Australian Government
Office of the Chief Scientist

AUSTRALIA'S STEM WORKFORCE

Science, Technology, Engineering and Mathematics

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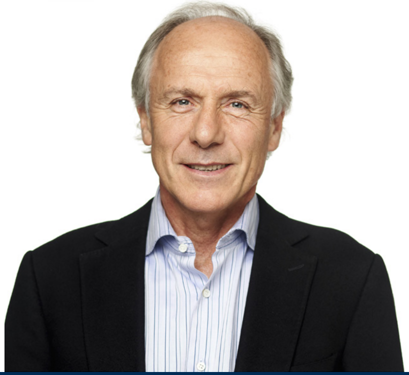
FOREWORD



Australians who have studied science, technology, engineering and mathematics (STEM) are helping to solve the problems of the future—meeting electricity demand and generation needs, adapting to the changing climate, integrating AI into society and optimising healthcare for ageing populations.

The impacts of bushfires and COVID-19 these last few months have also shown the value of an educated STEM workforce in developing solutions for response, recovery and long-term resilience.

However, the expertise needed to solve these problems does not develop overnight.

By understanding who is STEM qualified in the Australian workforce, and where they are working, we can develop strategies to build that workforce for the future.

In this second edition of **Australia's STEM Workforce**, we update much of the analysis in the first report published in 2016, showing what has changed over the last decade. It draws from the vast resources of the 2006, 2011 and 2016 Australian Bureau of Statistics Censuses.

This time, we have explored in far greater detail the diversity of Australians with STEM qualifications and the education and workforce experiences of these different groups.

Our analysis has revealed some fascinating insights. Of the more than 11 million people in the Australian labour force in 2016, almost two million had a qualification in a STEM field. People with qualifications in STEM earned more than those with non-STEM qualifications.

We learned that people with STEM qualifications can, and do, work across the economy, from education to health to construction to research. Some follow a linear path and work in the area they studied at a tertiary institution. Others pivot and use their skills to great advantage in surprising areas—chemical sciences graduates running vineyards, electrical engineers working in finance and IT graduates teaching at primary school.

In this report we have looked at where they were working, what jobs they were doing, how much they were earning, and whether age, gender, place of residence, or background played a role in these employment outcomes.

The skills developed in a STEM education cover a broad spectrum. In this report we divided people who have studied STEM into two groups; those with vocational qualifications, the "VET qualified" (Certificate 1 to Advanced Diploma) and the "university qualified" (Bachelor and above). We then analysed these two groups separately throughout. Unsurprisingly, our analysis shows that the two groups have vastly different demographics, occupations and industries of employment. This separation has allowed us to better reflect the experiences of Australia's STEM workforce.

Our investigation of diversity in the STEM workforce found that in some demographics, the diversity of the STEM qualified population aligns with the diversity of the Australian population. For example, the proportion of STEM qualified people aged over 45 and the geographical spread of STEM workers across the states and territories are broadly similar to that of Australia's general population. Workers with STEM qualifications also provide assistance to people with disabilities and care for children in similar proportions to the rest of the Australian workforce.

We also confirmed that some key groups are not well represented in STEM. Women continue to be underrepresented in STEM fields and management roles; and have higher unemployment rates and lower incomes than men.

The data have shown that over the last decade there have been some small improvements in the experiences of women in STEM. In 2006, 27% of STEM university graduates in the labour force were women, increasing to 29% in 2016. In 2006, 18% of managers with a university STEM qualification were women, increasing to 22% in 2016. And of STEM university graduates, we found that from 2011 onwards women were more likely than men to continue their studies and obtain a STEM PhD degree. In 2016, women also represented 49% of the university qualified labour force with science (excluding mathematics) qualifications.

The experiences of and information about our migrant STEM graduates, the trends of an ageing STEM workforce, the challenges for younger STEM trained workers, and the low level of involvement of Aboriginal and Torres Strait Islander peoples in STEM fields are also explored in detail in this report.

With digitalisation and automation continuing to rapidly and dramatically change the world of work, we can't predict many of the jobs that today's STEM students will hold as their careers unfold. But we can be certain that they will need deep discipline knowledge in their field, digital literacy and the flexibility to pivot their careers to embrace new challenges. A STEM education delivers these skills.

I trust that this report will be used to inform the development of policies, initiatives, and education and support programs to help attract our best and brightest to STEM fields as we build a workforce capable of meeting our future needs, whatever they may be.

Dr Alan Finkel, AO
Australia's Chief Scientist

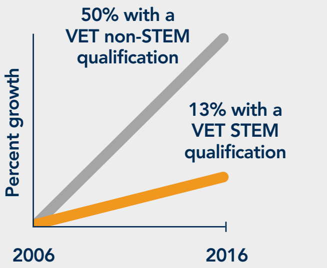
The VET STEM qualified labour force

In 2016, there were **11.5 million** people in the Australian labour force.

10% OF THESE PEOPLE HAD A VET STEM QUALIFICATION

1 Labour force population growth

Between 2006 and 2016, the size of the labour force grew by



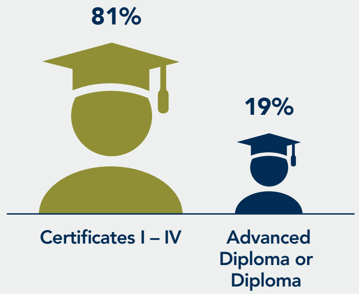
2 Fields of STEM qualification

% of the VET STEM qualified labour force

Engineering	80%
Agriculture and Environmental Science	10%
Information Technology	8%
Natural and Physical Sciences	2%

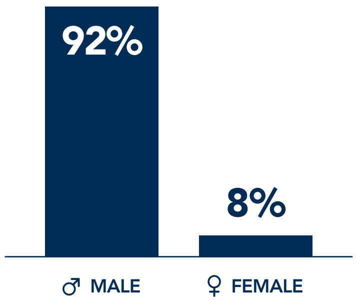
3 Level of STEM qualification

% of the VET STEM qualified labour force



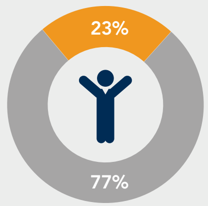
4 Gender

Gender breakdown of the VET STEM qualified labour force



5 Young people

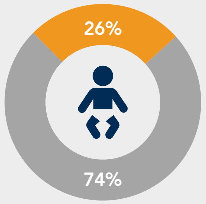
23% of the VET STEM qualified labour force were aged under 30



- Under 30
- 30 and over

6 Country of birth

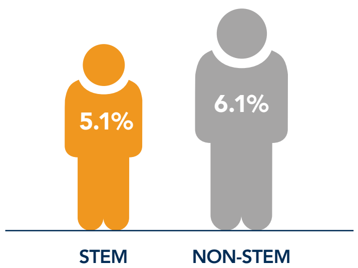
26% of the VET STEM qualified labour force were born overseas



- Born overseas
- Born in Australia

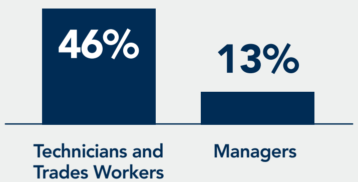
7 Unemployment rate

% of VET qualified people who were unemployed



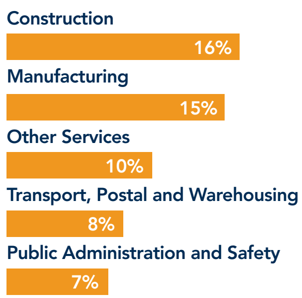
8 Top occupations

% of VET STEM qualified workers



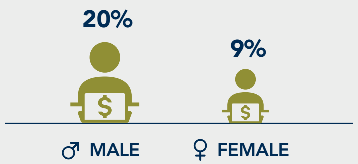
9 Top industries of employment

% of VET STEM qualified workers



10 Income

% of full-time workers with VET STEM qualifications earning $104 000 or above



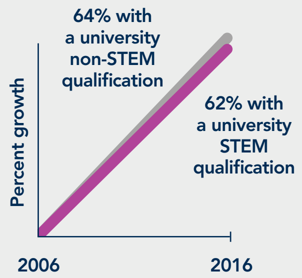
The university STEM qualified labour force

In 2016, there were **11.5 million** people in the Australian labour force.

6% OF THESE PEOPLE HAD A UNIVERSITY STEM QUALIFICATION

1 Labour force population growth

Between 2006 and 2016, the size of the labour force grew by



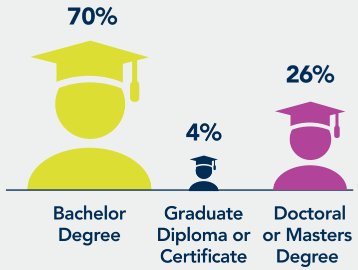
2 Fields of STEM qualification

% of the university STEM qualified labour force

Engineering	38%
Natural and Physical Sciences	29%
Information Technology	26%
Agriculture and Environmental Science	7%

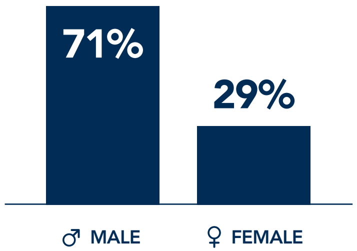
3 Level of STEM qualification

% of the university STEM qualified labour force



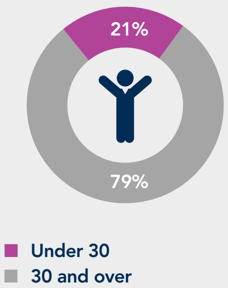
4 Gender

Gender breakdown of the university STEM qualified labour force



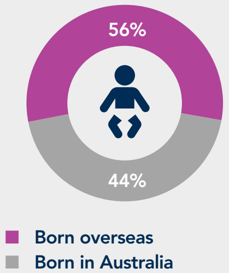
5 Young people

21% of the university STEM qualified labour force were aged under 30



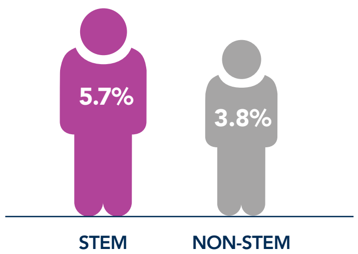
6 Country of birth

56% of the university STEM qualified labour force were born overseas



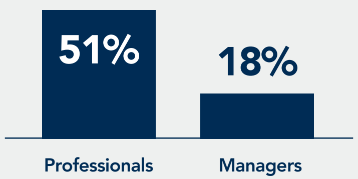
7 Unemployment rate

% of university qualified people who were unemployed



8 Top occupations

% of university STEM qualified workers

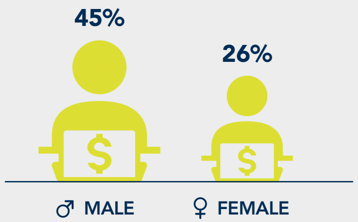


9 Top industries of employment

% of university STEM qualified workers

10 Income

% of full-time workers with university STEM qualifications earning $104 000 or above



CONTENTS

CHAPTER 1

1

READER'S GUIDE

Report structure

The Australia's STEM Workforce: 2020 report (this report) draws on data from the Australian Bureau of Statistics (ABS) Censuses of Population and Housing (the Censuses) to present analyses of people with science, technology, engineering and mathematics (STEM) qualifications in Australia.

This report is presented in three parts. **Part One (Chapters 2–3)** analyses the demographic characteristics and employment outcomes of STEM qualified people in Australia. It provides a comprehensive view of the STEM qualified population and compares this cohort to the non-STEM qualified population against a number of metrics.

Part Two (Chapters 4–14) investigates and compares the workforce destinations of university graduates from ten STEM fields. To plan for the future, students, policy-makers, industry, and universities need an understanding of the employment prospects of STEM graduates and of which industries employ graduates in what occupations.

To gain a deeper understanding of key areas of policy interest around Australia's STEM workforce, a more detailed analysis of three selected populations is presented in **Part Three (Chapters 15–17)**.

The three new chapters presenting this analysis are:

- Women in STEM (Chapter 15)
- Young people in STEM (Chapter 16)
- A closer look at Engineering (Chapter 17)

In addition, four minor focus areas provide a snapshot of the STEM qualified workforce in:

- Diversity in STEM (Chapter 2)
- STEMM[1] (Chapter 2)
- STEM in the defence force (Chapter 3)
- Doctoral graduates (Chapter 4)

This report is intended to be used as a reference document and does not provide commentary, conclusions, or recommendations regarding the data presented. This report also makes limited comparisons to general education and workforce conditions at the time that the Census data was collected. Further information about general labour markets conditions is available at the ABS website: https://www.abs.gov.au/employment-and-unemployment.

1 STEMM refers to STEM plus the two disciplines of Health, and Architecture and Building.

REPORT BACKGROUND

The first version of this report was produced by the Office of the Chief Scientist in 2016, primarily from 2011 Australian Census data. The 2016 *Australia's STEM Workforce Report* (hereafter referred to as 'the previous report') provided a comprehensive overview of people with STEM qualifications in Australia—where they work, how their careers progress, and differences between demographic groups.

The release of 2016 Census data offered the opportunity to update the data in the previous report and identify changes in Australia's STEM qualified population. While this report is not directly comparable to the previous report, it follows the same overarching structure and areas of focus, presenting an analysis of STEM qualified people in Australia using the most recent Census data.

What is STEM?

STEM, or science, technology, engineering and mathematics, refers collectively to a broad field of distinct and complementary approaches to knowledge.

Each has a critical role to play in its own right, but also enables discovery and progress in other fields. There are many different definitions of STEM and non-STEM. Accordingly, the analyses presented in this report may not align with analyses in other publications if different definitions of STEM and non-STEM have been used. For the purposes of this report the following definitions of STEM fields are used.

Science encompasses disciplines within the natural and physical sciences, and from agriculture and environmental studies: astronomy and the earth sciences; physics; chemistry; the materials sciences; biology; and agricultural and environmental science. These sciences are characterised by systematic observation, critical experimentation, and the rigorous testing of hypotheses.

Technology is a collection of goods and services that satisfy real world needs; operating at the cross-section of science and society. Information and communications technology is playing an ever increasing role in our society and provides enabling capacity to the other STEM disciplines. The output of the technology provided must eventually stand the test of users and the marketplace.

Engineering draws on scientific, mathematical, and technological knowledge and methods to design and implement physical and information-based products, systems, and services that address human needs, safely and reliably. Engineering takes into account economic, environmental, and aesthetic factors.

Mathematics seeks to understand the world by performing symbolic reasoning and computation on abstract structures and patterns in nature. It unearths relationships among these structures, and captures certain features of the world through the processes of modelling, formal reasoning, and computation.

A STEM education does not merely impart content knowledge in these fields—it seeks to provide frameworks in which new problems can be tackled.

STEM graduates cite higher order skills in research, logical thinking, and quantitative analysis as the return on their degrees; alongside the qualities of creativity, open-mindedness, independence, and objectivity.

Defining the STEM qualified workforce

DEFINING FIELDS OF EDUCATION

This report uses the Australian Standard Classification of Education (ASCED) to distinguish different fields of education (ABS, 2001). There are 12 broad fields of education defined in the ASCED, and each broad field is further classified into more detailed narrow fields. Throughout this report, the term **STEM qualified** refers to people who reported their highest level of post-secondary qualification in any of the following broad ASCED fields of education:

- Natural and Physical Sciences
- Information Technology
- Engineering and Related Technologies
- Agriculture, Environmental and Related Studies

Mathematical Sciences is a subfield of Natural and Physical Sciences and in most sections of this report has been extracted for separate analysis.[2]

The term non-STEM qualified refers to people with post-secondary qualifications in all other defined ASCED fields of education, including Health, Architecture and Building, and mixed field programs (programs providing general and personal development education). People who did not report or adequately describe their field of education are excluded from analyses in this report unless clearly noted.

This report does not include qualifications in Health or Architecture and Building in the definition of STEM. However, these are closely related fields and are sometimes included in other, broader definitions of STEM (sometimes called **STEMM**). A short analysis of the workforce qualified in these fields of education is provided at the end of **Chapter 2**.

A comprehensive list of the fields of education and the corresponding higher education and Vocational Education and Training (VET) discipline groups can be found in the ASCED (ABS, 2001).

In this report, terms used to describe the STEM fields have been simplified from the ASCED fields of education as outlined in Table 1.1.

Where appropriate, people with STEM qualifications have been compared in this report to people with non-STEM qualifications. Comparisons to people with no post-secondary qualifications or to general labour market conditions are limited.

The qualification level and field of education are self-reported by individuals in the Census, and the 2006, 2011, and 2016 Censuses captured information on respondents' highest qualification only. Therefore, it is likely that this data does not include all people with post-secondary qualifications in STEM fields, as some people with a STEM qualification will have higher qualifications in non-STEM fields, such as a Master of Business Administration. However, analysis by the ABS has indicated that approximately 89% of those with STEM qualifications reported it as their highest post-secondary qualification (ABS, 2014).

Table 1.1: Terms used in this report to describe STEM fields of education

Term used in this report	Corresponding ASCED field of education
Science	Natural and Physical Sciences (excluding Mathematical Sciences)
Agriculture and Environmental Science	Agriculture, Environmental and Related Studies
Information Technology	Information Technology
Engineering	Engineering and Related Technologies
Mathematics	Mathematical Sciences

2 When analysing certain subsets of the population, the number of people with Mathematical Sciences qualifications becomes too small to generate informative data. In these cases, the cohort is rolled into Natural and Physical Sciences and this is noted in the figure.

DEFINING QUALIFICATION LEVELS

In this report, the term **post-secondary qualifications** includes qualifications obtained at the following levels as defined by the ABS (ABS, 2011b):

- doctoral degree
- masters degree
- graduate diploma and graduate certificate
- bachelor degree
- advanced diploma and diploma
- certificates III and IV
- certificates I and II

In this report, certificate I to advanced diploma qualifications are referred to as **VET qualifications**, while the remainder are referred to as **university qualifications**. This broad grouping of qualifications is commonly used in analysis of tertiary education data (Norton, Cherastidtham, & Mackey, 2019) and has been used as a generalisation throughout this report. It should be noted that some qualifications can be taught in both sectors. Particularly, there is significant overlap between the sectors in which diplomas and advanced diplomas are offered, though in practice most are taught in the VET sector. Table 1.2 outlines the qualification levels discussed in this report, with their corresponding categorisation under the Australian Qualifications Framework.

In some chapters, the term postgraduate qualifications is used to refer to those with qualifications at the graduate certificate level or above.

The term university qualifications has been used in this report for clarity and simplicity. However, this report does note that Australia has a complex higher education system that includes a variety of different types of providers, including universities, university colleges, and higher education providers. All are authorised by the Tertiary Education Quality and Standards Agency (TEQSA) to offer at least one higher education qualification.

People who did not report or adequately describe their level of qualification are excluded from most analyses in this report.

Table 1.2: Structure of qualification levels discussed in this report

Classification for the purposes of this report	Australian Qualifications Framework[1]		ABS categories (1-digit level)
Vocational Education and Training (VET) Qualifications	1	Certificate I	Certificate I and II
	2	Certificate II	
	3	Certificate III	Certificate III and IV
	4	Certificate IV	
	5	Diploma	Advanced Diploma and Diploma
	6	Advanced Diploma; Associate Degree	
University Qualifications	7	Bachelor Degree	Bachelor Degree
	8	Bachelor Honours Degree; Graduate Certificate; Graduate Diploma	Graduate Certificate and Graduate Diploma
	9	Masters Degree	Masters Degree*
	10	Doctoral Degree	Doctoral Degree*

1 A review of the Australian Qualifications Framework was completed in October 2019, with a range of proposed reforms to the AQF. See: https://www.education.gov.au/australian-qualifications-framework-review-0.

* These two qualifications have been analysed in this report at the 2-digit qualification level to better reflect differences in outcomes and career trajectories.

Part Two (Chapters 4–14) of this report focuses on university qualified graduates. The simplified term **STEM graduates** is used to refer to the population with a university bachelor degree or above qualification (or university qualification), in any of the STEM ASCED fields outlined in Table 1.1. The term **non-STEM graduates** refers to people with a university bachelor degree or higher qualification in any other field of education, including mixed fields programs.

Doctoral graduates refers to people who have a qualification at the doctoral degree level, as defined by the ABS. This includes five discrete qualification types: higher doctorate, doctorate by research; doctorate by coursework; professional specialist qualification at doctoral degree level; and doctoral degree level not further defined.

DEFINING INDUSTRIES AND OCCUPATIONS

Australian industries are classified by the Australian and New Zealand Standard Industrial Classification (ANZSIC), where an individual business entity is assigned to an industry based on its predominant activity (ABS, 2006a). The ANZSIC is a hierarchical classification with four levels: divisions (the broadest level, denoted by a 1-digit code), subdivisions (2-digit), groups (3-digit), and classes (the most detailed level, 4-digit).

Australian occupations are classified by the Australian and New Zealand Standard Classification of Occupations (ANZSCO); a skill-based classification used to classify all occupations and jobs in the Australian and New Zealand labour markets (ABS, 2013a). The ANZSCO has five hierarchical levels grouped on the basis of their similarities in terms of skill level and skill specialisation: major group (the broadest level, denoted by a 1-digit code), sub-major group (2-digit), minor group (3-digit), unit group (4-digit) and occupations (the most detailed level, 6-digit). The unit group level of occupation classification is the most detailed level used in this report.

Both industries and occupations are self-reported by individuals in the Census.

Table 1.3 summarises the ANZSIC, ANZSCO, and ASCED classification structures.

