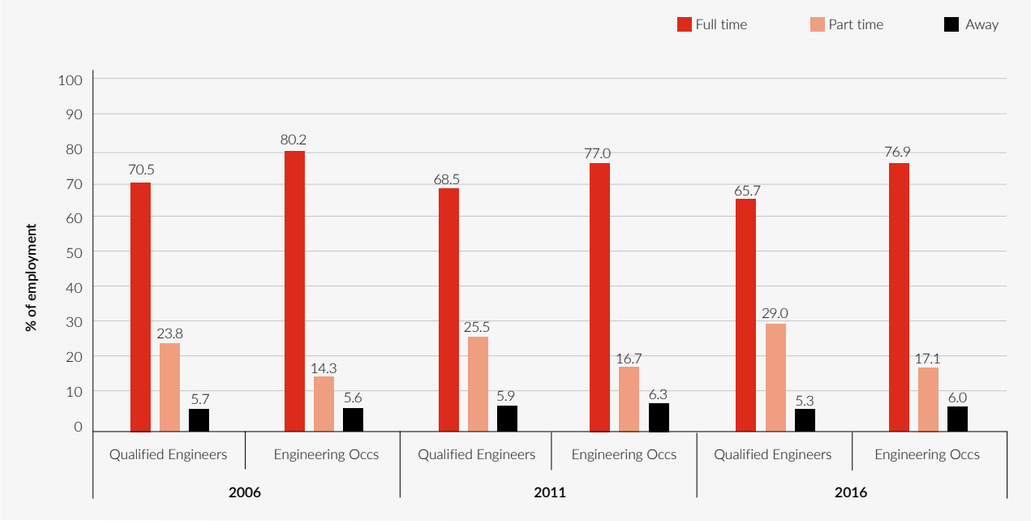



**Figure 2.19:** The changing structure of employment, women qualified engineers employed in engineering occupations, 2006 to 2016



**The share of full-time work is more important in engineering occupations for both genders.** For men, the share of full time work in engineering occupations was 88.8% in 2006, 89.2% in 2011 and 89.1% in 2016 compared to 84.8%, 85.0% and 82.6%, respectively for male qualified engineers engaged in any occupation. For women, the share of full time work in engineering occupations were 80.2% in 2006, 77.0% in 2011 and 76.9% in 2016 compared to 70.5%, 68.5% and 65.7%, respectively for female qualified engineers engaged in any occupation.

**Figure 2.20:** The structure of employment of qualified engineers in engineering occupations, Australia and overseas born men, 2006 to 2016

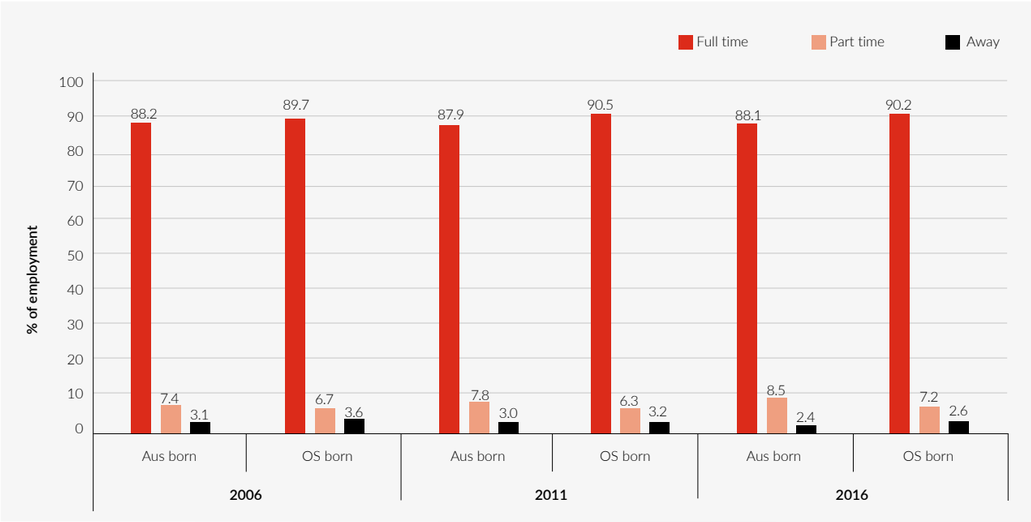
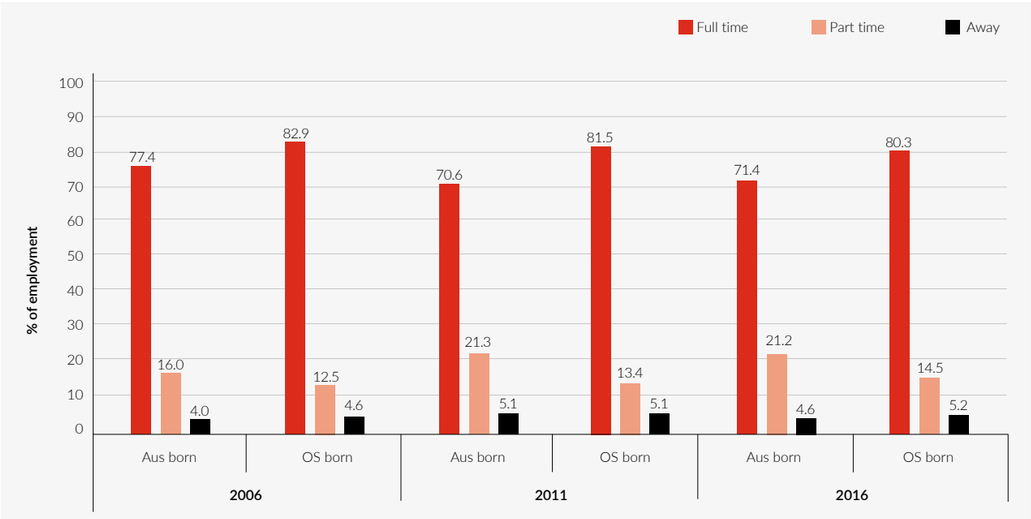



**Figure 2.21:** The structure of employment of qualified engineers in engineering occupations, Australia and overseas born women, 2006 to 2016








**For both men and women, the share of part-time work in engineering occupations was substantially less than for qualified engineers generally.** For men in engineering occupations, the shares of part-time work were 7.1% in 2006 and 2011 and 7.8% in 2016 compared to 10.8%, 11.0% and 14.0%, respectively for male qualified engineers generally. For women, the shares of part-time work in engineering occupations were higher than for men but far lower than for female qualified engineers generally. In engineering occupations, the shares were 14.3% in 2006, 16.7% in 2011 and 17.1% in 2016 compared to 23.8%, 25.5% and 29.0% respectively for female qualified engineers generally.

**Shares of part-time work become progressively lower as we move from women with other skills to female qualified engineers generally to female qualified engineers employed in engineering occupations.** This is despite the trend towards increasing part time work.

In Figures 2.20 and 2.21 we seek to establish whether the structure of employment in engineering occupations varies or is similar between Australian and overseas-born qualified engineers. The first illustration covers men and the second covers women.

The high incidence of full-time employment in engineering occupations is common to both Australian and overseas-born qualified engineers. Indeed, the proportion of full-time employment is slightly higher among the overseas-born group. The figures in Figure 2.20 are consistent over time and the small variability in them does not support any changing trend. The proportion of Australian-born qualified engineers employed part-time has remained low, despite increasing from 7.4% in 2006 to 8.5% in 2016. This upward trend was not observed for the overseas-born group among whom the incidence of part-time employment was even lower. In both groups, the share of employment away from work was very low.

A different pattern emerges for the employment of women qualified **female qualified engineers in engineering occupations**. In this group, the incidence of full-time employment was lower for Australian-born than overseas-born women. In 2006, 77.4% of Australian-born women in engineering occupations were employed full-time. This fell to 70.6% in 2011 before increasing to 71.4% in 2016. The corresponding shares for overseas-born women were 82.9%, 81.5% and 80.3%, respectively.

The converse was the case for part-time employment. More Australian-born women were employed in engineering occupations part-time than was the case for overseas-born women, and there are indications of an upwards trend in both cases.

## 2.11. The characteristics of migrant engineers

**KEY POINTS**

- Between 2006 and 2016, the overseas-born component of the engineering labour force increased from 48.4% to 58.5%. Most (95.6%) of this was due to skilled migration.
- Labour force participation in 2016 for overseas-born qualified engineers who arrived from 2012 onward has fallen well below rates for both other arrival cohorts and for Australian-born qualified engineers.
- Irrespective of when they arrived, overseas-born engineers experience higher unemployment rates than Australian-born engineers do, with recent arrivals experiencing higher rates than in the unskilled labour force segment.
- This raises concerns with the current policy of skilled migration to develop Australia's engineering capability.

In earlier sections, we considered the size and growth of employment for qualified engineers

In section 2.3, we considered the ethnic composition of the supply of qualified engineers. In this section, we examine the characteristics of migrant engineers in greater detail, including arrival in Australia and the range of labour market parameters covered in earlier parts of this chapter.

The first issue we consider is the arrival profile of migrant engineers and how it relates to our short-hand characterisation "overseas-born". Base line statistics for this purpose are presented in Table 2.7 which represents the statistics in Table 2.2 for overseas-born qualified engineers according to arrival in Australia[20].

**Table 2.7:** The overseas born engineering labour force in 2016, by time of arrival in Australia

| Arrival period | Labour market status | Men | Women | Total |
|---|---|---|---|---|
| Before 1990 | Employed | 29366 | 3094 | 32460 |
| | Unemployed | 1740 | 160 | 1900 |
| | Labour force | 31106 | 3254 | 34360 |
| | Not in LF | 20216 | 2186 | 22402 |
| | Population | 51322 | 5440 | 56762 |
| During 1990s | Employed | 24874 | 4896 | 29770 |
| | Unemployed | 1530 | 275 | 1805 |
| | Labour force | 26404 | 5171 | 31575 |
| | Not in LF | 4655 | 1782 | 6437 |
| | Population | 31059 | 6953 | 38012 |
| 2000 to 2006 | Employed | 28354 | 5191 | 33545 |
| | Unemployed | 1523 | 365 | 1888 |
| | Labour force | 29877 | 5556 | 35433 |
| | Not in LF | 2793 | 1325 | 4118 |
| | Population | 32670 | 6881 | 39551 |
| 2007 to 2011 | Employed | 35171 | 7041 | 42212 |
| | Unemployed | 2211 | 803 | 3014 |
| | Labour force | 37382 | 7844 | 45226 |
| | Not in LF | 3430 | 2371 | 5801 |
| | Population | 40812 | 10215 | 51027 |
| 2012 to 2016 | Employed | 32555 | 7704 | 40259 |
| | Unemployed | 4074 | 1960 | 6034 |
| | Labour force | 36629 | 9664 | 46293 |
| | Not in LF | 8824 | 5330 | 14154 |
| | Population | 45453 | 14994 | 60447 |
| All arrivals | Employed | 150320 | 27926 | 178246 |
| | Unemployed | 11078 | 3563 | 14641 |
| | Labour force | 161398 | 31489 | 192887 |
| | Not in LF | 39918 | 12994 | 52912 |
| | Population | 201316 | 44483 | 245799 |

20. The ABS perturbation procedure means the statistics in Table 2.6 are slightly different to those in Table 2.2. For example, in Table 2.,6 the all arrivals labour force is 192,887 compared to 192,899 in Table 2.2. These small differences are spread throughout Table 2.6 and do not affect conclusions.





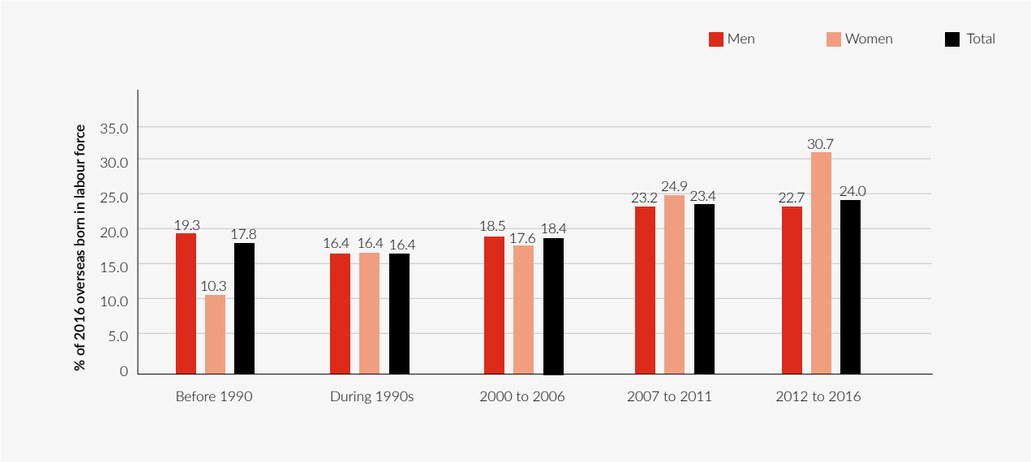
**The numbers of migrant qualified engineers arriving in Australia increased significantly between 1990 and 2016. These numbers made up an increasing proportion of the engineering labour force.** Their arrival profile is illustrated in Figure 2.22, which shows that prior to 1990, 56,762 migrant engineers arrived in Australia, and 34,360 were in the engineering labour force in 2016. The latter was 17.8% of the 2016 engineering labour force and was heavily weighted towards men.

During the 1990s, 38,012 migrant engineers arrived in Australia; and 31,575 of them, or 16.4% were in the engineering labour force in 2016. From 2000 onwards, successive cohorts of migrant engineers increased in size:

- Arrivals between 2000 to 2006 were 39,551, which contributed 18.4% of the 2016 labour force.
- Arrivals between 2007 to 2011 were 51,027, which contributed 23.4% of the 2016 labour force.
- Arrivals between 2012 to 2016 were 60,447, which contributed 24.0% of the 2016 labour force.

Figure 2.22 clearly demonstrates the increase in the proportion of women engineers migrating to Australia in successive arrival cohorts since 1990.

**Figure 2.22:** The overseas born engineering labour force in Australia in 2016 by time of arrival



**Most (95.6%) of the increase in overseas-born engineers between 2006 and 2016 came from skilled migration.** This is shown in the figures in Table 2.7, which can be applied to establish the relationship between skilled migration of engineers and the number of overseas-born engineers.

Between the 2006 and 2016 censuses, the supply of overseas-born qualified engineers increased by 95,706 from 97,193 to 192,899. New migrant engineers arrived in three cohorts over this period; and 91,519 of them were in the engineering labour supply in 2016. This accounted for 95.6% of the increase in overseas-born qualified engineers. The remainder of the change (4,187 or 4.4%) comprised migrants who arrived in Australia before 2006 and then joined the labour force between 2006 and 2016, and migrants from any cohort who changed participation decisions and joined the labour force.

**Before proceeding, it is important to remind readers that skilled migration statistics relate to the net outcome of both permanent and temporary migration.** Temporary migrations increased strongly between 2006 and 2011 but reversed during 2011 to 2016. Permanent migration has continued on an upwards trend, but the rate of increase has slowed in recent years.

The selection criteria for permanent migrant visas deliberately favour younger people to maximise the working lives of new migrants in Australia. The results of this policy should be reflected in labour force participation rates. This is examined in Figure 2.23, which compares the participation rate for overseas-born qualified engineers (all arrivals) shown in Figure 2.7, to the labour force participation rates for the arrival cohorts presented in Table 2.7. All participation rates relate to the engineering labour force in 2016.

**Figure 2.23:** Labourforce participation rates for overseas born qualified engineers in 2016 by time of arrival in Australia

Migrant qualified engineers who arrived in Australia before 1990 are now beginning to retire, which is reflected in the lower labour force participation rates shown in Figure 2.16. These comparatively low participation rates combine with the size of this cohort to reduce the all arrivals participation rate.

**The cohort that arrived in Australia during the 1990s had participation rates higher than the all arrivals rates, and well above those for the cohort that arrived in Australia before 1990.** The highest participation rates were those for the two cohorts that arrived in Australia between 2000 and 2011. In 2016, the overall labour force participation rates were 89.6% for the 2000 to 2006 arrival cohort, and 88.6% for the 2007 to 2011 arrival cohort. The 2016 participation rates for men in these cohorts were 91.5% and 91.6% respectively. This is well above the 80.2% recorded for all arrivals, and substantially higher than the 79.7% participation rate for Australian-born men shown in Figure 2.7.

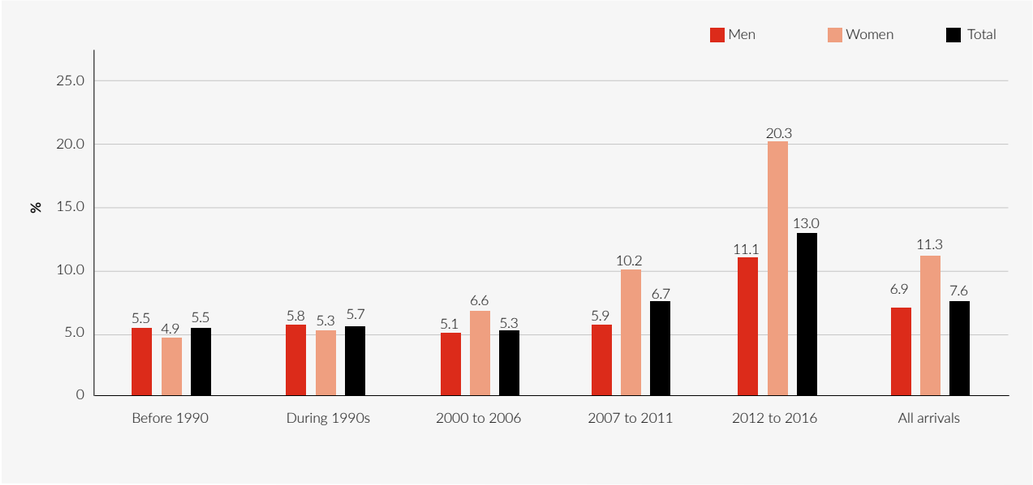
The participation rates for women in these cohorts were 80.7% and 76.8% respectively, which were also higher than the all arrivals participation rate of 70.8%. However, both rates were lower than the 2016 participation rate of 81.1% recorded for Australian-born women.

**Figure 2.16 shows that the 2016 labour force participation rates for the 2012 to 2016 arrival cohort are lower than for all cohorts except for arrivals before 1990.** In principle, the characteristics of migrant qualified engineers in the latest arrival cohort should be similar to the two cohorts that preceded it. However, selection criteria were unchanged and the preference for younger migrants ensures that age retirement should not figure in discussions.

There are two possible explanations for this result. The first is that the most recently arrived migrants experience some difficulties in integrating into the Australian engineering labour force for some time immediately after arrival in Australia. The second is their experience reflects the serious downturn in the engineering labour market between 2011 and 2016. Both explanations are probably relevant to some extent.

**In summary, the observed low 2016 labour force participation rates for all migrant arrivals are due to two factors.** The first is the beginning of age retirement in the oldest cohort; that is, arrivals in Australia before 1990. The second is the difficulties experienced in the engineering labour market by the most recently arrived migrants, who arrived in Australia between 2012 and 2016. It is important to note that this arrival cohort is the largest of those illustrated in Figure 2.22, and accounts for 24% of the overseas-born engineering labour force in 2016.

**Figure 2.24:** Unemployment rates for overseas born qualified engineers in 2016 by time of arrival in Australia



**In Figure 2.13, we noted that unemployment rates in 2016 were higher for overseas-born than Australian-born qualified engineers.** Unemployment rates for overseas-born qualified engineers were 6.9% for men, 11.3% for women and 7.6% overall. These rates are illustrated at the right-hand extremity of Figure 2.17. The corresponding 2016 unemployment rates for Australian-born qualified engineers were 3.7% for men, 3.8% for women and 3.7% overall.

In Figure 2.24 we divide the 2016 unemployment rate for overseas-born qualified engineers according to arrival in Australia.

Several points are noteworthy:

- ***Migrant qualified engineers who arrived in Australia prior to 2012 had unemployment rates below the rates for all arrivals.*** It appears that very high rates of unemployment for the most recently arrived group lifted the overall unemployment rate for overseas-born qualified engineers from 4.7% in 2011 to 7.6% in 2016.
- ***The gender gap in unemployment for migrant qualified engineers differed from that of all qualified engineers as shown in Figure 2.13.*** Migrant women who arrived before 2000 actually had lower unemployment rates than men in their cohort. From 2000 onwards, the unemployment rates for migrant women grew progressively higher than for men in successive arrival cohorts. Migrant women in the most recent arrival cohort experienced an unemployment rate of 20.3%.
- ***Irrespective of arrival in Australia, overseas-born qualified engineers have experienced higher rates of unemployment than Australian-born qualified engineers.*** In the case of men, the unemployment rate for Australian-born qualified engineers in 2016 was 3.7%. The lowest rate for overseas-born qualified engineers was 5.1% for arrivals between 2000 and 2006. In the case of women, the 2016 unemployment rate for Australian-born qualified engineers was 3.8% and the lowest rate for overseas-born women was 4.9% for arrivals prior to 1990.

In section 2.9, we argued that assessing the utilisation of the supply of qualified engineers was more complex than the conventional approach of simply evaluating changes in unemployment rates. This is because qualified engineers are not restricted to work in in engineering occupations. We observed that the proportion of overseas-born qualified engineers employed in engineering occupations was lower than the corresponding proportions for Australian-born qualified engineers.

In 2016, 50.9% of overseas-born men were employed in engineering occupations compared to 67.1% for Australian-born men. For women, the comparison was 40.8% for overseas-born women and 59.3% for Australian born-women. For the genders combined, the comparison was 49.3% for overseas-born qualified engineers and 66.3% for Australian-born.

**Figure 2.25:** The proportion of the supply of overseas born qualified engineers in 2016 employed in engineering occupations by time of arrival in Australia

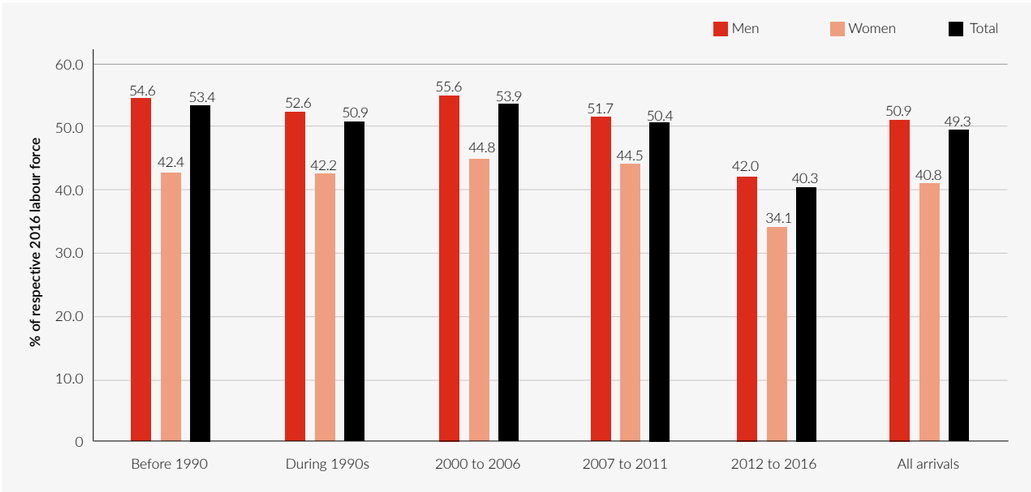







**Table 2.8:** Utilisation of Australia's overseas born qualified engineers in 2016

| Arrival period | Employed in engineering | | | Employed elsewhere | | | Unemployed | | | Labour force | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | Women | Total | Men | Women | Total | Men | Women | Total | Men | Women | Total |
| Before 1990 | 16979 | 1381 | 18360 | 12387 | 1713 | 14100 | 1740 | 160 | 1900 | 31106 | 3254 | 34360 |
| During 1990s | 13893 | 2184 | 16077 | 10981 | 2712 | 13693 | 1530 | 275 | 1805 | 26404 | 5171 | 31575 |
| 2000 to 2006 | 16599 | 2491 | 19090 | 11755 | 2700 | 14455 | 1523 | 365 | 1888 | 29877 | 5556 | 35433 |
| 2007 to 2011 | 19313 | 3494 | 22807 | 15858 | 3547 | 19405 | 2211 | 803 | 3014 | 37382 | 7844 | 45226 |
| 2012 to 2016 | 15386 | 3291 | 18677 | 17169 | 4413 | 21582 | 4074 | 1960 | 6034 | 36629 | 9664 | 46293 |
| All arrivals | 82170 | 12841 | 95011 | 68150 | 15085 | 83235 | 11078 | 3563 | 14641 | 161398 | 31489 | 192887 |

The figures for the proportion of all migrant engineer arrivals employed in engineering occupations are repeated at the right-hand extremity of Figure 2.25. These and the other figures in the illustration can be used to evaluate the utilisation of the arrival cohort components of the overseas born engineering labour force in 2016.