Table 1.3: Industry, occupation and field of education classification structures used in this report

	Australian and New Zealand Standard Industrial Classification (ANZSIC) *Classifies industries*		Australian and New Zealand Standard Classification of Occupations (ANZSCO) *Classifies occupations and jobs*		Australian Standard Classification of Education (ASCED) *Classifies fields of education*	
Broad	1-digit	Division	1-digit	Major Group	2-digit	Broad Fields
↕	2-digit	Subdivisions	2-digit	Sub-major Group	4-digit	Narrow Fields
	3-digit	Groups	3-digit	Minor Group	6-digit	Detailed Fields
	4-digit	Classes	4-digit	Unit Group		
Narrow			6-digit	Occupations		

Defining labour force characteristics

The **population** refers to all people aged 15 and over, comprising those in the labour force and those not in the labour force.

The **labour force** is comprised of people who are either **employed** or **unemployed**:

- **Employed** people are defined as those aged 15 years and over who worked for payment or profit, or as an unpaid helper in a family business, during the week prior to Census night, or were away from work (had a job from which they were on leave or otherwise temporarily absent);
- **Unemployed** people are those aged 15 years and over who were not employed during the week prior to Census night, had actively looked for work in the previous four weeks, and were available to start work in the week prior to Census night.

The **labour force participation rate** is calculated as the proportion of people in the population who were in the labour force.

The **unemployment rate** is calculated as the number of unemployed people as a percentage of the labour force.

Persons not in the labour force are defined as people aged 15 and over who were neither employed nor unemployed, as defined above.

Defining demographic characteristics

Adults are defined as anyone who was aged 15 years and over on the day of the Census.

Young people are defined as people who were aged 15 to 29 on the day of the Census. This age bracket is used to capture the period in which most people complete a post-secondary education, reflecting the focus of this report. This bracket is used by other domestic and international organisations to define young people, including the Foundation for Young Australians and the Organisation for Economic Co-operation and Development (OECD).[3]

Mature aged people are defined as anyone who was aged 55 years and over on the day of the Census, consistent with the definition used by the Australian Human Rights Commission.

Aboriginal and Torres Strait Islander peoples are defined as those who indicated on the Census that they were of Aboriginal or Torres Strait Islander origin, or both. Non-Indigenous people are those who indicated that they were not of Aboriginal or Torres Strait Islander origin.

Sex and gender

The Census asks respondents to state whether they are **male** or **female**, and this report uses these terms when reporting Census data.

While the 2016 Census made provisions to allow people to report a sex other than male or female, this information is not available for analysis due to limitations in the data. We recognise that the response options of male and female may not adequately capture those who are intersex or have a non-binary gender identity.

This report also uses the word **gender** rather than sex when reporting Census data. The Census question does not specifically mention sex or gender; as such, we have chosen to use the term gender as it may more closely align with respondents' self-reported identity.[4]

3 See, https://www.oecd.org/els/soc/CO_3_5_Young_people_not_in_education_or_employment.pdf

4 Further information on gender and sex in the 2016 Census is available in, 2071.0—Census of Population and Housing: Reflecting Australia—Stories from the Census, 2016

Data sources

The majority of information presented in this report was collected from the ABS 2006, 2011 and 2016 Censuses of Population and Housing (ABS, 2006b; ABS, 2011c; ABS, 2016)

The Census collects data on all people who were in Australia on Census night (for the 2016 Census, this was on 9 August 2016). The Census is usually completed by one person in each household, and this person answers questions on behalf of all people who reside in that household. Overseas visitors (people who plan to reside in Australia for less than one year) are counted in the Census, but their data is excluded from all analyses in this report.

The Census is not conducted on a sample of people, but on the entire population. Nonetheless, small cohorts are analysed with care in this report, because inaccuracies in self-reported data are more influential on a smaller population than on a larger one.

The ABS TableBuilder online tool was used to retrieve Census data for this report. Analyses that focused on geographical distribution of people used the Counting Persons, Place of Usual Residence (MB) dataset. Unless otherwise stated, all other analyses were conducted using the Counting Persons, Place of Enumeration (MB) dataset.

Some analyses in this report utilise the Australian Census Longitudinal Datasets, 2006–2011 and 2011–2016 (ABS, 2011a; ABS, 2018). Figures using these data sources have been identified.

NOTES ON DATA

Undefined and unclassified data

Some Census data is not able to be classified at all levels of detail, either because respondents did not provide enough information in their Census response, or the response could not be coded into an existing category. In cases where data could not be defined into a more detailed category, the term **not further defined (nfd)** is used. In cases where responses could not be placed into an existing category, the term **not elsewhere classified (nec)** is used.

Data that was not stated nor adequately described

Most Census variables report on data that was **not stated, inadequately defined**, and **not applicable**. These categories capture instances where responses were missing, unable to be defined or categorised, or were not applicable to the respondent, respectively. In this report, responses which fell under these categories have been excluded from most analyses.

Data not shown

Throughout this report, some reported statistics are accompanied by the indication **data not shown.** In these instances the data is from the Census but has not been displayed in a graph or table in this report.

Rounding

All proportions and percentages, other than unemployment rates, have been rounded to the nearest whole number. Unemployment rates are reported to one decimal point to align with commonly reported unemployment data. Due to rounding, some figures may not sum to 100%, and the lengths of bars in some graphs may appear slightly different despite data labels reporting the same values.

Perturbation of data

To prevent the identification of individuals in the Census data, the ABS introduces small random errors into the Census data. This randomisation has the largest impact on categories with small numbers. In this report, the randomisation may make small bars in stacked bar charts appear out of order, as the sum of the stacked bars may be slightly different to the 'total' category value generated from Census data.

CONTEXT OF UNEMPLOYMENT RATES

Unemployment data in this report should be read with reference to prevailing labour market and unemployment conditions in the years in which the Census was undertaken. Table 1.4 shows the general Australian unemployment rates for people in the labour force with STEM qualifications, non-STEM qualifications, no post-secondary qualifications, or people whose level of education was not stated or not adequately described.

It should also be noted that while comparing unemployment rates within a given Census year, and to previous Census data sets, is informative, the rates reported in this report may be significantly different to current labour market unemployment rates in some fields.

Further reading on labour market and household conditions around the time of the Census collection can be found in ABS catalogues:

- 6291.0.55.001—Labour Force, Australia, August 2016
- 6523.0—Household Income and Wealth, Australia, 2015–16
- 6227.0—Education and Work, Australia, May 2016
- 6226.0—Participation, Job Search and Mobility, Australia, February 2016

Table 1.4: General unemployment rates in Australia, 2006, 2011, and 2016[5]

	2006		2011		2016	
	Size of labour force	Unemployment rate	Size of labour force	Unemployment rate	Size of labour force	Unemployment rate
VET qualification, all fields	2 889 986	3.9	3 437 170	4.5	3 892 913	5.8
University qualification, all fields	2 062 738	2.7	2 691 792	3.3	3 374 152	4.3
No post-secondary qualification	4 131 363	7.3	4 088 349	8.0	3 879 624	10.1
Education level not stated or inadequately described	523 904	6.1	441 148	6.4	324 607	8.1
Total labour force	**9 607 990**	**5.2**	**10 658 456**	**5.6**	**11 471 295**	**6.9**

LIMITATIONS OF PERSONAL INCOME DATA

To determine personal income brackets, people were asked to report the total of all their wages and salaries, government benefits, pensions, allowances, and any other income they usually receive, before deductions. Using Census data, an individual's income cannot be split into earned and non-earned income streams.

All dollar amounts in this report are nominal figures and have not been adjusted for inflation. Information about inflation can be found in the ABS catalogue 6401.0—Consumer Price Index, Australia, Sep 2016.

5 The Census and the Labour Force Survey (LFS) both collect information about the labour market activity of people aged 15 years and over. Due to a number of differences between the surveys, these two data sets are not directly comparable. Unemployment rates in this report should be compared only with rates also calculated from Census data.

Key changes to the analysis for this report

This report largely follows the structure of the previous report, however some changes to the content and structure have been made in this report and are outlined below.

QUALIFICATION LEVEL

The previous report defined the STEM qualified workforce as those who held a certificate III or above post-secondary qualification(s) in a STEM field of education. This report expands the definition of the STEM qualified workforce to include those with certificate I and II qualifications in STEM fields.

This report separates all analysis of VET and university qualified people, rather than present these populations together as was done in the previous report.

ANALYSIS OF UNIVERSITY GRADUATES

Chapter 4 (Part 2) of this report provides an overview of graduates who hold a university qualification in STEM. The fields of education examined in this report were restructured from the previous report in order to capture more of the STEM qualified population and to adopt a broader focus. A summary of these changes is presented in Chapter 4, Table 4.1.

A more detailed analysis of graduates from the fields of education examined in Chapter 4 are presented in Chapters 5 to 14 (with the exception of Natural and Physical Sciences not further defined).

Reliability of 2016 Census data

The 2016 Census was the first Census intended to be completed online by the majority of respondents. Difficulties encountered during the electronic roll out of the Census led to the Census website being unavailable for a short time period during the Census day of 9 August 2016 and the following days.

Despite these technical difficulties, the 2016 Census was completed by a majority of people in Australia and yielded data of comparable quality to previous Censuses. The 2016 Census had a response rate of 94.8%, comparable to the 2011 response rate of 93.3%, and the 2006 response rate of 95.8% (Harding et. al. 2017). An independent investigation into the quality of the 2016 Census concluded that "the quality of the 2016 Census data is comparable with the Censuses conducted in 2011 and 2006, is fit for purpose, and can be used with confidence" (Harding et. al. 2017, p.43).

PART 1

AUSTRALIA'S STEM CAPABILITY

This report presents a comprehensive analysis of people with STEM qualifications and how STEM qualifications are used in the Australian workforce. In 2016, there were 2.5 million adults (aged 15 years and over) with a post-secondary qualification in a STEM field. This cohort is separated throughout this report into those with certificate I to advanced diploma qualifications (VET STEM qualified population) and those with bachelor and above qualifications (university STEM qualified population).[6]

Of these STEM qualified populations, 73% of those with VET qualifications and 81% of those with university qualifications were in the labour force—either working or looking for work.

6 Refer to Chapter 1, page 2 for more information about how the STEM qualified population is defined.

Australians qualified in STEM fields have an important contribution to make. With globalisation and technological advances changing the nature of work, the number and variety of occupations requiring STEM skills and advanced STEM literacy is increasing. This skills demand on the Australian workforce is becoming increasingly important for our national economy.

To meet this skills demand, Australia requires a suitably qualified population from which to draw, and on which a prosperous economy can be built. In this context, there is value in analysing the entire STEM qualified population regardless of their labour force status.

In 2016, around a third of the total adult population was out of the labour force. Analysis by the Australian Bureau of Statistics found that the reasons for being out of the labour force were heavily influenced by age and gender (ABS 2013b). Young people were most likely to be studying, while older adults were more likely to be retired or voluntarily inactive. For people aged 25 to 64, childcare responsibilities were frequently cited by women, while men were most likely to be out of the labour force due to long term illness or disability. Respondents also cited short-term reasons for being out of the labour force, including discouragement with the job market and family considerations.

Irrespective of their reason for being out of the labour force, people with STEM qualifications continue to engage in society with the benefit of the education they have received and the skills they have developed. Their existence is therefore an important component of the STEM qualified workforce, and has been included in this chapter.

Chapter 2 of this report looks at all people with a STEM qualification in Australia and presents broad demographic trends, including the number, age, geographical distribution, and diversity of the STEM qualified population.

Chapter 3 of this report focuses on those people with STEM qualifications who are in the labour force, reporting on employment outcomes such as employment status, the industries and occupations of employment, business ownership, and income.

CHAPTER 2

2

DEMOGRAPHICS OF AUSTRALIA'S STEM QUALIFIED POPULATION

HIGHLIGHTS

- In 2016, 1 588 452 people in Australia aged 15 and over (adults) had a VET STEM qualification, representing 31% of all people with a VET qualification. 907 639 adults in Australia had a university STEM qualification, representing 22% of all people with a university qualification.
- Between 2011 and 2016, the number of people with VET STEM qualifications grew by 8% and the number of people with university STEM qualifications grew by 29%.
- In 2006, 9% of the VET STEM qualified population were female. This proportion was the same in 2016. In comparison, in 2016 60% of the VET non-STEM qualified population were female.
- In 2006, 28% of the university STEM qualified population were female. This proportion increased to 31% in 2016. In comparison, in 2016 63% of the university non-STEM qualified population were female.
- For those with university STEM qualifications, there was a greater percentage increase in the size of the female population than the size of the male population between 2011 and 2016 in all STEM fields.
- The STEM qualified population has a larger migrant representation than the general Australian population, particularly at the university level. 28% of people with VET STEM qualifications and 57% of those with university STEM qualifications living in Australia were born overseas. In comparison, 26% of the total Australian population was born overseas.
- Aboriginal and Torres Strait Islander peoples are under-represented in STEM, particularly at the university level, where 0.5% of the Aboriginal and Torres Strait Islander population had a STEM qualification, compared to 5% of the non-Indigenous population.
- Over the last 5 years, the increase in the proportion of people aged 45 and over was greater in the STEM qualified population than in the total adult Australian population. This increase was driven by the VET STEM qualified population, where the percent of people aged 45 and over increased from 55% in 2011 to 58% in 2016. Over the same time period, the percentage of the total adult population aged over 45 increased from 49% to 50%.

How many STEM qualified people are there in Australia?

In 2016, of the 19.3 million Australian adults, 9.6 million held a post-secondary qualification. More than half (56%) of these were VET qualifications and 44% were university qualifications. Just over one-quarter of qualified Australians had a STEM qualification, while the majority (73%) had a non-STEM qualification (Table 2.1).

The number of qualified people and the level of those qualifications varied substantially across the STEM fields (data listed in Table 2.1 and shown in Figure 2.1). The largest STEM field at both the VET and university levels of education was Engineering, accounting for 81% of the VET STEM qualified population and 38% of the university STEM qualified population.

Within VET, people with Science, Information Technology, or Mathematics qualifications most commonly held a diploma or advanced diploma. The most common VET qualifications in Agriculture and Environmental Science and Engineering were certificates III or IV. The most common VET qualifications in non-STEM fields were also certificates III or IV.

A comparatively small proportion of people had a certificate I or II as their highest qualification, indicating that these entry level courses mostly lead to further study.

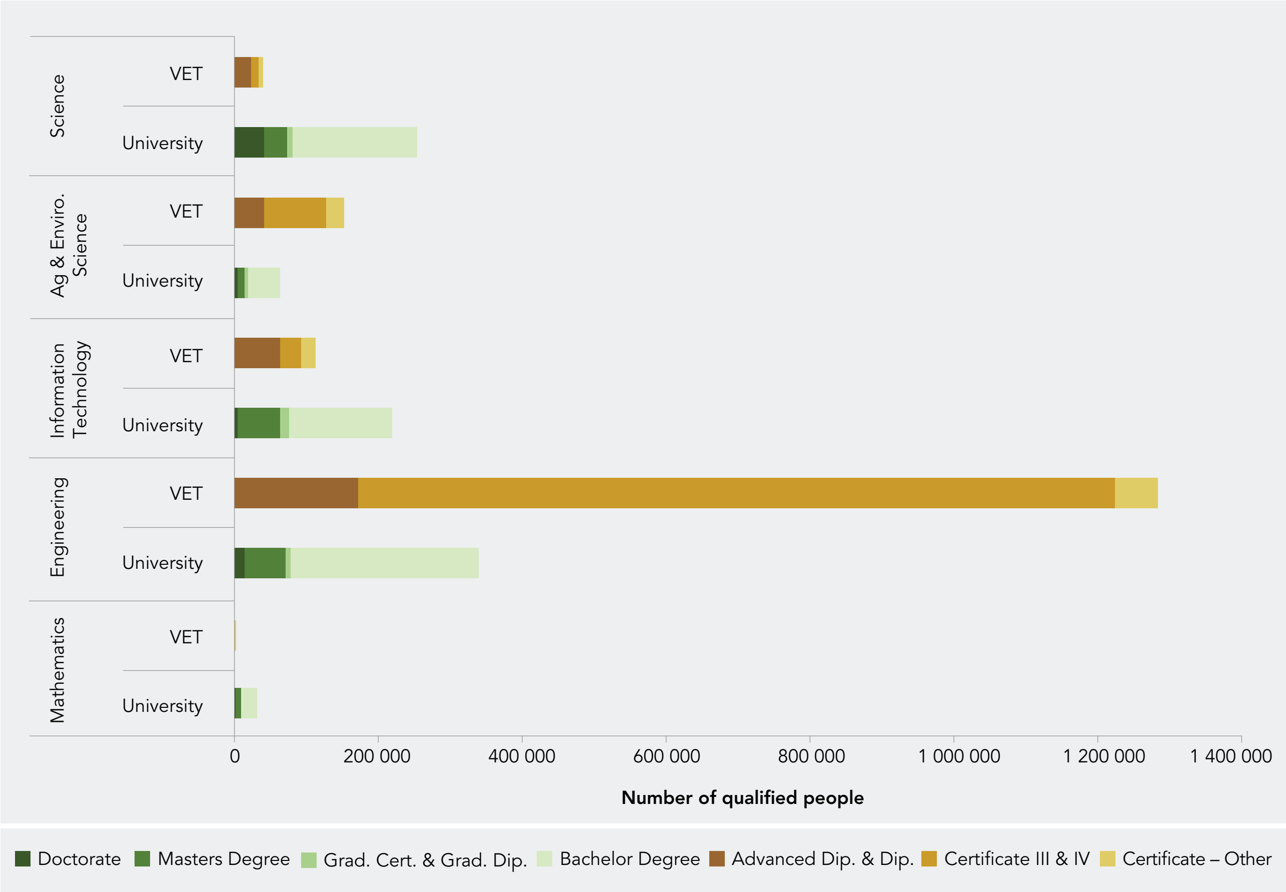
Table 2.1: People living in Australia with post-secondary qualifications, by field and level

	Science	Ag. & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total Non-STEM
Doctorate	41 361	3 771	4 229	13 981	3 434	66 776	81 365
Masters Degree	32 939	11 170	60 122	56 665	5 498	166 394	574 073
Postgraduate Degree, nfd (a)	533	163	566	542	70	1 874	15 421
Graduate Certificate or Diploma	6 483	3 866	12 839	8 494	1 391	33 073	340 940
Bachelor Degree	172 216	44 163	141 353	260 847	20 943	639 522	2 164 970
University total	**253 532**	**63 133**	**219 109**	**340 529**	**31 336**	**907 639**	**3 176 769**
Advanced Diploma or Diploma	22 810	40 922	63 638	172 221	971	300 562	1 354 094
Certificate, nfd (a)	5 190	13 045	7 426	39 824	419	65 904	297 455
Certificate III & IV	8 923	87 336	30 863	1 052 749	92	1 179 963	1 707 624
Certificate I & II	845	10 746	10 618	19 745	69	42 023	164 814
VET total	**37 768**	**152 049**	**112 545**	**1 284 539**	**1 551**	**1 588 452**	**3 523 987**
Level not stated	2 310	5 623	3 974	33 542	203	45 652	172 067
Level inadequately described	4 459	2 025	10 103	17 019	367	33 973	114 749

Note: (a) Where the respondent did not provide adequate information for their response to be coded, the 'Not further defined' (nfd) category is used.

For those with university qualifications, a bachelor degree was the most widely held qualification across all STEM fields. It was also the most widely held non-STEM university qualification. For those with Science qualifications, the next most common university qualification was a doctorate degree. For all other STEM fields of education and for non-STEM, the second most common university qualification was a masters degree. A slightly higher percentage of non-STEM graduates had postgraduate qualifications (32%) compared to STEM graduates (30%).

Figure 2.1: Number of people living in Australia in 2016 with post-secondary qualifications, by field and level



Note: The values in the above graph do not include respondents with inadequately described or not stated level of education ('Certificate—Other' includes certificates I, II, and nfd.)

How has the size of the STEM qualified population changed over recent years?

In 2006, 38% of adults living in Australia held post-secondary qualifications in a STEM or non-STEM field, increasing to 48% in 2016. Between 2006 and 2016 there was no change in the percentage of people in Australia with VET STEM qualifications and a 2 percentage point increase in the proportion of people with university STEM qualifications. Across the same period, the proportion of people with non-STEM VET qualifications rose by 5 percentage points and the proportion of people with non-STEM university qualification also rose by 5 percentage points (Figure 2.2).

The percentage change in the size of the post-secondary qualified population between 2011 and 2016 is shown in Figure 2.3. At the VET level, the increase in the Mathematics population represented just 450 people. The next largest percentage increase was in Science, which grew by 14% (4 711 people) over the 5 years to 2016. The smallest percentage increase across the VET STEM fields was in Engineering (7%).

At the university level the largest percentage increase in the STEM qualified population between 2011 and 2016 was in Information Technology (36%) and the smallest percentage increase was in Agriculture and Environmental Science (19%).

Figure 2.2: Proportions of people living in Australia with post-secondary qualifications, by field and level, 2006 to 2016

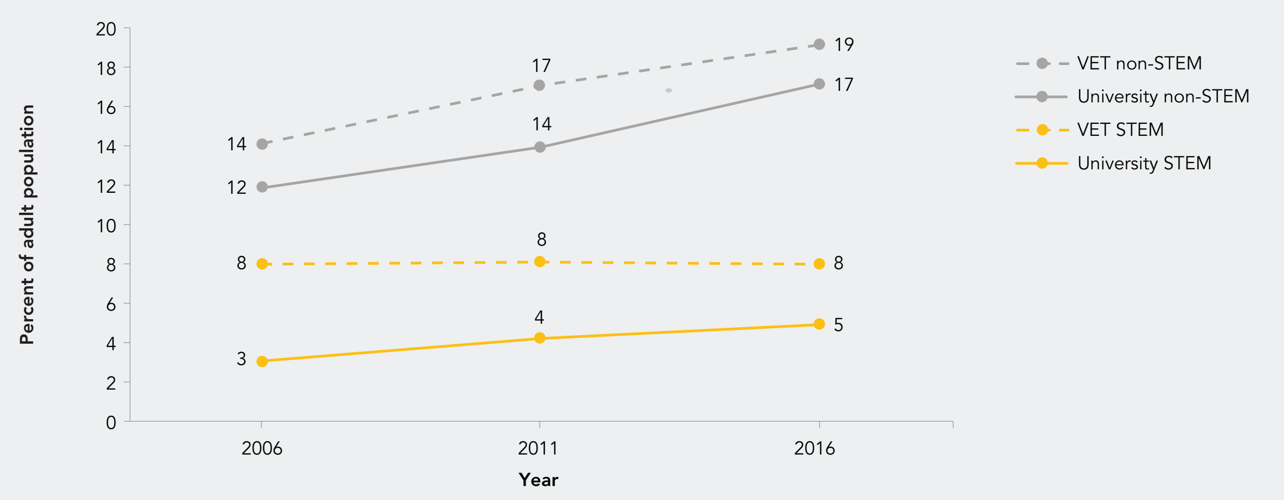
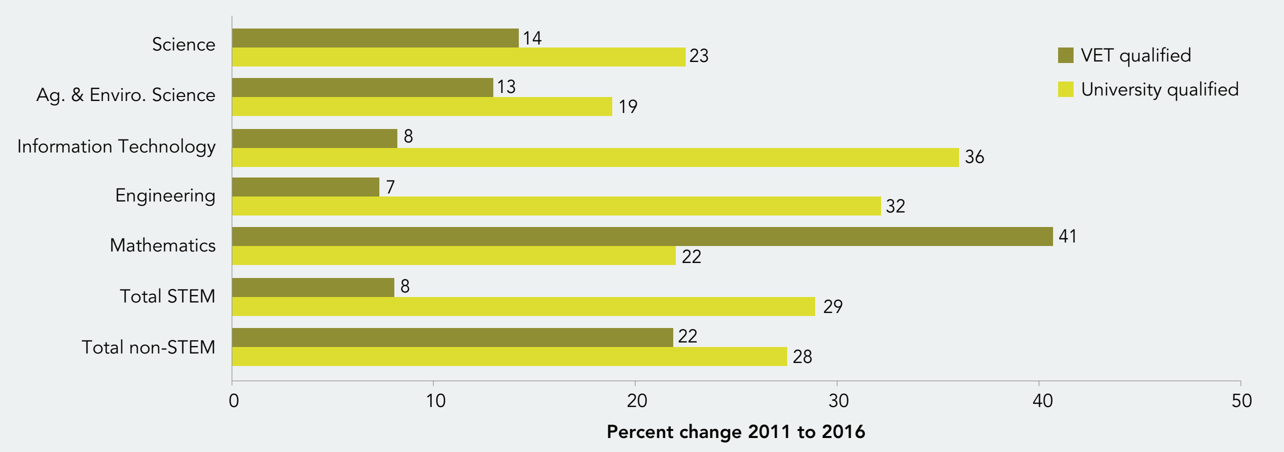


Figure 2.3: Percentage change in the number of people living in Australia with post-secondary qualifications, by field and level of education, 2011 to 2016



What are the proportions of male and female STEM qualified people in Australia?

In 2016, 9% of people with VET STEM qualifications were female and 91% were male. 31% of people with university STEM qualifications were female and 69% were male.

Of the VET STEM fields, the highest female representation was in Science (56% female) and the lowest was in Engineering (5% female; Figure 2.4). By comparison, females represented 60% of the non-STEM VET qualified population.

Of the university STEM fields, the highest female representation was in Science (50% female) and the lowest representation was in Engineering (16% female; Figure 2.5). By comparison, females represented 63% of the non-STEM university qualified population.

The workforce characteristics of women in STEM are presented and discussed in more detail in Part Three, Chapter 16 *Women in STEM.*

Figure 2.4: Gender distribution of VET qualified populations, by field

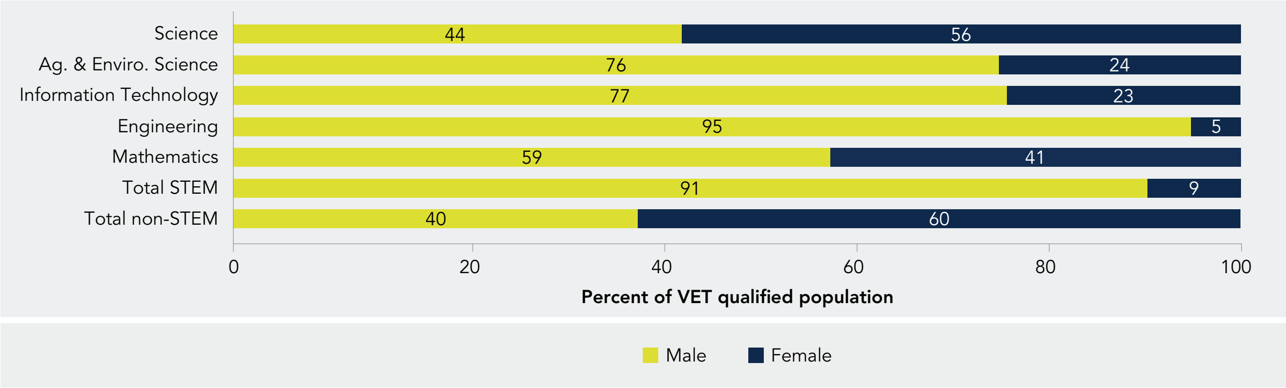
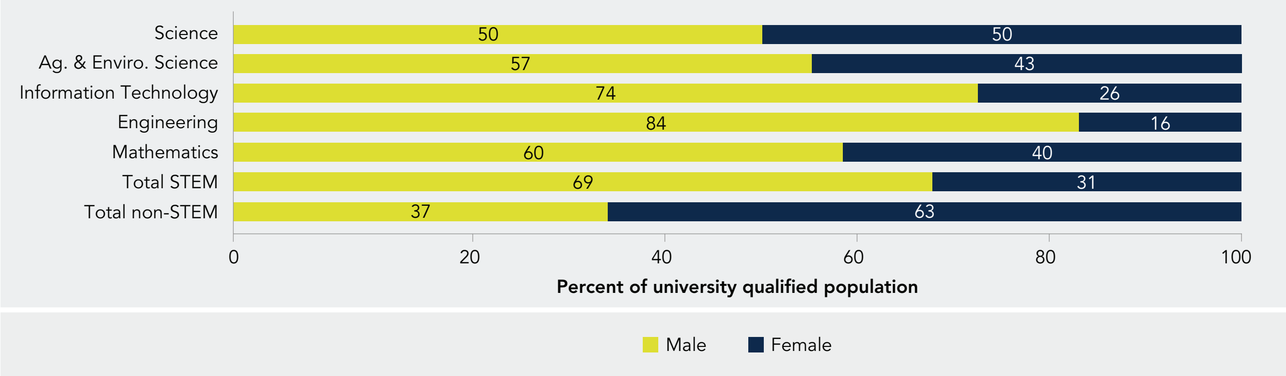


Figure 2.5: Gender distribution of university qualified populations, by field



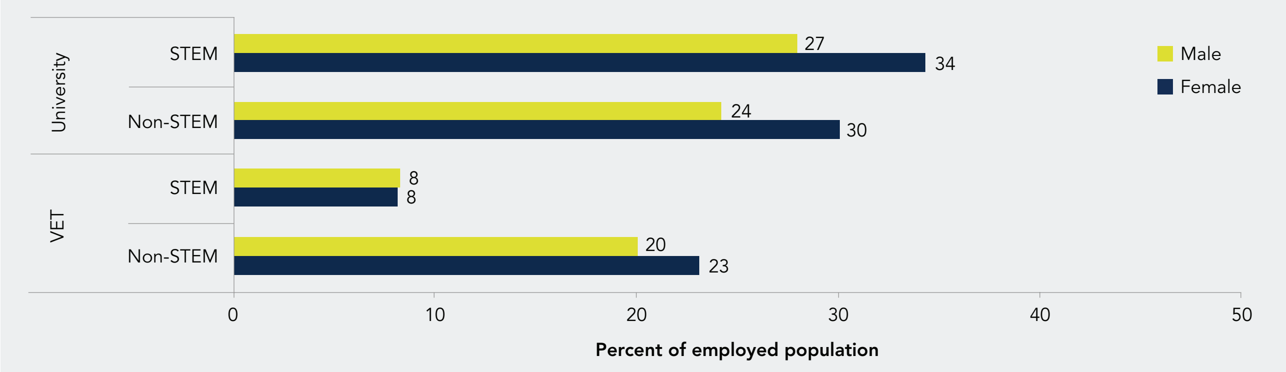
How did these proportions change over the decade 2006 to 2016?

In 2006, 9% of the VET STEM qualified population was female. This percentage was unchanged in 2016 (data not shown).

In 2006, 28% of the university STEM qualified population was female. This percentage rose 3 percentage points to 31% in 2016. In comparison, the female proportion of the non-STEM university qualified population increased from 61% in 2006 to 63% in 2016.

The change in the number of people with qualifications between 2011 and 2016 is shown in Figure 2.6. Growth in the number of people with university STEM, university non-STEM, and VET non-STEM qualifications were all more than 20% for both genders. Growth in the number of people with VET STEM qualifications was just 8% for both genders.

Figure 2.6: Percentage change in the number of people with post-secondary qualifications, by gender, field and level, 2011 to 2016



For those with VET qualifications, the female population had a stronger growth than the male population in Science and Engineering, while the male population increased by a larger proportion than the female population in all other STEM fields (Figure 2.7). The large percentage changes in Mathematical Sciences represented increases of just 269 males and 165 females. The next largest percentage increases for those with VET qualifications were in Science for females (which saw an increase of 19%) and Agriculture and Environmental Science for males (increase of 14%). The smallest changes were in Information Technology for females, where the population size decreased by 5%, and Engineering for males, which increased by 7%.

For those with university qualifications, there was a greater percentage increase for females than for males in all STEM fields. The fields with the largest percentage growth for females (Figure 2.8) were Engineering (52%) and Information Technology (42%), and for men were Information Technology (34%) and Engineering (29%). The smallest changes, albeit still positive, were in Agriculture and Environmental Science, at 25% for females and 15% for males.

Figure 2.7: Percentage change in the number of people with VET post-secondary qualifications, by field and gender, 2011 to 2016

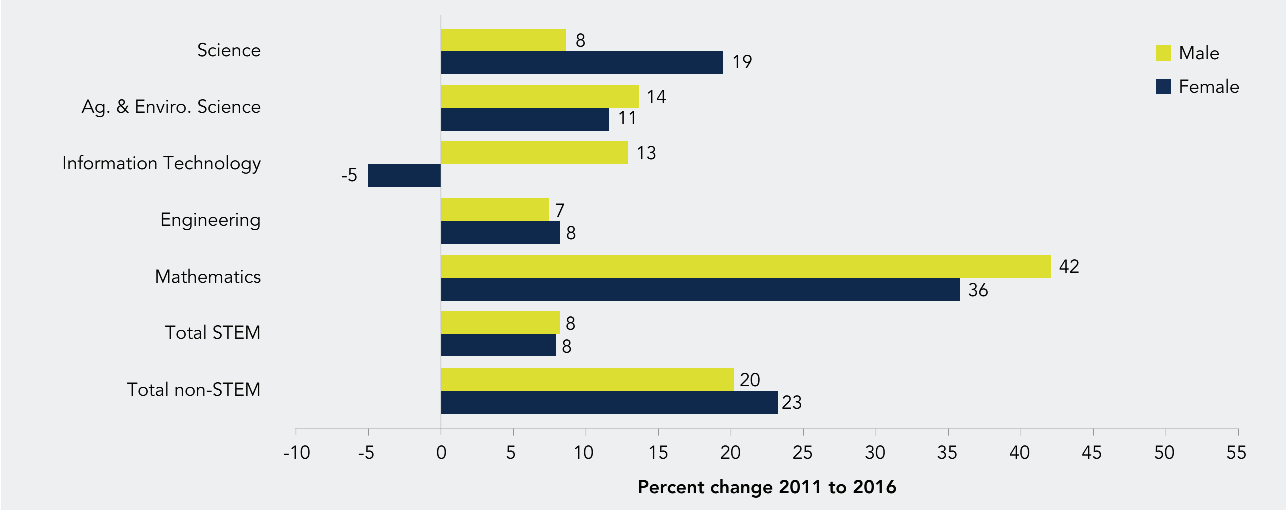
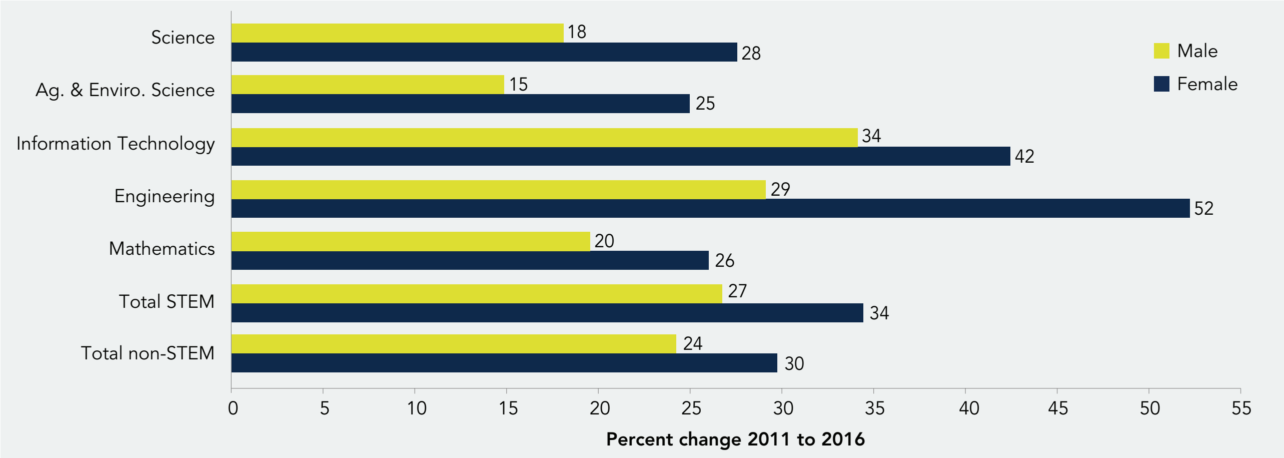


Figure 2.8: Percentage change in the number of people with university post-secondary qualifications, by field and gender, 2011 to 2016



What proportion of the Australian population has a STEM qualification?

In 2016, 8% of the adult Australian population had a VET STEM qualification and 19% had a VET non-STEM qualification. The percentage varied across the states and territories; ranging from 6% of the population in the Australian Capital Territory to 10% in Western Australia with VET STEM qualifications, and from 16% in the Australian Capital Territory to 20% in Queensland with a VET non-STEM qualification.

In 2016, 5% of the adult Australian population had a university STEM qualification and 17% had a university non-STEM qualification. The percentage varied across the states and territories; ranging from 3% of the population in Tasmania and the Northern Territory to 9% in the Australian Capital Territory with university STEM qualifications, and from 13% in Tasmania and the Northern Territory to 27% in Australian Capital Territory with a university non-STEM qualification (Table 2.2).

The Australian Capital Territory was an outlier, with 36% of residents holding a university qualification in either a STEM or non-STEM field, compared to the second highest (Victoria) at 24%.

Table 2.2: The distribution of qualified people in Australia, by state or territory of usual residence

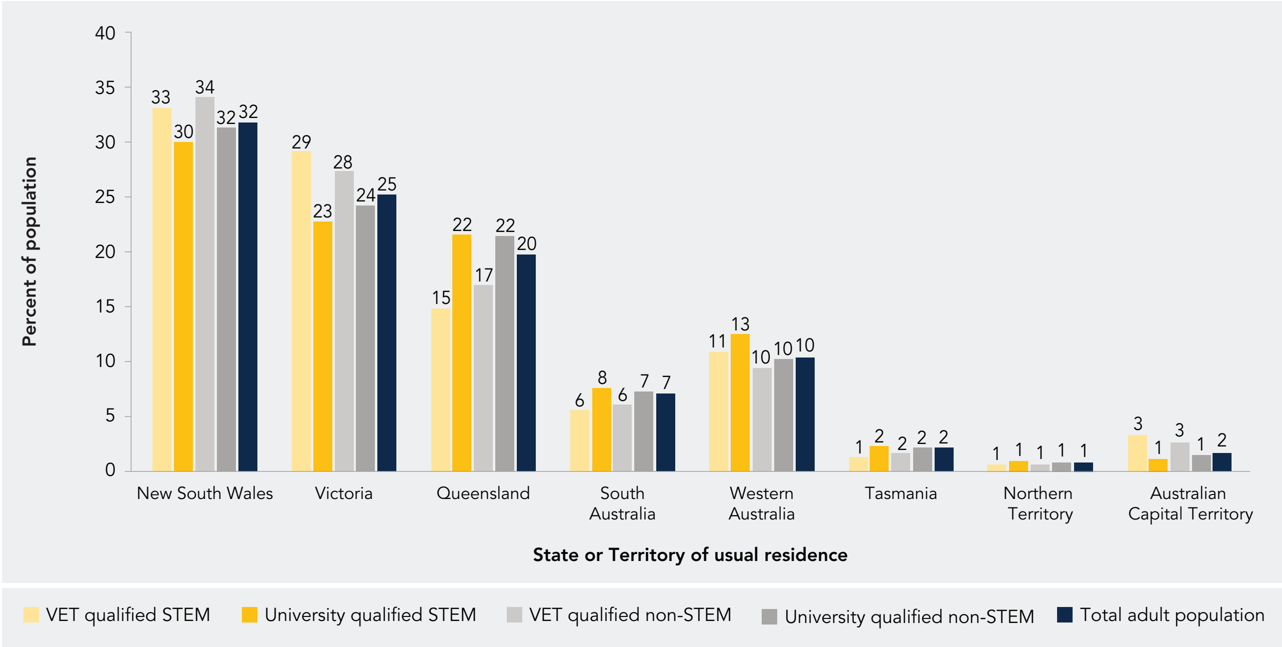
	Size of adult population	Percentage with a VET STEM qualification	Percentage with a university STEM qualification	Percentage with a VET non-STEM qualification	Percentage with a university non-STEM qualification
NSW	6 093 897	8	5	18	18
Vic.	4 845 709	8	6	18	18
Qld	3 790 497	9	4	20	14
SA	1 383 652	9	4	19	14
WA	1 997 728	10	5	18	15
Tas.	419 757	9	3	19	13
NT	179 363	9	3	17	13
ACT	322 917	6	9	16	27
Other Territories	3 773	10	3	17	9
Total Australia	**19 037 278**	**8**	**5**	**19**	**17**

Where do STEM qualified people live in Australia?

Of the VET STEM qualified population, approximately one-third lived in New South Wales (33%), 30% lived in Victoria and 15% lived in Queensland (Figure 2.9). These proportions were similar for the non-STEM VET qualified population. Compared to the total Australian adult population, the most substantial differences were seen in Queensland (hosting 20% of the Australian adult population but only 15% of those with VET STEM qualifications) and in Victoria (25% of the adult population and 29% of those with VET STEM qualifications).

Of the university qualified STEM population, 30% lived in New South Wales, and just under one quarter lived in Victoria (23%) and Queensland (22%). These proportions were also similar for the non-STEM population (Figure 2.9). Compared to the total Australian adult population, the most substantial differences were seen in Victoria (hosting 25% of the Australian adult population and 23% of those with university STEM qualifications) and in Western Australia (10% of the adult population and 13% of those with university STEM qualifications).

Figure 2.9: Distribution of people with post-secondary qualifications across Australia by field, level and state or territory of usual residence

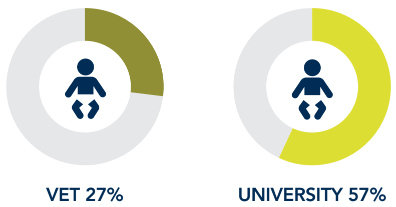


How diverse is Australia's STEM qualified population?

The STEM qualified population reflects the diversity found across the broader Australian population, yet differs in some key demographics. In 2016, both women and Aboriginal and Torres Strait Islander peoples were underrepresented in STEM, and a greater proportion of people with STEM qualifications were born outside Australia than in the general Australian population.

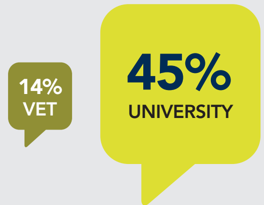
The infographics below summarise key aspects of diversity in the STEM qualified population.

1 Born overseas



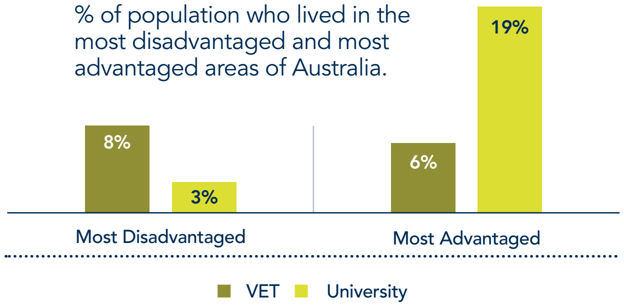
2 Language

% of population who spoke a language other than English at home.

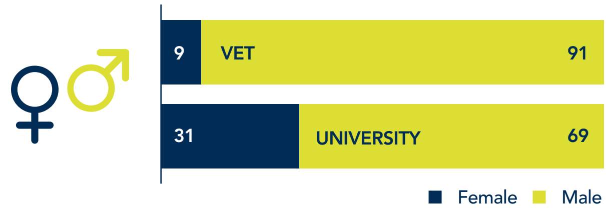


3 Socioeconomic status

% of population who lived in the most disadvantaged and most advantaged areas of Australia.