**Utilisation of the overall engineering labour force deteriorated substantially. Utilisation has now fallen to below the 2006 reference level.** Recall that in Section 2.9, we used 2006 as a reference point to gauge utilisation of the Australian engineering labour force. In that year, the proportion of qualified engineers not employed in engineering or unemployed was 39.1%.

By 2011, this proportion had fallen to 37.9%, indicating that utilisation of the engineering labour force had improved. However, by 2016, the proportion of qualified engineers employed in engineering occupations fell to 56.3% and the number unemployed more than doubled. The result was that the proportion of the engineering labour force not employed in engineering occupations or unemployed increased to 43.7%. We can apply the same analysis to the arrival cohorts of migrant engineers, and these estimates are presented in Table 2.8.

**In each census year, the degree of utilisation of the overseas-born component of the engineering labour force was substantially lower than utilisation of the Australian-born component.**

Consider the Australian-born component first: in 2016, 41,129 did not work in engineering and 5,035 were unemployed. The Australian-born engineering labour force was 137,058, so the proportion of the Australian-born labour force not employed in engineering was 33.7%.

The corresponding estimates for 2006 and 2011 were 31.4% and 30.1%. The changes in utilisation move in the same direction as the overall estimates but with a much higher degree of utilisation. Relative to 31.4% in 2006, utilisation of the Australian-born engineering labour force increased by 2011 when the estimate was 30.1% and deteriorated by 2016 when the estimate was 33.7%.

In contrast, the estimates of the proportion of the overseas-born engineering labour force not employed in engineering occupations or unemployed was 47.2% in 2006, 44.5% in 2011 and 50.7% in 2016. Although changes in the utilisation of the overseas-born engineering labour force occurred in the same directions as did the utilisation of the Australian-born component, utilisation of the overseas-born component was substantially lower in all years.

**In every arrival cohort, estimated proportions of engineers not employed in engineering or unemployed were significantly higher for overseas-born than for Australian-born engineers.**

In the 2016 overseas-born engineering labour force, the estimates of the proportions not employed in engineering or unemployed were 46.6% for arrivals prior to 1990, 49.1% for arrivals during the 1990s, 46.1% for arrivals during 2000 to 2006, 49.6% for arrivals during 2007 to 2011 and 59.7% for arrivals during 2012 to 2016.

In other words, even though utilisation of the Australian-born engineering labour force deteriorated between 2011 and 2016, its level of utilisation was substantially better than any arrival cohort of overseas-born qualified engineers.

**The gap between the two segments is sufficiently high to call into question the effectiveness of skilled migration in contributing to the development of Australia's engineering capability.** Finally, the estimate for the most recently arrived cohort confirms that a disproportionate share of engineering labour market adjustment has fallen on the most recently arrived migrant engineers.

## 2.12. Sources of Australia's migrant engineers

**KEY POINTS**

- The composition of the source Australia's labour force of overseas-born qualified engineers has shifted over time to favour Asian countries. In the most recent arrival period, India, China and the Philippines account for 43.5% of new migrant engineers.
- However, in qualified engineers from eight of the top ten source countries, unemployment rates were higher and utilisation rates were lower than for Australian-born engineers.
- These figures suggest that continuing large scale intakes of qualified engineers will not further develop Australia's engineering capability.

**The composition of Australia's labour force of overseas-born qualified engineers has changed over time.** It has been sourced from 166 of the 249 countries and/or locations in the ABS global classification. In any given arrival period, the number of source countries is remarkably stable, varying between 138 and 140. At the same time, the number of migrant engineers from historical source countries has fallen and has been replaced by substantially larger increases from other countries. We examine the changes that have occurred in two ways; first, we consider the changes that have occurred in the number of migrant qualified engineers arriving in Australia from nine global regions, and then we consider what are the top ten source countries and how has this list changed over time.

Figure 2.26 illustrates the proportion of qualified engineers who arrived in Australia from the nine regions in the ABS classification in each of the arrival periods identified in the previous section. **Historically, the United Kingdom and Europe were the important sources for Australia's migrants.** However, the proportions of qualified engineers from these regions have fallen and are now quite small. The proportion of migrant qualified engineers from North-West Europe has fallen from 24.9% for the pre-1990 arrival period to 9.0% during 2012 to 2016. Similarly, the proportions arriving from Southern and Eastern Europe have fallen from 12.3% to 4.5%.

Migration from Asian regions is sometimes thought to be a recent phenomenon. However, Figure 2.26 shows that sourcing qualified engineers from Asian regions was already well established among the group that arrived before 1990. In particular, 20.8% were from South East Asia, 11.6% were from North East Asia and 7.1% were from Southern and Central Asia.

**However, while Asian source regions grew in importance over time, there has been pronounced shift in migration between regions.** In the most recent arrival period, the share coming from South East Asia has fallen to 12.3%, the share coming from North East Asia has followed a roller-coaster trend, initially rising, but then contracting back to its initial size. In contrast, the share coming from Southern and Central Asia has rapidly expanded from 7.1% before 1990 to 39.5% in the 2012 and 2016 arrival period.





**Figure 2.26:** The overseas born engineering labour force in 2016 by arrival in Australia and global region of birth

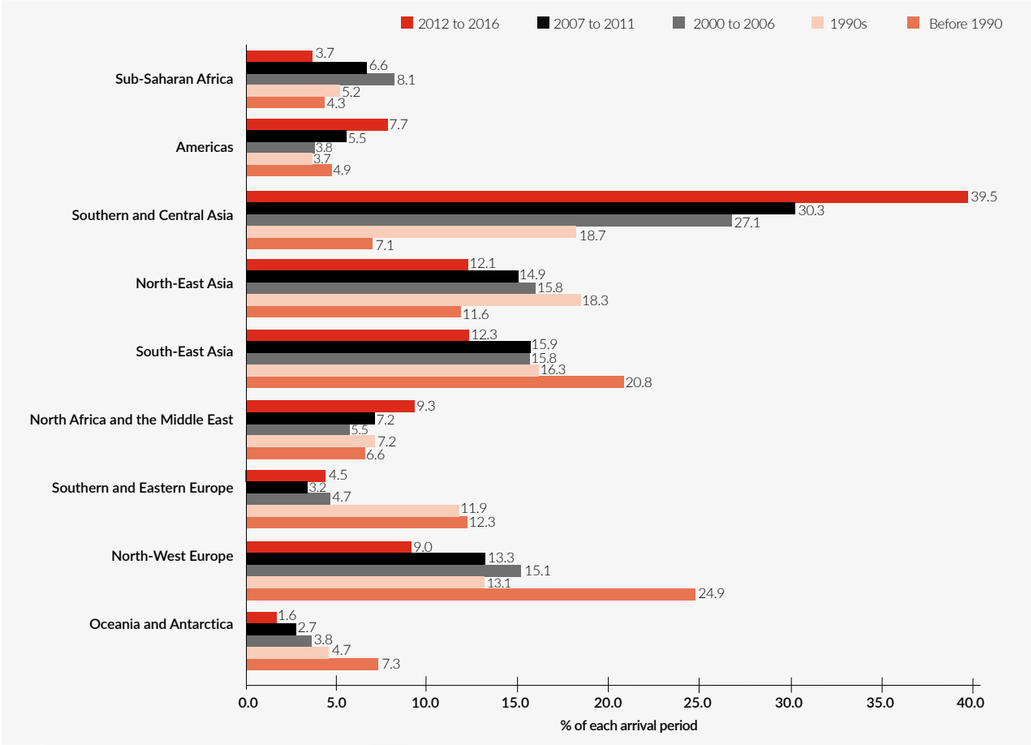



**Figure 2.27:** Region of birth of migrant engineers who arrived in Australia between 2007 and 2016

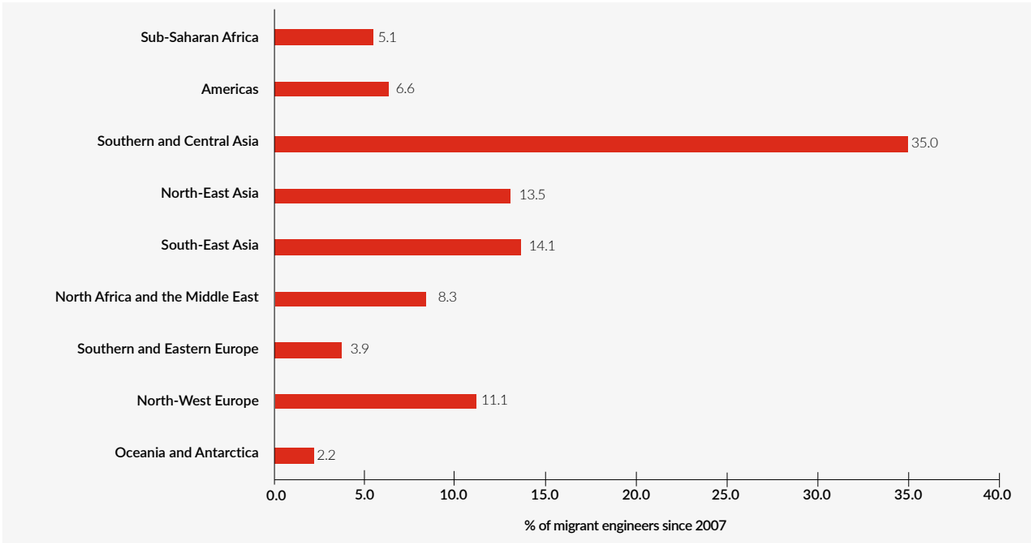


**Table 2.9:** The top ten source countries for Australia's overseas born qualified engineers

| Before 1990 | | 1990s | | 2000 to 2006 | | 2007 to 2011 | | 2012 to 2016 | | All arrivals | | Since 2007 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Number | Country | Number | Country | Number | Country | Number | Country | Number | Country | Number | Country | Number |
| England | 5483 | China | 3638 | India | 6958 | India | 9745 | India | 13472 | India | 34283 | India | 23217 |
| Vietnam | 2494 | India | 3028 | China | 4254 | China | 5472 | China | 4122 | China | 19907 | China | 9594 |
| China | 2421 | England | 2469 | England | 3148 | Philippines | 3684 | Philippines | 3266 | England | 15782 | Philippines | 6950 |
| New Zealand | 1754 | Philippines | 2110 | Philippines | 1963 | England | 2922 | Iran | 2598 | Philippines | 12505 | England | 4682 |
| Malaysia | 1699 | Sri Lanka | 1795 | South Africa | 1706 | Iran | 1972 | England | 1760 | Sri Lanka | 6842 | Iran | 4570 |
| Philippines | 1482 | Hong Kong | 1182 | Malaysia | 1548 | South Africa | 1849 | Pakistan | 1686 | Malaysia | 6822 | Malaysia | 2707 |
| India | 1080 | South Africa | 976 | Sri Lanka | 1223 | Malaysia | 1711 | Sri Lanka | 1084 | South Africa | 6086 | Sri Lanka | 2762 |
| Sri Lanka | 1062 | New Zealand | 949 | New Zealand | 927 | Sri Lanka | 1678 | Columbia | 1008 | Iran | 5999 | South Africa | 2672 |
| Poland | 958 | Malaysia | 870 | Indonesia | 697 | Ireland | 1032 | Malaysia | 994 | New Zealand | 5132 | Pakistan | 2451 |
| Hong Kong | 946 | Vietnam | 862 | Iran | 569 | New Zealand | 906 | Bangladesh | 979 | Vietnam | 4666 | Bangaldesh | 1805 |
| Total top 10 | 19379 | Total top 10 | 17879 | Total top 10 | 22993 | Total top 10 | 30971 | Total top 10 | 30969 | Total top 10 | 118024 | Total top 10 | 61410 |
| All arrivals | 34360 | All arrivals | 31569 | All arrivals | 35425 | All arrivals | 45216 | All arrivals | 46299 | All arrivals | 192869 | All arrivals | 91515 |
| % top 10 | 56.4 | % top 10 | 56.6 | % top 10 | 64.9 | % top 10 | 68.5 | % top 10 | 66.9 | % top 10 | 61.2 | % top 10 | 67.1 |

Arrivals from the Americas have slowly increased to 7.7% in the most recent arrivals period. Arrivals from Sub-Saharan Africa have waxed and waned but remain a small share. Arrivals from North Africa and the Middle East have increased their share in an irregular way and arrivals from other Oceania countries have steadily fallen.

**Figure 2.27 shows that the bulk of Australia's migrant qualified engineers come from Asian regions.** This figure concentrates on the arrivals of qualified engineers from the nine regions during the decade to 2016. It shows that three regions, Southern and Central Asia, North East Asia and South East Asia, accounted for 62.6% of the 91,515 qualified engineers who arrived in Australia between 2007 and 2016. Immigration from European sources is still prominent and contributed 15.0% of the intake. African and Middle East regions contributed 13.4%, but arrivals from Oceania and the Americas were small, niche sources.

Altogether there are 249 countries in the nine regions discussed; and Australia has accepted migrant qualified engineers from 166 of them. However, the main source countries constitute a more limited list, with the top ten source countries consistently accounting for well over half the intake in every arrival period. In Table 2.9, we list the top ten source countries in each arrival period, and the number of qualified engineers originating from them. For reference, a similar list is shown for all arrivals of qualified engineers.

**Before 1990, 34,360 qualified engineers migrated to Australia and the top ten source countries accounted for 19,379 or 56.4%.** The largest source was England which contributed 5,483. The next two most important sources were from Asian regions and were Vietnam with 2,494 and China with 2,421. The fourth most important source country was New Zealand with 1,754. Five of the remaining six countries were from Asian regions, and Poland was the only other European country in the top ten.

**During the 1990s, migration from England, Vietnam and New Zealand contracted, while migration from China and India expanded substantially.** Overall immigration was 31,569, and the top ten source countries contributed 17,879 or 56.6%. The top two source countries were China with 3,638 and India with 3,028, together contributing 21.1% of the intake. England slipped to be the third most important source country with 2,469, and only half as many qualified engineers arrived from New Zealand as had been the case before 1990. England and New Zealand together contributed 10.8% of the intake. The remaining countries in the top ten sources were from Asian regions.

**In the 2000 to 2006 period, arrivals of qualified engineers increased to 35,425 and the top ten source countries contributed 22,993 or 64.9%.** These figures were a pronounced shift compared to earlier arrival periods. Arrivals of qualified engineers from India more than doubled to 6,958, and there was also a large increase in the number of migrants from China which contributed 4,254. These countries accounted for 31.6% of the intake. Arrivals from England also increased above the level achieved during the 1990s





but well below intake numbers before 1990. Arrivals from New Zealand were comparable to the 1990s and the prominence of the Philippines was confirmed.

**During 2007 to 2011, numbers increased to 45,216, 27.6% higher than in the previous five years; and the top ten source countries contributed 30,971 or 68.5% of the intake.** The prominence of India, China and the Philippines as source countries for Australian migrant qualified engineers was again apparent during the 2007 to 2011 arrival period. Arrivals from all three increased substantially: arrivals from India increased by 40.1% over the previous arrival period to 9,745; arrivals from China increased by 28.6% to 5,472 and arrivals from the Philippines increased by 87.7% to 3,684. Together, these countries were the source for 18,901 qualified engineers or 41.8% of the intake during this period.

**The intake of qualified engineers stabilised somewhat during 2012 to 2016, increasing by just 2.4% to 46,299; and the top ten source countries contributed 30,969 or 66.9% of them.** The rank order of the top three sources did not change, but numbers from them did. There was an increase of 38.2% in qualified engineers from India, a fall of 24.7% in qualified engineers from China and an 11.3% fall in qualified engineers from the Philippines to 3,266. Even so, the combined intake from these countries increased 10.4% to 20,860. which was 45.1% of the total intake.

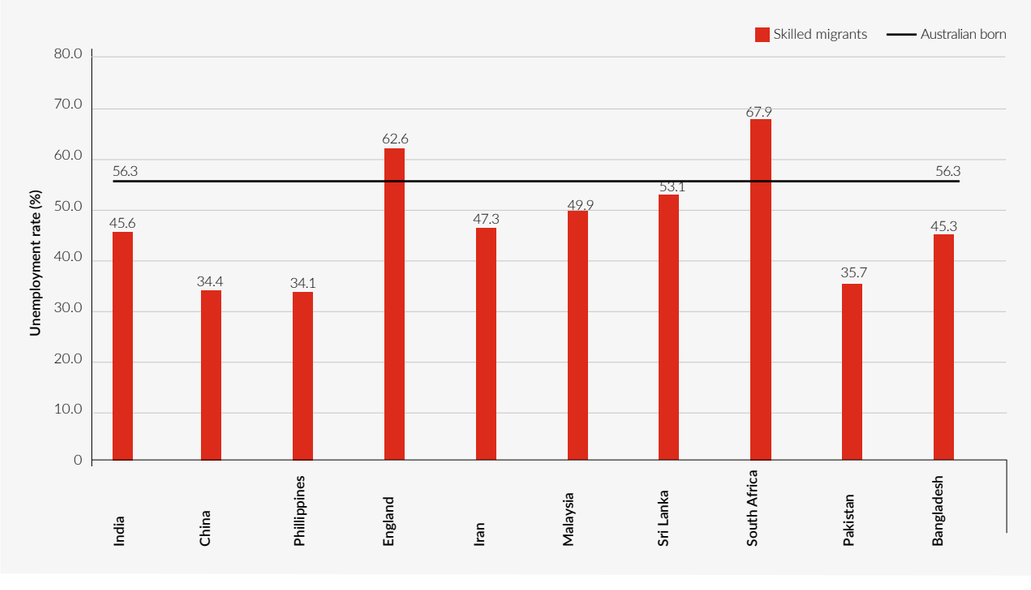
**Since 2007, the top three source countries have been India, China and the Philippines.** The number of qualified engineers from India was 23,217 or 25.4% of the intake over the decade. The intake from India was almost two and a half times as large as the intake from China, which contributed 9,595 qualified engineers. The third largest source was from the Philippines, which contributed 6,950 qualified engineers. Together, these countries accounted for 39,761 or 43.5% of the intake. England is the only European source country that figures in the top ten sources over the decade, contributing 4,682 qualified engineers or 5.1% of the decade intake.

## UTILISATION FOR ENGINEERS FROM THE TOP TEN SOURCE COUNTRIES

Section 2.10 assessed the utilisation of qualified engineers using the proportion of the supply of qualified engineers not employed in engineering occupations or unemployed.

We observed that although utilisation of Australian-born and overseas-born qualified engineers moved parallel to each other over time, there was a distinct difference in the degree of utilisation between the two components. This showed that utilisation was substantially lower for overseas-born compared to Australian-born qualified engineers. We now consider how this issue impacts qualified engineers from the top ten source countries.

**Figure 2.28:** Proportion of qualified engineers employed in engineering occupations in 2016, Australian born compared to top ten country arrivals between 2007 and 2016

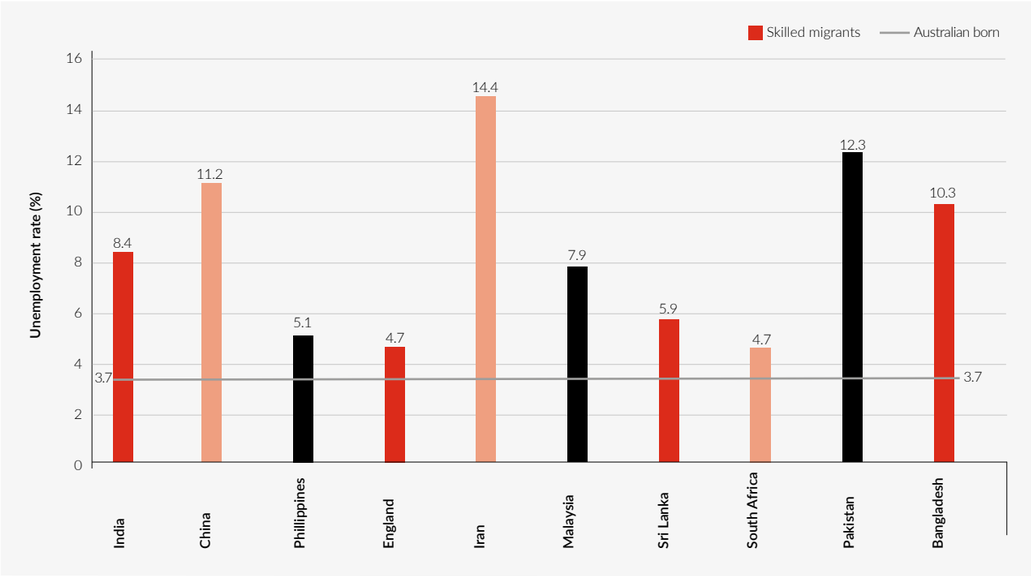


In Figure 2.28 we compare the proportion of 2016 supply of qualified engineers employed in engineering occupations for Australian-born qualified engineers to the corresponding proportions for the top ten source countries for migrant qualified engineers. In 2016, 56.3% of Australian-born qualified engineers were employed in engineering occupations, illustrated by the blue line in Figure 2.27.

The red bars illustrate the proportions of the 2016 supply of qualified engineers from the top ten source countries who arrived in Australia between 2007 and 2016 and who were employed in engineering occupations. Two source countries, England and South Africa, have proportions of qualified engineers employed in engineering occupations that are higher than for Australian-born qualified engineers.

Combined, these countries contributed 8.0% of the intake of qualified engineers between 2007 and 2016. The remaining eight countries had proportions of qualified engineers that were lower, often substantially so, than those for Australian-born qualified engineers.

**Figure 2.29:** Unemployment rates in 2016 for qualified engineers in the top ten source countries who arrived in Australia berween 2007 and 2016








**Unemployment rates, the second element for assessing utilisation, were also higher in qualified engineers from most source countries than for Australian-born engineers.** In Figure 2.29, we compare the unemployment rate in 2016 for the supply of Australian-born qualified engineers (the blue horizontal blue line) to the unemployment rates experienced in 2016 by qualified engineers from the top ten source countries who arrived in Australia between 2007 and 2016.

Consistent with our earlier discussion, unemployment rates for migrant qualified engineers are higher than those for Australian-born qualified engineers in each of the ten source countries. The lowest rates experienced were by migrants from England and South Africa, which had the highest proportions employed in engineering occupations.

**Based on Figures 2.28 and 2.29, there is a considerable gap between the utilisation of Australian-born qualified engineers and that of qualified engineers from eight of the top ten source countries.** The high proportions employed in engineering occupations and lower unemployment rates experienced by qualified engineers from England and South Africa suggest that utilisation of qualified engineers from these countries was comparable to that of Australian-born qualified engineers.

*There is a considerable gap between the utilisation of Australian-born qualified engineers and that of qualified engineers from eight of the top ten source countries*

Australia's skilled migration programs are aimed at increasing the average level of skills of the Australian labour force by giving preference to prospective migrants who meet educational and experience criteria used to construct the Medium to Long Term Strategic Skills List (MLTSSL). There are numerous engineering occupations on this list, but the precise objective of policy with respect to engineers is fairly unclear. The presumption is that it is to help grow Australia's engineering capability.

During years of high demand for qualified engineers, such as between 2006 and 2011, this presumption was realistic: qualified engineers were needed, and unemployment was very low. Since 2012 however, demand for qualified engineers has been much lower; and we have observed that the overseas-born engineering labour force is substantially under-utilised compared to its Australian born counterpart. These circumstances suggest that continuing large-scale intakes of qualified engineers have more to do with the general objective of policy than Australia's engineering capability.

# 3.

# The situation in States and Territories

## 3.1 Relative size of State and Territory engineering labour markets

**KEY POINTS**

- Engineering labour force growth resulted from policies that sought to alleviate shortages of engineers during the resources boom.
- However, the changes within key resources States were relatively small. Queensland's share of the ten-year increase in the national engineering labour force was 17.1%, while Western Australia's was 17.6%. This contrasts starkly with 56.8% shares of the increase in NSW and Victoria.
- These results underscore the view that shortages in the resources sector competed with shortages in other sectors (e.g. infrastructure), particularly in large States.

**In this chapter, we compare the experiences of qualified engineers across Australian jurisdictions.** The distribution of the engineering labour force throughout Australian jurisdictions is presented in Table 3.1, consistent with the statistics in Table 2.2. Jurisdictional shares of the engineering labour force and how they have changed are compared to shares of Australia's gross product[21] in Figure 3.1.