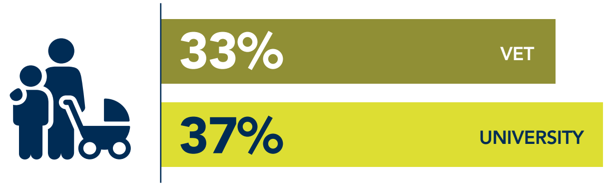


4 Gender distribution



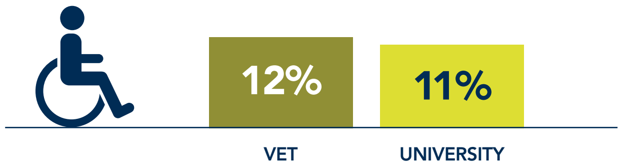
5 Childcare responsibilities

% of working population who had childcare responsibilities.



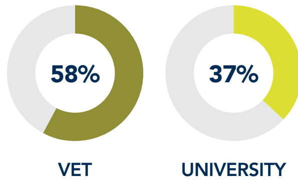
6 Caring responsibilities

% of population who provided assistance to a person with a disability.

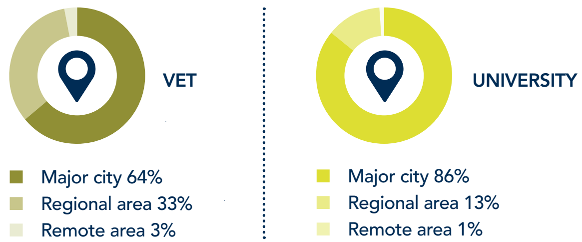


7 Age

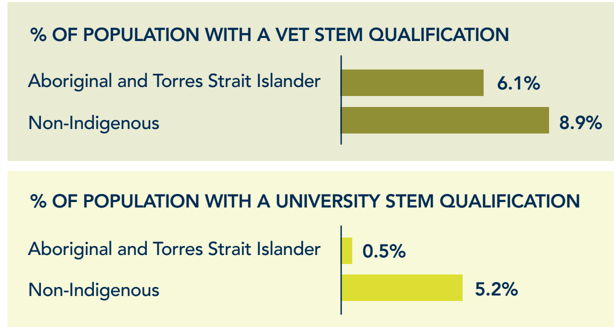
% of population that were aged 45 and over.



8 City and regional representation



9 Aboriginal and Torres Strait Islander population



How many Aboriginal and Torres Strait Islander peoples are STEM qualified?

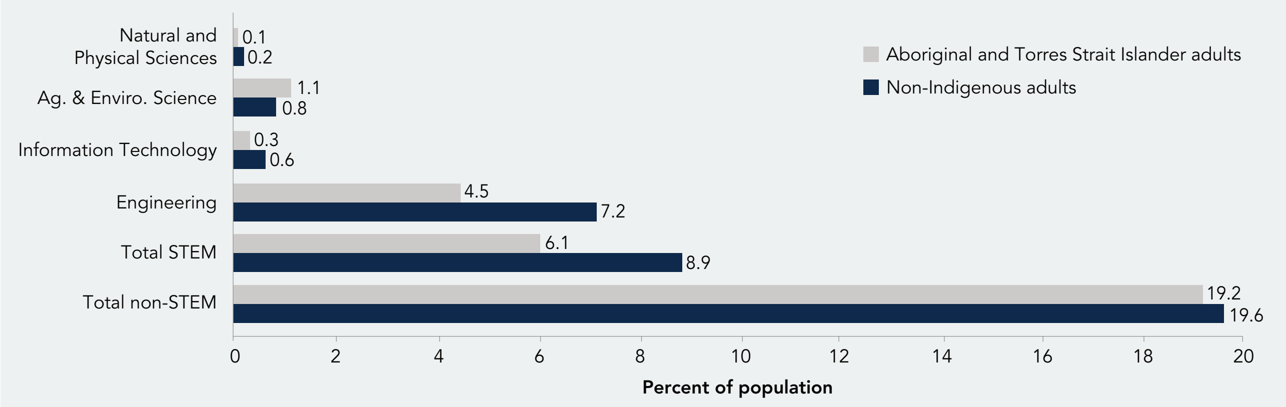
This section counts Aboriginal and Torres Strait Islander peoples that have graduated from post-secondary institutions with certificate qualifications or above.

Science has been an integral part of Aboriginal and Torres Strait Islander culture for thousands of years, with Aboriginal and Torres Strait Islander sciences including sophisticated knowledge of meteorology and seasons, astronomy, natural resource management, and bush food, medicine and healing.

In 2016, 26 035 adults who identified as Aboriginal and Torres Strait Islander peoples held a VET STEM qualification and 2 313 people held a university STEM qualification. Compared to non-Indigenous people, a lower proportion of Aboriginal and Torres Strait Islander peoples held qualifications in both STEM and non-STEM fields.

6% of adult Aboriginal and Torres Strait Islander peoples held a VET STEM qualification, and 19% held a VET non-STEM qualification (Figure 2.10). In comparison, 9% of adult non-Indigenous people held a VET STEM qualification and 20% held a VET non-STEM qualification. Of the VET STEM fields, Agriculture and Environmental Science had a stronger representation of Aboriginal and Torres Strait Islander peoples, while the remaining STEM fields showed a stronger representation of non-Indigenous peoples.

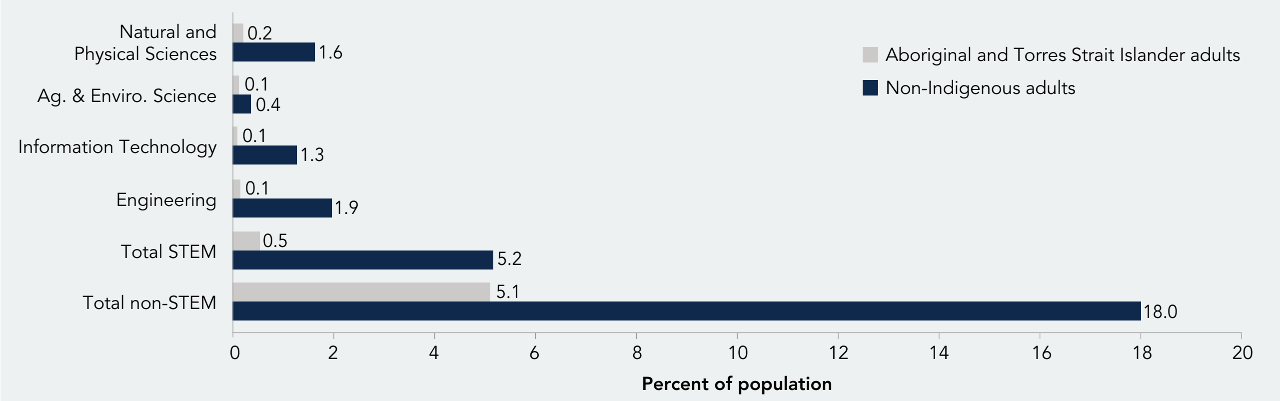
Figure 2.10: Percentage of Aboriginal and Torres Strait Islander and non-Indigenous adult populations with VET qualifications, by field[7]



7 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed with Science in the field of Natural and Physical Sciences.

The underrepresentation of Aboriginal and Torres Strait Islander peoples was more pronounced in relation to university qualifications (Figure 2.11). In 2016, less than 1% of Aboriginal and Torres Strait Islander adults held a university STEM qualification and 5% held a university non-STEM qualification. In comparison, 5% of the adult non-Indigenous population held a university STEM qualification and 18% held a university non-STEM qualification. Aboriginal and Torres Strait Islander peoples had lower representation than non-Indigenous Australians across all STEM fields.

Figure 2.11: Percentage of Aboriginal and Torres Strait Islander and non-Indigenous adult populations with university qualifications, by field[8]



8 Due to the small number of Aboriginal and Torres Strait Islander peoples with university qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

Although Aboriginal and Torres Strait Islander peoples were underrepresented in post-secondary STEM qualifications, the number of qualified people has increased over the decade to 2016 (Table 2.3).

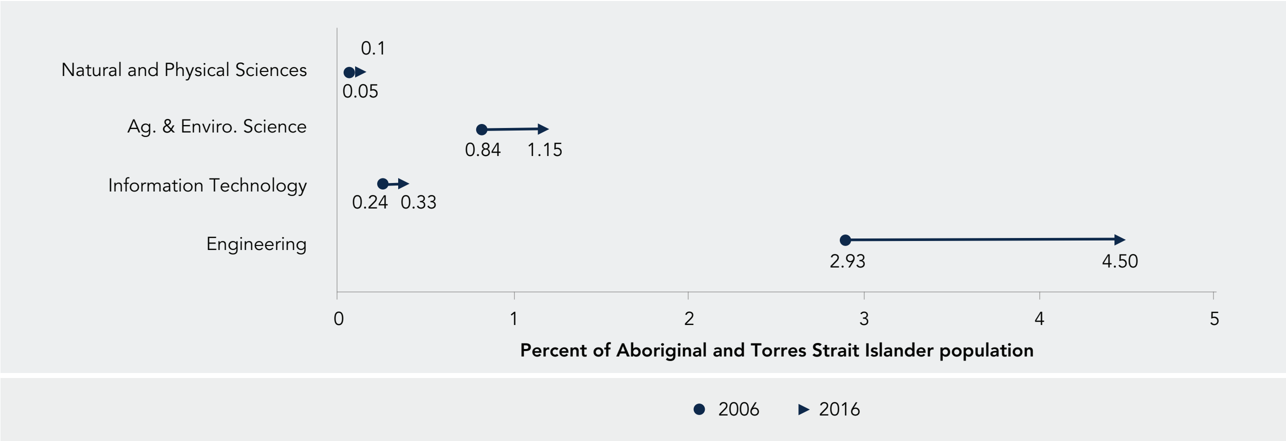
At the VET level, this increase was reflected in an increase in the proportion of the population with post-secondary qualifications between 2006 and 2016 in all fields (Figure 2.12). The STEM field that had the largest number of qualified Aboriginal and Torres Strait Islander peoples and the largest increase in the size of this population over the decade was Engineering.

At the university level, these numerical increases did not correspond to a substantial increase in the proportion of Aboriginal and Torres Strait Islander peoples holding qualifications (data not shown).

Table 2.3: Number of qualified Aboriginal and Torres Strait Islander peoples, by year, level and field

	VET		University	
	2006	2016	2006	2016
Natural and Physical Sciences	149	417	387	918
Ag. and Enviro. Science	2 375	4 927	165	437
Information Technology	690	1 414	146	351
Engineering	8 316	19 283	225	606

Figure 2.12: Percent of the adult Aboriginal and Torres Strait Islander population with VET STEM qualifications, by field, 2006 to 2016



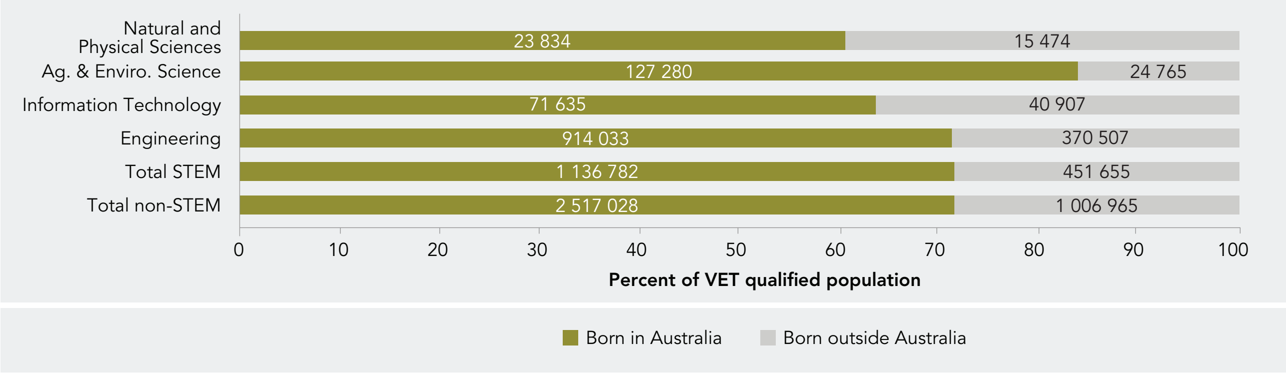
What proportion of STEM qualified people living in Australia were born outside of Australia?

In 2016, 28% of people with a VET STEM qualification and 57% of people with a university STEM qualification were born outside of Australia. In comparison, 29% of people with a VET non-STEM qualification and 41% of people with a university non-STEM qualification were born outside of Australia. For reference, in 2016, 39% of the general adult population living in Australia were born outside of Australia.

For people with VET STEM qualifications, a greater percentage were born in Australia than outside of Australia across all fields (Figure 2.13). People with Agriculture and Environmental Science qualifications had the lowest percentage born outside of Australia (16%) and people with Natural and Physical Sciences qualifications had the highest percentage born outside Australia (39%). Similar proportions of people with STEM and non-STEM VET qualifications were born outside of Australia.

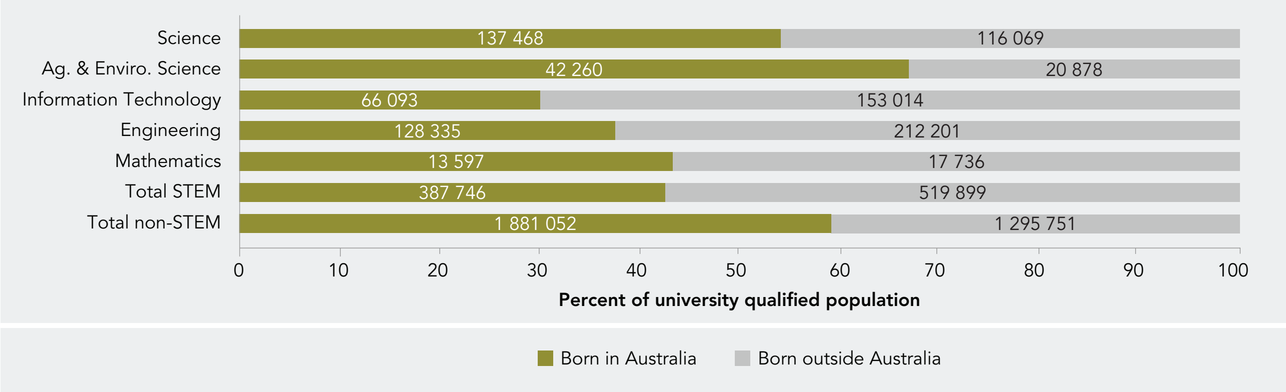
For people with university STEM qualifications, the majority of people qualified in Information Technology, Engineering and Mathematics were born outside of Australia (Figure 2.14). People with Agriculture and Environmental Science qualifications had the lowest proportion born outside of Australia (33%) and people with Information Technology qualifications had the highest proportion (70%) born outside of Australia. A much higher percentage of people with university STEM qualifications were born outside of Australia than those with university non-STEM qualifications.

Figure 2.13: People living in Australia with VET qualifications by field and place of birth. Data labels show the number of qualified people[9]



Note: These totals include only those where the country of birth was both stated and adequately described.

Figure 2.14: People living in Australia with university qualifications by field and place of birth. Data labels show the number of qualified people



Note: These totals include only those where the country of birth was both stated and adequately described.

9 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed with Science in the field of Natural and Physical Sciences.

The proportion of VET qualified people born overseas was largely unchanged between 2011 and 2016 (Figure 2.15). For those with university qualifications, there was an increase in the proportion of people born overseas across all STEM fields of education (Figure 2.16). The most substantial increase was for those qualified in Information Technology, where the proportion born overseas increased by 6 percentage points.

Figure 2.15: Percentage of people with VET qualifications born outside Australia, by field, 2011 and 2016

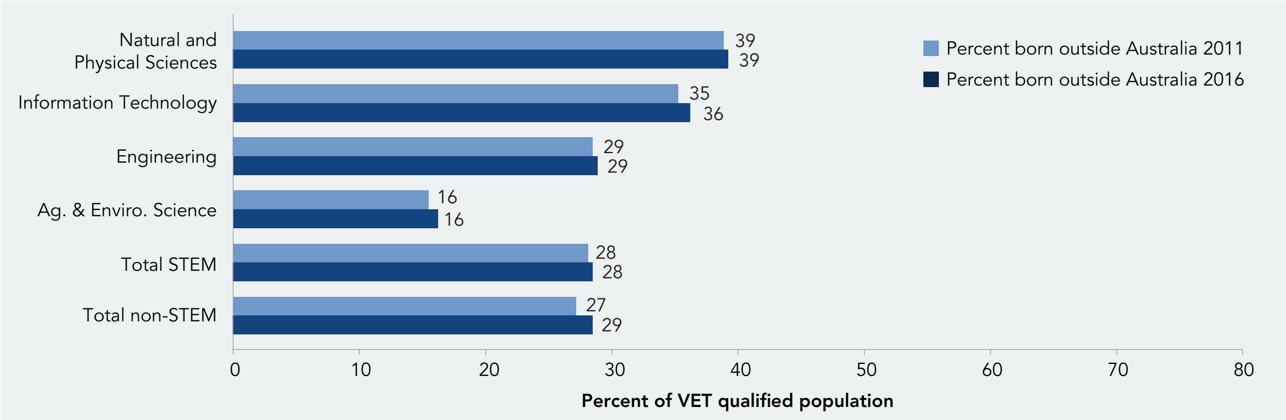
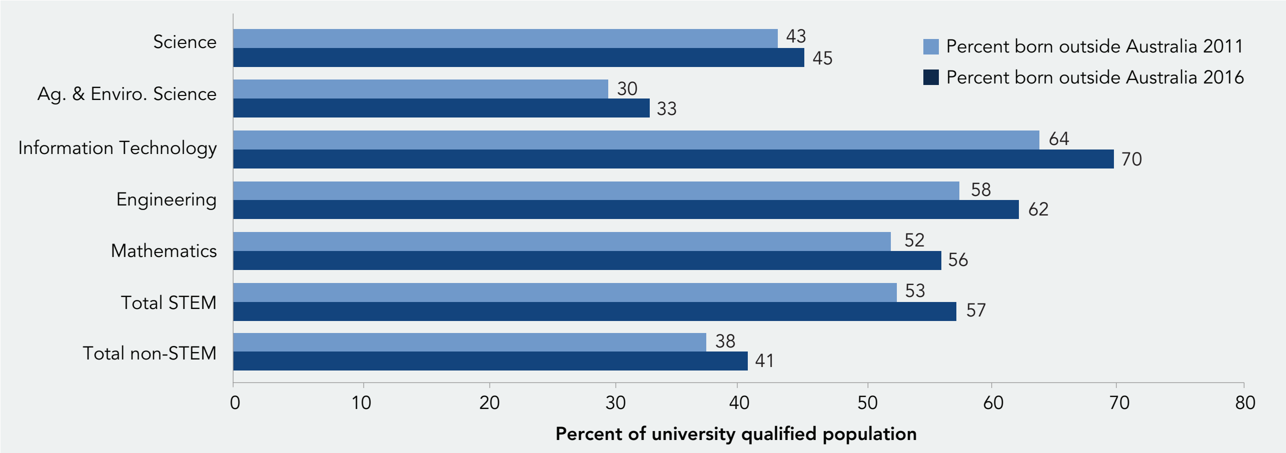


Figure 2.16: Percentage of people with university qualifications born outside Australia, by field, 2011 and 2016



How many STEM qualified people speak a language other than English at home?

In 2016, 15% of the VET STEM qualified population spoke a language other than English (LOTE) at home (Figure 2.17). The most common languages other than English spoken were Italian (20 093 speakers), Greek (15 076) and Mandarin (13 487; data not shown).

In 2016, 45% of the university STEM qualified population spoke a language other than English at home (Figure 2.18). The most common languages other than English spoken were Mandarin (68 720 speakers), Hindi (26 337), and Cantonese (23 249; data not shown).

At both VET and university levels of education, the Information Technology qualified population had the highest percentage of people who spoke a language other than English at home (27% of the VET qualified population and 60% of the university qualified population). The Agriculture and Environmental Science qualified population had the lowest percentage of people who spoke a language other than English at home (6% of the VET qualified population and 21% of the university qualified population).