21. Sourced from ABS, Australian National Accounts, State Accounts, Cat No 5220.0, www.abs.gov.au . Gross product shares are based on chain volume measures for end June in years cited.

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**Table 3.1:** The distribution of the Australian engineering labour force, 2006 to 2016

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Men | Women | Combined | Women | Combined | Men | Women | Total | |
| NSW | 29263 | 2602 | 31865 | 33158 | 5445 | 38603 | 62421 | 8047 | 70468 |
| Victoria | 26343 | 2738 | 29081 | 23350 | 3903 | 27253 | 49693 | 6641 | 56334 |
| Queensland | 18399 | 1439 | 19838 | 10682 | 1296 | 11978 | 29081 | 2735 | 31816 |
| WA | 10136 | 888 | 11024 | 10526 | 1123 | 11649 | 20662 | 2011 | 22673 |
| SA | 6273 | 491 | 6764 | 4347 | 546 | 4893 | 10620 | 1037 | 11657 |
| Tasmania | 1590 | 109 | 1699 | 631 | 72 | 703 | 2221 | 181 | 2402 |
| NT | 781 | 53 | 834 | 481 | 56 | 537 | 1262 | 109 | 1371 |
| ACT | 2122 | 192 | 2314 | 1340 | 227 | 1567 | 3462 | 419 | 3881 |
| Other | 9 | 0 | 9 | 10 | 0 | 10 | 19 | 0 | 19 |
| Australia | 94920 | 8508 | 103428 | 84527 | 12666 | 97193 | 179447 | 21174 | 200621 |
| 2011 | Men | Women | Combined | Women | Combined | Men | Women | Total | |
| NSW | 32800 | 2948 | 35748 | 42973 | 7772 | 50745 | 75773 | 10720 | 86493 |
| Victoria | 30225 | 3287 | 33512 | 33131 | 6131 | 39262 | 63356 | 9418 | 72774 |
| Queensland | 22482 | 2034 | 24516 | 17629 | 2666 | 20295 | 40111 | 4700 | 44811 |
| WA | 12871 | 1274 | 14145 | 18508 | 2347 | 20855 | 31379 | 3621 | 35000 |
| SA | 7322 | 617 | 7939 | 6136 | 919 | 7055 | 13458 | 1536 | 14994 |
| Tasmania | 1850 | 137 | 1987 | 851 | 110 | 961 | 2701 | 247 | 2948 |
| NT | 883 | 98 | 981 | 795 | 106 | 901 | 1678 | 204 | 1882 |
| ACT | 2418 | 260 | 2678 | 1900 | 386 | 2286 | 4318 | 646 | 4964 |
| Other | 19 | 0 | 19 | 7 | 0 | 7 | 26 | 0 | 26 |
| Australia | 110870 | 10655 | 121525 | 121930 | 20425 | 142355 | 232800 | 31080 | 263880 |
| 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 36340 | 3842 | 40182 | 56057 | 11754 | 67811 | 92397 | 15596 | 107993 |
| Victoria | 33739 | 4012 | 37751 | 45155 | 9401 | 54556 | 78894 | 13413 | 92307 |
| Queensland | 25108 | 2568 | 27676 | 22253 | 3979 | 26232 | 47361 | 6547 | 53908 |
| WA | 14428 | 1619 | 16047 | 25363 | 3970 | 29333 | 39791 | 5589 | 45380 |
| SA | 8183 | 821 | 9004 | 7757 | 1441 | 9198 | 15940 | 2262 | 18202 |
| Tasmania | 2001 | 183 | 2184 | 883 | 153 | 1036 | 2884 | 336 | 3220 |
| NT | 1092 | 127 | 1219 | 1449 | 182 | 1631 | 2541 | 309 | 2850 |
| ACT | 2675 | 306 | 2981 | 2464 | 618 | 3082 | 5139 | 924 | 6063 |
| Other | 7 | 7 | 14 | 20 | 0 | 20 | 27 | 7 | 34 |
| Australia | 123573 | 13485 | 137058 | 161402 | 31497 | 192899 | 284975 | 44982 | 329957 |

### NEW SOUTH WALES

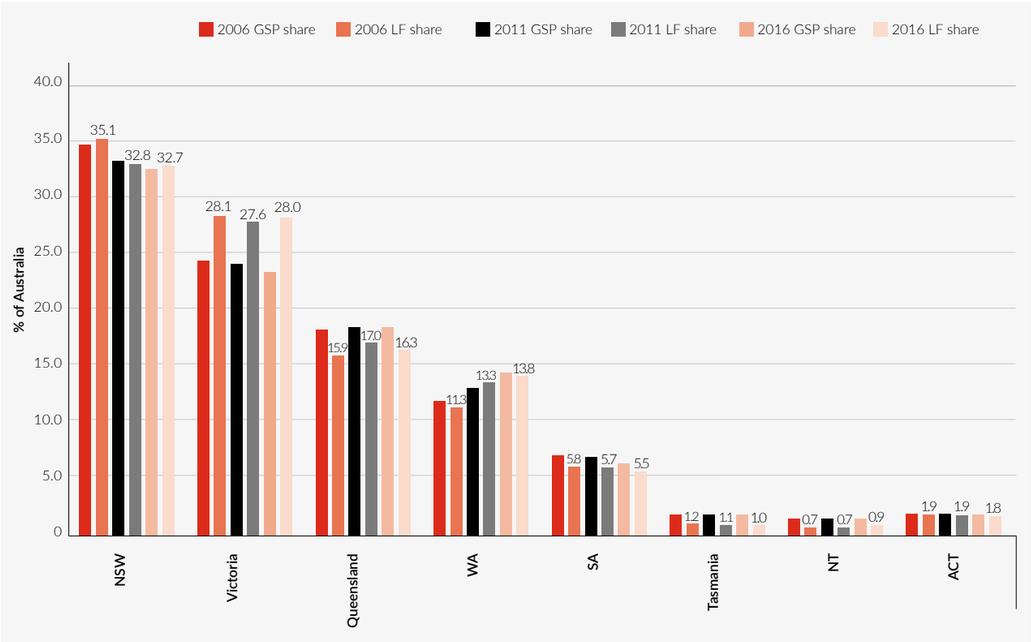
**Despite a small fall in the overseas-born share of the labour force in 2016, NSW has continued to receive a disproportionate share of migrant engineers.**

In 2006, NSW accounted for 35.1% of the Australian engineering labour force and for 34.4% of Australia's gross product. The State's share of the overseas-born component of the engineering labour force was even higher at 39.7%.

Between 2006 and 2011, the resources boom realigned jurisdictional shares. NSW's share of Australia's gross product fell to 33.1% and its share of the engineering labour force fell to 32.9%. However, the State continued to attract a disproportionate share of migrant engineers. While the share of the overseas-born component of the engineering labour force fell to 35.6%, this was still higher than its share of the labour force.

By 2016, the NSW share of Australia's gross product had fallen further to 32.7%, but its share of the engineering labour force stabilised at this figure. There was a small fall in the overseas-born share of the labour force to 35.2%.

**Figure3.1:** Jurisdictional shares, gross State product compared to engineering labourforce, 2006 to 2016




## VICTORIA

**Victoria has also had a disproportionate share of Australia's engineering labour force in each of the three censuses under review.**

In 2006, the State's share of Australia's gross product was 24.3%, but its share of the engineering labour force was 28.1%. Unlike NSW, the Victorian share of overseas-born qualified engineers was consistent with its share of the engineering labour force at 28.0%.

Victoria's share of Australia's gross product also fell over time, but more moderately compared to NSW. By 2011 it had fallen to 24.0%, and by 2016 to 23.3%. The State's share of the engineering labour force was slightly lower at 27.6% in 2011, but by 2016 it had recovered to 28.0%. These changes were mirrored by the State's share of overseas-born qualified engineers, but the 2016 figure of 28.3% pointed to an increase in migrant engineers settling in the State.

## QUEENSLAND

**Queensland's share of both the engineering labour force and overseas-born qualified engineers was lower in each census year than its share of Australia's gross product.**

In 2006, Queensland's share of Australia's gross product was 18.1%, but its share of the national engineering labour force was lower at 15.9%. Its share of overseas-born qualified engineers was even less at 12.3%.

The resources boom resulted in a small increase in the State's gross product share over the next ten years to 18.3% in each of 2011 and 2016. The State's share of the national engineering labour force experienced a pronounced increase to 17.0% in 2011 before settling back to 16.3% in 2016.

Despite the national emphasis on skilled migration, the Queensland share of overseas-born qualified engineers remained below its share of the national engineering labour force: 14.3% in 2011 and 13.6% in 2016.

## WESTERN AUSTRALIA

**Western Australia's share of Australia's gross product increased strongly, and its share of overseas-born engineers reflected the same trend.**





The Western Australian share of Australia's gross product increased strongly through the ten years 2006 to 2016. In 2006, it was 11.8%, by 2011 it had grown to 13.0%, and by 2016 it had grown to 14.4%.

In 2006, the Western Australian share of the engineering labour force was lower than its gross product share at 11.3%. By 2011, this relationship had reversed with a labour force share higher than the State's gross product share: 13.3% compared to 13.0%. Reflecting the shift from a construction to a production phase of the resources boom, the 2006 relationship was re-established in 2016, but with a higher 13.8% share of the national engineering labour force.

The effect of skilled migration is observed in an increasing State share of overseas-born qualified engineers. In 2006, it was 12.0%, already higher than the State's share of the engineering labour force. By 2011, it had increased to 14.6% and by 2016 to 15.2%.

## SOUTH AUSTRALIA

**South Australia has consistently had an engineering labour force share that is lower than its gross product share.**

South Australia has experienced a falling share of national gross product from 6.7% in 2006, to 6.6% in 2011 and 6.0% in 2016. The State's share of Australia's engineering labour force has been consistently lower than its gross product shares and has also fallen over time. It was 5.8% in 2006, 5.7% in 2011 and 5.5% in 2016.

The South Australian share of overseas-born qualified engineers has been lower than its shares of the engineering labour force and has fallen in the last five years. It was 5.0% in 2006 and 2011, but 4.8% in 2016.

## TASMANIA

**Tasmania's share of the national engineering labour force was lower than its share of gross product, and its share of the overseas-born qualified engineers was even lower.**

Tasmania maintained its share of national gross product at 1.9% in 2006 and 2011 but recorded a fall to 1.7% in 2016. The State's share of the national engineering labour force was less than these shares and fell over time; the share was 1.2% in 2006, 1.1% in 2011 and 1.0% in 2016.

The Tasmanian shares of overseas-born qualified engineers were substantially lower than its labour force shares: 0.7% in 2007 and 2011 and 0.5% in 2016.

## NORTHERN TERRITORY

**The Northern Territory has consistently had an engineering labour force share that was around half of its gross product share, and a lower share of overseas-born qualified engineers.**

The Northern Territory has slowly increased its share of national gross product from 1.3% in 2006 to 1.4% in 2011 and 1.5% in 2016. The Territory's share of the national engineering labour force was about half its gross product share in 2006 and 2011 and increased to 0.8% in 2016, still well below it gross product share.

Despite this relationship, the Northern Territory share of overseas-born qualified engineers has been less than its engineering labour market shares. These figures may reflect arrangements whereby qualified engineers are recruited from elsewhere in Australia for specific projects, and then return to their home base when work has been completed.

## AUSTRALIAN CAPITAL TERRITORY

**The Australian Capital Territory has had roughly proportional shares of national product and engineering labour force, with a slightly lower share of overseas-born qualified engineers.**

In 2006, the Australian Capital Territory accounted for 2.0% of national product and 1.9% of the national engineering labour force. The share of gross product increased to 2.2% in 2011 and 2016. The share of the national engineering labour force was maintained at 1.9% in 2011 but fell to 1.8% in 2016.

Throughout the ten years under review, the Territory's share of overseas born qualified engineers has remained constant at 1.6%, below the Territory's labour market shares.

## 3.2 Ethnic and gender shares

**KEY POINTS**

- Skilled migration has changed the ethnic composition of the engineering labour force in every Australian jurisdiction, but particularly in NSW and Western Australia.
- In 2016, only South Australian and Tasmanian engineering labour forces remained majority Australian-born.
- Gender shares have changed slowly; and in 2016, women were still only 13.6% of the engineering labour force. Progress in all jurisdictions has been slower among Australian-born than among overseas-born engineers.

In section 3.1, we noted that there were marked differences in shares of overseas-born qualified engineers between jurisdictions. In this section, we consider the ethnic composition of jurisdictional engineering labour forces in greater detail. We also examine the gender composition in a similar manner. We begin with Table 3.2 which sets out statistics on ethnic composition.

**Table 3.2:** Ethnic shares in the engineering labour force, States & Territories, 2006 to 2016

| State or Territory | Australian born | | | Overseas born | | |
|---|---|---|---|---|---|---|
| 2006 | Men | I Women | I Combined | Men | I Women | I Combined |
| NSW | 46.9 | 32.3 | 45.2 | 53.1 | 67.7 | 54.8 |
| Victoria | 53.0 | 41.2 | 51.6 | 47.0 | 58.8 | 48.4 |
| Queensland | 63.3 | 52.6 | 62.4 | 36.7 | 47.4 | 37.6 |
| WA | 49.1 | 44.2 | 48.6 | 50.9 | 55.8 | 51.4 |
| SA | 59.1 | 47.3 | 58.0 | 40.9 | 52.7 | 42.0 |
| Tasmania | 71.6 | 60.2 | 70.7 | 28.4 | 39.8 | 29.3 |
| NT | 61.9 | 48.6 | 60.8 | 38.1 | 51.4 | 39.2 |
| ACT | 61.3 | 45.8 | 59.6 | 38.7 | 54.2 | 40.4 |
| Australia | 52.9 | 40.2 | 51.6 | 47.1 | 59.8 | 48.4 |
| 2011 | Men | Women | Combined | Women | Combined | Men |
| NSW | 43.3 | 27.5 | 41.3 | 56.7 | 72.5 | 58.7 |
| Victoria | 47.7 | 34.9 | 46.0 | 52.3 | 65.1 | 54.0 |
| Queensland | 56.0 | 43.3 | 54.7 | 44.0 | 56.7 | 45.3 |
| WA | 41.0 | 35.2 | 35.4 | 59.0 | 64.8 | 59.6 |
| SA | 53.6 | 31.6 | 50.6 | 46.4 | 68.4 | 49.4 |
| Tasmania | 58.0 | 61.6 | 58.3 | 42.0 | 38.4 | 41.7 |
| NT | 52.6 | 48.0 | 52.1 | 47.4 | 52.0 | 47.9 |
| ACT | 56.0 | 40.2 | 53.9 | 44.0 | 59.8 | 46.1 |
| Australia | 47.6 | 34.3 | 46.1 | 52.4 | 65.7 | 53.9 |
| 2016 | Men | Women | Combined | Men | Women | Combined |
| NSW | 39.3 | 24.6 | 37.2 | 60.7 | 75.4 | 62.8 |
| Victoria | 42.8 | 29.9 | 40.9 | 57.2 | 70.1 | 59.1 |
| Queensland | 53.0 | 39.2 | 51.3 | 47.0 | 60.8 | 48.7 |
| WA | 36.3 | 29.0 | 35.4 | 63.7 | 71.0 | 64.6 |
| SA | 57.9 | 42.8 | 56.4 | 42.1 | 57.2 | 43.6 |
| Tasmania | 67.8 | 60.7 | 67.2 | 32.2 | 39.3 | 32.8 |
| NT | 43.0 | 41.1 | 42.8 | 57.0 | 58.9 | 57.2 |
| ACT | 52.1 | 33.1 | 49.2 | 47.9 | 66.9 | 50.8 |
| Australia | 43.4 | 30.0 | 41.5 | 56.6 | 70.0 | 58.5 |





**In 2006, Australian-born qualified engineers were already in a minority in NSW and Western Australia but were a majority elsewhere.** They accounted for 45.2% of the NSW engineering labour force and 48.6% of the Western Australian engineering labour force. Because all other jurisdictions retained Australian-born majorities, the overall Australian engineering labour force was majority Australian-born.

By 2011, skilled migration had reduced the Australian-born shares of the NSW and Western Australian engineering labour forces further to 41.3% in NSW and to 35.4% in Western Australia. As well, Victoria changed from being majority Australian-born to majority overseas-born, with the former share falling from 51.6% to 46.0%. Once again, all other jurisdictions remained majority Australian-born. This included Queensland, which at the time claimed severe shortages of engineers.

**However, the changes that occurred were sufficient to shift the Australian engineering labour force from majority Australian-born in 2006 to majority overseas-born in 2011.**

Permanent skilled migration continued unabated through to 2016, but there were comparatively large repatriations of temporary migrants on 457 visas. The trends that resulted in the three jurisdictions that were majority overseas-born in 2011 intensified, so that NSW was 37.2% Australian-born, Victoria 40.9% and Western Australia 35.4%.

In addition, the two Territories switched to being majority-overseas born. Only Tasmania with 67.2% and South Australia with 56.4% remained majority Australian-born engineering labour forces.

**Overall in 2016, the Australian engineering labour force was 41.5% Australian-born and 58.5% overseas-born.**

**Table 3.3:** Gender shares in the engineering labour force, States & Territories, 2006 to 2016

| State or Territory | Australian born | Overseas born | Engineering team |
|---|---|---|---|
| 2006 | | | |
| NSW | 8.2 | 14.1 | 11.4 |
| Victoria | 9.4 | 14.3 | 11.8 |
| Queensland | 7.3 | 10.8 | 8.6 |
| WA | 8.1 | 9.6 | 8.9 |
| SA | 7.3 | 11.2 | 8.9 |
| Tasmania | 6.4 | 10.2 | 7.5 |
| NT | 6.4 | 10.4 | 8.0 |
| ACT | 8.3 | 14.5 | 10.8 |
| Australia | 8.2 | 13.0 | 10.6 |
| 2011 | | | |
| NSW | 8.2 | 15.3 | 12.4 |
| Victoria | 9.8 | 15.6 | 12.9 |
| Queensland | 8.3 | 13.1 | 10.5 |
| WA | 9.0 | 11.3 | 10.3 |
| SA | 7.8 | 13.0 | 10.2 |
| Tasmania | 6.9 | 11.4 | 8.4 |
| NT | 10.0 | 11.8 | 10.8 |
| ACT | 9.7 | 16.9 | 13.0 |
| Australia | 8.8 | 14.3 | 11.8 |
| 2016 | | | |
| NSW | 9.6 | 17.3 | 14.4 |
| Victoria | 10.6 | 17.2 | 14.5 |
| Queensland | 9.2 | 15.2 | 12.1 |
| WA | 10.1 | 13.5 | 12.3 |
| SA | 9.1 | 15.7 | 12.4 |
| Tasmania | 8.4 | 14.8 | 10.4 |
| NT | 10.4 | 11.2 | 10.8 |
| ACT | 10.3 | 20.1 | 15.2 |
| Australia | 9.8 | 16.3 | 13.6 |

Table 3.3 describes the gender composition of jurisdictional engineering labour forces. The results are broadly similar to those described in Figure 2.5.

**The proportion of female qualified engineers has slowly increased in all jurisdictions.** It is higher among overseas-born than Australian-born qualified engineers. Progress through skilled migration has obscured just how slow progress in lifting the women's shares of Australian-born qualified engineers has been.

In 2016, the women's shares in NSW, Victoria and the ACT were above the national figure of 13.6%. All other jurisdictions were below this figure with the lowest share, 10.4%, occurring in Tasmania.





## 3.3 Labour force participation and supply

**KEY POINTS**

- Growth in the national supply of qualified engineers slowed from an average of 5.6% per year between 2006 and 2011 to average 4.6% per year between 2011 to 2016.
- During the first period, high growth nationally was driven by higher-than-average rates in the three recources jurisdictions: Western Australia, Queensland and the Northern Territory. The remaining jurisdictions recorded growth below the national average.
- During the second period, the rate of growth in supply fell, mirroring the national outcome, in all jurisdictions except for NSW and the Northern territory.

**Labour force participation rates are influenced by economic conditions and jurisdictional differences reflect that connection.** The participation rates presented in Table 3.4 extend the results discussed in section 2.5:

- Labour force participation rates for men are higher than for women in both ethnic groups.
- Labour force participation rates are generally lower for overseas-born qualified engineers than for Australian-born qualified engineers.

However, there are some important differences.

The highest participation rates have occurred in the Northern Territory. In 2006, the Territory's participation rate was 90.8%; and in each of 2011 and 2016, it was 90.7%. Participation was high for both Australian-born and overseas-born qualified engineers, but with a small margin in favour of the former.

Participation by women was lower than by men but has increased for Australian-born women from 76.8% in 2006 to 92.0% in 2016. At this point, it was higher than for Australian-born men. Participation by overseas-born women has deteriorated over time, falling from 81.2% in 2006 to 77.4% in 2011 and 2016. The Territory's high labour force participation rates are likely due to its transitory nature.

**The labour force participation rates in Queensland and Western Australia were also above average in each census year, particularly in Western Australia.** This was due to the influence of strong conditions in the resources sector that encouraged high labour force participation by both Australian-born and overseas-born qualified engineers, but particularly among Australian-born men. In Western Australia, the participation rates for this group were 87.3% in 2006 and 87.8% in 2011. Evidence of better targeting of skilled migration is the State's 86.8% participation rate for overseas-born men.

**We noted earlier the large fall in national labour force participation between 2011 and 2016.** For Australian-born men, labour force participation fell in every jurisdiction, with the highest fall, 4.5%, occurring in Western Australia. Participation by overseas-born men fell in all jurisdictions except Tasmania, where it was already very low. The largest fall in participation for this group was in Queensland with a fall of 2.7% to 80.0%. Despite Western Australia recording the largest fall in participation, in 2016 the labour force participation rate in this jurisdiction was 83.0% compared to a national figure of 79.0%.

**Table 3.4:** Labour force participation rates, engineering labour force, States & Territories, 2006 to 2016

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 81.9 | 79.3 | 81.7 | 82.7 | 73.0 | 81.1 | 82.3 | 74.9 | 81.4 |
| Victoria | 83.9 | 81.3 | 83.6 | 82.1 | 71.1 | 80.7 | 82.8 | 74.3 | 81.6 |
| Queensland | 84.3 | 81.9 | 84.1 | 79.0 | 70.2 | 77.9 | 82.2 | 75.9 | 81.7 |
| WA | 87.3 | 78.3 | 86.5 | 83.5 | 71.9 | 82.2 | 85.3 | 74.6 | 84.3 |
| SA | 81.2 | 78.6 | 81.0 | 77.5 | 65.3 | 75.9 | 79.6 | 71.0 | 78.8 |
| Tasmania | 76.1 | 67.3 | 75.5 | 63.6 | 68.6 | 64.1 | 72.1 | 67.8 | 71.8 |
| NT | 93.6 | 76.8 | 92.6 | 89.1 | 81.2 | 88.2 | 92.0 | 79.0 | 90.8 |
| ACT | 83.4 | 84.6 | 83.5 | 77.8 | 71.4 | 76.8 | 81.1 | 76.9 | 80.7 |
| Australia | 83.4 | 80.1 | 83.1 | 81.6 | 71.6 | 80.2 | 82.6 | 74.8 | 81.7 |
| 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 80.8 | 79.4 | 80.7 | 82.1 | 71.9 | 80.4 | 81.5 | 73.8 | 80.5 |
| Victoria | 82.9 | 81.2 | 82.7 | 82.7 | 71.1 | 80.7 | 82.8 | 74.3 | 81.6 |
| Queensland | 84.3 | 83.6 | 84.2 | 82.7 | 74.1 | 81.4 | 83.6 | 77.9 | 82.9 |
| WA | 87.8 | 81.7 | 87.2 | 86.8 | 75.3 | 85.3 | 87.2 | 77.5 | 86.1 |
| SA | 81.4 | 80.5 | 81.4 | 79.6 | 68.2 | 77.9 | 80.6 | 72.7 | 79.7 |
| Tasmania | 75.7 | 71.7 | 72.5 | 61.8 | 62.7 | 61.9 | 68.7 | 68.4 | 68.7 |
| NT | 91.6 | 87.5 | 91.2 | 92.8 | 77.4 | 90.2 | 91.8 | 82.8 | 90.7 |
| ACT | 83.3 | 84.4 | 83.4 | 78.2 | 73.9 | 77.4 | 80.9 | 77.8 | 80.5 |
| Australia | 82.9 | 81.2 | 82.7 | 82.8 | 72.2 | 81.0 | 82.8 | 75.0 | 81.8 |
| 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 77.9 | 80.3 | 78.1 | 79.4 | 70.5 | 77.7 | 78.8 | 72.7 | 77.9 |
| Victoria | 80.1 | 80.9 | 80.2 | 80.2 | 69.8 | 78.2 | 80.2 | 72.8 | 79.0 |
| Queensland | 80.7 | 84.0 | 81.0 | 80.0 | 72.3 | 78.7 | 80.3 | 76.5 | 79.8 |
| WA | 83.3 | 81.2 | 83.1 | 84.6 | 74.3 | 83.0 | 84.1 | 76.1 | 83.0 |
| SA | 79.1 | 81.6 | 79.3 | 77.2 | 69.2 | 75.8 | 78.2 | 73.3 | 77.5 |
| Tasmania | 72.3 | 74.1 | 72.5 | 61.8 | 62.7 | 61.9 | 68.7 | 68.4 | 68.7 |
| NT | 91.4 | 92.0 | 91.4 | 92.1 | 77.4 | 90.2 | 91.8 | 82.8 | 90.7 |
| ACT | 79.8 | 85.5 | 80.4 | 75.9 | 71.2 | 74.9 | 77.9 | 75.4 | 77.5 |
| Australia | 79.7 | 81.1 | 79.8 | 80.2 | 70.8 | 78.5 | 79.9 | 73.6 | 79.0 |





**Table 3.5:** Contributions to growth, engineering labour force, States & Territories, 2006 to 2016 (% per year)

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 to 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 2.3 | 2.5 | 2.3 | 5.3 | 7.4 | 5.6 | 4.0 | 5.9 | 4.2 |
| Victoria | 2.8 | 3.7 | 2.9 | 7.3 | 9.5 | 7.6 | 5.0 | 7.2 | 5.3 |
| Queensland | 4.0 | 7.3 | 4.2 | 10.4 | 14.9 | 10.9 | 6.5 | 11.1 | 6.9 |
| WA | 4.9 | 7.5 | 5.1 | 12.0 | 15.9 | 12.4 | 8.7 | 12.5 | 9.1 |
| SA | 3.1 | 4.7 | 3.3 | 7.1 | 11.0 | 7.6 | 4.9 | 8.2 | 5.2 |
| Tasmania | 3.1 | 4.7 | 3.2 | 6.2 | 8.9 | 6.5 | 4.0 | 6.4 | 4.2 |
| NT | 3.3 | 10.9 | 6.5 | 3.2 | 10.5 | 6.3 | 3.9 | 8.8 | 5.8 |
| ACT | 2.3 | 6.3 | 3.0 | 7.2 | 11.2 | 7.9 | 4.5 | 9.0 | 5.0 |
| Australia | 3.2 | 4.6 | 3.3 | 7.6 | 10.0 | 7.9 | 5.3 | 8.0 | 5.6 |
| 2011 to 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 2.1 | 5.4 | 2.4 | 5.5 | 8.6 | 6.0 | 4.1 | 7.8 | 4.5 |
| Victoria | 2.2 | 4.1 | 2.4 | 6.4 | 8.9 | 6.8 | 4.5 | 7.3 | 4.9 |
| Queensland | 1.7 | 4.3 | 2.0 | 3.9 | 7.6 | 4.4 | 2.7 | 6.1 | 3.1 |
| WA | 2.3 | 4.9 | 2.7 | 6.5 | 11.1 | 7.1 | 4.7 | 9.1 | 5.3 |
| SA | 2.3 | 5.9 | 2.6 | 4.8 | 9.4 | 5.5 | 3.4 | 8.1 | 4.0 |
| Tasmania | 1.6 | 6.0 | 1.9 | 0.7 | 6.8 | 4.5 | 1.3 | 6.4 | 1.8 |
| NT | 4.4 | 12.6 | 8.7 | 4.4 | 12.2 | 8.4 | 3.6 | 9.9 | 6.4 |
| ACT | 2.0 | 3.3 | 2.2 | 5.3 | 9.9 | 6.2 | 3.5 | 7.4 | 4.1 |
| Australia | 2.2 | 4.8 | 2.4 | 5.8 | 9.1 | 6.3 | 4.1 | 7.7 | 4.6 |

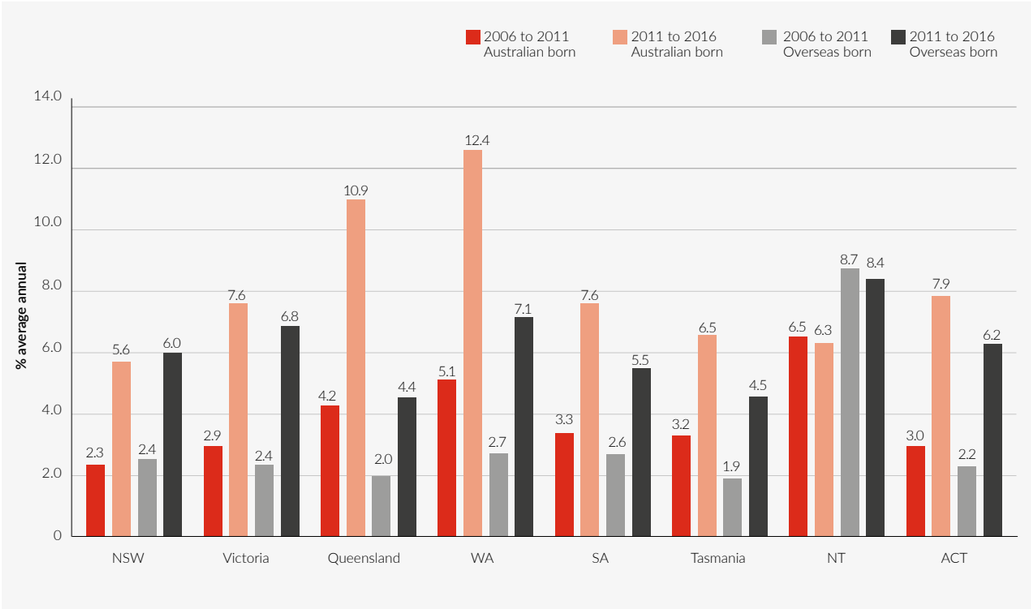
At a national level, the highest labour force participation rate in 2016 was for Australian-born women with a rate of 81.1%. All jurisdictions except Victoria (which already had high participation) contributed to this outcome.

Average annual growth rates for the supply of qualified engineers were estimated for each State and Territory for the two inter-census periods and are presented in Table 3.5. To assist discussion, the growth rates for Australian-born and overseas-born cohorts are illustrated in Figure 3.2.

**The table shows that the supply of female qualified engineers has grown faster than the supply of men, irrespective of jurisdiction, ethnicity and period.**

In part, these high growth rates reflect the low bases from which they were calculated, but reference to Table 3.1 shows that numerically, the number of female qualified engineers increased substantially. Growth in the number of overseas-born women has exceeded that for Australian-born women in both periods by a substantial margin. The margin would have been even larger had labour force participation rates for overseas-born women been on par with participation by Australian-born women.

**Figure 3.2:** Growth in the supply of qualified engineers, Australian and overseas born, 2006 to 2016




**Growth in the supply of qualified engineers slowed between 2006 to 2011 and 2011 to 2016, but the slower rate was still substantial.** During the first period, growth in supply averaged 5.6% per year; and during the second, it averaged 4.6% per year. Figure 3.2 shows that in all jurisdictions, overall growth was driven by skilled migration.

Nationally, the supply of Australian-born qualified engineers grew by an average 3.3% per year between 2006 and 2011; and growth slowed to average 2.4% per year between 2011 and 2016. Both rates were well below the corresponding overall national rates. During the first period, supply growth was driven by the changes in Queensland, Western Australia and the Northern Territory, which were substantially above national growth. During the second period, Western Australia and the Northern Territory grew faster than other jurisdictions, but there was a closer relationship between the latter and the national average.

**In contrast, the national supply of overseas-born qualified engineers grew by an average of 7.9% per year between 2006 and 2011.** It then slowed to an average of 6.3% per year between 2011 and 2016. As Figure 3.2 shows, the supply of overseas-born qualified engineers grew much faster than the supply of Australian-born qualified engineers in every jurisdiction in both periods examined.

In the first period, growth rates for overseas-born engineers were especially high in Queensland and in Western Australia. High growth in Queensland fell dramatically in the second period to average 4.4% per year, well below the national average. Western Australia continued to support high growth in overseas-born qualified engineers, and the Northern Territory increased its growth rate over the earlier period.





## 3.4 Demand for engineers and unemployment

**KEY POINTS**

- Between 2006 to 2016, the growth in demand for qualified engineers slowed nationally from an average of 5.5% per year to average 4.0% per year.
- During 2006 to 2011, demand growth was strong in all jurisdictions, although the national increase was driven by extraordinary expansion in the resources states.
- During 2011-2061, NSW, Victoria, Western Australia and the Northern Territory enjoyed above-average demand growth, while remaining jurisdictions had below-average demand growth.
- Slower demand growth caused unemployment rates to increase markedly across nearly every jurisdiction, particularly in the resources States. Rates were higher for overseas-born than for Australian-born qualified engineers and reached double digits for overseas-born women in all jurisdictions except the Northern Territory.

The demand for qualified engineers has also slowed. We estimated average annual growth rates for the demand, measured by employment, for qualified engineers in all jurisdictions for both Australian-born and overseas-born cohorts and both genders. These estimates are presented in Table 3.6.

**Table 3.6:** Contributions to growth, employment of qualified engineers, States & Territories, 2006 to 2016 (% per year)

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 to 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 2.2 | 2.4 | 2.2 | 5.3 | 7.1 | 5.5 | 3.9 | 5.7 | 4.1 |
| Victoria | 2.7 | 3.7 | 2.8 | 7.2 | 9.4 | 7.5 | 4.9 | 7.1 | 5.1 |
| Queensland | 4.0 | 7.3 | 4.2 | 10.4 | 14.9 | 10.9 | 6.5 | 11.1 | 6.9 |
| WA | 4.8 | 7.4 | 5.0 | 11.9 | 15.7 | 12.2 | 8.6 | 12.3 | 9.0 |
| SA | 3.1 | 4.7 | 3.2 | 7.2 | 10.7 | 7.6 | 4.8 | 7.9 | 5.1 |
| Tasmania | 2.8 | 4.5 | 3.0 | 6.0 | 7.5 | 6.5 | 3.8 | 5.7 | 3.9 |
| NT | 2.4 | 12.9 | 3.2 | 10.2 | 12.7 | 10.5 | 5.7 | 12.8 | 6.3 |
| ACT | 2.6 | 6.6 | 3.0 | 6.8 | 11.4 | 7.5 | 4.3 | 9.2 | 4.9 |
| Australia | 3.1 | 4.6 | 3.2 | 7.6 | 9.8 | 7.8 | 5.3 | 7.7 | 5.5 |
| 2011 to 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 1.9 | 5.4 | 2.2 | 5.1 | 8.2 | 5.2 | 3.8 | 7.4 | 4.2 |
| Victoria | 2.0 | 4.0 | 2.2 | 6.0 | 8.1 | 6.3 | 4.1 | 6.7 | 4.5 |
| Queensland | 1.7 | 4.3 | 2.0 | 3.9 | 7.6 | 4.4 | 2.7 | 6.1 | 3.1 |
| WA | 1.5 | 4.3 | 1.8 | 5.3 | 9.1 | 5.7 | 3.8 | 7.5 | 4.2 |
| SA | 2.0 | 5.5 | 2.2 | 3.8 | 8.7 | 4.5 | 2.8 | 7.4 | 3.3 |
| Tasmania | 1.3 | 4.9 | 1.6 | 0.1 | 7.2 | 1.5 | 0.9 | 5.9 | 1.4 |
| NT | 4.3 | 5.5 | 4.4 | 12.4 | 10.8 | 12.2 | 8.4 | 8.3 | 8.4 |
| ACT | 1.9 | 2.7 | 2.0 | 5.1 | 8.9 | 5.8 | 3.4 | 6.4 | 3.8 |
| Australia | 1.9 | 4.6 | 2.1 | 5.2 | 8.2 | 5.6 | 3.6 | 7.0 | 4.0 |

**Between 2006 and 2011, the demand for qualified engineers grew by an average 5.5% per year.** This was driven by higher growth in Queensland, Western Australia and the Northern Territory. There was lower growth in the other jurisdictions, but growth rates exceeded average 4% in all jurisdictions except Tasmania, which grew at a rate close to this figure.

**Between 2011 and 2016, the demand for qualified engineers slowed to an average 4.0% per year, a more substantial slowdown than occurred for supply.** The main reason for the slowdown was that demand growth more than halved in Queensland and Western Australia as the resources boom transitioned from construction to production phases.

During this period, the dominant influences on demand growth were NSW and Victoria. This effect occurred not because these jurisdictions increased their demand for qualified engineers, but because they maintained their demand at levels similar to the earlier period.

During this period, demand growth in Queensland, South Australia and Tasmania was well below the national average.

**The demand for female qualified engineers was higher than for men in both periods for both ethnic cohorts and was particularly strong for overseas-born women.** This result was consistent across all jurisdictions, although there was substantial variation between them. In contrast, the slowest growth was recorded for Australian-born men, whose employment increased by just average 1.9% per year, compared to average 5.2% per year for overseas-born men.

The differences between the supply growth rates in Table 3.5 and the demand growth rates in Table 3.6 resulted in higher unemployment rates. Unemployment rates were estimated for each of the ethnic and gender groups in those Tables for 2006, 2011 and 2016 and are presented in Table 3.7.

**Table 3.7:** Unemployment rates for qualified engineers, States & Territories, 2006 to 2016 (%)

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 1.9 | 2.2 | 1.9 | 4.2 | 7.1 | 4.6 | 3.1 | 5.5 | 3.4 |
| Victoria | 2.0 | 2.6 | 2.0 | 4.6 | 7.4 | 5.0 | 3.2 | 5.4 | 3.5 |
| Queensland | 1.4 | 2.5 | 1.5 | 3.2 | 6.4 | 3.6 | 2.1 | 4.4 | 2.3 |
| WA | 1.2 | 1.8 | 1.3 | 2.3 | 5.2 | 2.5 | 1.8 | 3.7 | 1.9 |
| SA | 1.8 | 3.5 | 2.0 | 4.9 | 9.3 | 5.4 | 3.1 | 6.6 | 3.4 |
| Tasmania | 1.8 | 0.0 | 1.7 | 3.8 | 6.9 | 4.1 | 2.4 | 2.8 | 2.4 |
| NT | 1.4 | 0.0 | 1.3 | 0.6 | 0.0 | 0.6 | 1.1 | 0.0 | 1.0 |
| ACT | 1.5 | 1.6 | 1.5 | 2.3 | 7.5 | 3.1 | 1.8 | 4.8 | 2.1 |
| Australia | 1.7 | 2.3 | 1.8 | 3.9 | 7.0 | 4.3 | 2.8 | 5.1 | 3.0. |
| 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 2.3 | 2.7 | 2.3 | 4.5 | 8.1 | 5.0 | 3.5 | 6.6 | 3.9 |
| Victoria | 2.4 | 2.9 | 2.5 | 4.8 | 7.8 | 5.3 | 3.7 | 6.1 | 4.0 |
| Queensland | 1.9 | 1.9 | 1.9 | 3.7 | 9.1 | 4.4 | 2.7 | 6.0 | 3.0 |
| WA | 1.6 | 2.4 | 1.6 | 2.7 | 5.9 | 3.1 | 2.2 | 4.7 | 2.5 |
| SA | 2.3 | 3.6 | 2.4 | 4.8 | 10.3 | 5.5 | 3.4 | 7.6 | 3.8 |
| Tasmania | 3.0 | 0.7 | 2.8 | 4.6 | 12.7 | 5.5 | 3.5 | 6.1 | 3.7 |
| NT | 1.7 | 1.0 | 1.6 | 2.1 | 3.8 | 2.3 | 1.9 | 2.5 | 2.0 |
| ACT | 1.6 | 0.0 | 1.4 | 4.3 | 6.7 | 4.7 | 2.8 | 4.0 | 2.9 |
| Australia | 2.1 | 2.6 | 2.2 | 4.2 | 7.9 | 4.7 | 3.2 | 6.1 | 3.6 |
| 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 3.0 | 3.1 | 3.0 | 5.9 | 10.0 | 6.6 | 4.8 | 8.3 | 5.3 |
| Victoria | 3.3 | 3.3 | 3.3 | 6.8 | 11.3 | 7.6 | 5.3 | 9.0 | 5.8 |
| Queensland | 4.3 | 4.2 | 4.3 | 7.5 | 12.2 | 8.2 | 5.8 | 9.1 | 6.2 |
| WA | 5.4 | 5.3 | 5.4 | 8.3 | 14.1 | 9.0 | 7.2 | 11.5 | 7.7 |
| SA | 3.7 | 5.1 | 3.8 | 9.1 | 13.3 | 9.8 | 6.3 | 10.3 | 6.8 |
| Tasmania | 4.4 | 5.5 | 4.5 | 7.5 | 11.1 | 8.0 | 5.3 | 8.0 | 5.6 |
| NT | 2.1 | 0.0 | 1.9 | 3.6 | 6.6 | 3.9 | 3.0 | 3.9 | 3.1 |
| ACT | 2.2 | 2.9 | 2.3 | 5.2 | 11.0 | 6.3 | 3.6 | 8.3 | 4.3 |
| Australia | 3.7 | 3.8 | 3.7 | 6.9 | 11.3 | 7.6 | 5.5 | 9.1 | 6.0 |





**In 2006, the national unemployment rate for qualified engineers was 3.0%.** The unemployment rate for overseas-born qualified engineers at 4.3% was over twice as high as for Australian-born at 1.8%. This result was mainly due to much higher rates of unemployment for overseas-born qualified engineers in NSW, Victoria and South Australia. Although the unemployment rates in other jurisdictions for this cohort were lower, they were often higher than for Australian-born qualified engineers. Among the latter, the unemployment rates were typically in the region of "frictional unemployment" at 2% or less.

**By 2011, the national unemployment rate for qualified engineers had increased to 3.6%, mainly due to increased rates in NSW, Victoria, South Australia and Tasmania.** There was a small increase in unemployment among Australian-born qualified engineers, with Tasmania recording the largest change. However, unemployment rates among overseas-born qualified engineers were substantially higher than for Australian-born qualified engineers, even in the resources States where demand was strong.

**By 2016, the situation had deteriorated further, and the national unemployment rate had increased to 6.0%.** Unemployment rates increased in all jurisdictions, but the increases in Queensland, Western Australia and South Australia were particularly severe with rates above the national level. Unemployment rates for Australian-born qualified engineers increased out of the frictional unemployment range, with Tasmania joining the three States mentioned earlier. There was a particularly strong increase in unemployment among overseas-born qualified engineers, whose national average rate increased to 7.6% with five States experiencing higher or equal unemployment rates.

**Unemployment rates for women have been higher than for men in each census year.** Much of this result is due to the circumstances of overseas-born women. Over time, the gap between unemployment rates for Australian-born men and women has narrowed and was effectively eliminated in 2016.

However, overseas-born women experienced substantially higher rates of unemployment than overseas-born men throughout the period reviewed. As the national rate for the overseas-born cohort has increased, the gender gap has only widened. For any group, double digit unemployment rates in 2016 is exceptional; and this occurred in all jurisdictions except the Northern Territory.

## 3.5 Utilisation of qualified engineers

**KEY POINTS**

- The proportion of qualified engineers employed in engineering occupations increased from 60.9 to 62.1% between 2006 and 2011, then fell to 56.3% in 2016.
- These figures are low and show that Australia has a problem in retaining qualified engineers in engineering.

**The proportion of qualified engineers employed in engineering occupations nationally increased slightly from 2006 to 2011, but then fell to well below 2006 levels after 2012.**

In this report, we have argued that qualified engineers are fully utilised when employed in engineering occupations consistent with their educational qualifications and professional formation. In 2006, 60.9% of qualified engineers were fully utilised. Strong conditions in the engineering labour market increased the proportion to 62.1% by 2011. Similarly, as the engineering labour market weakened from about 2012, the proportion employed in engineering occupations fell to 56.3% by 2016.

Statistics on the number of qualified engineers employed in engineering occupations in the States and Territories are presented in Table 3.8. These statistics are combined with those in Table 3.1 to produce the proportions of qualified engineers employed in engineering occupations set out in Table 3.9 and illustrated in Figure 3.3. In this illustration, the national figures cited in the previous paragraph are included as dashed horizontal lines.

**There is substantial variability in the proportions of qualified engineers employed in engineering occupations between States and Territories.** In 2006, the proportions in NSW and Victoria were lower than the national average of 60.9% while the proportions in the other jurisdictions were above the national average. The highest proportion of qualified engineers employed in engineering occupations was in Western Australia with 69.3% and there was a sizable gap to the next highest which was 67.0% in Tasmania.

**In 2011, the national average proportion of qualified engineers employed in engineering occupations increased to 62.1%.** This change was driven by NSW, Queensland and Western Australia, where the proportions increased. Western Australia continued to have the highest proportion with 69.5% and was closely followed by Queensland where the proportion was 68.3%. The proportion of qualified engineers employed in engineering occupations remained unchanged in Victoria and fell in the remaining four jurisdictions.

**By 2016, the national proportion of qualified engineers employed in engineering occupations had fallen to 56.3%.** All jurisdictions experienced falls in the proportion of qualified engineers employed in engineering occupations, and there was some convergence of jurisdictional proportions towards the national average. The largest falls were in Western Australia and Queensland; but only NSW and Victoria had proportions employed in engineering occupations below the national average.