Figure 2.17: Language spoken at home by VET qualified population, by field. Data labels show the number of qualified people

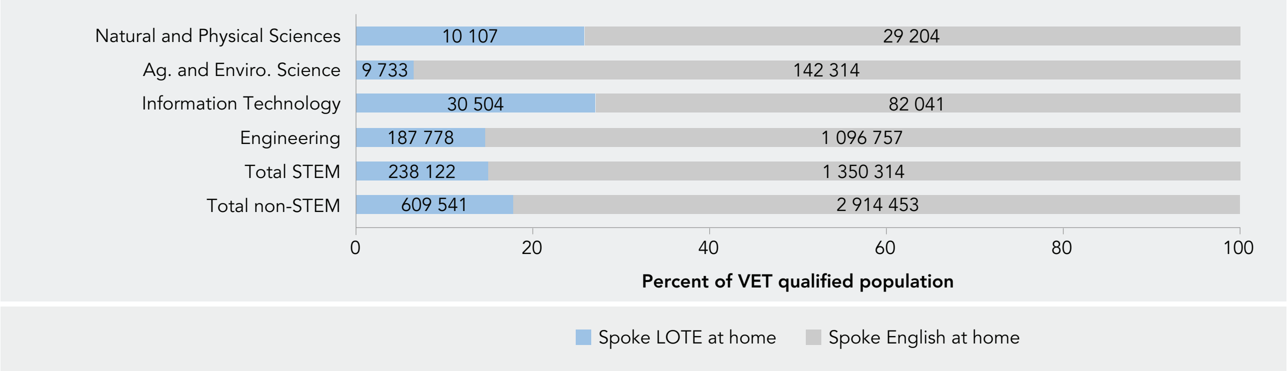
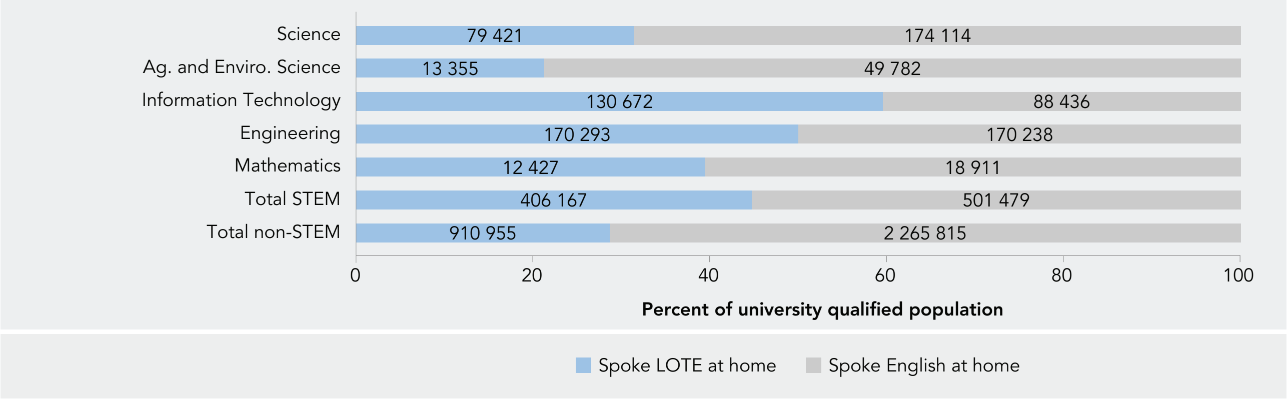


Figure 2.18: Language spoked at home by university qualified population, by field. Data labels show the number of qualified people



How old are STEM qualified people in Australia?

In 2011, 55% of people with a VET STEM qualification were aged 45 and over, increasing to 58% in 2016. Across the STEM fields, those with VET Information Technology qualifications had the lowest proportion of people aged 45 and over (33%), while Engineering had the highest proportion of people aged 45 and over (61%; Figure 2.19). The VET non-STEM qualified population was younger overall than the VET STEM qualified population, with 45% aged 45 years and over.

In 2011, 37% of people with a university STEM qualification were aged 45 and over, a proportion that was unchanged in 2016. Across the narrow fields of STEM, those with university Information Technology qualifications had the lowest proportion of people aged 45 and over (24%), while Mathematics had the highest proportion of people aged 45 and over (57%; Figure 2.20). The university non-STEM qualified population was older than the university STEM qualified population, with 48% aged 45 years and over.

Over the last 5 years, the increase in the proportion of people aged 45 and over was greater in the STEM qualified population than in the total adult Australian population. In 2011, 49% of the adult Australian population were aged 45 and over, increasing to 50% in 2016.

Figure 2.19: Proportion of VET qualified populations in each age group, by field

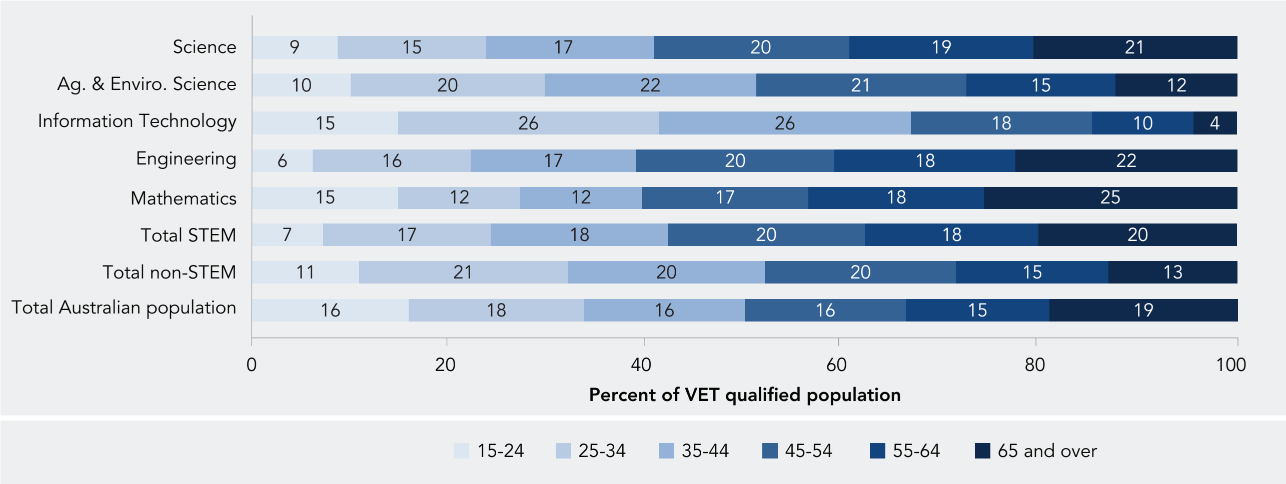
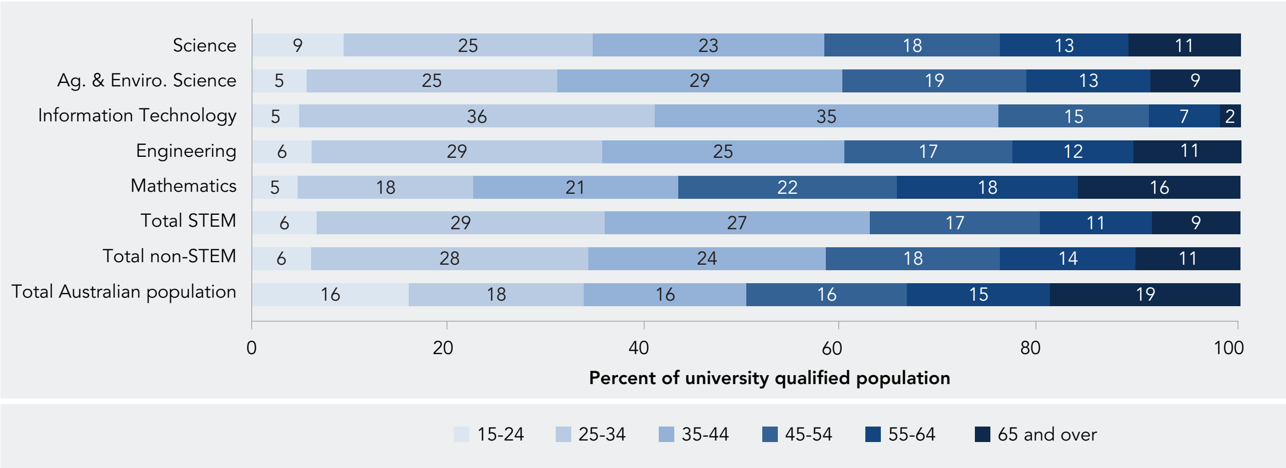


Figure 2.20: Proportion of university qualified populations in each age group, by field



While the STEM qualified population as a whole is ageing, there were variations by age group and field (Table 2.4 and Table 2.5). For those with VET qualifications, between 2011 and 2016 there was a decrease in the number of STEM qualified people in the 15 to 24 and 35 to 44 age brackets, and an increase in the other age brackets. The decrease in the 35 to 44 age bracket was driven by a decrease of 17 331 people with VET Engineering qualifications. The largest increase across VET STEM was in the 65 and over age bracket, which increased by 77 516 people (32%), reflecting large increases across all STEM fields.

The number of university STEM qualified people increased between 2011 and 2016 across almost all fields and age brackets, with the exception of people with Agriculture and Environmental Science qualifications in the 25 to 34 age bracket (which decreased by 485 people). The largest increase was in the 35 to 44 age bracket, which increased by 62 598 people (65%), reflecting increases in all STEM fields, particularly Information Technology.

Table 2.4: Change in number of people with VET qualifications by field and age group, 2011 to 2016. Numbers in brackets show the percentage increase from 2011

Age group	Science	Ag. & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
15-24	827 (34)	- 155 (-1)	- 866 (-5)	- 2 774 (-3)	136 (148)	- 2 832 (-2)	30 433 (9)
25-34	1 088 (23)	54 (0)	- 2 642 (-8)	22 213 (12)	42 (28)	20 755 (8)	125 236 (20)
35-44	- 237 (-4)	788 (2)	3 041 (12)	- 17 337 (-7)	3 (2)	- 13 742 (-5)	71 794 (11)
45-54	252 (3)	4 236 (15)	3 097 (18)	- 2 819 (-1)	36 (16)	4 802 (2)	116 970 (21)
55-64	575 (9)	6 415 (38)	3 128 (37)	22 389 (10)	28 (11)	32 535 (13)	126 581 (31)
65+	2 218 (40)	6 168 (49)	2 781 (127)	66 171 (30)	178 (84)	77 516 (32)	161 734 (53)
Total	**4 723 (14)**	**17 506 (13)**	**8 539 (8)**	**87 843 (7)**	**423 (38)**	**119 034 (8)**	**632 748 (22)**

Table 2.5: Change in number of people with university qualifications by field and age group, 2011 to 2016. Numbers in brackets show the percentage increase from 2011

Age group	Science	Ag. & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
15-24	6 146 (36)	609 (22)	2 830 (37)	7 411 (58)	467 (49)	17 463 (42)	30 996 (19)
25-34	7 867 (14)	- 485 (-3)	6 430 (9)	26 624 (36)	928 (20)	41 364 (19)	193 476 (28)
35-44	8 965 (18)	3 392 (23)	30 188 (65)	20 036 (32)	17 (0)	62 598 (35)	152 285 (25)
45-54	6 892 (18)	2 108 (22)	9 114 (38)	8 521 (17)	1 106 (19)	27 741 (22)	91 699 (20)
55-64	6 296 (24)	2 189 (38)	6 614 (74)	7 557 (22)	804 (16)	23 460 (29)	87 163 (25)
65+	10 562 (58)	2 239 (65)	3 007 (193)	12 978 (54)	2 345 (84)	31 131 (62)	131 567 (64)
Total	**46 728 (23)**	**10 052 (19)**	**58 183 (36)**	**83 127 (32)**	**5 667 (22)**	**203 757 (29)**	**687 186 (28)**

Broadening the definition of STEM

There is no one nationally or internationally recognised definition of STEM. The definition of STEM qualifications used by the Office of the Chief Scientist and throughout this report encompasses the fields of:

- Natural and Physical Sciences
- Information Technology
- Engineering and Related Technologies
- Agriculture, Environment and Related Studies

Other definitions of STEM are sometimes expanded to include the fields of Health, Medicine and Building, to form 'STEMM' or 'STEM+'. For example, the Australian Academy of Science's Science in Australia Gender Equity (SAGE) initiative includes the two ASCED fields of Health, and Architecture and Building, alongside the 'core' STEM fields in their definition of STEMM. While Health, and Architecture and Building are not included in the core STEM disciplines in this report, qualifications in these fields confer some of the skills and knowledge base that underpin traditional STEM fields. This section provides a brief overview of the demographics and workforce outcomes of people with qualifications in Health, and Architecture and Building, considering them alongside the STEM qualified population where appropriate.

What is Health?

"Health is the study of maintaining and restoring the physical and mental wellbeing of humans and animals.

The main purpose of this broad field of education is to develop an understanding of the principles and practices of identifying, treating, controlling and preventing injury and disease. It is also involves developing an understanding of the principles and practices of providing preventative, curative, rehabilitative and palliative care."

— Australian Bureau of Statistics 2001

What is Architecture and Building?

"Architecture and Building is the study of the art, science and techniques involved in designing, constructing, adapting and maintaining public, commercial, industrial and residential structures and landscapes. It includes the study of the art and science of designing and planning urban and regional environments.

The main purpose of this broad field of education is to develop an understanding of integrating structural and aesthetic elements in buildings and environments, and construction methods, techniques and materials."

— Australian Bureau of Statistics 2001

Table 2.6: Number of people with qualifications in Health, and Architecture and Building in 2016, by level of qualification

	Health	Architecture and Building	STEM
Postgraduate Degree	111 074	18 027	235 044
Graduate Diploma and Graduate Certificate	56 590	3 957	33 073
Bachelor Degree	486 507	59 689	639 522
University total	**654 171**	**81 673**	**907 639**
Advanced Diploma and Diploma	216 756	48 417	300 562
Certificate Level	150 704	487 455	1 287 890
VET total	**367 460**	**535 872**	**1 588 452**
Inadequately described	18 780	7 546	33 973
Not stated	36 021	9 674	45 652

How many people have qualifications in Health and Architecture and Building?

In 2016, there were 367 460 people with a VET Health qualification and 654 171 people with a university Health qualification living in Australia (Table 2.6). There were 535 872 people with a VET Architecture and Building qualification and 81 673 people with a university Architecture and Building qualification.

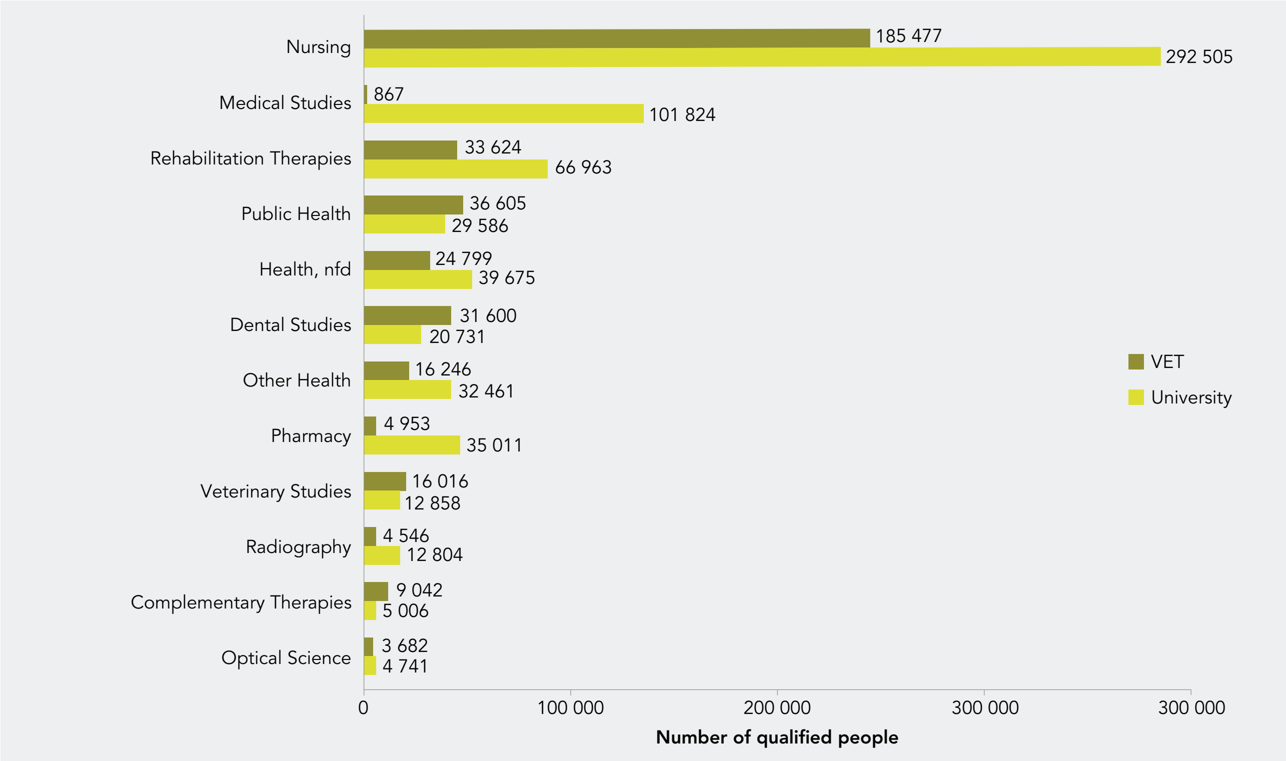
HEALTH

Health is generally not included in the core STEM fields due to its high proportion of vocational and caring roles. However, Health qualifications rely on scientific knowledge, principles and practice, so are included in some broader definitions of STEMM.

Health is a diverse field, comprising 12 narrow (4-digit) fields of education (Figure 2.21). In 2016, Nursing was the largest narrow field, representing 45% of people with VET Health qualifications and 50% of people with university Health qualifications.

The majority of the Health qualified population were female, with women making up 82% of those with VET qualifications and 74% of those with university qualifications in 2016 (Table 2.8, page 35). Of those qualified in Health, a higher percentage of men (25%) had a postgraduate qualification than women (14%; data not shown).

Figure 2.21: Size of Health qualified population by narrow field and level of qualification



A much smaller proportion of those with Health qualifications than the STEM qualified population worked full-time, with nearly half (47%) of those with VET Health qualifications and 37% of those with university Health qualifications employed on a part-time basis (Figure 2.22).

The occupations of the Health qualified population differed by qualification level. The most common major group occupation for the VET qualified population was Community and Personal Service Workers, while most university graduates worked as Professionals (Figure 2.23). In comparison, the majority of the VET STEM population were employed as Technicians and Trades workers and the most common major group occupation for university STEM graduates was also Professionals.

In 2016 the majority of people (59%) with VET Health qualifications worked in the industry division of Health Care and Social Assistance. The majority of people with university Health qualifications (74%) also worked in this industry (data not shown).

People with Health qualifications earned less than STEM qualified people at both VET and university levels. They also had lower unemployment, particularly those with university qualifications. Health qualified university graduates had an unemployment rate of just 2.0% compared to 5.7% for STEM qualified university graduates (Table 2.8).

Figure 2.22: Labour force status of employed people, by field and level of qualification

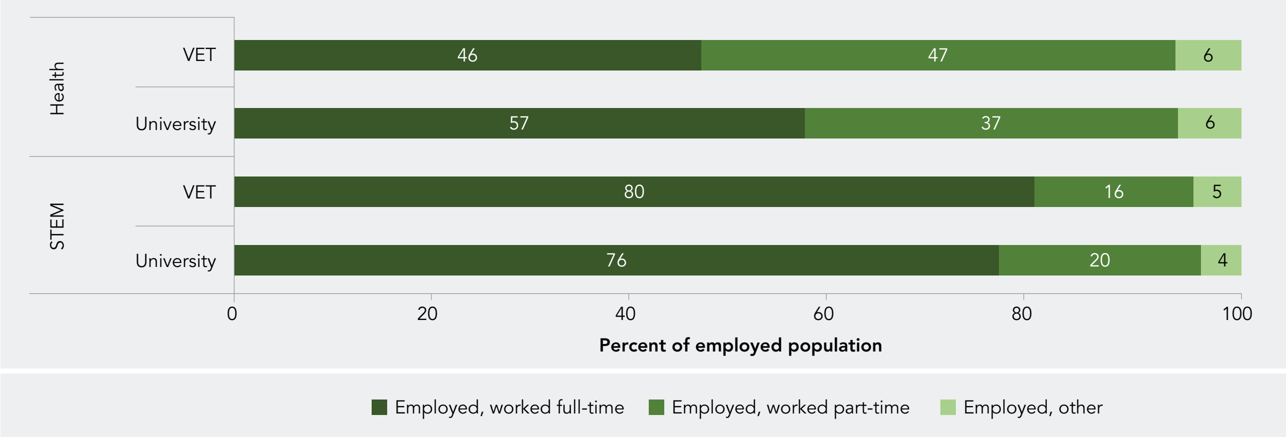
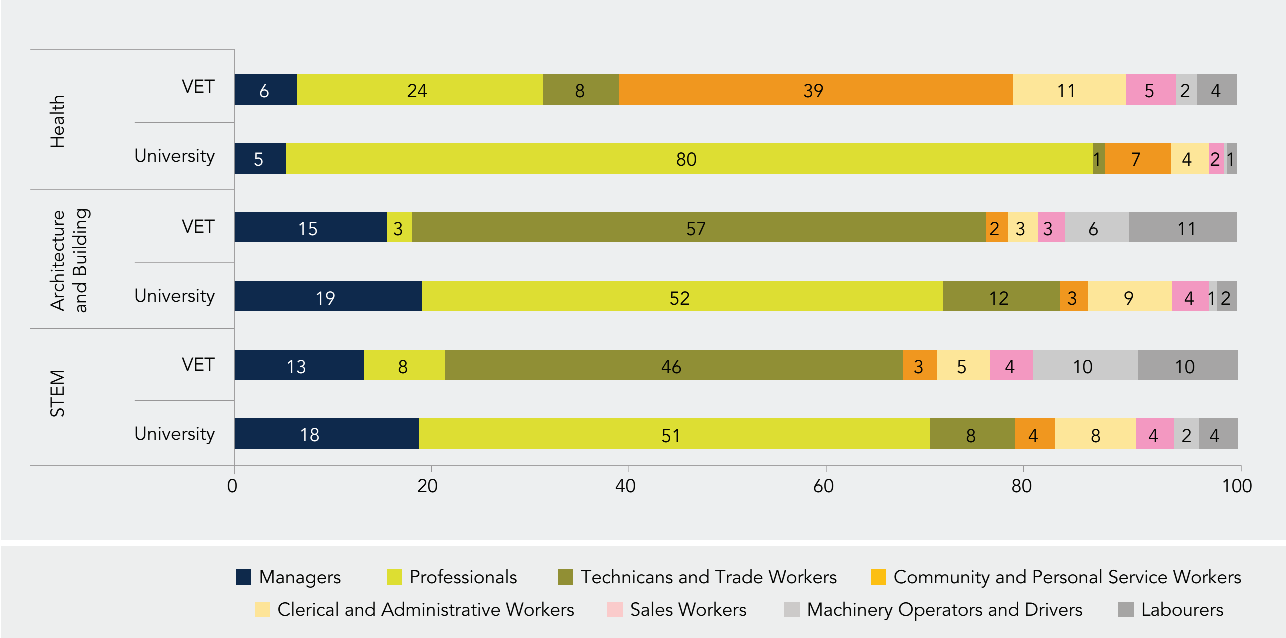


Figure 2.23: Major group occupations of Heath, and Architecture and Building qualified workers, by level of education



ARCHITECTURE AND BUILDING

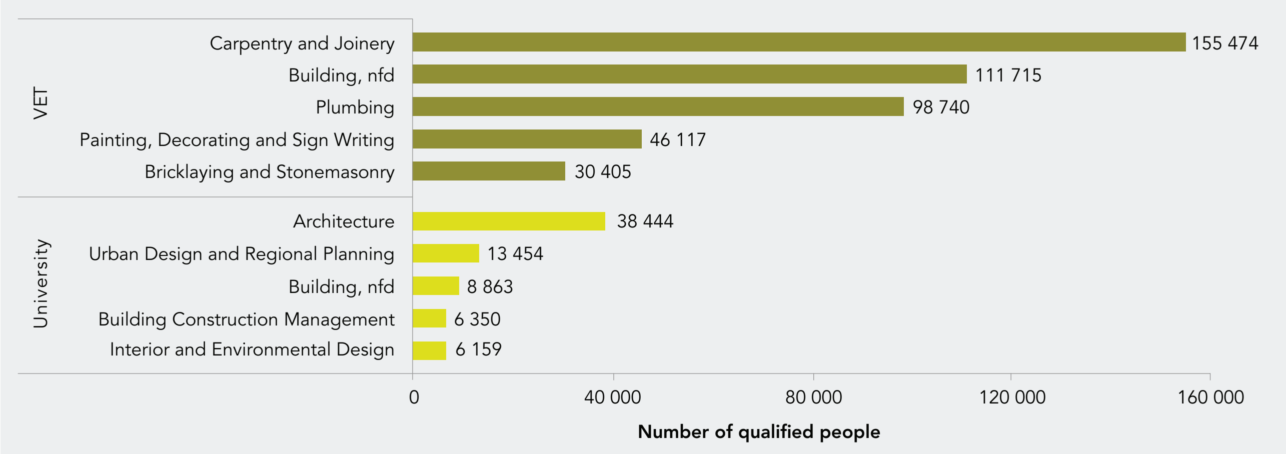
Similar to Health, Architecture and Building is typically not included as a core STEM field, but many of its qualifications are heavily reliant on technical skills. Like Engineering, Architecture and Building contains a number of trade qualifications (Table 2.7) at the VET level.