**Table 3.8:** Employment in engineering occupations, States and Territories, 2006 to 2016

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 19754 | 1375 | 21129 | 16926 | 1955 | 18881 | 36680 | 3330 | 40010 |
| Victoria | 17723 | 1536 | 19259 | 12103 | 1476 | 13579 | 29826 | 3012 | 32838 |
| Queensland | 13318 | 910 | 14228 | 6312 | 576 | 6888 | 19630 | 1486 | 21116 |
| WA | 7439 | 637 | 8076 | 7026 | 604 | 7630 | 14465 | 1241 | 15706 |
| SA | 4573 | 318 | 4891 | 2379 | 227 | 2606 | 6952 | 545 | 7497 |
| Tasmania | 1113 | 58 | 1171 | 403 | 35 | 438 | 1516 | 93 | 1609 |
| NT | 530 | 39 | 569 | 301 | 22 | 323 | 831 | 61 | 892 |
| ACT | 1515 | 101 | 1616 | 863 | 100 | 963 | 2378 | 201 | 2579 |
| Other | 9 | 0 | 9 | 4 | 0 | 4 | 10 | 0 | 10 |
| Australia | 65975 | 4970 | 70945 | 46311 | 5001 | 51312 | 112286 | 9971 | 122257 |
| 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 22557 | 1644 | 24201 | 23130 | 3264 | 26394 | 45687 | 4908 | 50595 |
| Victoria | 20430 | 1924 | 22354 | 17450 | 2627 | 20077 | 37880 | 4551 | 42431 |
| Queensland | 16588 | 1429 | 18017 | 11222 | 1381 | 12603 | 27810 | 2810 | 30620 |
| WA | 9721 | 903 | 10624 | 12391 | 1325 | 13716 | 22112 | 2228 | 24340 |
| SA | 5346 | 413 | 5759 | 3407 | 407 | 3814 | 8753 | 820 | 9573 |
| Tasmania | 1272 | 82 | 1354 | 534 | 43 | 577 | 1806 | 125 | 1931 |
| NT | 619 | 69 | 688 | 453 | 39 | 492 | 1072 | 108 | 1180 |
| ACT | 1738 | 178 | 1916 | 1130 | 185 | 1315 | 2868 | 363 | 3231 |
| Other | 19 | 0 | 19 | 7 | 0 | 7 | 26 | 0 | 26 |
| Australia | 78292 | 6640 | 84932 | 69708 | 9273 | 78981 | 148000 | 15913 | 163913 |
| 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 24293 | 2147 | 26440 | 28866 | 4891 | 33757 | 53159 | 7038 | 60197 |
| Victoria | 21938 | 2203 | 24141 | 21837 | 3774 | 25611 | 43775 | 5977 | 49752 |
| Queensland | 17139 | 1710 | 18849 | 11884 | 1603 | 13487 | 29023 | 3313 | 32336 |
| WA | 9872 | 1037 | 10909 | 13392 | 1646 | 15038 | 23264 | 2683 | 25947 |
| SA | 5688 | 499 | 6187 | 3586 | 538 | 4124 | 9274 | 1037 | 10311 |
| Tasmania | 1322 | 97 | 1419 | 477 | 57 | 534 | 1799 | 154 | 1953 |
| NT | 742 | 79 | 821 | 726 | 63 | 789 | 1468 | 142 | 1610 |
| ACT | 1894 | 202 | 2096 | 1390 | 283 | 1673 | 3284 | 485 | 3769 |
| Other | 15 | 17 | 32 | 9 | 0 | 9 | 24 | 17 | 41 |
| Australia | 82903 | 7991 | 90894 | 82175 | 12847 | 95022 | 165078 | 20838 | 185916 |

NB Columns may not sum due to data pertubation undertaken by the ABS

**Table 3.9:** Proportions of qualified engineers employed in engineering occupations, 2006 to 2016

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 67.5 | 52.8 | 66.3 | 51.0 | 35.9 | 48.9 | 58.8 | 41.4 | 56.8 |
| Victoria | 67.3 | 56.1 | 66.2 | 51.8 | 37.8 | 49.8 | 60.0 | 45.4 | 58.3 |
| Queensland | 72.4 | 63.2 | 71.7 | 59.1 | 44.4 | 57.5 | 67.5 | 54.3 | 66.4 |
| WA | 73.4 | 71.7 | 73.3 | 66.7 | 53.8 | 65.5 | 70.0 | 61.7 | 69.3 |
| SA | 72.9 | 64.8 | 72.3 | 54.7 | 41.6 | 53.3 | 65.5 | 52.6 | 64.3 |
| Tasmania | 70.0 | 53.2 | 68.9 | 63.9 | 48.6 | 62.3 | 68.3 | 51.4 | 67.0 |
| NT | 67.9 | 73.6 | 68.2 | 62.6 | 39.3 | 60.1 | 65.8 | 56.0 | 65.1 |
| ACT | 71.4 | 52.6 | 69.8 | 64.4 | 44.1 | 61.5 | 68.7 | 48.0 | 66.5 |
| Australia | 69.5 | 58.4 | 68.6 | 54.8 | 39.5 | 52.8 | 62.6 | 47.1 | 60.9 |
| 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 68.8 | 55.8 | 67.7 | 53.8 | 42.0 | 52.0 | 60.3 | 45.8 | 58.5 |
| Victoria | 67.6 | 58.5 | 66.7 | 52.7 | 42.8 | 51.1 | 59.8 | 48.3 | 58.3 |
| Queensland | 73.8 | 70.3 | 73.5 | 63.7 | 51.8 | 62.1 | 69.3 | 59.8 | 68.3 |
| WA | 75.5 | 70.9 | 75.1 | 66.9 | 56.5 | 65.8 | 70.5 | 61.5 | 69.5 |
| SA | 73.0 | 66.9 | 72.5 | 55.5 | 44.3 | 54.1 | 65.0 | 53.4 | 63.8 |
| Tasmania | 68.8 | 59.9 | 68.1 | 62.7 | 39.1 | 60.0 | 66.9 | 50.6 | 65.5 |
| NT | 70.1 | 70.4 | 70.1 | 57.0 | 36.8 | 54.6 | 63.9 | 52.9 | 62.7 |
| ACT | 71.9 | 68.5 | 71.5 | 59.5 | 47.9 | 57.5 | 66.4 | 56.2 | 65.1 |
| Australia | 70.6 | 62.3 | 69.9 | 57.2 | 45.4 | 55.5 | 63.6 | 51.2 | 62.1 |
| 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 66.8 | 55.9 | 65.8 | 51.5 | 41.6 | 49.8 | 57.5 | 45.1 | 55.7 |
| Victoria | 65.0 | 54.9 | 63.9 | 48.4 | 40.1 | 46.9 | 55.5 | 44.6 | 53.9 |
| Queensland | 68.3 | 66.6 | 68.1 | 53.4 | 40.3 | 51.4 | 61.3 | 50.6 | 60.0 |
| WA | 68.4 | 64.1 | 68.0 | 52.8 | 41.5 | 51.3 | 58.5 | 48.0 | 57.2 |
| SA | 69.5 | 60.8 | 68.7 | 46.2 | 37.3 | 44.8 | 58.2 | 45.8 | 56.6 |
| Tasmania | 66.1 | 53.0 | 65.0 | 54.0 | 37.3 | 51.5 | 62.4 | 45.8 | 60.7 |
| NT | 67.9 | 62.2 | 67.4 | 50.1 | 34.6 | 48.4 | 57.8 | 46.0 | 56.5 |
| ACT | 70.8 | 66.0 | 70.3 | 56.4 | 45.8 | 54.3 | 63.9 | 52.5 | 62.2 |
| Australia | 67.1 | 59.3 | 66.3 | 50.9 | 40.8 | 49.3 | 57.9 | 46.3 | 56.3 |

**From Table 3.9, it is clear that the proportions of Australian-born qualified engineers employed in engineering occupations are generally higher than the national averages**. It is also clear that the proportions of overseas-born qualified engineers so employed are lower than the national averages. The two exceptions to this generalisation are Western Australia and Queensland, but only in 2006 and 2011. During this period, the proportions of overseas-born qualified engineers employed in engineering occupations were at least equal to the national averages, but still below the corresponding Australian-born figures.

**Another key conclusion is that the proportion of female qualified engineers employed in engineering occupations is generally lower than for men.** While this relationship holds for Australian-born qualified engineers, the proportion of Australian-born women employed in engineering occupations is higher than for overseas-born engineers of either gender.

During the resource boom years, the gap between Australian-born men and women employed in engineering occupations narrowed considerably in Western Australia and Queensland. The only other jurisdiction where this occurred was the ACT in 2011.

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**Figure 3.3:** The proportions of qualified engineers employed in engineering occupations, States and Territories, 2006 to 2016

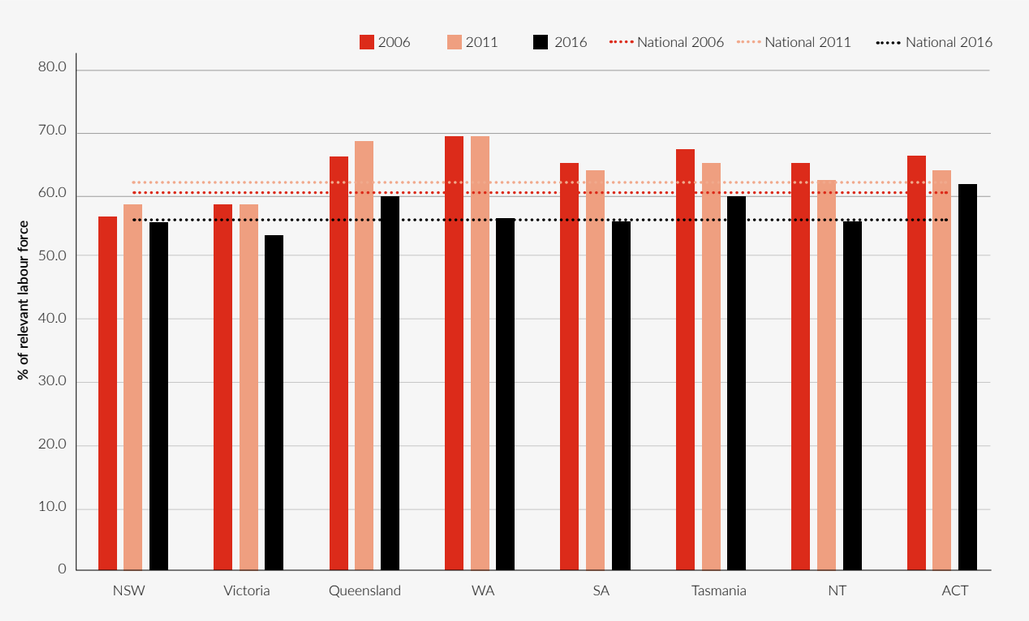



**Table 3.10:** Contributions to growth of employment in engineering occupations, States and Territories, 2006 to 2016 (%)

| State or Territory | Australian born | | | Overseas born | | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| 2006 to 2011 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 2.7 | 3.6 | 2.8 | 6.4 | 10.8 | 6.9 | 4.5 | 8.1 | 4.8 |
| Victoria | 2.9 | 4.6 | 3.0 | 7.6 | 12.2 | 8.1 | 4.9 | 8.6 | 5.3 |
| Queensland | 4.5 | 9.5 | 4.8 | 12.2 | 19.1 | 12.8 | 7.2 | 13.6 | 7.7 |
| WA | 5.5 | 7.2 | 5.6 | 12.0 | 17.0 | 12.5 | 8.9 | 12.4 | 9.2 |
| SA | 3.2 | 5.4 | 3.3 | 7.5 | 12.4 | 7.9 | 4.7 | 8.5 | 5.0 |
| Tasmania | 2.7 | 7.2 | 3.0 | 5.8 | 4.2 | 5.7 | 3.6 | 6.1 | 3.7 |
| NT | 3.2 | 12.1 | 3.9 | 8.5 | 12.1 | 8.8 | 5.2 | 12.1 | 5.8 |
| ACT | 2.8 | 12.0 | 3.5 | 5.5 | 13.1 | 6.4 | 3.8 | 12.6 | 4.6 |
| Australia | 3.5 | 6.0 | 3.7 | 8.5 | 13.1 | 9.0 | 5.7 | 9.8 | 6.0 |
| 2011 to 2016 | Men | Women | Combined | Men | Women | Combined | Men | Women | Combined |
| NSW | 1.5 | 5.5 | 1..8 | 4.5 | 8.4 | 5.0 | 3.1 | 7.5 | 3.5 |
| Victoria | 1.4 | 2.8 | 1.6 | 4.6 | 7.5 | 5.0 | 2.9 | 5.6 | 3.2 |
| Queensland | 0.7 | 3.7 | 0.9 | 1.2 | 3.0 | 1.4 | 0.9 | 3.4 | 1.1 |
| WA | 0.3 | 2.8 | 0.5 | 1.6 | 4.4 | 1.9 | 1.0 | 3.8 | 1.3 |
| SA | 1.3 | 3.9 | 1.4 | 1.0 | 5.7 | 1.6 | 1.2 | 4.8 | 1.5 |
| Tasmania | 0.8 | 3.4 | 0.9 | -2.2 | 5.8 | -1.5 | -0.1 | 4.3 | 0.2 |
| NT | 3.7 | 2.7 | 3.6 | 9.9 | 10.1 | 9.9 | 6.5 | 5.6 | 6.4 |
| ACT | 1.7 | 2.6 | 1.8 | 4.2 | 8.9 | 4.9 | 2.8 | 6.0 | 3.1 |
| Australia | 0.9 | 3.8 | 1.4 | 3.4 | 6.7 | 3.8 | 2.2 | 5.5 | 2.6 |





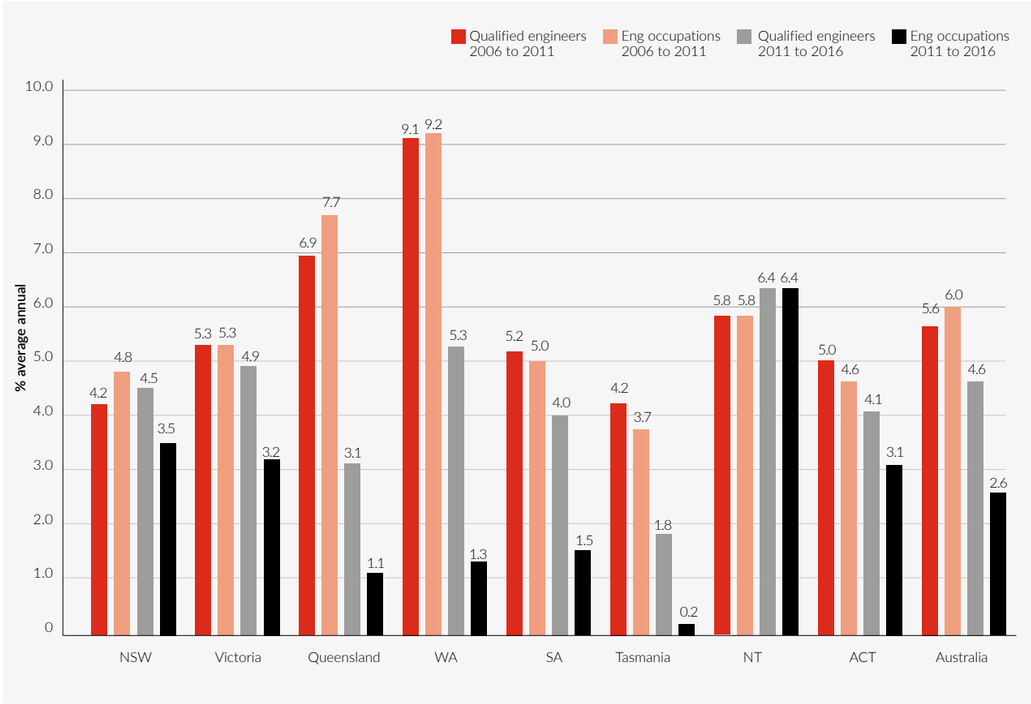
Corresponding to Table 3.6, which covers annual growth in the employment of qualified engineers, Table 3.10 presents estimated average annual growth rates for qualified engineers employed in engineering occupations. The two Tables together provide a useful way to analyse the changed conditions in the engineering labour market. An engineering skill shortage occurs when the demand for qualified engineers to be employed in engineering occupations grows faster than the supply of qualified engineers. The key results are illustrated in Figure 3.4.

**Between 2006 and 2011, the national supply of qualified engineers grew by an average 5.6% per year, while the demand for qualified engineers to be employed in engineering occupations grew by an average 6.0% per year.**

This relationship indicates that nationally, Australia experienced a shortage of qualified engineers to be employed in engineering occupations between 2006 and 2011. These conditions also occurred in NSW, Queensland and Western Australia.

In Victoria and the Northern Territory, the two growth rates were balanced; but because we are basing our conclusion on average annual growth, there was most likely a skill shortage at some point during the five years under discussion. However, there was no skill shortage in South Australia, Tasmania or the ACT.

**Figure 3.4:** Growth in the engineering labour force compared to employment of qualified engineers in engineering occupations, States and Territories, 2006 to 2016



**The situation changed dramatically in the period 2011 to 2016.** At a national level, annual growth in the supply of qualified engineers fell from an average of 5.6% to 4.6%, but annual growth in qualified engineers employed in engineering occupations fell from an average of 6.0% to 2.6%. These figures indicate that at the national level, there is not a shortage of qualified engineers to fill engineering occupations.

**Growth in employment in engineering occupations has fallen in all jurisdictions.** The largest falls occurred in Western Australia from an average of 9.2% per year to 1.3% per year, and in Queensland from an average of 7.7% per year to 1.1% per year.

These falls offset some of the more moderate growth experienced in NSW (3.5% per year), Victoria (3.2% per year) and the ACT (3.1% per year). The highest growth recorded was in the NT with an average of 6.4% per year; and there was low growth in south Australia (1.5% per year) and Tasmania (0.2% per year).

**In every jurisdiction except the Northern Territory, growth in the supply of qualified engineers exceeded growth in qualified engineers employed in engineering occupations, in most cases by a considerable margin.** These results indicate that there was no shortage of qualified engineers to fill engineering occupations in any jurisdiction other than the Northern Territory. In the latter, the two growth rates were balanced; and at some time during the five-year period, there may have been a shortage of engineers.

*These results indicate that there was no shortage of qualified engineers to fill engineering occupations in any jurisdiction other than the Northern Territory.*

**These figures create cause for concern regarding Australia's engineering capability.** It is unlikely that a situation in which all qualified engineers are employed in engineering would ever occur. Some people will always change their minds about their career choice and greener pastures will always be attractive. However, that aside, the figures for qualified engineers employed in engineering occupations are very low.

The fall in the proportion of qualified engineers in engineering occupations and the slow growth of employment opportunities has serious implications for Australia's future. Once qualified engineers leave the profession, it is difficult to return without significant investment to recoup lost currency in knowledge and engineering practices between departure and return to the profession. The low growth of employment in engineering occupations does little to attract qualified engineers back to the profession.

**The full implications of these results require drawing on statistics other than census statistics, which is deferred until the final part of this report.**





## 3.6 Location of qualified engineers within jurisdictions

**KEY POINTS**

- In almost all States, concentrations of both qualified engineers and engineers employed in engineering occupations are disproportionately higher in capital city regions than in other regions within the State.
- Concentration of skilled workers in capital cities is not unique to qualified engineers, but a feature of all skilled workers. However, with the exception of Hobart, the concentration of qualified engineers in capitals is higher than for other skills.

In section 3.5, we observed that the distribution of qualified engineers throughout Australia was broadly in line with the gross product share of jurisdictions modified by the effects of the resources boom. Within jurisdictions, the distribution of qualified engineers varies widely, but a feature common to all is heavy concentrations in capital cities. This section examines the within-jurisdiction distribution of qualified engineers in greater detail.[22]

### NEW SOUTH WALES

**KEY POINTS**

- In NSW, the regions with the largest number of qualified engineers and qualified engineers employed in engineering occupations are predominantly in metropolitan Sydney. In comparison, the numbers in the two largest non-metropolitan regions are similar to smaller metropolitan regions.
- More metropolitan than non-metropolitan regions experienced growth above the State average in the number of qualified engineers and the numbers employed in engineering occupations.

**In 2016, 80.4% of qualified engineers and 78.7% of qualified engineers employed in engineering occupations in New South Wales were located in metropolitan Sydney.** Both figures are an increase over 2011, when they were 79.0% and 76.1% respectively. The ABS geographic classification identifies fourteen regions in Metropolitan Sydney. In Figure 3.5, we illustrate the distribution of qualified engineers and employment in engineering occupations across these regions in 2016. Similarly, there are fourteen non-metropolitan regions in the State, and Figure 3.6 illustrates these distributions for these regions.

Outside Sydney, the largest concentration of qualified engineers in New South Wales is in the Newcastle and Lake Macquarie region. This region has 4.4% of qualified engineers and 5.4% of qualified engineers employed in engineering occupations in 2016. It has a long industrial history, which this is reflected in the proportion of qualified engineers employed in engineering occupations. This was 68.6% compared to the State average of 55.7% and the Sydney metropolitan average of 54.5%.

22. Ideally, our analysis should consider both inter-census periods. However, the geographic distribution used by the ABS in 2006 changed substantially before the 2011 census. As a result, we confine our work to changes between 2011 and 2016.

However, comparisons between Figures 3.5 and 3.6 show that nine metropolitan regions have more qualified engineers than the Newcastle and Lake Macquarie region and seven have more qualified engineers employed in engineering occupations. None of these metropolitan regions have proportions of qualified engineers employed in engineering occupations on par with Newcastle and Lake Macquarie.

The second largest non-metropolitan region is another historical industrial region. The Illawarra region has 3.5% of the State's qualified engineers and 3.7% of qualified engineers employed in engineering occupations in 2016. The proportion of qualified engineers employed in engineering occupations was 58.6%. Ten metropolitan regions had more qualified engineers than the Illawarra region and ten had more qualified engineers employed in engineering occupations. All other non-metropolitan region had fewer qualified engineers than the smallest metropolitan region.

The largest metropolitan region is the North Sydney and Hornsby region which has 10.7% of the State's qualified engineers and 12.3% of qualified engineers employed in engineering occupations in 2016. The proportion of qualified engineers employed in engineering occupations was 64.1%. Other large concentrations are in the Parramatta region with 10.2% of the State's qualified engineers and 9.5% of employment in engineering occupations and the Inner South West region with 9.0% and 7.3% respectively.

**Figure 3.5:** The proportional distribution of qualified engineers and those employed in engineering occupations, NSW metropolitan regions, 2016

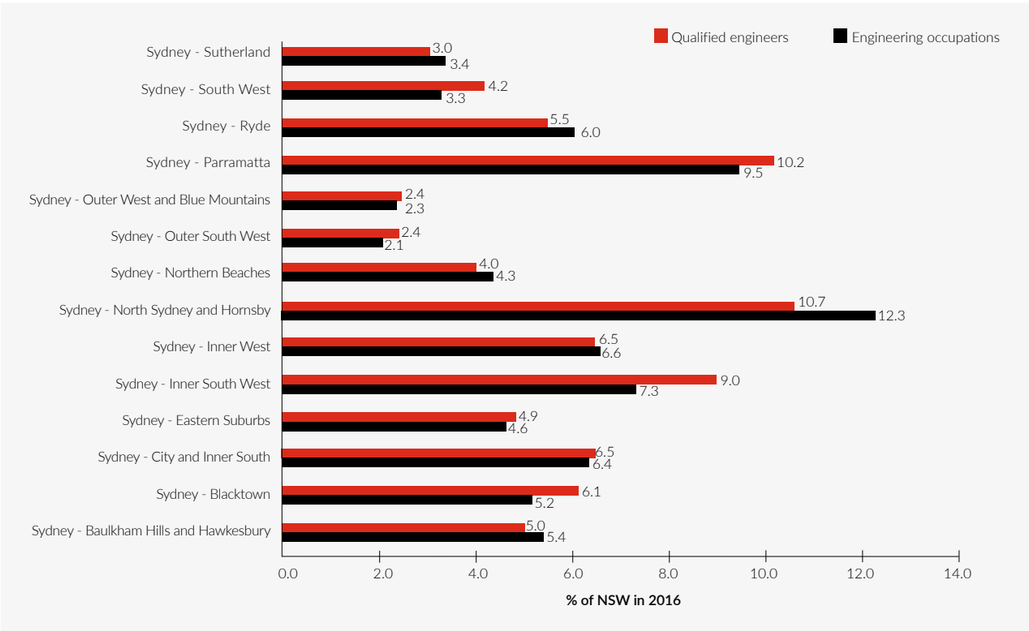







**Figure 3.6:** The proportional distribution of qualified engineers and those employed in engineering occupations, NSW non-metropolitan regions, 2016

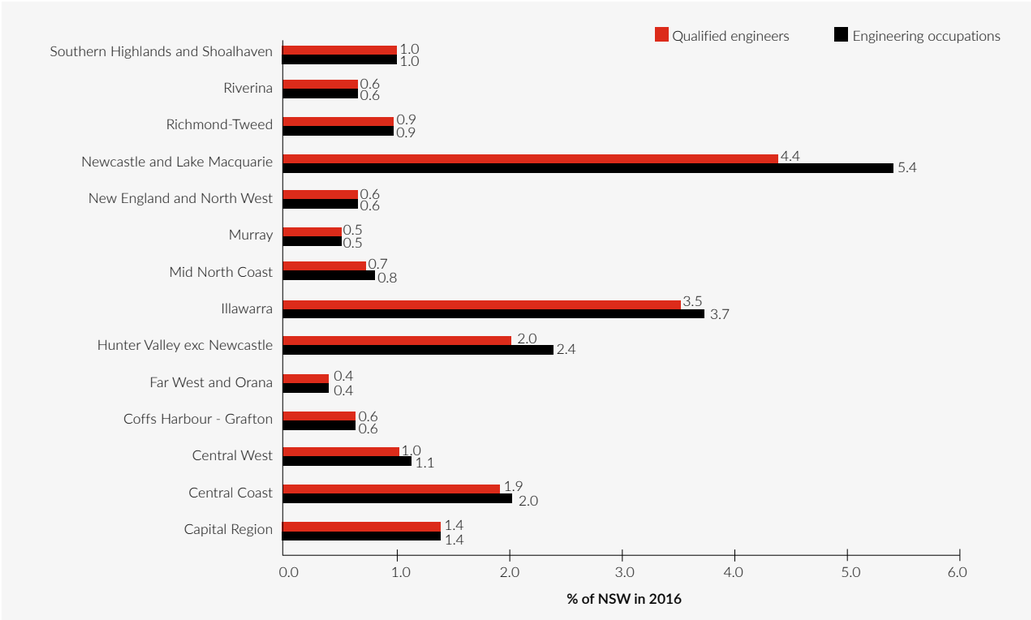



**Figure 3.7:** Changes in the number of qualified engineers and numbers employed in engineering occupations, NSW metropolitan regions, 2011 to 2016

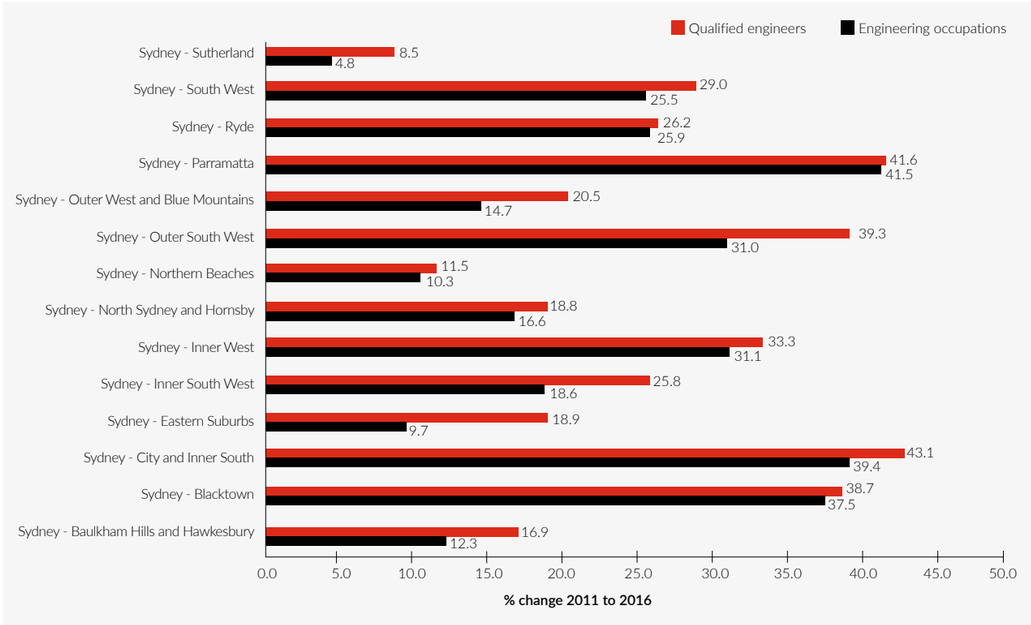
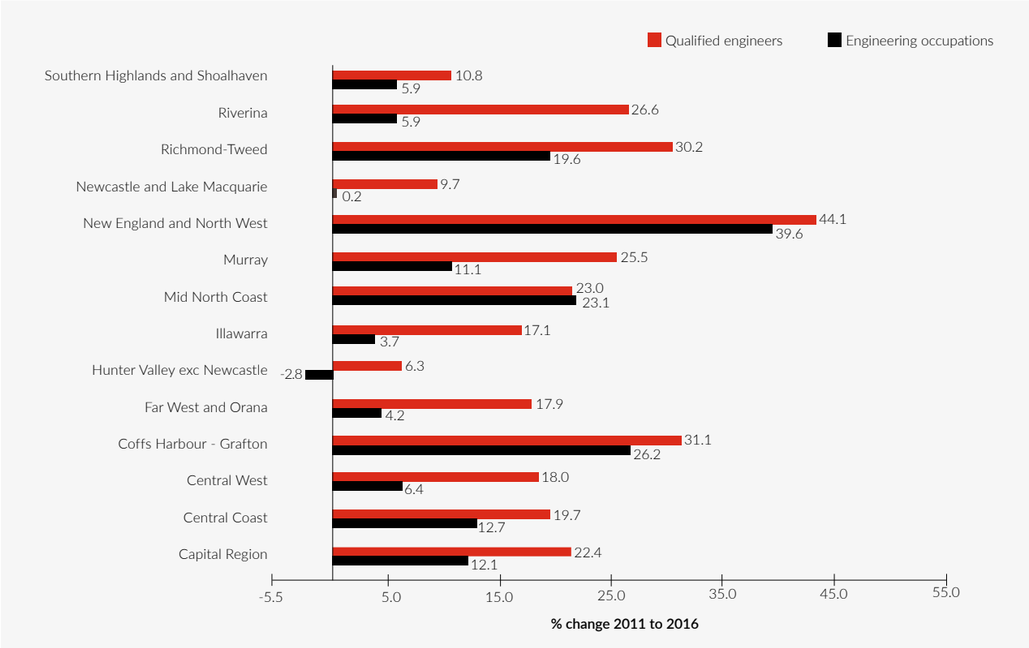


**Figure 3.8:** Changes in the number of qualified engineers and the number employed in engineering occupations, NSW non-metropolitan regions, 2011 to 2016




Earlier, we observed that in New South Wales, growth in the number of qualified engineers increased from an average of 4.2% per year between 2006 and 2011 to average 4.5% per year between 2011 and 2016. In contrast, growth in the number of qualified engineers employed in engineering occupations slowed from an average of 4.8% per year to 3.5% per year over the same periods. The latter compares well with the national rate, which slowed even more to average 2.6% per year.

**The difference between the State and national growth rates over 2011 to 2016 matches perceptions that Sydney, in particular, has benefited from infrastructure development.** However, it is important to realise that opportunities in engineering occupations grew more slowly than in the earlier period. This background provides a useful benchmark with which to gauge regional changes. The State's 2011 to 2016 growth rates are equivalent to a 24.9% increase in the number of qualified engineers over this five-year period, and a 19.0% increase in the number of qualified engineers employed in engineering occupations.

From Figure 3.7, we observe that eight metropolitan regions had proportionally larger increases in the number of qualified engineers than the State average, and six regions had proportionally lower increases. In non-metropolitan regions, Figure 3.8 shows that five had proportionally larger increases and nine had proportionally lower increases. Over 86% of the NSW increase in qualified engineers and over 92% of qualified engineers employed in engineering occupations between 2011 and 2016 were located in Sydney regions.

The numbers were very similar for regional increases in the number of qualified engineers employed in engineering occupations. Seven metropolitan regions had larger increases than the State average and seven had lower increases. In non-metropolitan regions, five had larger increases than the State average and nine had lower increases.

The regions experiencing the largest increases were typically small with less than one percent of the State's numbers. The two largest non-metropolitan regions experienced below average growth; and in the Hunter Valley (excluding Newcastle) region, the number of qualified engineers employed in engineering occupations contracted.





## VICTORIA

### KEY POINTS

- In Victoria, regions with the most pronounced concentration of both qualified engineers and qualified engineers employed in engineering occupations are all in metropolitan Melbourne.
- One non-metropolitan region, Geelong, experienced above-state-average growth in the number of qualified engineers but substantially below-State-average growth in employment in engineering occupations.
- All other non-metropolitan regions experienced below-State-average growth in both measures.

**In Victoria, the ABS identified seventeen regions: eight in metropolitan Melbourne and nine non-metropolitan regions.** Following the approach used to discuss New South Wales statistics, Figure 3.9 illustrates the distribution of qualified engineers and the distribution of qualified engineers employed in engineering occupations in the seventeen regions in 2016. Figure 3.10 illustrates the size of the changes that occurred in these regions between 2011 and 2016.

**Qualified engineers are more geographically concentrated in Victoria than in New South Wales.** In 2016, 87.5% of qualified engineers and 87.3% of qualified engineers employed in engineering occupations were located in Melbourne. The largest metropolitan region was Inner Melbourne, which had 16.1% of the State's qualified engineers and 18.0% of qualified engineers employed in engineering occupations.

The smallest metropolitan region was North West Melbourne, which had 5.6% and 5.2%, respectively. However, this region had substantially larger numbers than the largest non-metropolitan region, Geelong, which had 3.3% of the State's qualified engineers and 3.1% of its employment in engineering occupations.

**The average proportion of qualified engineers employed in engineering occupations in Victoria in 2016 was 53.9% compared to 58.0% in 2011.** This proportion fell in all regions. In metropolitan regions in 2016, it ranged from 47.0% in West Melbourne to 60.3% in Inner Melbourne. In non-metropolitan regions, the proportion of qualified engineers employed in engineering occupations ranged from 48.8% in the North West region to 64.1% in Bendigo.

**Victorian growth in the number of qualified engineers slowed from an average of 5.3% per year between 2006 to 2011 to 4.9% per year between 2011 and 2016.** There was a larger slowdown in the growth of employment in engineering occupations from an average of 5.3% per year to 3.2% per year in the same periods.

The lower growth translates to an increase of 26.9% in the number of qualified engineers between 2011 and 2016; and an increase of 17.3% in the number of qualified engineers employed in engineering occupations. These figures serve as benchmarks to evaluate the changes illustrated in Figure 3.10.

**Figure 3.9:** The proportional distribution of qualified engineers and those employed in engineering occupations, Victorian regions, 2016

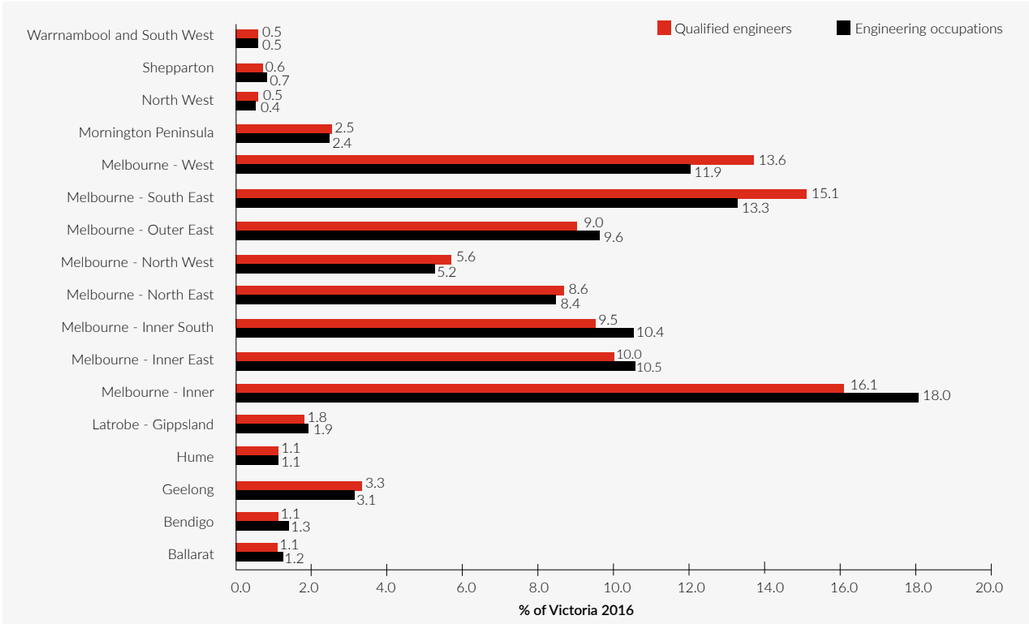
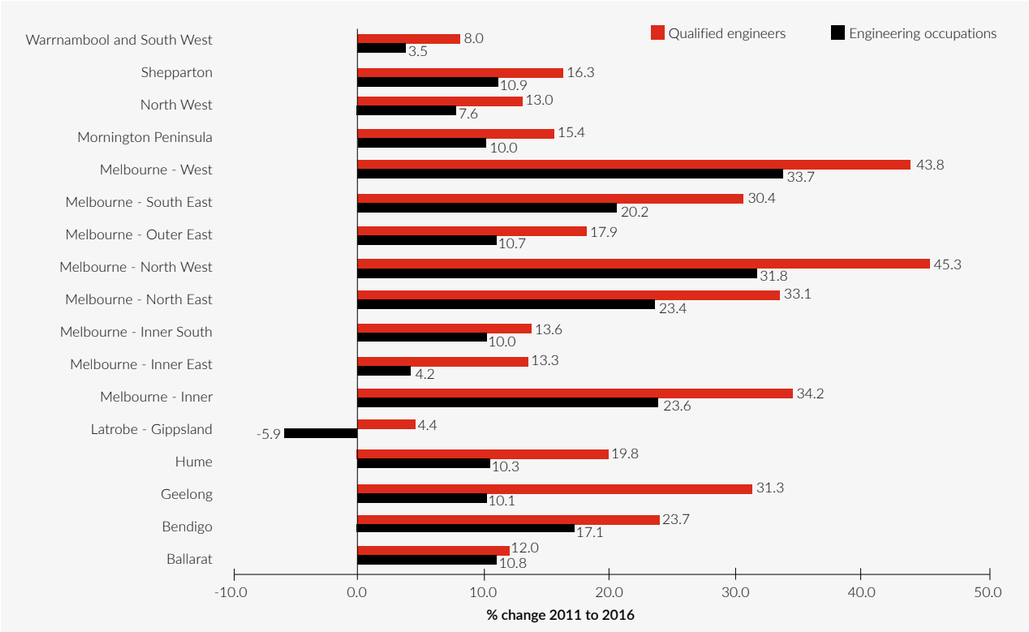



**Figure 3.10:** Changes in the number of qualified engineers and numbers employed in engineering occupations, Victorian regions, 2011 to 2016








**Five of the eight metropolitan regions recorded proportionally higher growth in the number of qualified engineers than the State average between 2011 and 2016.** They were West Melbourne, South East Melbourne, North West Melbourne, North East Melbourne and Inner Melbourne. Proportionally lower growth than the State average was recorded in Outer East, Inner East and Inner South Melbourne. This pattern was repeated for changes in the number of qualified engineers employed in engineering occupations.

Only one non-metropolitan region, Geelong, recorded proportionally above-average growth, and that was a 31.3% increase in the number of qualified engineers. It was accompanied by a 10.1% increase in employment in engineering occupations, which was substantially below the State average. All other non-metropolitan regions recorded below-State-average changes; and in the Gippsland region, the number of qualified engineers employed in engineering occupations fell by 5.9%.

## QUEENSLAND

### KEY POINTS

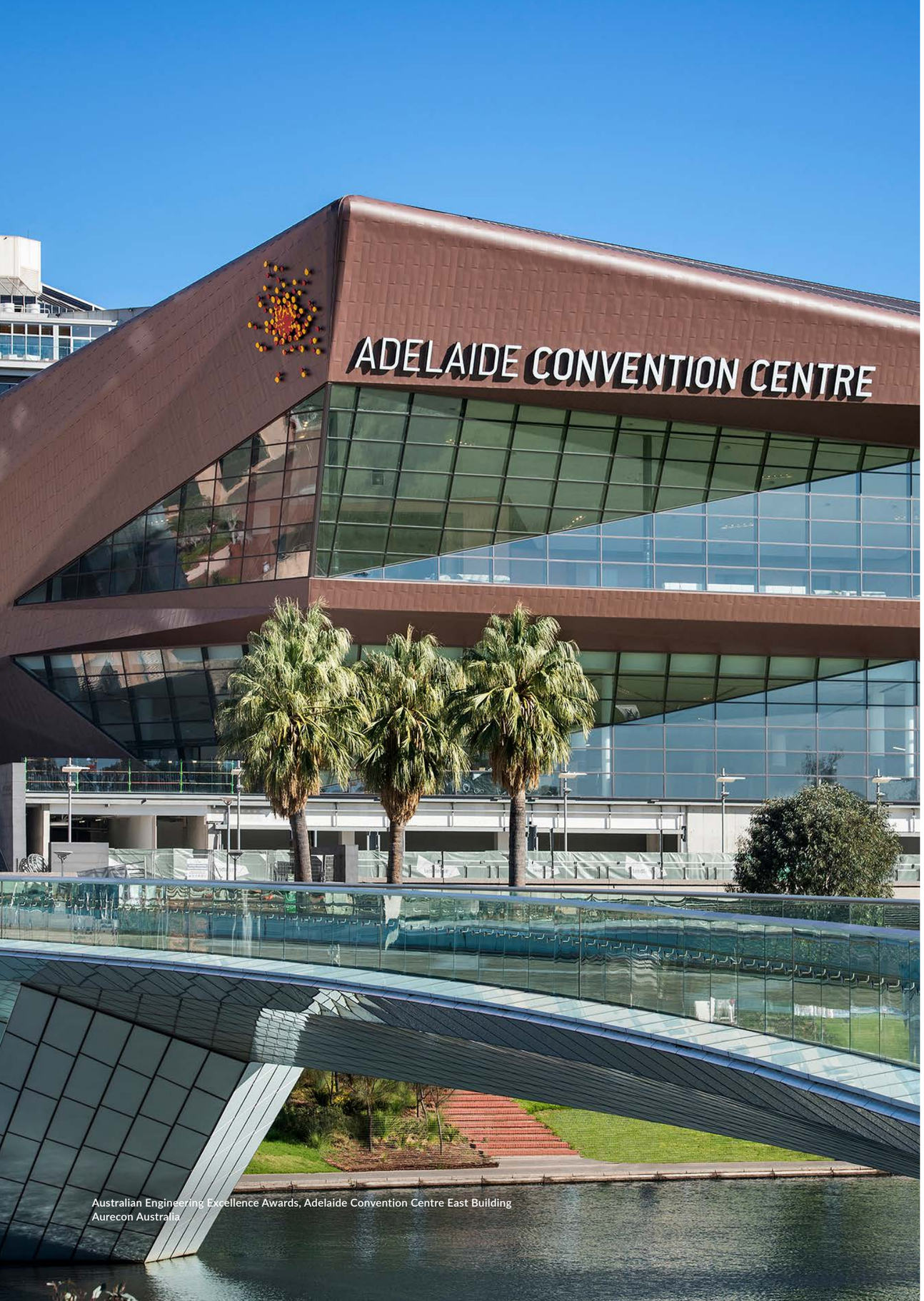
- Slowdown in the growth of the number of qualified engineers in Queensland was stronger than in the two largest jurisdictions, although the average 3.3% annual growth between 2011 and 2016 is still fairly robust.
- However, the State has experienced a profound boom-bust in the number of qualified engineers employed in engineering occupations. This has created a tumultuous disruption to the engineering profession.

**Compared to New South Wales and Victoria, the distribution of qualified engineers and qualified engineers employed in engineering occupations is more dispersed throughout the State.** This is evident in Figure 3.11, which shows the proportional distribution of the two measures throughout the nineteen ABS regions used in our analysis. Five regions that cover metropolitan Brisbane accounted for 49.8% of qualified engineers and 52.7% of employment in engineering occupations in 2016. These shares were almost unchanged from 2011.

**The largest concentration of qualified engineers was in South Brisbane, which accounted for 14.1% of the State's qualified engineers in 2016.** This region was the second highest in terms of employment in engineering occupations with 13.4%. The second largest region, Inner City Brisbane had fewer qualified engineers, but more of them were employed in engineering occupations. The proportion employed in these occupations in this region was 66.0% compared to 57.1% in South Brisbane. In general, the proportion of qualified engineers employed across the five Brisbane regions was 63.4% in 2016, substantially higher than in either Sydney or Melbourne.

Outside of Brisbane there were significant congregations of qualified engineers on the Gold Coast (8.8% of the State in 2016), Ipswich (5.3%), South Moreton Bay (4.7%), Sunshine Coast (4.6%), Central Queensland (4.1%), Cairns (3.3%), Townsville (3.5%) and Mackay (3.2%) as well as a number of other locations. With the exception of Townsville and Mackay, nearly all these regions had proportions employed in engineering occupations that were lower than in the Brisbane metropolitan regions.

**In Queensland, growth in the number of qualified engineers more than halved from an average of 6.9% per year between 2006 to 2011 to average 3.3% per year between 2011 and 2016.** The collapse in employment in engineering occupations was even more dramatic, falling from an average of 7.7% per year between 2006 and 2011 to 1.1% per year between 2011 and 2016. The rates experienced in the second period establish the benchmarks to evaluate regional changes: 20.4% increase in the State's qualified engineers and 5.6% increase in employment in engineering occupations. The 2011 to 2016 regional changes are shown in Figure 3.12.




Australian Engineering Excellence Awards, Adelaide Convention Centre East Building
Aurecon Australia



**Figure 3.11:** The proportional distribution of qualified engineers and those employed in engineering occupations, Queensland regions, 2016

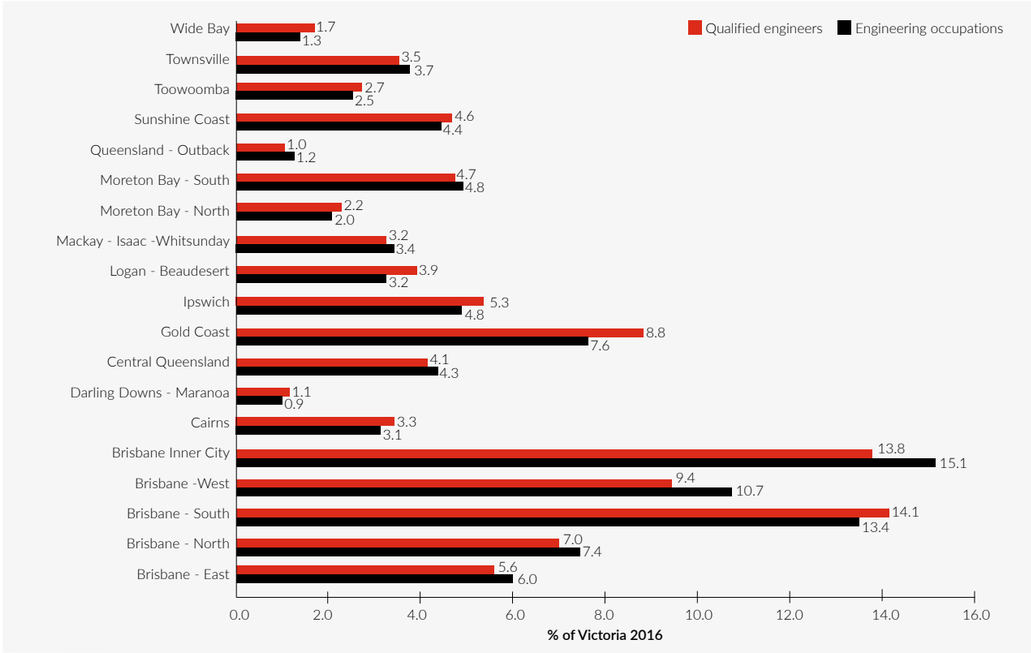
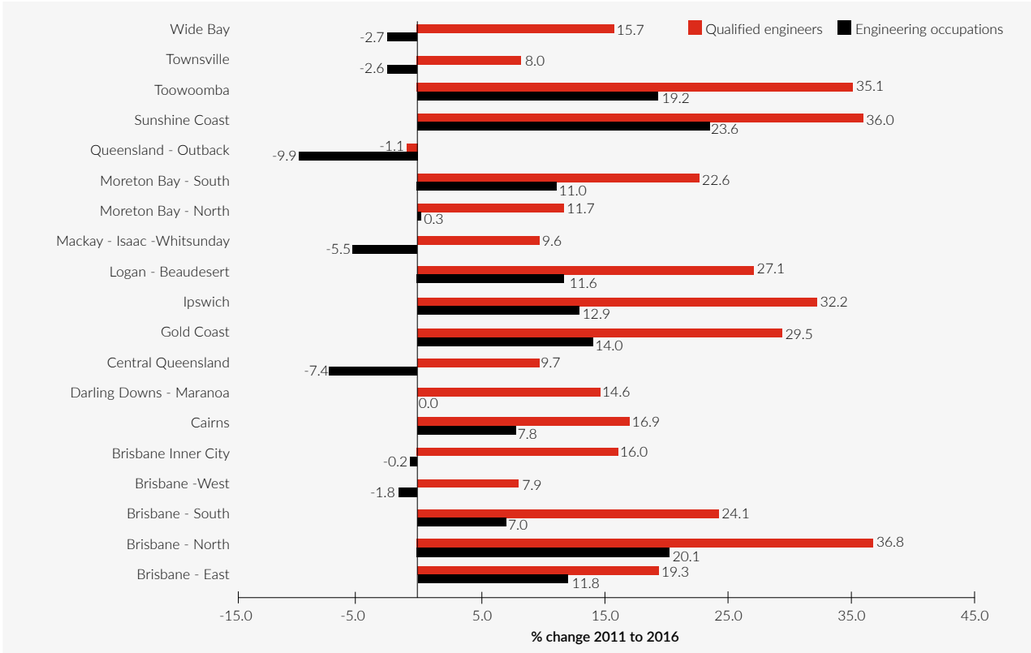



**Figure 3.12:** Changes in the number of qualified engineers and numbers employed in engineering occupations, Queensland regions, 2011 to 2016



**The number of qualified engineers grew proportionally more than the State average in eight of the nineteen regions.** Two regions, North and South Brisbane, were in the metropolitan area but Gold Coast, Ipswich, Logan, South Moreton Bay, Sunshine Coast and Toowoomba, were widely dispersed. The number of qualified engineers contracted in Outback Queensland.

**Employment of qualified engineers in engineering occupations increased by more than the State average in ten regions.** These regions included the eight regions in which the number of qualified engineers increased by more than the State average, and East Brisbane and Cairns. Overall however, the growth recorded in these regions was less than in most parts of Australia.

Employment in engineering occupations fell, or was zero, relative to 2011 in eight regions: Brisbane West and Inner City Brisbane in the metropolitan area and Darling Downs, Central Queensland, Mackay, Outback Queensland, Townsville and Wide Bay. The situation was essentially static in North Moreton Bay. where the number employed in engineering occupations increased by just 0.3% over the five-year period.

## SOUTH AUSTRALIA

### KEY POINTS

- With one exception, regional growth in the number of qualified engineers in South Australian regions has been fairly robust. This is a comment on supply, and the demand perspective is more complex.
- Overall State demand for qualified engineers in engineering occupations has fallen sharply and is comparatively low.