Architecture and Building has 24 different detailed (6-digit) fields of education[10], the most common of which are shown in Figure 2.24. The most common fields were different for people with VET and university qualifications. Carpentry and Joinery was the largest VET field, representing 29% of the VET qualified population. Architecture was the largest university field, representing 47% of the university qualified population.

Table 2.7: VET trade qualifications in Engineering and Architecture and Building

Engineering trades	Architecture and Building trades
Electrical and Electronics Engineering	Plumbing
Metal Fitting and Machining	Carpentry and Joinery
Vehicle Mechanics	Painting
Boilermaking and Welding	Bricklaying
Printing	Plastering
	Building

Figure 2.24: Five most common detailed fields of education in Architecture and Building, by level of education



10 Architecture and Building includes three narrow (4-digit) fields of education: Architecture and Urban Environment; Building, and Architecture and Building not further defined. Analyses are presented here at the detailed (6-digit) field of education level.

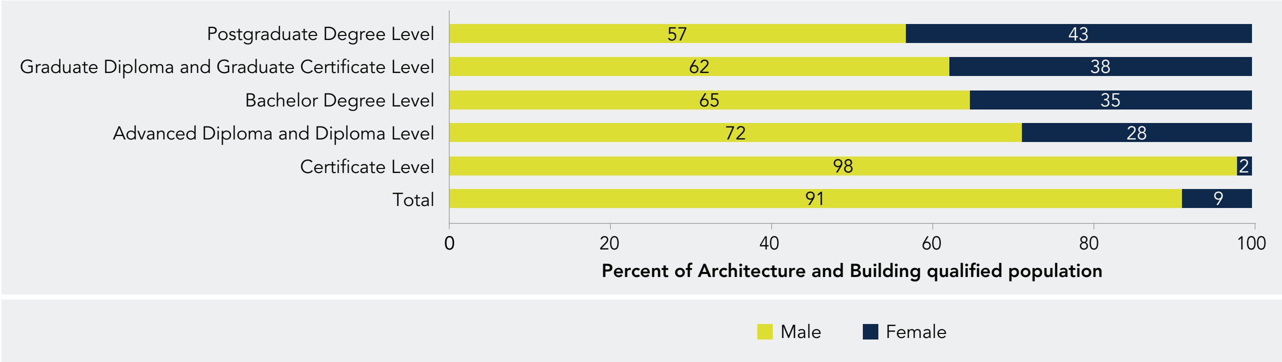
Only 4% of people with VET Architecture and Building qualifications were female, while 37% of those with university Architecture and Building qualifications were female. The gender split became more even at higher qualification levels (Figure 2.25).

In 2016, the majority of people (67%) with VET Architecture and Building qualifications worked in the Construction industry division, while those with university qualifications mainly worked in Professional, Scientific and Technical Services (41%) or Construction (22%).

The type of occupations held by people with Architecture and Building qualifications were similar to those with qualifications in STEM fields. For people with VET Architecture and Building qualifications, the most common major group occupation was Technicians and Trades Workers (57%). For people with university qualifications, the most common major group occupation was Professionals (52%; data not shown).

A greater proportion of the Architecture and Building qualified population owned their own business than the STEM qualified population, with 15% of the working VET qualified population and 10% of the working university qualified population indicating they owned a business with at least one employee, compared to 8% and 5% of the respective STEM qualified populations.

Figure 2.25: Gender distribution of Architecture and Building qualified population, by qualification level



Comparing the STEM and STEMM populations

Table 2.8 compares the Health, Architecture and Building, and STEM qualified populations, looking separately at those with VET and university qualifications. The table also includes a STEMM column, which combines the three fields to show what the STEM population would look like if it were expanded from the core fields of education used in this report.

For those with VET qualifications, the three populations of Health, Architecture and Building, and STEM were similar across a number of indicators, including average age, birthplace, labour force status and unemployment rate. The largest difference was seen in the representation of females—the majority (82%) of the Health qualified population were female, while only 4% of those with qualifications in Architecture and Building and 9% of the STEM qualified population were female. There were also noticeable differences in income, with the average full-time worker with a Health qualification earning $10 272 less than the average STEM qualified worker, and $6 082 less than the average Architecture and Building qualified worker.

For those with university qualifications, the three populations were quite distinct in some aspects. The majority (57%) of people with university qualifications in STEM fields were born overseas, while for the Health, and Architecture and Building populations, the majority of graduates were born in Australia. While over four-fifths of each population were in the labour force, the unemployment rates were quite different. Of the three fields, Health had the lowest unemployment rate, at 2.0%, while STEM had the highest unemployment rate, at 5.7%.

Health had the highest female representation at the university level, with women making up nearly three quarters (74%) of the qualified population. This large proportion of females in the Health qualified population means that at the university level, the STEMM population approaches equal gender representation, at 48% female and 52% male.

Table 2.8: Comparison of the Health, Architecture and Building, STEM, and STEMM qualified populations

The VET qualified population	Health	Architecture and Building	STEM	STEMM
Size of population	367 460	535 872	1 588 452	2 491 775
Average age	48	46	49	48
Percent female	82	4	9	19
Percent born overseas	29	23	27	27
Percent who identify as Aboriginal and/or Torres Strait Islander	2.5	2	1.6	1.8
Percent in labour force	72	78	74	74
Unemployment rate	4.9	4.3	5.1	4.9
Percent employed in the private sector*	78	96	90	90
Percent that own a small business* with at least one employee	3	15	8	9
Average annual income (full-time employment)**	$66 830	$72 912	$77 102	$75 178
The university qualified population	**Health**	**Architecture and Building**	**STEM**	**STEMM**
Size of population	654 171	81 673	907 639	1 643 488
Average age	45	41	42	43
Percent female	74	37	31	48
Percent born overseas	39	43	57	49
Percent who identify as Aboriginal and/or Torres Strait Islander	0.7	0.3	0.3	0.4
Percent in labour force	82	85	81	82
Unemployment rate	2	4.1	5.7	4.2
Percent employed in private sector*	62	84	79	72
Percent that own a small business* with at least one employee	8	10	5	7
Average annual income (full-time employment)**	$95 991	$93 599	$98 250	$97 215

* These percentages reflect the proportion of the employed population.

** Average incomes are estimated from the number of people in each income bracket reported in the Census. This income includes both earned an non-earned income, from salaries, government benefits, pensions, allowances, and any other income the worker usually receives, before deductions.

CHAPTER 3

3

EMPLOYMENT OUTCOMES FOR AUSTRALIA'S STEM QUALIFIED LABOUR FORCE

HIGHLIGHTS

Labour force status of STEM qualified people in Australia

- In 2016, of the 1 588 452 people with VET STEM qualifications in Australia, 1 166 444 (73%) were in the labour force. This cohort represented 10% of people in the Australian labour force.
- Of the 907 639 people with university STEM qualifications in Australia, 738 074 (81%) were in the labour force. This cohort represented 6% of people in the Australian labour force.

Unemployment

- STEM qualified people had higher unemployment rates in 2016 than in previous years. In 2011, the unemployment rate was 3.5% for people with VET STEM qualifications and 3.9% for people with university STEM qualifications, increasing to 5.1% and 5.7% respectively in 2016.
- In 2016, females experienced higher unemployment rates than males across all STEM fields and levels of qualification. For people with VET qualifications, the unemployment rate was 7.6% for females and 4.9% for males. For people with university qualifications, the unemployment rate was 9.2% for females and 5.6% for males.
- Aboriginal and Torres Strait Islander peoples experienced higher rates of unemployment than non-Indigenous people at the VET and university levels of qualification. In 2016, the unemployment rate for Aboriginal and Torres Strait Islander peoples was 12.4% for those with VET STEM qualifications, and 7.0% for those with university STEM qualifications.
- The unemployment rate was higher for STEM qualified people born overseas (5.9% for the VET qualified population and 7.4% for the university qualified population) compared to the unemployment rate of STEM qualified people born in Australia (4.8% and 3.6%, respectively). In general, unemployment rates of people born overseas decreased with time lived in Australia.

Industries of employment for STEM qualified people in Australia

- In 2016, Construction was the top industry of employment for people with VET STEM qualifications, employing 16% of this cohort. The majority (90%) of people with VET STEM qualifications worked in the private sector.
- In 2016, Professional, Scientific and Technical Services was the top industry of employment for people with university STEM qualifications, employing 23% of this cohort. The majority (79%) of people with university STEM qualifications worked in the private sector.

Occupations of STEM qualified people in Australia

- The most common occupations of STEM qualified people differed depending on gender and qualification level.
  - For people with a VET STEM qualification, the most common occupation for males was Technicians and Trades Workers (48%), while for females the most common occupations were Technicians and Trades Workers (20%) and Clerical and Administrative Workers (19%).
  - For people with a university STEM qualification, the most common occupation for both males and females was Professionals (52% and 48% respectively).

Incomes of STEM qualified people in Australia

- In 2016, more people with STEM qualifications than those with non-STEM qualifications had an income in the highest bracket ($104 000 or above), at both VET and university levels of qualification. Among those with STEM qualifications, 17% of the VET qualified population and 34% of the university qualified population had an income in the highest bracket.

What is the labour force?

The labour force comprises people who are currently employed and people who are looking for work (unemployed).[11] People who are not in the labour force may be retired, studying, or unable to work due to illness, disability, or caring responsibilities.

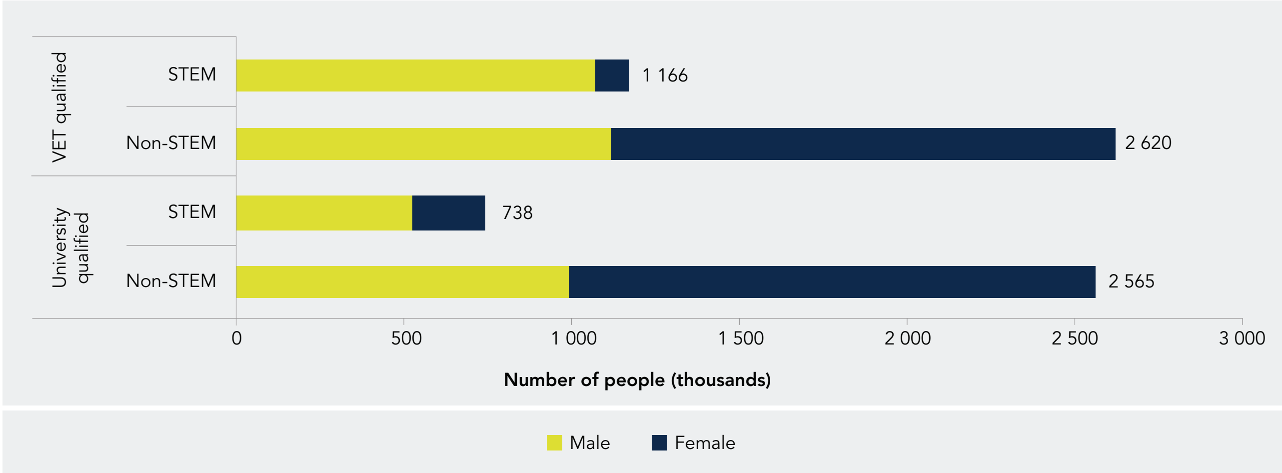
Chapter 2 (Part One) contains an analysis of Australia's STEM qualified population and offers insights into demographic trends, including age, geographic distribution, and the diversity of the STEM qualified population. This chapter focuses on Australians with STEM qualifications who were in the labour force on Census night—examining their employment outcomes as compared to the non-STEM qualified population.

How big is the STEM qualified labour force?

In 2016, of the 1 588 452 people with VET STEM qualifications in Australia, 1 166 448 (73%) were in the labour force. Of the 907 639 people with university STEM qualifications in Australia, 738 061 (81%) were in the labour force.

The number of STEM and non-STEM qualified people in the labour force, by education level, are shown in Figure 3.1.

Figure 3.1: Size of the labour force by field, level of qualification, and gender. Data labels show the total number of people in the labour force



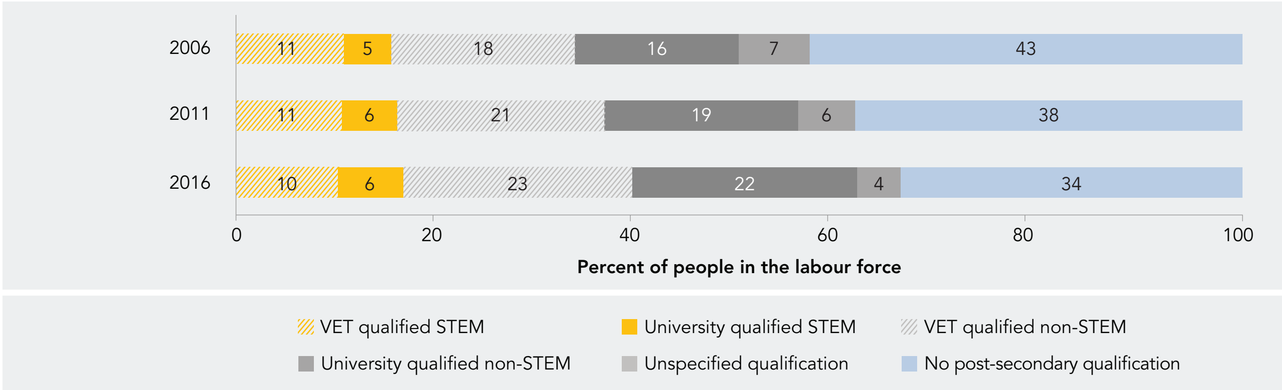
11 A complete definition of the labour force is included in Chapter 1, page 6.

What proportion of the total Australian labour force has a STEM qualification?

In 2016, approximately half of the Australian population (11.5 million people) were in the labour force. The proportion of people in the labour force with post-secondary qualifications is increasing. In 2006, 57% of people in the Australian labour force had a post-secondary qualification, while in 2016 this had risen to 66%. Of those in the labour force in 2016, 10% had a VET STEM qualification and 6% had a university STEM qualification (Figure 3.2).

Over the last decade, the proportion of the Australian labour force with a STEM qualification has remained relatively unchanged, while the proportion of people with non-STEM qualifications at the VET and university levels has increased.

Figure 3.2: Proportion of the Australian labour force with post-secondary qualifications, by year



What proportion of STEM qualified people are in the labour force in Australia?

Nearly three-quarters (74%) of people with a VET STEM qualification were in the labour force in 2016 (Figure 3.3). Of the VET qualified population, people with Information Technology qualifications had the highest proportion in the labour force (81%), followed by Agriculture and Environmental Sciences, at 80%. The lowest labour force participation was in Mathematics, but only 821 people were qualified in this field at the VET level. The next lowest labour force participation (66%) was for those qualified in Science.

Over four-fifths (81%) of people with university STEM qualifications were in the labour force in 2016 (Figure 3.4). Of the university qualified population, people with Information Technology qualifications had the highest labour force participation (88%), while those with Mathematics qualifications had the lowest labour force participation (72%).

Figure 3.3: Labour force status of population with VET qualifications, by field

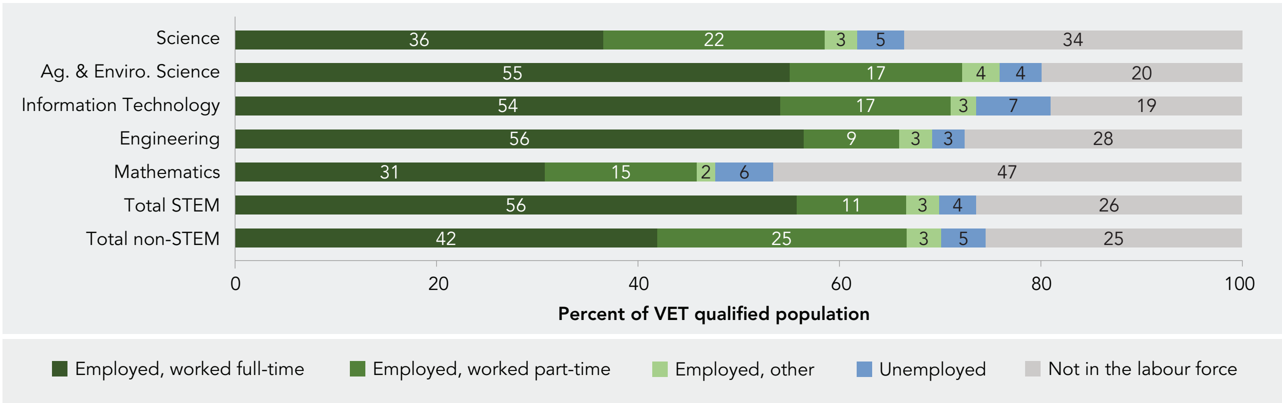
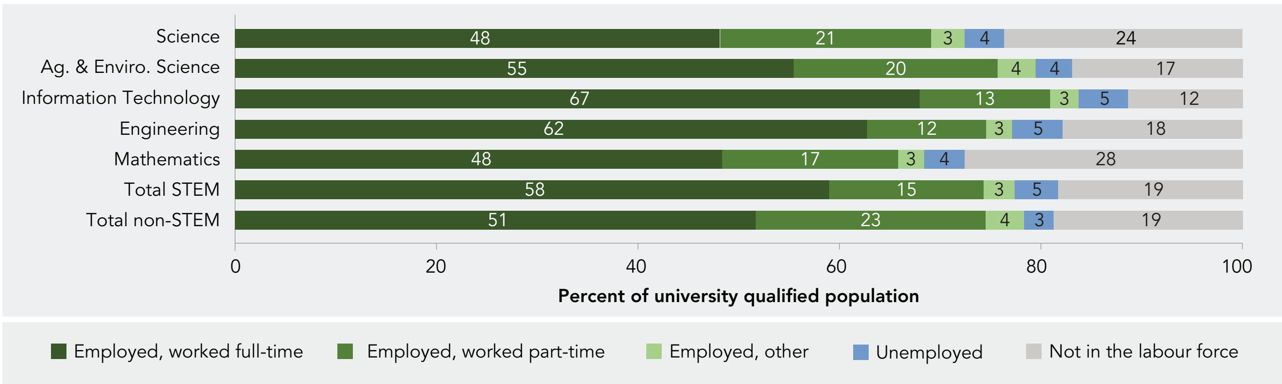


Figure 3.4: Labour force status of population with university qualifications, by field



There were clear differences in labour force participation rates[12] across gender and level of qualification (Table 3.1). Those with non-STEM qualifications had slightly higher labour force participation rates across both genders and all levels of education, and males had higher participation rates than females across the board. Of the cohorts analysed in Table 3.1, females with VET STEM qualifications had the lowest labour force participation rate (64%), while males with university non-STEM qualifications had the highest participation rate (84%).

What proportion of the STEM qualified labour force is female?