Seven regions in South Australia have been analysed, with four of them constituting metropolitan Adelaide. Figure 3.13 illustrates the 2016 distribution of qualified engineers and qualified engineers employed in these regions.

The engineering profession in South Australia is concentrated in Adelaide. In 2016, 91.7% of the State's qualified engineers were located in the four metropolitan regions as were 92.2% of qualified engineers employed in engineering occupations. These figures were a little higher than in 2011 when they were 91.0% and 91.3% respectively. The shares of both measures in the other three regions were typically less than four percentage points. The State-wide proportion of qualified engineers employed in engineering occupations has experienced a large fall from 63.7% in 2011 to 56.6% in 2016.

The State-wide growth experience had some similarities to Queensland. There was a slowdown in growth in the number of qualified engineers from an average of 5.2% per year between 2006 and 2011 to average 4.0% per year between 2011 and 2016. However, the latter figure could by no means be described as low growth.

There was a much greater reduction in growth in the number of qualified engineers employed in engineering occupations from an average of 5.0% per year between 2006 and 2011 to 1.5% per year between 2011 and 2016. The growth rates for the second period provide the benchmarks of 21.3% expansion in qualified engineers and 7.8% expansion in employment in engineering occupations we use to evaluate the regional changes illustrated in Figure 3.14.

*Employment of qualified engineers in engineering occupations increased by more than the State average in ten regions.*





**Figure 3.13:** The proportional distribution of qualified engineers and those employed in engineering occupations, South Australia, 2016

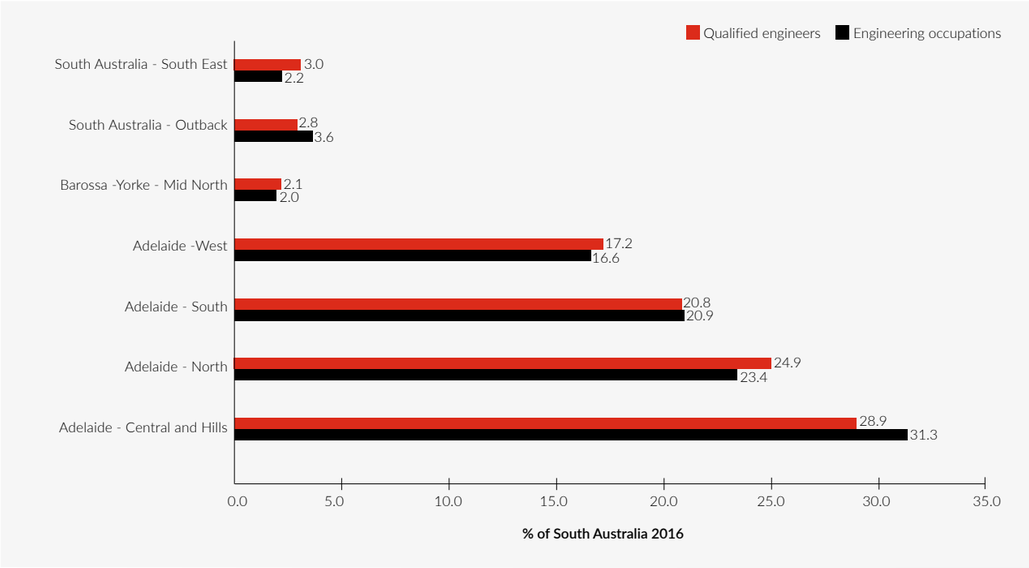
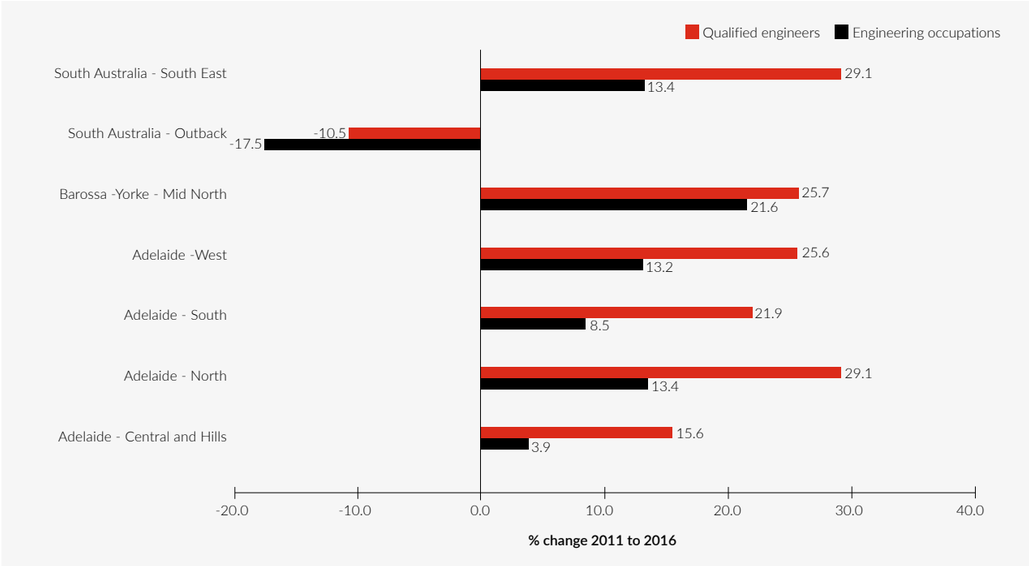



**Figure 3.14:** Changes in the number of qualified engineers and numbers employed in engineering occupations, South Australia regions, 2011 to 2016



**The number of qualified engineers increased proportionally in three of the four Adelaide regions between 2011 and 2016, more than the State average.** The exception was the Central Adelaide and Hills region. The number of qualified engineers also increased proportionally more than the State average in two of the three non-metropolitan regions. The exception was the Outback South Australia region, where the number of qualified engineers contracted by 10.5%.

Employment in engineering occupations increased proportionally more than average in five of the State's seven regions. The two exceptions were the Central Adelaide and Hills region, which experienced half of the State average growth, and South Australia Outback, where employment in engineering occupations contracted by 17.5%.

## WESTERN AUSTRALIA

### KEY POINTS

- As in Queensland, the engineering profession in Western Australia experienced a pronounced boom and bust.
- Between 2006 and 2011, growth in both the number of qualified engineers and qualified engineers employed in engineering occupations was extraordinary.
- Then, between 2011 and 2016, growth in the number of qualified engineers slowed dramatically. Meanwhile, growth in employment in engineering employment collapsed, with growth in half of the State's regions offset by contractions in the other half.

There are sixteen regions in Western Australia, of which five cover metropolitan Perth. Although Western Australia is known as a resources State, in 2016, 87.6% of the State's qualified engineers and 87.4% of qualified engineers employed in engineering occupations were located in Perth. These shares are increases on 2011 when they were 86.0% and 86.3%, respectively. Figure 3.15 illustrates the distribution of the two measures throughout the State and emphasises the concentrations in the capital.

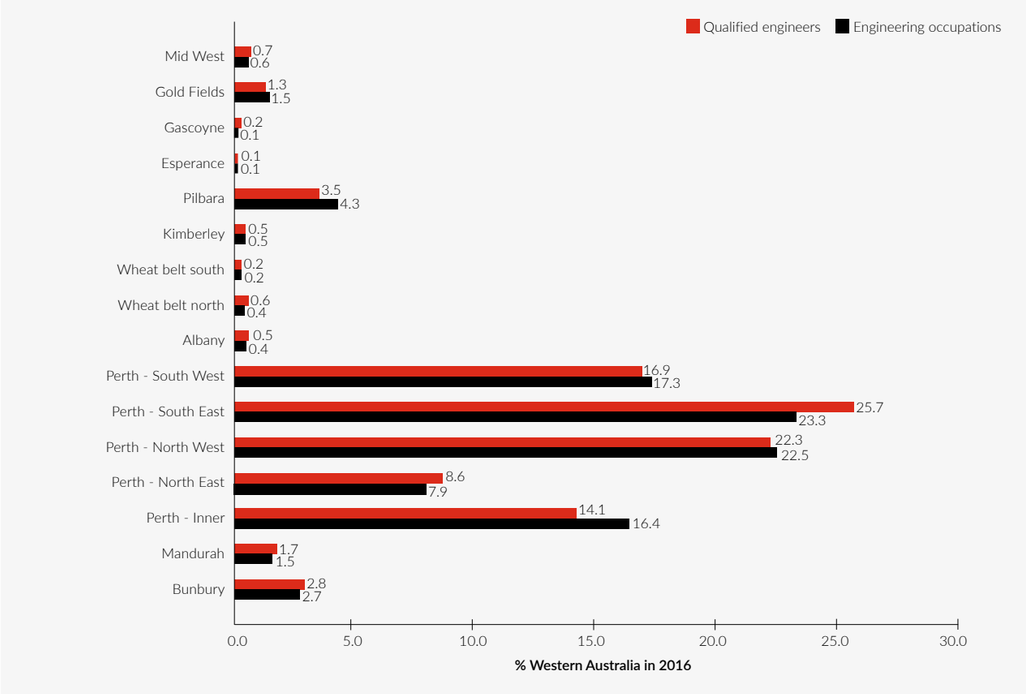
**The region with the most qualified engineers was South East Perth, which had 25.5% of qualified engineers and 23.3% of qualified engineers employed in engineering occupations.** The proportion of qualified engineers employed in engineering occupations in 2016 was 51.9%, compared to a State average of 57.2%.

Both figures are well down on 2011, when 67.3% of qualified engineers in the region were employed in engineering occupations compared to 69.6% in the State. **This fall in employment in engineering occupations was widespread, across regions and occurred in fourteen of the sixteen regions.**





**Figure 3.15:** The proportional distribution of qualified engineers and those employed in engineering occupations, Western Australian regions, 2016




The metropolitan region with the fewest qualified engineers in 2016, North East Perth, had over twice as many qualified engineers as the largest non-metropolitan region, the Pilbara. North East Perth experienced the fall in the proportion of qualified engineers employed in engineering occupations reported above, with the proportion falling from 66.1% in 2011 to 52.7% in 2016. In contrast, the proportion of qualified engineers employed in engineering occupations has remained high despite a fall from 76.5% in 2011 to 70.1% in 2016. Indeed, the latter was the highest proportion in the sixteen regions.

**Between 2006 and 2011, the number of qualified engineers in Western Australia grew by an astonishing average of 9.1% per year.** The evidence supporting perceptions of a skill shortage was that the demand for qualified engineers to be employed in engineering occupations grew even faster, by an average of 9.2% per year.

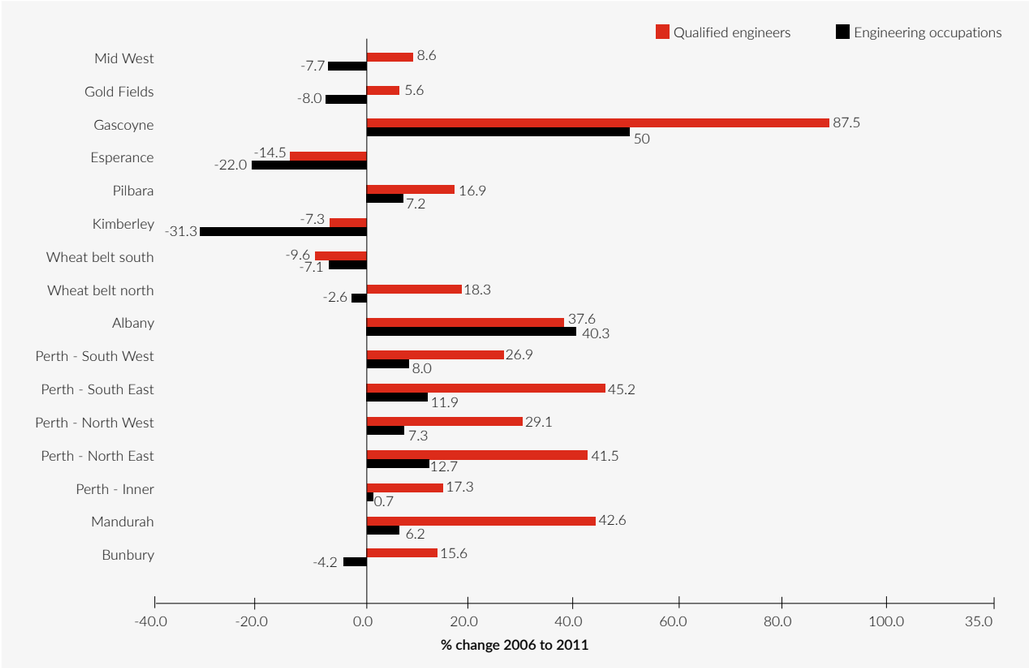
**This changed radically between 2011 and 2016, when growth in the number of qualified engineers slowed to average 5.3% per year.** In normal circumstances, this would be regarded as very strong growth; but against recent history, it was a substantial slowing.

As well, the demand for qualified engineers to be employed in engineering occupations collapsed to average 1.3% per year, similar to what occurred in Queensland and South Australia. We use the two slower growth rates to evaluate the experience of Western Australian regions between 2011 and 2016. Regional changes are illustrated in Figure 3.16.

Five regions experienced above-State-average growth in the number of qualified engineers: Mandurah, South East and North East Perth, Albany and Gascoyne. Three of these regions came from very small base figures. Nine regions experienced below-State-average growth in the number of qualified engineers; and three of these experienced contractions: Kimberley, Esperance and Wheat Belt South.

Seven regions experienced above-State-average growth in the number of qualified engineers employed in engineering occupations. The seven regions that experienced below-State-average growth actually contracted.

**Figure 3.16:** Changes in the number of qualified engineers and numbers employed in engineering occupations, Western Australia regions, 2011 to 2016




## TASMANIA

### KEY POINTS

- Growth in the numbers of engineers in Tasmania between 2006 and 2011 did not match the extraordinary figures in resources jurisdictions but were by no means discouraging.
- The proportion of qualified engineers employed in engineering occupations was higher than in the two biggest States, a result shared by each of the four regions.
- Between 2011 and 2016, the supply of qualified engineers continued to grow at a rate not far removed from the earlier period, but employment in engineering occupations collapsed.

Four Tasmanian regions are identified in Figure 3.17, which illustrates the 2016 distribution of qualified engineers and employment in engineering occupations in the State.

**Unlike in other jurisdictions, the distribution of qualified engineers in Tasmania is more proportional to the size of the regions.** Even though the largest numbers are in the capital, proportionally the numbers there are not as concentrated as in other capitals. The State-wide proportion of qualified engineers employed in engineering occupations fell from 65.7% in 2011 to 60.7% in 2016 and fell in each of the four regions.





**Figure 3.17:** The proportional distribution of qualified engineers and those employed in engineering occupations, Tasmanian regions, 2016

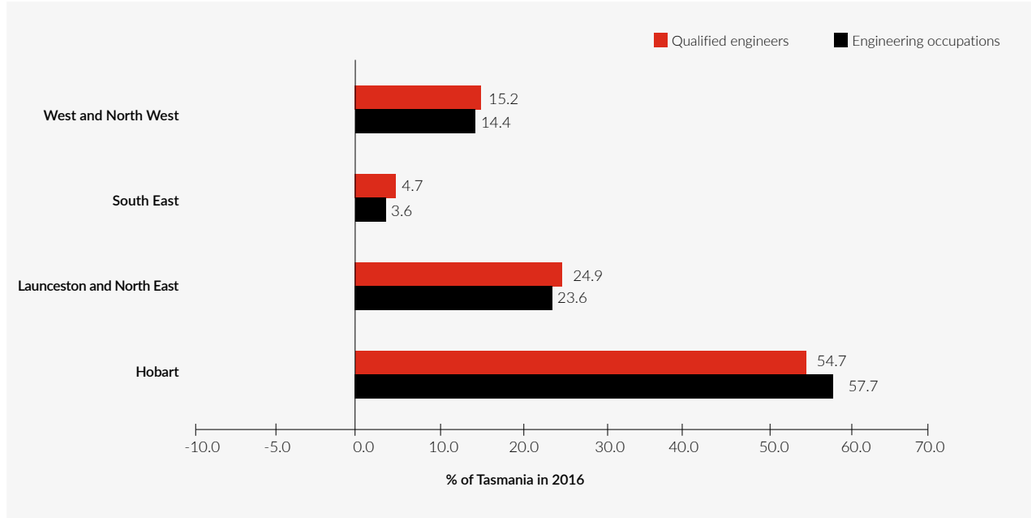



**Figure 3.18:** Changes in the number of qualified engineers and numbers employed in engineering occupations, Tasmanian, 2011 to 2016

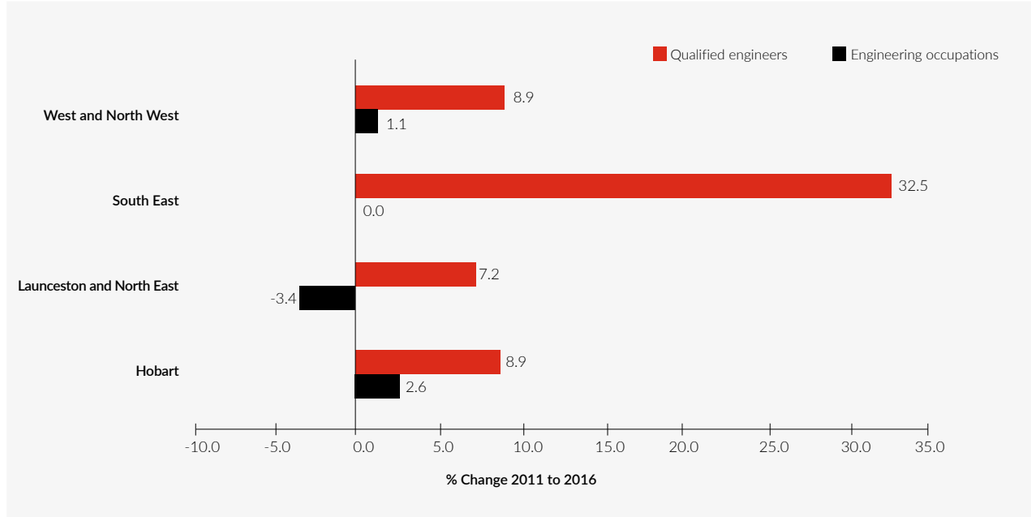


Figure 3.4 illustrated the background against which to evaluate regional changes. Between 2006 and 2011, the number of qualified engineers in Tasmania grew by an average of 4.2% per year but slowed to average 1.8% per year between 2011 and 2016. Employment in engineering occupations grew by an average of 3.7% per year in the first period but was effectively static in the second; growing by just an average of 0.2% per year.

Only the South East region experienced above-State-average growth in the number of qualified engineers. Much of this result is due to the low base that growth is calculated from. The proportion employed in engineering occupations in this region is the lowest in the State at 47.0%. Two regions, West and North West and Hobart, experienced growth in the number of qualified engineers close to the State average. The proportions employed in engineering occupations in both regions were above the State average. Both regions experienced at least State-average growth in employment in engineering occupations. However, the gains in these regions were substantially offset by a static situation in the South East and a pronounced contraction in Launceston and the North East.

## NORTHERN TERRITORY

### KEY POINTS

- The distribution of qualified engineers in the Northern Territory reflects population and specific projects.
- The Territory is unusual in that it is the only jurisdiction that experienced higher growth between 2011 and 2016 than between 2006 and 2011. Although part of this result was due to the small numerical base, it is nevertheless important.

**Although the number of qualified engineers in the Northern Territory is small, the Territory's vast geographic spread suggests that regional analysis was worthwhile.** In Figure 3.19, nine regions are identified with two covering metropolitan Darwin and its suburbs. In 2016, these regions accounted for 59.7% of the Territory's qualified engineers and 60.8% of employment in engineering occupations. The proportion of qualified engineers employed in engineering occupations in 2016 was 56.5%, down from 62.5% in 2011.

The distribution of qualified engineers across Palmerston, Alice Springs and Katherine are broadly consistent with populations; and the other regions are ones with particular activities.

Earlier, we observed that the Northern Territory was unusual in that growth in both the number of qualified engineers and employment in engineering occupations increased between 2006 to 2011 and 2011 to 2016. In part, the scale of these changes is overstated by the low base in the Territory.

**However, Figure 3.20 shows that growth between 2011 and 2016 was far from uniform.** Five regions experienced above-Territory-average growth in the number of qualified engineers. They were Katherine, Barkly, Palmerston, Litchfield and Darwin City. Four of these regions also experienced above-average growth in employment in engineering occupations, although the exception was Barkly. However, the number of qualified engineers contracted in East Arnhem; and the numbers employed in engineering occupations were static or contracted in four regions: East Arnhem, Daly-West Arnhem, Barky and Alice Springs.



AUSTRALIA'S ENGINEERING CAPABILITY: HOW THE LAST TEN YEARS WILL INFLUENCE THE FUTURE

**Figure 3.19:** The proportional distribution of qualified engineers and those employed in engineering occupations, Northern Territory regions, 2016

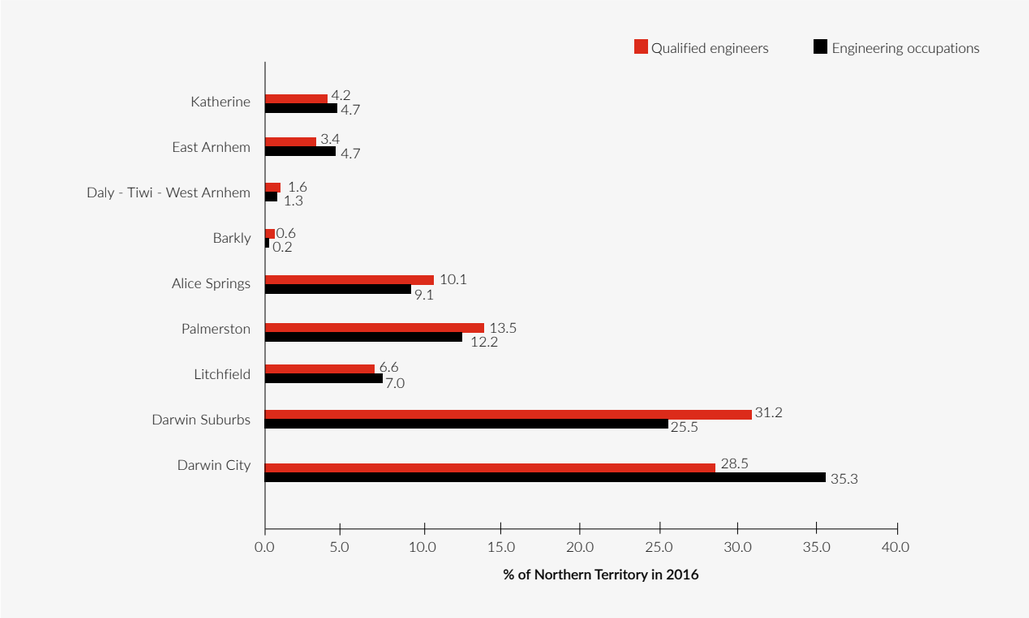
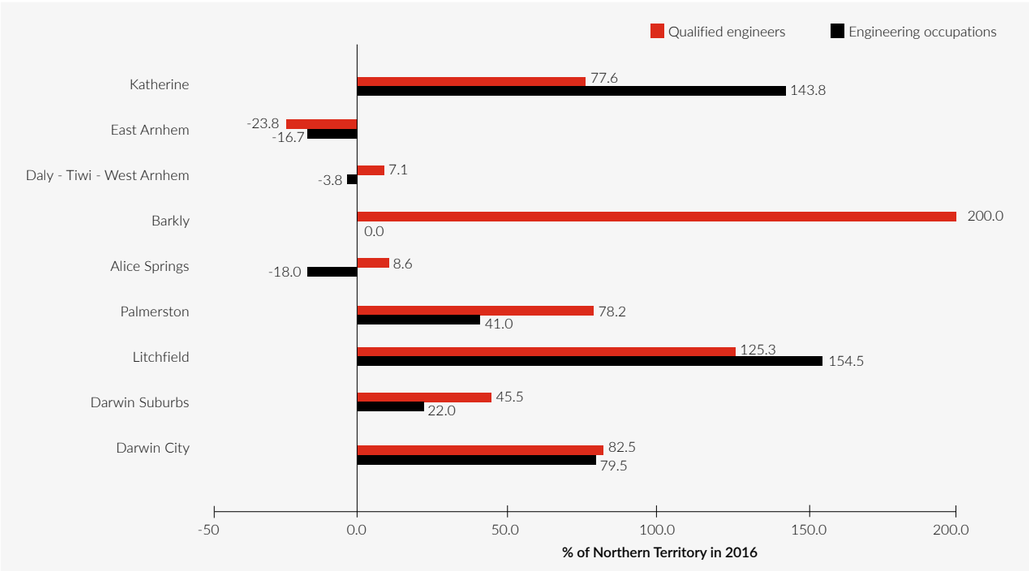



**Figure 3.20:** Changes in the number of qualified engineers and numbers employed in engineering occupations, Northern Territory, 2011 to 2016



### AUSTRALIA CAPITAL TERRITORY

We did not extend the analysis of distribution to the Australian Capital Territory because of its more confined geography. Statistics relating to specific locations are available on request.