In 2016, females made up 8% of the VET STEM qualified labour force and 29% of the university STEM qualified labour force (Figure 3.5). This largely reflects the gender split of the STEM qualified population, as shown in Chapter 2 in Figures 2.4 and 2.5. In contrast, females made up around two-thirds of the non-STEM qualified labour force at both levels of qualification.

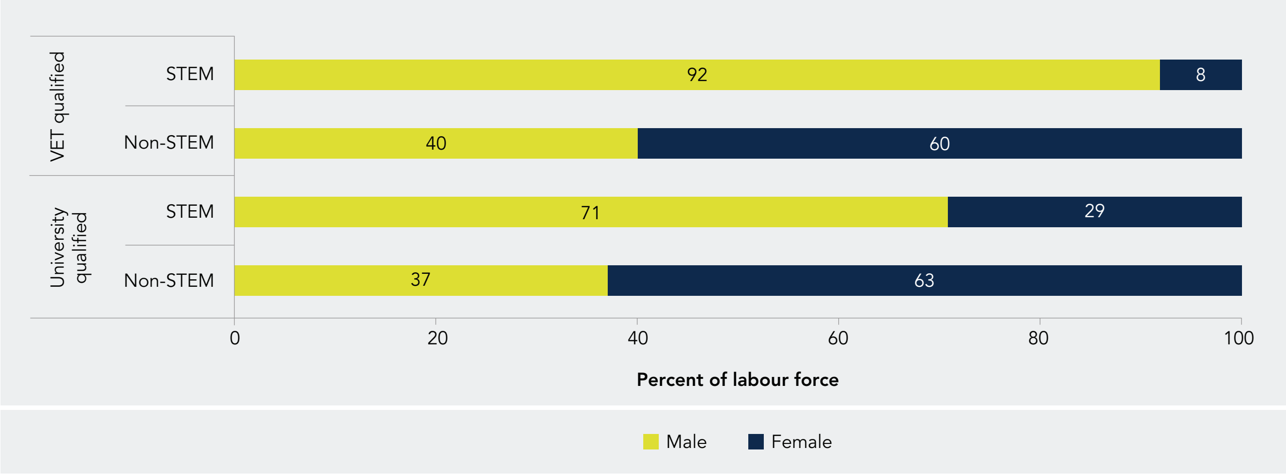
In 2011, females made up 8% of the VET STEM qualified labour force and 27% of the university STEM qualified labour force (data not shown).

The representation, demographics and employment outcomes of STEM qualified females is explored in detail in Chapter 15: Women in STEM.

Table 3.1: Labour force participation rate (%), by gender, level of education and field of qualification

		STEM	Non-STEM
Male	VET qualified	75%	79%
	University qualified	83%	84%
Female	VET qualified	64%	72%
	University qualified	77%	79%
Total	VET qualified	74%	75%
	University qualified	81%	81%

Figure 3.5: Gender distribution of the labour force by field, level of qualification and gender



12 Labour force participation rate refers to the percentage of the qualified population who were either working or looking for work.

How many STEM qualified people are employed in Australia?

In 2016, 1 107 193 people with VET STEM qualifications were employed (data not shown). Between 2011 and 2016, the number of employed VET STEM qualified people grew by 2%, while the number of employed people with VET non-STEM qualifications grew by 18% (Figure 3.6). Across STEM fields, the largest absolute growth in the employed VET qualified population was among people with Agriculture and Environmental Science qualifications (10 181).

In 2016, 695 769 people with university STEM qualifications were employed (data not shown). Between 2011 and 2016, the number of employed university STEM qualified people grew by 23%, while the number of employed people with university non-STEM qualifications grew by 24% (Figure 3.6). Across STEM fields, the largest absolute growth in the employed university qualified population was among people with Engineering qualifications (50 785) while the largest percentage growth was in Information Technology (31%).

When looking at a longer time period, the growth in the size of the employed university STEM qualified population has been fairly consistent over the past decade, but slowed in the recent five year period to 2016 for the VET STEM qualified population (Figure 3.7).

Figure 3.6: Percentage change (bars) and absolute change (data labels) in employed population by field and level of qualification, 2011 to 2016

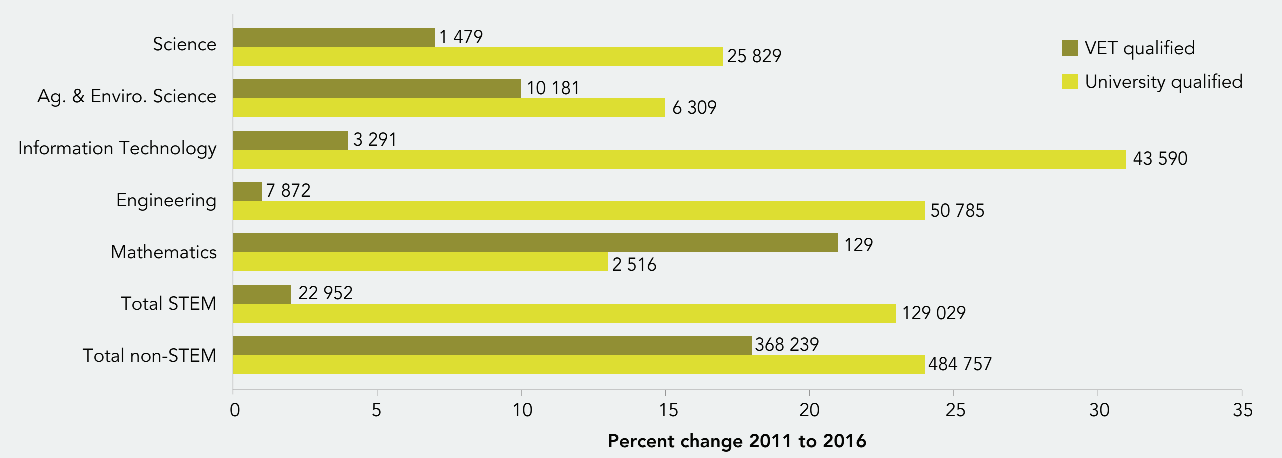
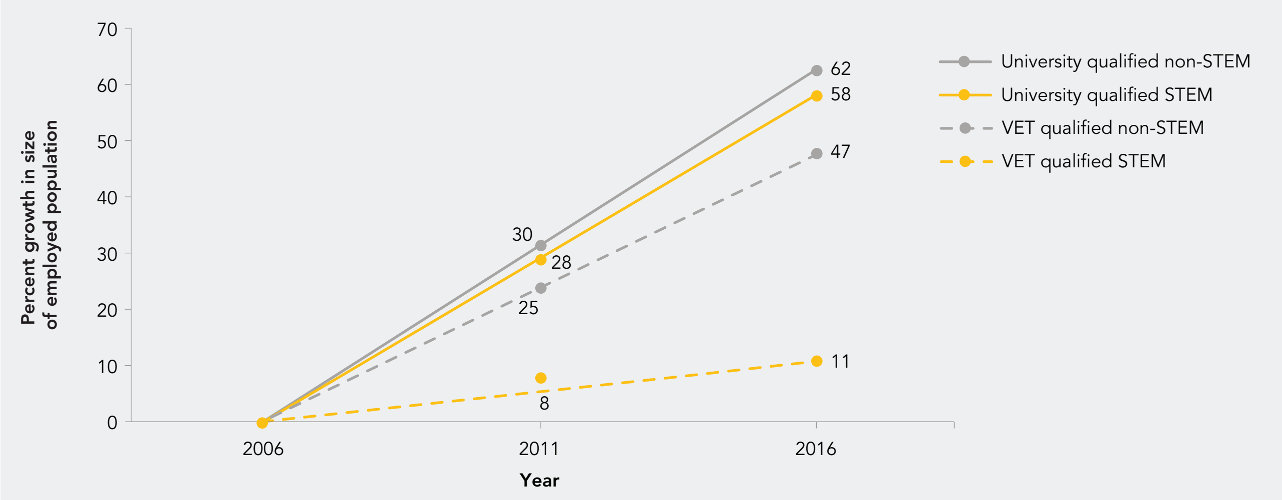


Figure 3.7: Percent growth in employed population by field, 2006 to 2016



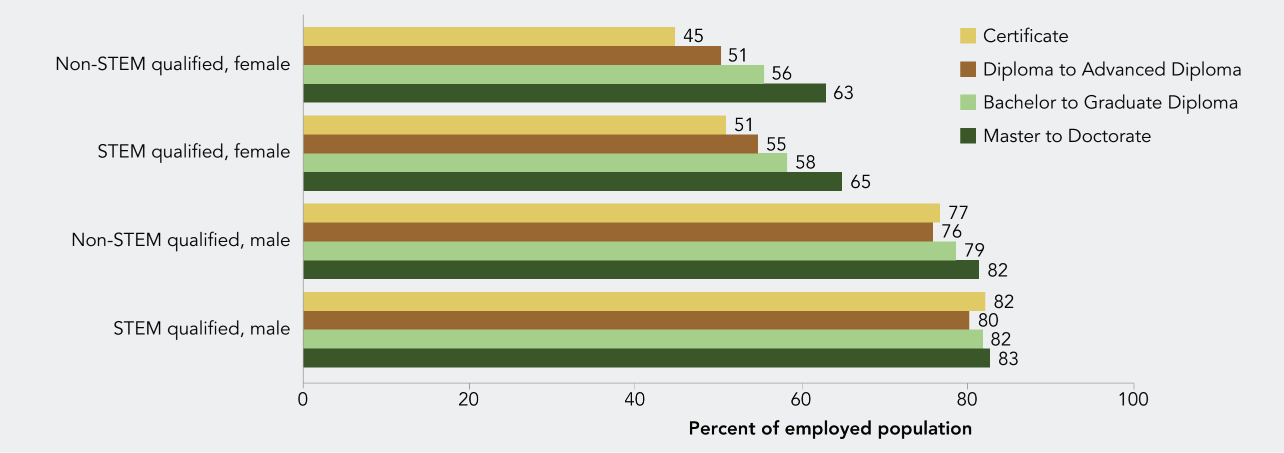
Over the decade 2006 to 2016, the number of employed VET STEM qualified people increased by 11% (from 1 000 922 to 1 107 198) and by 58% for employed university STEM graduates (from 441 540 to 695 773). In the same time period, the number of employed people with non-STEM qualifications grew by 47% at the VET level (from 1 678 521 to 2 461 203) and by 62% at the university level (from 1 521 410 to 2 466 205).

What proportion of employed STEM qualified people were working full-time?

In 2016, substantially more males than females worked full-time, a trend that was apparent across all fields and levels of qualification (Figure 3.8). A greater proportion of STEM qualified people of both genders worked full-time than those with non-STEM qualifications, and these differences were similar for the VET and university qualified populations. The proportion of people working full-time also varied by qualification level, with a higher percentage of those with university qualifications working full-time than those with VET qualifications. For example, just over half (51%) of employed females with a certificate I-IV in a STEM field worked full-time, while over two thirds (65%) of employed females with a STEM masters or doctoral qualification worked full-time.

Between 2011 and 2016, there was a decrease of 3 to 8 percentage points in the proportion of qualified people working full-time across the different qualification levels (data not shown).

Figure 3.8: Percentage of employed people working full-time by field, gender and level of qualification



How many unemployed STEM qualified people are there in Australia?

In 2016, there were 59 251 unemployed people with a VET STEM qualification (data not shown). Between 2006 and 2011, the number of unemployed people with a VET STEM qualification increased by 18%. Between 2011 and 2016, the number of unemployed people with a VET STEM qualification increased by a further 49%.

In 2016, there were 42 305 unemployed people with a university STEM qualification (data not shown). Between 2006 and 2011, the number of unemployed people with a university STEM qualification increased by 50%. Between 2011 and 2016, the number of unemployed people with a university STEM qualification increased by a further 86%.

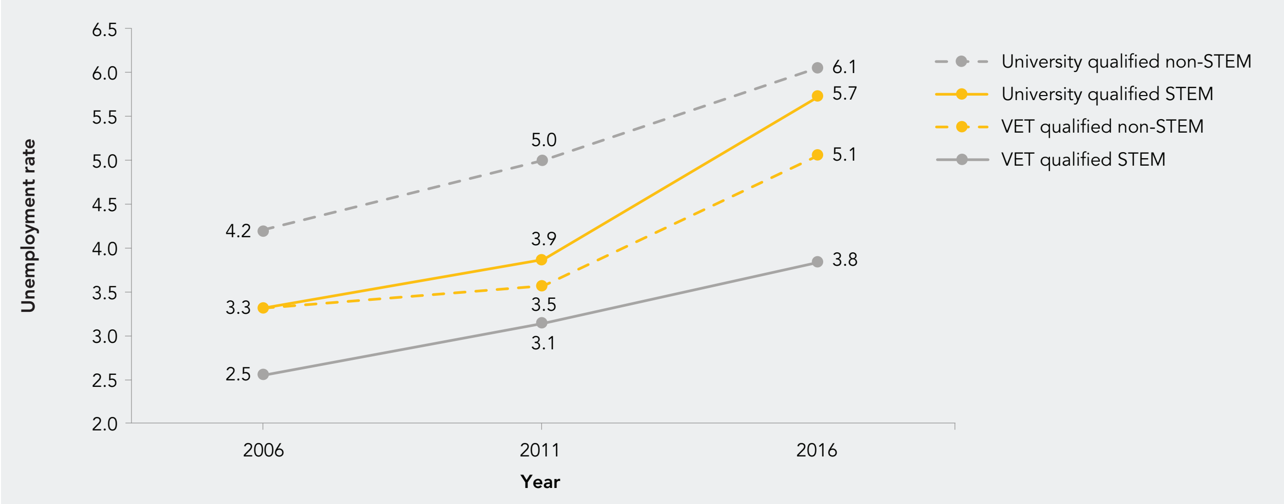
These increases in the numbers of unemployed people should be interpreted with reference to the growth in the STEM qualified populations and to the labour market conditions in the relevant years (Chapter 1, page 8).

How do the unemployment rates of STEM qualified people compare across fields and to those with non-STEM qualifications?

In 2016, the unemployment rate for people with VET STEM qualifications (5.1%) was lower than for people with VET non-STEM qualifications (6.1%, Figure 3.9). In contrast, in 2016, the unemployment rate for people with university STEM qualifications (5.7%) was higher than the unemployment rate for people with university non-STEM qualifications (3.8%).

The unemployment rates for the VET and university STEM qualified populations increased sharply in the 5 years between 2011 and 2016. In contrast, the unemployment rates for people with non-STEM qualifications at the VET and university levels rose steadily over the decade.

Figure 3.9: Unemployment rate by field and level of qualification, 2006 to 2016



The rates of unemployment increased across all STEM fields and levels of education in the decade to 2016 (Figure 3.10 and Figure 3.11).

Among those with VET qualifications, people with Engineering qualifications had the lowest unemployment rate in both 2006 (2.7%) and in 2016 (4.6%), while people with Information Technology qualifications had the highest unemployment rate in both 2006 and 2016 (7.5% in 2006 and 9.1% in 2016).[13]

Among those with university qualifications, in 2006, the lowest unemployment rate was among graduates with Engineering qualifications (2.9%) and the highest was among people with Information Technology qualifications (4.8%). In 2016, the lowest unemployment rate was among people with Agriculture and Environmental Science qualifications (4.6%) while the highest unemployment rate was among people with Engineering qualifications (6.1%).

Figure 3.10: Unemployment rate of VET qualified population by field and year, 2006 to 2016

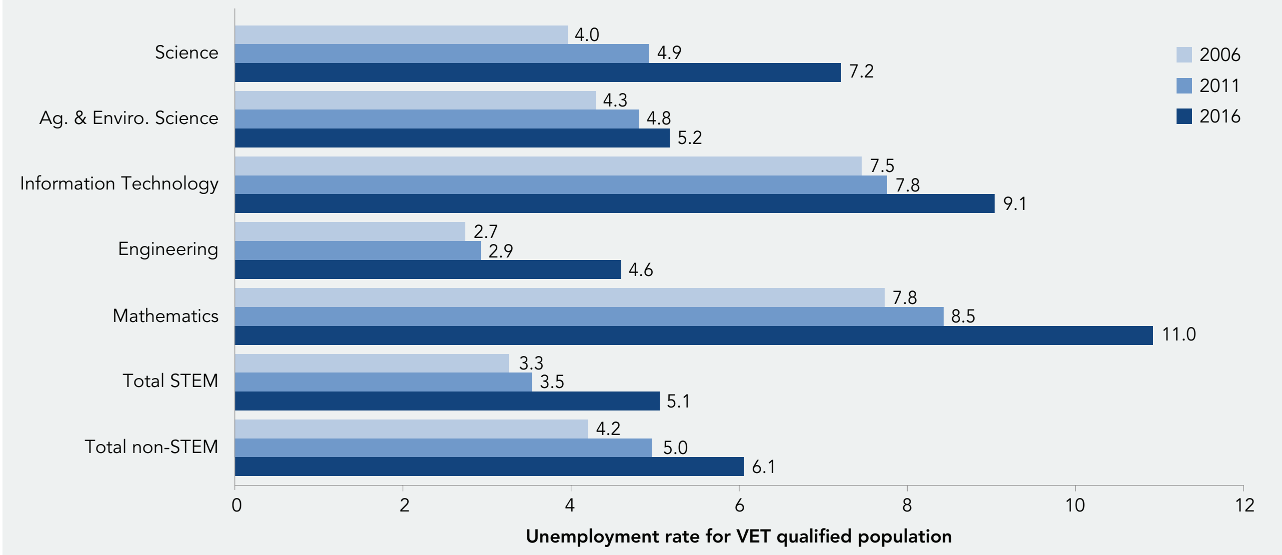
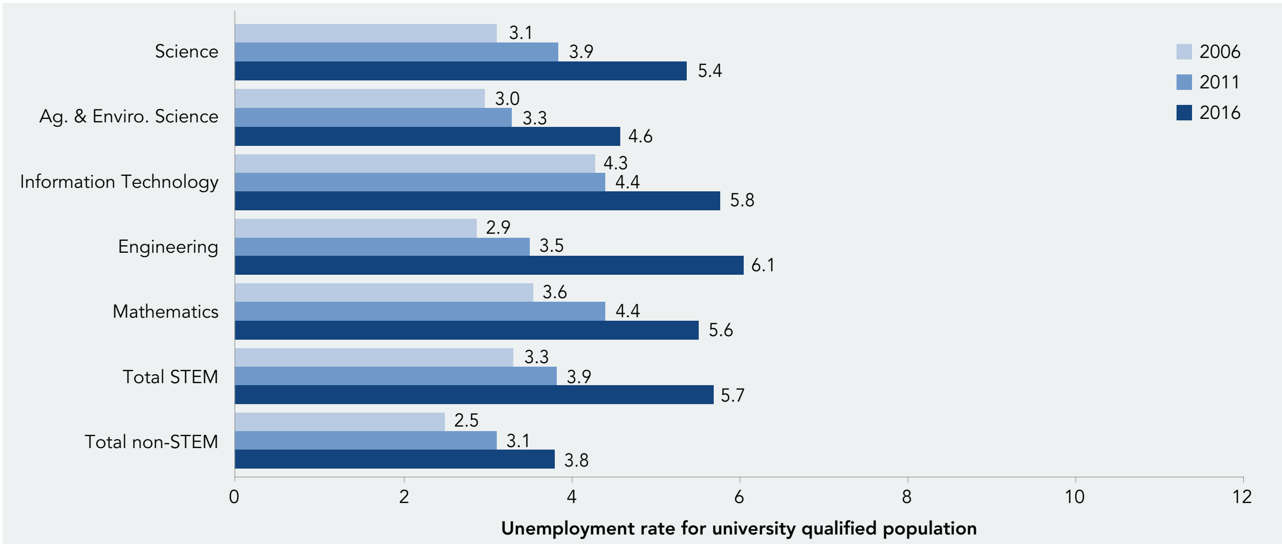


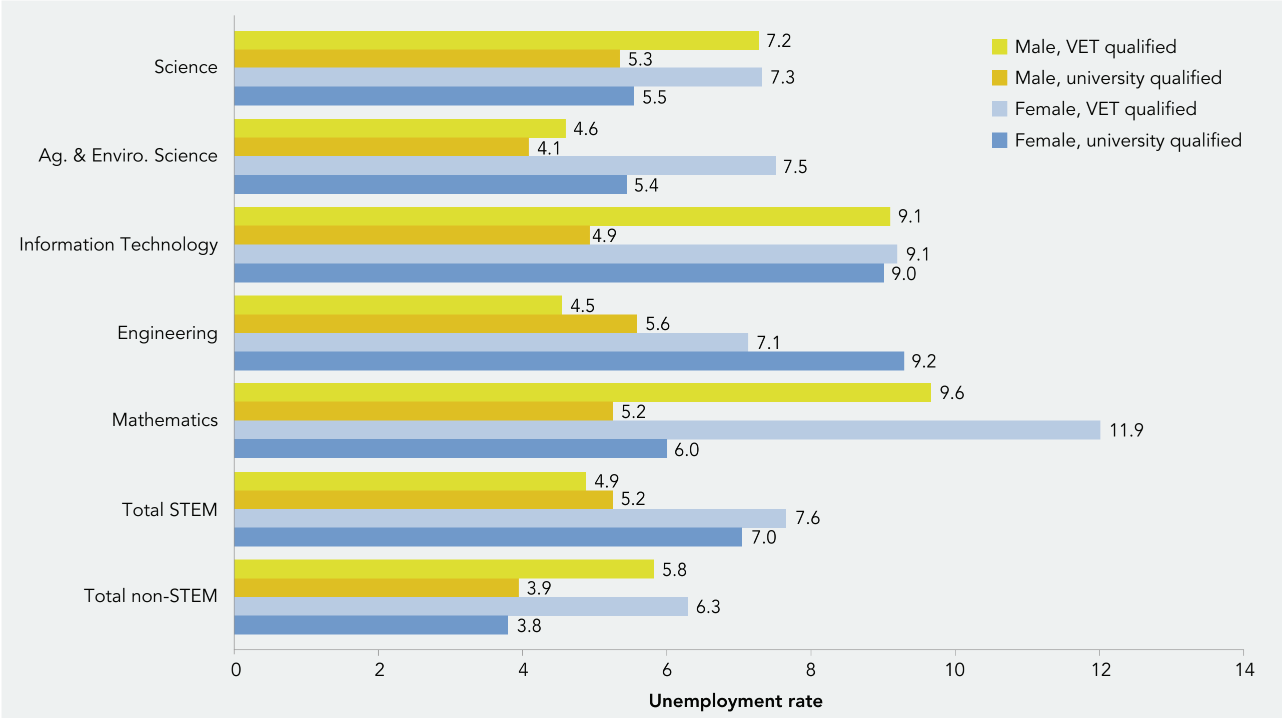
Figure 3.11: Unemployment rate of university qualified population by field and year, 2006 to 2016



13 Excluding Mathematics where there were only 821 people with VET qualifications in the labour force in 2016 and 632 in 2006.