### LOCATION IN CAPITAL CITIES

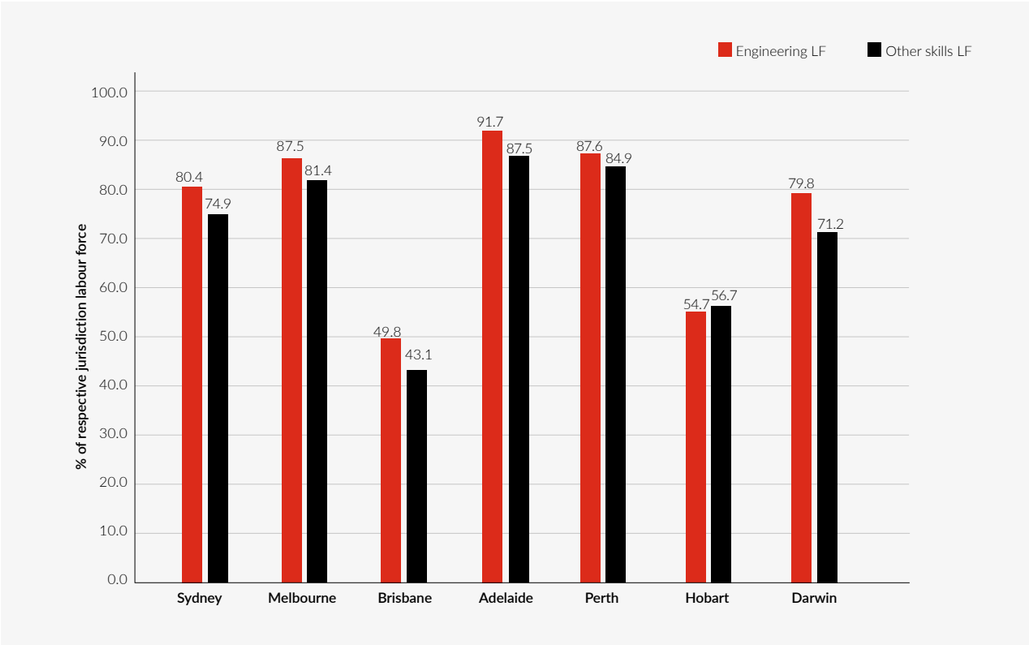
**This section has demonstrated that qualified engineers appear to be heavily concentrated in capital cities, except in Queensland where the distribution was more dispersed.** This begs the question of whether this distribution is unique to qualified engineers, or whether it applies more broadly to all skilled workers.

Figure 3.21 compares the concentration of qualified engineers in capital cities to the proportions of other skilled workers in the capitals in 2016. There is no doubt that concentration in capital cities is a feature of all skilled workers. However, with the exception of Hobart, more qualified engineers are located in the capitals than other skilled workers. For example:

- in Sydney, 80.4% qualified engineers were located there, compared to 74.9% other skilled workers
- in Melbourne, 87.5% of qualified engineers were located there, compared to 81.4% other skilled workers
- in Adelaide 91.7% of qualified engineers were located there, compared to 87.5% of other skilled workers
- in Perth, 87.6% of qualified engineers were located there, compared to 84.9% of other skilled workers
- in Darwin, the figures are 79.8% compared to 71.2%
- even in Brisbane, there is a similar gap between the two skilled groups.

Only in Hobart was the concentration of other skilled workers higher than the concentration of qualified engineers.

**Figure 3.21:** Location of skilled labour forces in capital cities, qualified engineers coompared to other skills, 2016








## 3.7 The location pattern of skilled migration

**KEY POINTS**

- The lion's share (an average of 63.6% across all arrival cohorts) of skilled migration of qualified engineers is located in NSW and Victoria, irrespective of demand conditions in other jurisdictions.
- The resources boom did attract migrant qualified engineers away from NSW and Victoria, mainly to Queensland and Western Australia. However, the changes involved were relatively small compared to the overall intake of migrant qualified engineers.
- Migrant qualified engineers are far more concentrated in capital cities than are Australian-born qualified engineers, particularly in Sydney and Melbourne. This helps to explain the high unemployment rates experienced by the most recently arrived migrant engineers.

Australia's skilled migration policy has two objectives:

- permanent migration is intended to supplement the skills output of Australian educational institutions in the medium-to-long-term
- temporary migration is intended to address short term skill shortages.

In the first five years of the decade investigated by this report, the demand for engineers was exceptionally high, and both objectives were important in addressing perceived shortages of engineers. Since 2012, the tide has turned and the demand for engineers has been much weaker.

The permanent migration program has been largely unchanged during this period. On the other hand, the number of temporary migrant engineers in Australia on temporary visas has fallen sharply, broadly in line with the intent of skilled migration policy. However, temporary visa statistics showed that just prior to the 2016 census, about 5,000 qualified engineers were still working in Australia on temporary 457 visas.

**When the topic of discussion was a shortage of engineers, its focus was mainly on the resources sector, especially in Queensland and Western Australia.** But engineers are employed in a wide spread of industries throughout the country. Skilled migration is not necessarily directed to those locations in greatest need, because a substantial component of the program relates to independent skilled migrants and where these people locate is a matter of choice for them.

**Therefore, an important question is, "What has been the locational outcome of the migration of qualified engineers?"** Not only this, but to what extent did the extraordinary surge in skilled migration actually relate to resources jurisdictions, and what was the effect of the large proportion of independent migrants on location decisions?

We apply arrival cohort analysis to these matters to examine this issue by dividing migrant qualified engineers in Australia in 2016 according to arrival cohorts in Australia. Five cohorts are identified:

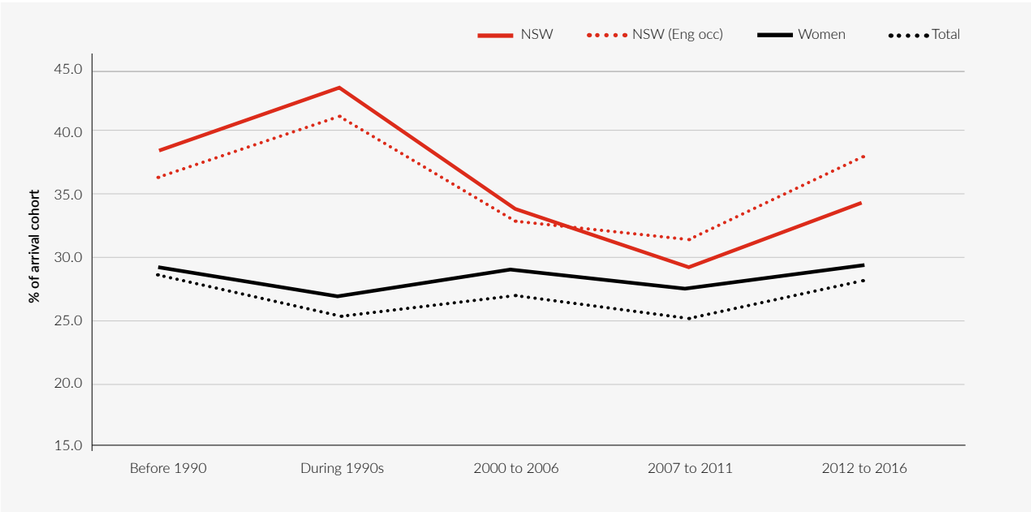
- migrants who arrived in Australia before 1990
- migrants who arrived in Australia during the 1990s
- migrants who arrived in Australia during 2000 to 2006 (inclusive)
- migrants who arrived during 2007 to 2011 (inclusive)
- migrants who arrived during 2012 to 2016 (inclusive).

Bear in mind that our statistics are the net outcomes of changes in permanent and temporary skilled migration and include locational changes by migrants after they arrived in Australia.

### NEW SOUTH WALES AND VICTORIA

The proportions of migrant qualified engineers from the five arrival cohorts that were located in New South Wales and Victoria in 2016 are illustrated in Figure 3.22. The solid lines show the proportions of qualified engineers from each cohort and the dashed lines the proportions of qualified engineers employed in engineering occupations.

**Figure 3.22:** The proportion of migrant qualified engineers and employment in engineering occupations locating in NSW and Victoria in 2016, by arrival in Australia




**These two jurisdictions have attracted proportionally more migrant qualified engineers than the other jurisdictions**. Together, they have accounted for well over half of all migrant engineers. Individually, their experiences are quite different.

The New South Wales share of migrants from successive intake cohorts has varied markedly, from as low as 29.3% to as high as 43.1%. The State had 38.4% of migrant qualified engineers who arrived in Australia before 1990. The share of the cohort that arrived in Australia during the 1990s was substantially higher at 43.2%.

**Despite variability across arrival groups, the proportion of qualified engineers locating in NSW has been consistently high.** The State's share of the next two intake cohorts showed evidence of the demand pull from other locations, most likely the resources States: the share of the 2000 to 2006 cohort fell to 33.6% and the share of the 2007 to 2011 cohort fell to 29.3%. But the proportion of the most recently arrived cohort locating in NSW has increased to 34.1%.

The dashed blue line shows that the proportions of migrant qualified engineers employed in engineering occupations located in New South Wales was lower for the first three arrival cohorts, suggesting that locational factors outweighed occupational ones. For cohorts that arrived in Australia from 2007 onwards, the situation reversed and the proportions employed in engineering occupations were higher than the proportions of qualified engineers locating in the State. This reversal suggests that occupational factors were more important for arrivals in Australia over the past decade.

**In Victoria, the share of successive intake cohorts has been more stable with smaller changes over arrival cohorts.** Just as New South Wales attracted a higher share of the most recently arrived cohort, so too did Victoria. The State's share of this cohort is at the same level as the cohort that arrived before 1990. Averaged over all arrival cohorts, 28.3% of migrant qualified engineers located in Victoria.

The Victorian share of migrant qualified engineers employed in engineering occupations mirrored its shares of qualified engineers, but at a lower level.





There appeared to be little evidence of demands from other jurisdictions reducing the State's shares during the years of highest demand for qualified engineers.

The similarity in movements and juxtaposition of the two purple trends in Figure 3.22 suggests that in Victoria, locational factors relating to Melbourne were as important as occupational choice.

## THE RESOURCES STATES

**We observed earlier that demand for qualified engineers was extraordinary in the resources states between 2006 and 2011.** The increase in demand commenced some years earlier, but this is not covered by our statistics which commence in 2006.

To the extent that skilled migration helped to satisfy this surge in demand, we would expect proportions of migrant engineers locating in these jurisdictions to increase for arrivals during the years of highest demand. The proportions of the five migrant arrival cohorts located in the three resources States of Queensland, Western Australia and South Australia are illustrated in Figure 3.23.

Across all arrival cohorts, the three States received 13.6% of arrivals to Queensland, 15.2% to Western Australia and 4.8% to South Australia. Consider how these shares have changed by arrival group.

**The South Australian share of successive arrival cohorts fluctuated within a narrow band from 3.7% of the arrivals during the 1990s cohort, to 5.3% of the arrivals between 2007 to 2011.** In Figure 3.23, we observe that this higher figure coincides with the timing of highest demand for qualified engineers, but that it fell back to 5.0% of the most recently arrived cohort. The proportions employed in engineering occupations equalled the proportion of qualified engineers for the first three arrival cohorts.

However, the downwards trend since 2000 suggests that the increase in qualified engineering locating to South Australia was locational, rather than being attracted by work in engineering occupations. These occupations are particularly relevant to resources-related activities.

**Both Queensland and Western Australia showed evidence of pronounced demand pull influences on the location of migrant qualified engineers for arrival cohorts from 2000 onwards.** The two States had similar shares of the 2000 to 2006 arrival cohort: 15.3% and 15.0% respectively. Queensland attracted a slightly higher share of the 2007 to 2011 arrival cohort with 15.9%, but this change paled when compared to the 19.2% share attracted to locating in Western Australia.

In both States, the most recently arrived cohort of migrants faced weaker demand conditions. In Queensland, this meant that 12.2% of the arrival cohort located in the State, a much lower share than the previous cohort, but much the same as the shares of the cohorts arriving before 2000. Western Australia's share of the most recent arrivals also fell to 16.0%, which was a little higher than the State's share of the 2000 to 2006 arrival cohort.

**Figure 3.23:** The proportions of migrant qualified engineers and employment in engineering occupations located in Queensland, South Australia and Western Australia in 2016 by time of arrival in Australia

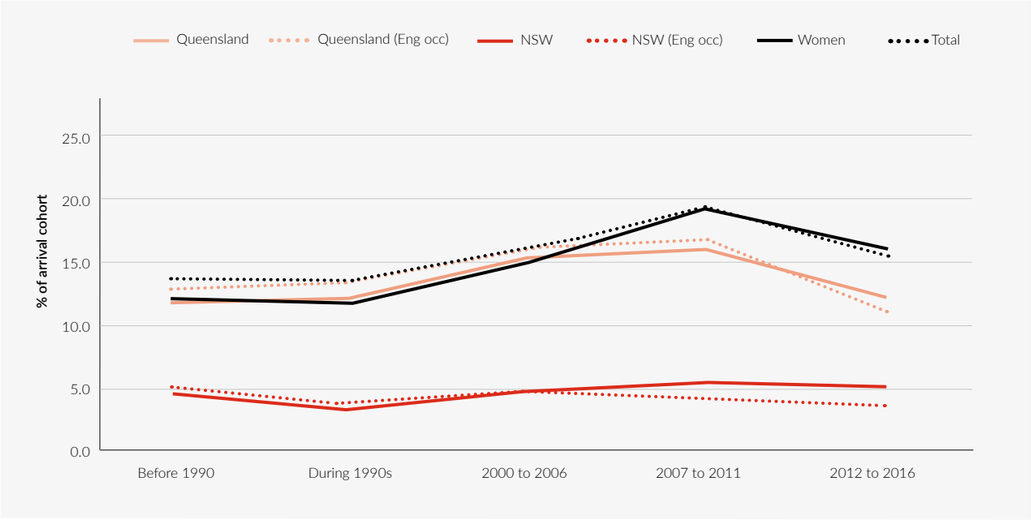
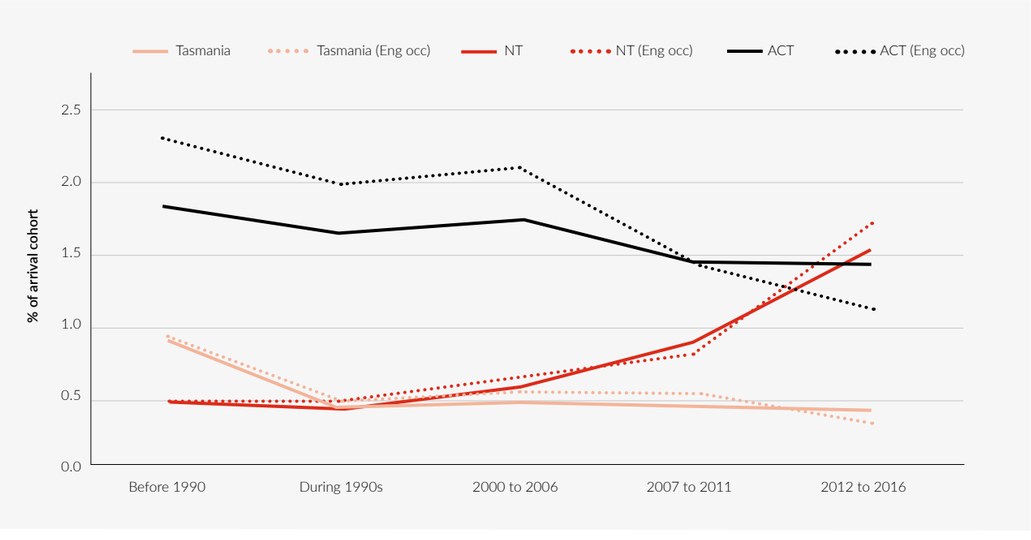



**Figure 3.24:** The proportions of migrant qualified engineers and their employment in engineering occupations in Tasmania, the Northern Territory and the Australian Capital Territory by time of arrival in Australia








**In both Queensland and Western Australia, the State shares of migrants employed in engineering occupations were higher than shares of qualified engineers for arrival cohorts up to 2011.** In Western Australia, the State's share of migrants employed in engineering occupations fell back to equal its share of qualified engineers for most recently arrived migrants. The suggestion in these figures is that migration to the State has been more targeted to engineering jobs.

A similar conclusion applies to Queensland. However, this is weaker in respect to the latest arrival cohort, for which the State's share of employment in engineering occupations was the lowest of the five arrival cohorts.

**The migrant arrival shares locating in Queensland and in Western Australia suggest that skilled migration was an important factor in dealing with the high demand for qualified engineers due to the resources boom.**

## SMALLER JURISDICTIONS

To complete our analysis, the proportion of the five migrant arrival cohorts that located in Tasmania, the Northern Territory and the Australian Capital Territory are illustrated in Figure 3.24.

**The proportions of successive migrant arrival cohorts locating in these jurisdictions are low and have fallen, with the exception of the Northern Territory.** In the latter case, the Territory has been able to attract an increasing share of arrival cohorts since 2000. To put that into perspective, the Territory's share of migrant qualified engineers who arrived in Australia since 2012 was just 1.5%.

In Tasmania and the Northern Territory, the proportions employed in engineering occupations and the proportions of qualified engineers were much the same for successive arrival cohorts. In the Australian Capital Territory, the proportions employed in engineering occupations has fallen faster than the proportions of qualified engineers. This suggests that skilled migrants have found fewer engineering opportunities.

## LOCATION OF MIGRANT ENGINEERS IN CAPITAL CITIES

**We have already noted that the locations of qualified engineers are more concentrated in capital cities than is the case for other skilled workers.** To what extent is this result due to the locational decisions of migrant qualified engineers?

In Figure 3.25, we compare the locational distribution of Australian-born qualified engineers in capital cities to the corresponding locational distribution for migrant qualified engineers. We use two measures for the distribution of migrants:

- first, all migrant qualified engineers, irrespective of arrival time in Australia
- second, the most recently arrived cohort of migrant engineers.

The proportions of Australian-born qualified engineers located in capital cities are lower than the figures shown in Figure 3.21 for all qualified engineers in a jurisdiction. We noted that 80.4% of the New South Wales engineering labour force was located in Sydney, compared to 74.9% of other skilled workers.

Figure 3.25 takes this comparison a step further by dividing qualified engineers between Australian-born and overseas-born components. We observe that 66.7% of NSW Australian-born qualified engineers are located in Sydney, compared to 91.5% of migrant qualified engineers.

**Figure 3.25:** The proportion of skilled labour forces located in jurisdictional capitals, qualified engineers compared to other skills in 2016

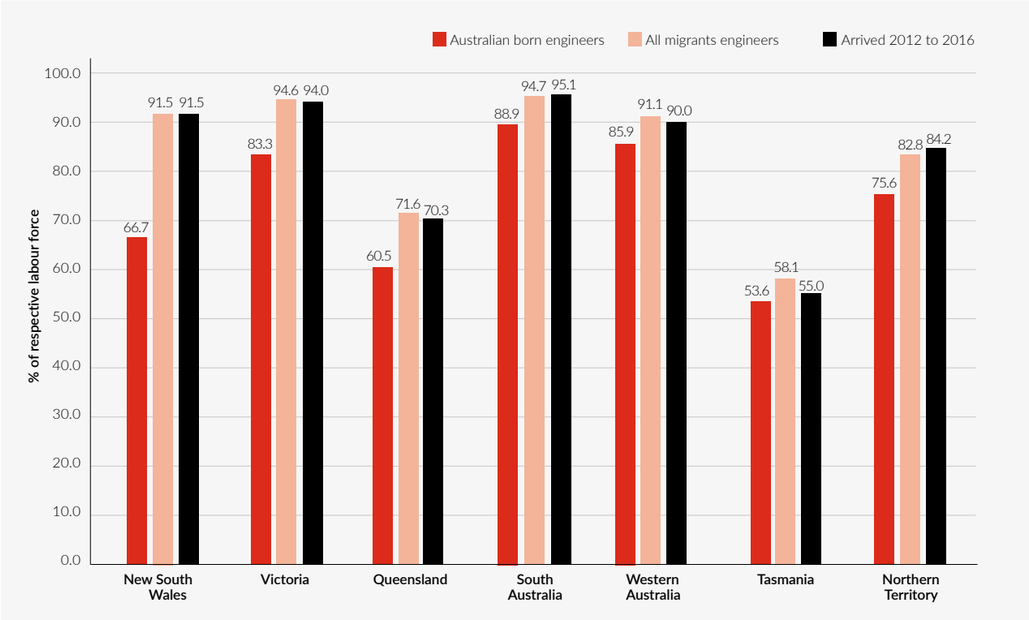
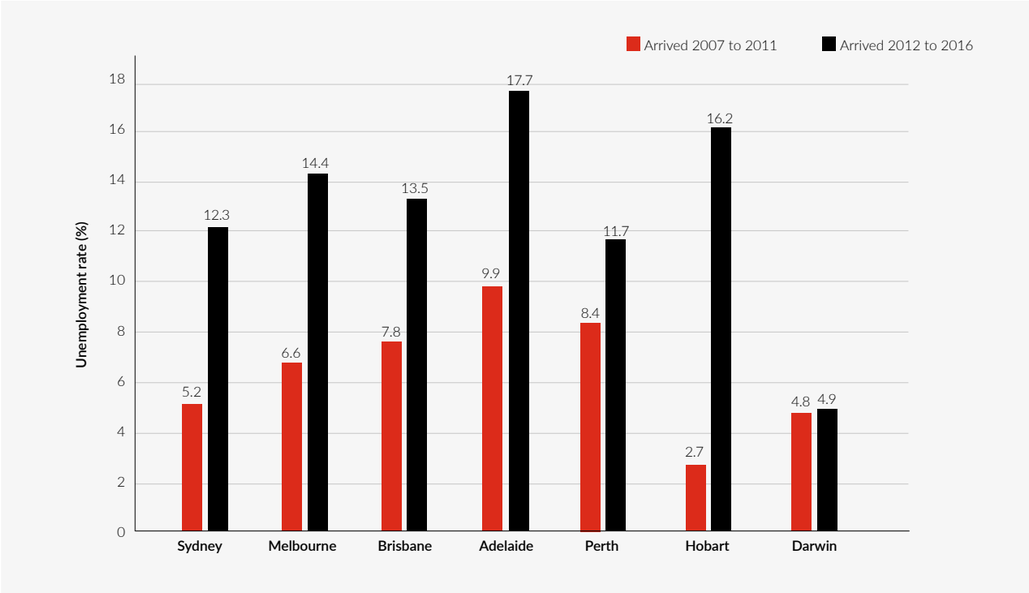



**Figure 3.26:** Unemployment rates in capital cities for migrant qualified engineers who arrived in Australia 2007 to 2016








**In Victoria, the proportion of Australian-born qualified engineers located in Melbourne was 83.3%, higher than in Sydney.** However, there was still a substantial gap between this group and the 94.6% of Victorian overseas-born qualified engineers who located in Melbourne. The importance of these results is underscored by the average 63.5% of migrant qualified engineers across all arrival cohorts locating in New South Wales and Victoria.

**With the exception of Tasmania, Figure 3.25 shows that migrant qualified engineers locate in State and Territory capitals to a much greater extent than Australian-born qualified engineers.** These locational decisions are probably relevant in explaining the disproportionally higher unemployment rates experienced by migrant qualified engineers irrespective of arrival time in Australia. These unemployment rates were especially high for the last two arrival cohorts, that is, arrivals between 2007 to 2011 and 2012 to 2016.

In Figure 3.26 we consider this issue further by examining 2016 unemployment rates for migrant qualified engineers in these arrival periods who were located in capital cities. For the 2007 to 2011 arrival period, the overall unemployment rate was 6.7%.

We observe from Figure 3.26 that the unemployment rates in Melbourne, Brisbane, Adelaide and Perth were higher than this at a time when the demand for qualified engineers was high. For the 2012 to 2016 arrival period the overall unemployment rate was 13.0%. This rate was exceeded by those in Melbourne, Brisbane, Adelaide and Hobart. The unemployment rates in Sydney and Perth were not far from the national rate. The only exception was Darwin and we observed earlier that the demand for qualified engineers was unusually high in this jurisdiction.

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