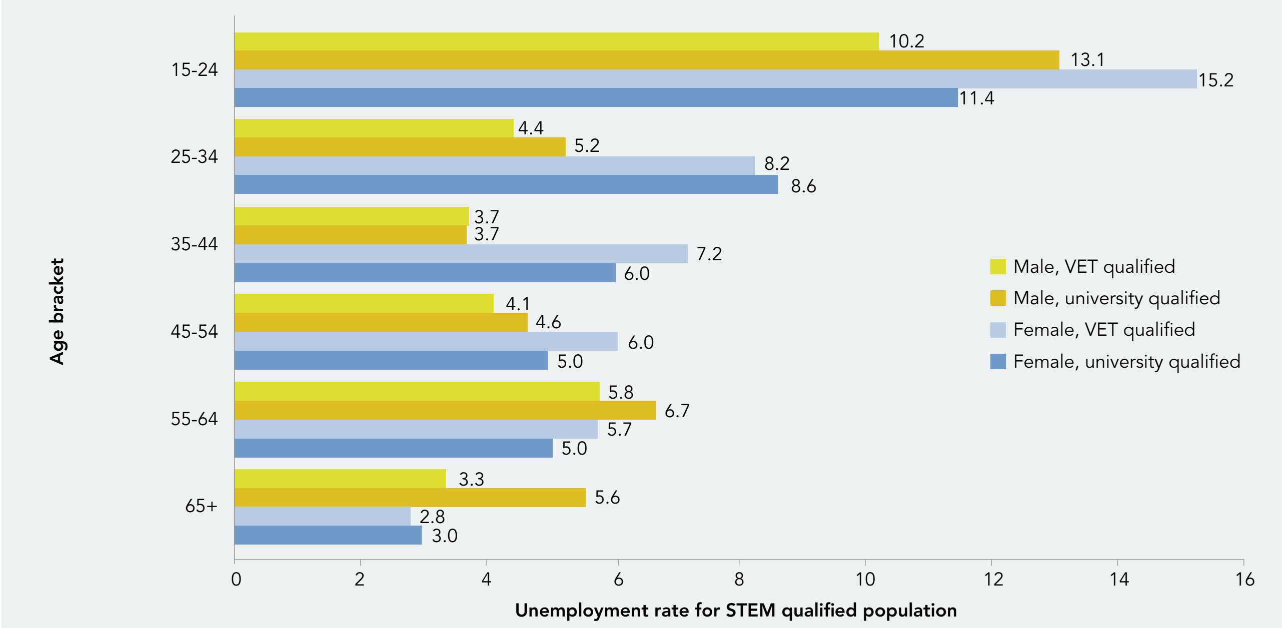
In 2016, females had a higher unemployment rate than males across most STEM fields and levels of education (Figure 3.12). The biggest differences between male and female unemployment rates were seen in the university qualified Information Technology cohort where the female unemployment rate was 4.1 percentage points higher than the male unemployment rate and in Engineering where the difference was 3.6 percentage points.

Figure 3.12: Unemployment rate by field, level of qualification and gender



In 2016 unemployment rates were higher for females than males across most age brackets, except for those aged 55 and over, where females had lower unemployed rates than males at both the VET and university levels of qualification (Figure 3.13). Among VET and university qualified females, there was an overall trend of unemployment rates decreasing with increasing age. Unemployment rates were noticeably higher for young people aged 15 to 24 compared to people in older age brackets, across all levels of education. For males, there was a large decrease in unemployment rates between the 15 to 24 and 25 to 34 age brackets, after which unemployment rates fluctuated between 3% and 6%.

Figure 3.13: Unemployment rate by level of qualification, age and gender



Are unemployment rates of STEM qualified people different across states and territories?

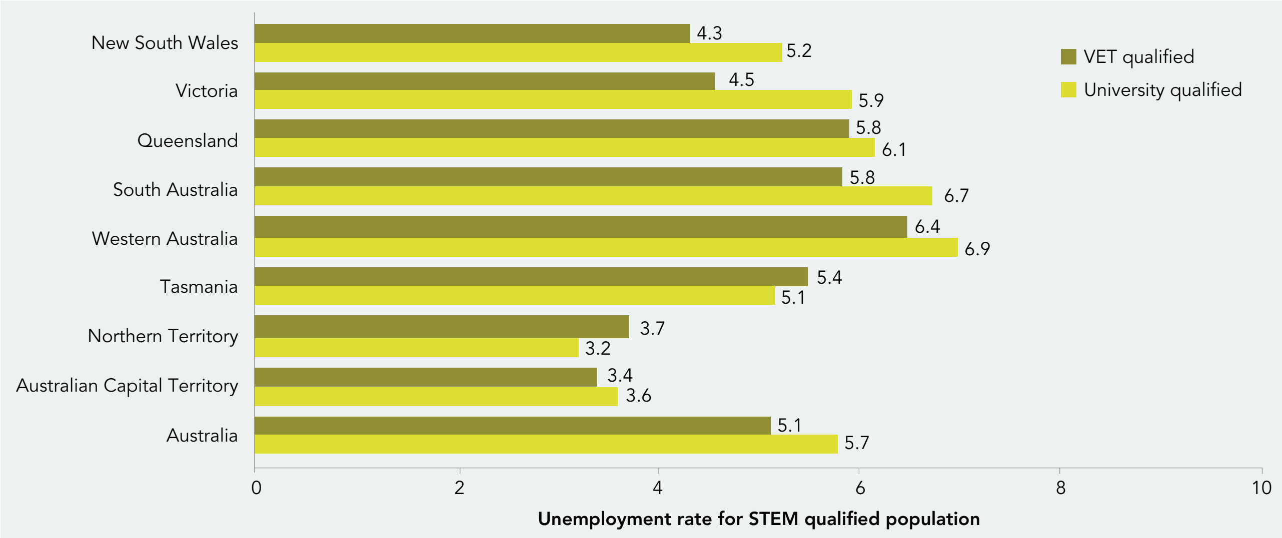
There was considerable variation in the unemployment rates of STEM qualified populations across the states and territories in 2016 (Figure 3.14).

In 2016, Western Australia had the highest unemployment rates, at 6.4% for the VET STEM qualified population and 6.9% for the university STEM qualified population. The lowest unemployment rate for people with VET STEM qualifications was in the Australian Capital Territory (3.4%), while the lowest unemployment rate for people with university STEM qualifications was in the Northern Territory (3.2%).

The unemployment rates of STEM qualified people have increased in all states and territories since 2011 (data not shown). In 2011, the highest unemployment rate for people with VET STEM qualifications was in Tasmania (4.7%), while the equal highest unemployment rates for people with university STEM qualifications were in Victoria (4.2%) and South Australia (4.2%). In 2011, the lowest unemployment rate for people with VET STEM qualifications was in the Australian Capital Territory (2.2%), while the lowest unemployment rate for people with university STEM qualifications was in the Northern Territory (1.7%).

Contextual information on general unemployment rates for the Australian population is provided in Chapter 1, page 8.

Figure 3.14: Unemployment rate of STEM qualified population in 2016, by state or territory of usual residence and level of qualification



Do Aboriginal and Torres Strait Islander peoples experience higher unemployment rates compared to non-Indigenous people?

In 2016, Aboriginal and Torres Strait Islander peoples experienced higher rates of unemployment than non-Indigenous people at the VET and university levels of qualification (Table 3.2). For those with VET qualifications, the unemployment rate for Aboriginal and Torres Strait Islander peoples was more than double the unemployment rate for non-Indigenous people, in STEM and non-STEM fields. For those with university qualifications the unemployment rate for Aboriginal and Torres Strait Islander peoples was 1.3 percentage points higher among those with STEM qualifications and 0.5 percentage points higher among those with non-STEM qualifications compared to non-Indigenous people.

Table 3.2: Unemployment rate for Aboriginal and Torres Strait Islander and non-Indigenous adults, by field and level of qualification

		Aboriginal and Torres Strait Islander	Non-Indigenous
STEM	VET qualified	12.4	4.9
	University qualified	7	5.7
Non-STEM	VET qualified	12.9	5.9
	University qualified	4.3	3.8

Do people born overseas have higher unemployment rates than people born in Australia?

In 2016, the unemployment rate for people with STEM qualifications was higher for people born overseas than for people born in Australia across most fields of qualification (Figure 3.15 and Figure 3.16). As highlighted in Chapter 2, people born overseas make up a considerable proportion of the STEM qualified population (Figure 2.13 and Figure 2.14).

Among the VET STEM qualified population, the unemployment rate for people born overseas was higher than the unemployment rate for people born in Australia in most fields of qualification, except for Agriculture and Environmental Science and Information Technology. Within VET STEM fields, the difference between the unemployment rates for people born in Australia and people born overseas was largest for people with qualifications in Mathematics (however, there were only 821 people with VET Mathematics qualifications in the labour force in 2016) and Science, and smallest for people with qualifications in Agriculture and Environmental Science.

Among the university STEM qualified population, the unemployment rate for people born overseas was higher than the unemployment rate for people born in Australia in all fields of qualification. Within university STEM fields, the difference between the unemployment rates for people born in Australia and people born overseas was largest for people with qualifications in Engineering, and smallest for people with qualifications in Information Technology.

Figure 3.15: Unemployment rates of people living in Australia with VET qualifications by field of qualification and place of birth

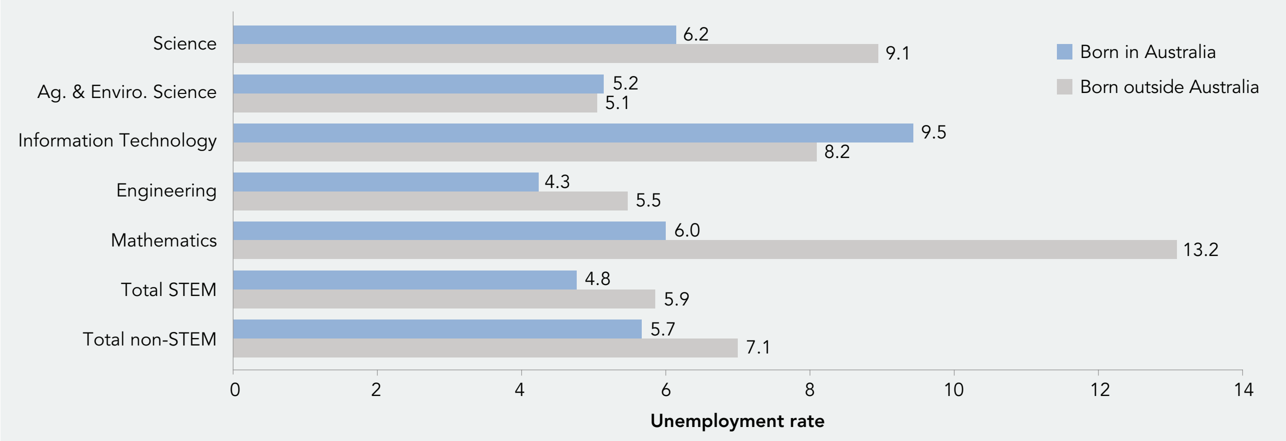
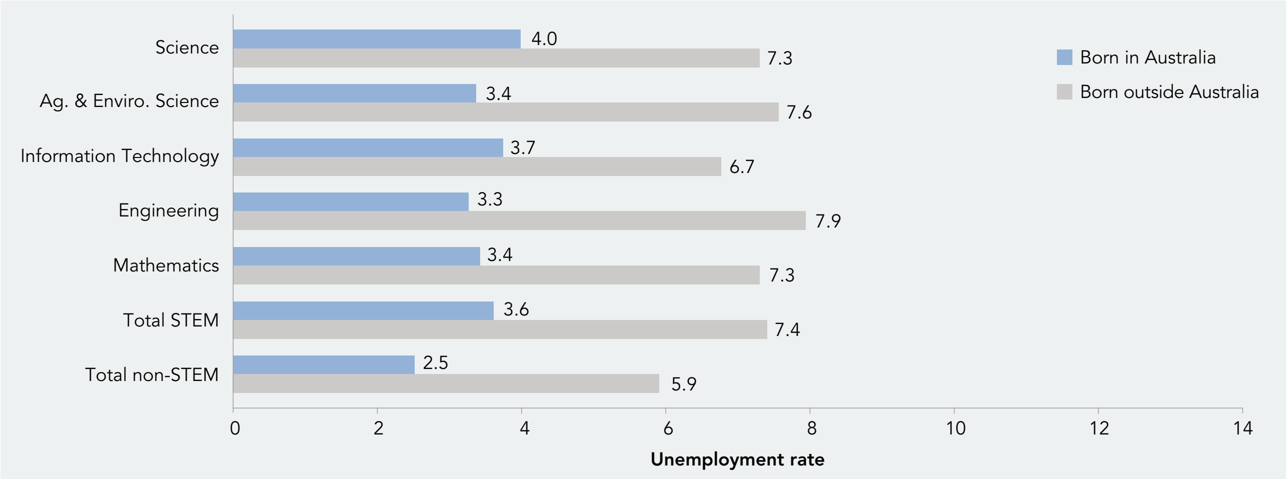


Figure 3.16: Unemployment rates of people living in Australia with university qualifications by field of qualification and place of birth

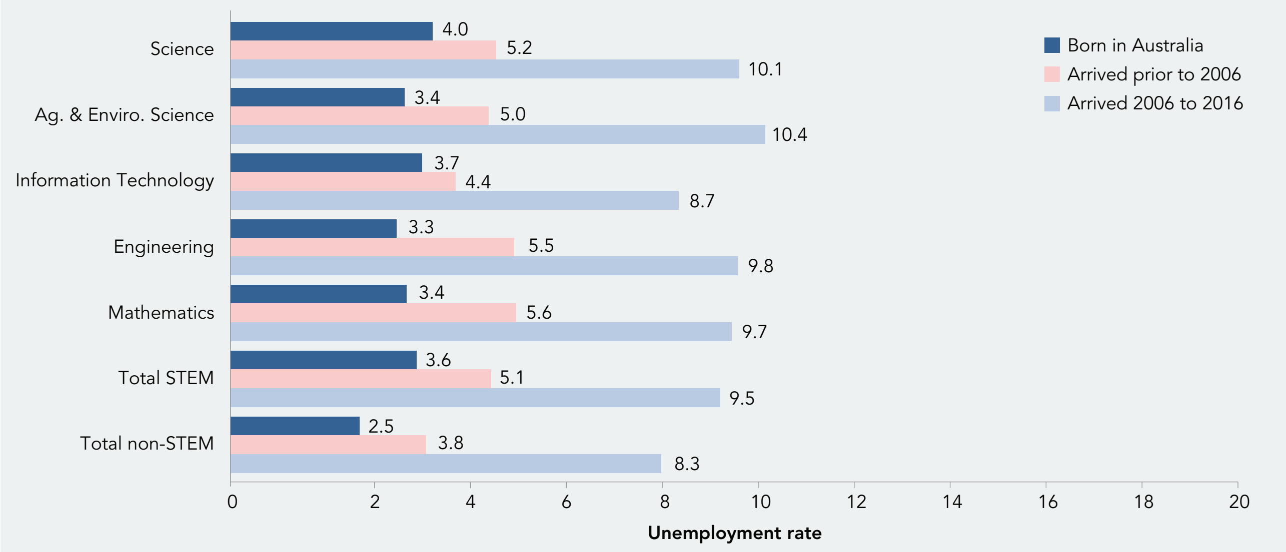


The unemployment rate of those born overseas also differed depending on how long they had lived in Australia, as shown in Figure 3.17 and Figure 3.18. Across all fields and levels of qualification, people who had been in Australia longer than 10 years experienced lower unemployment rates compared to those who had arrived in Australia within the decade to 2016. People with VET qualifications in Information Technology or Agriculture and Environmental Science who had arrived in Australia prior to 2006 were the only immigrant populations to have lower unemployment than those who were born in Australia with qualifications in the same field.

As the Census does not include information on where qualifications were obtained, no conclusions can be drawn regarding the relative employment outcomes of people who gained their qualification in Australia and people who gained their qualification from another country.

Figure 3.17: Unemployment rates of people living in Australia with VET qualifications by field, place of birth, and date of arrival

Figure 3.18: Unemployment rates of people living in Australia with university qualifications by field, place of birth, and date of arrival

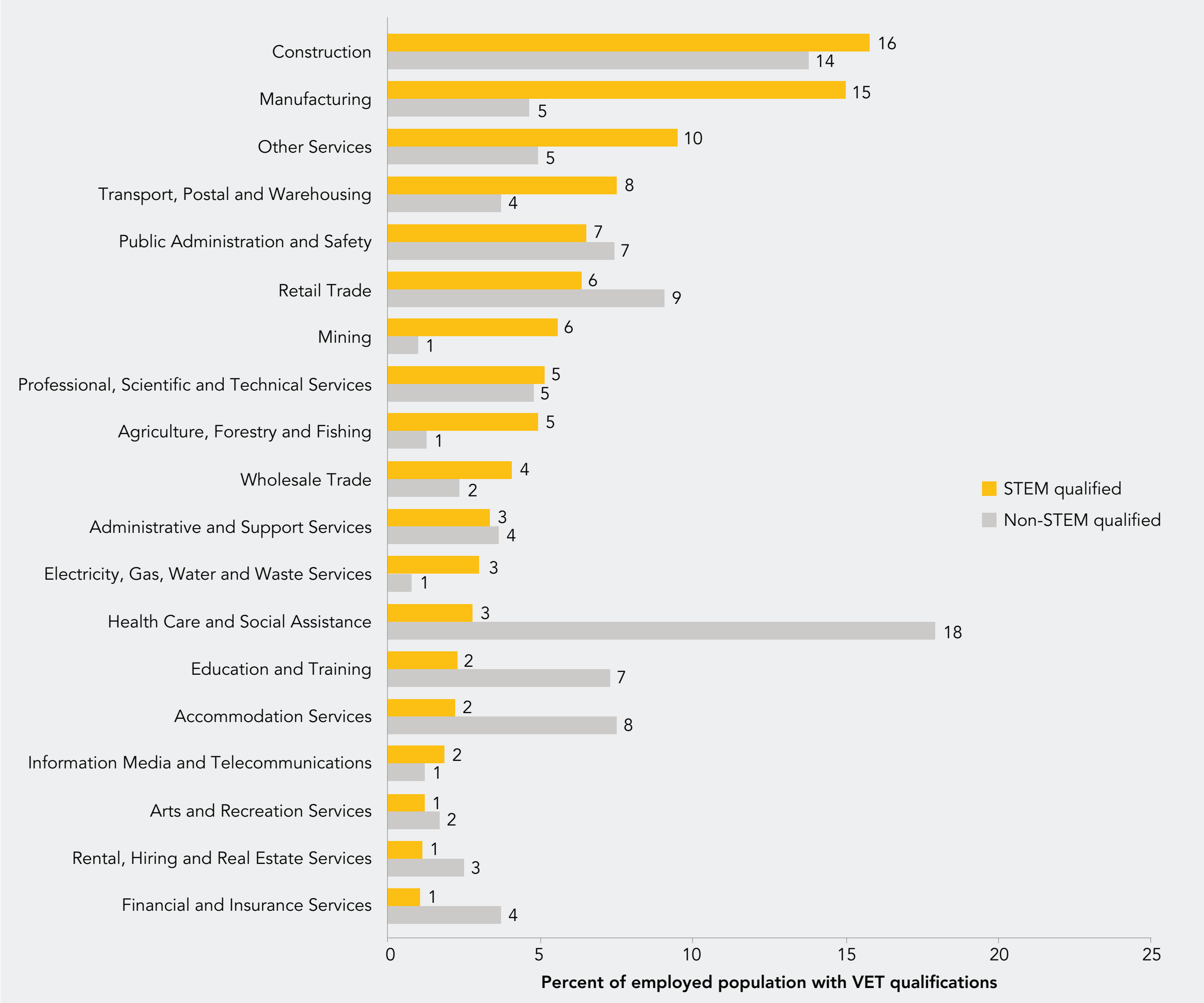


Which industries employ the most STEM qualified people?

In 2016, the top industries of employment for STEM qualified people differed depending on level of qualification. For people with VET STEM qualifications, the top three industry divisions of employment were Construction (16% of VET STEM qualified people), Manufacturing (15%), and Other Services (10%), which includes industries relating to repair, maintenance, and personal services (Figure 3.19). Between 2011 and 2016, there was little change in the distribution of workers across industries with the exception of Manufacturing, which decreased from employing 20% of the VET STEM qualified population in 2011 to 15% in 2016 (data not shown).

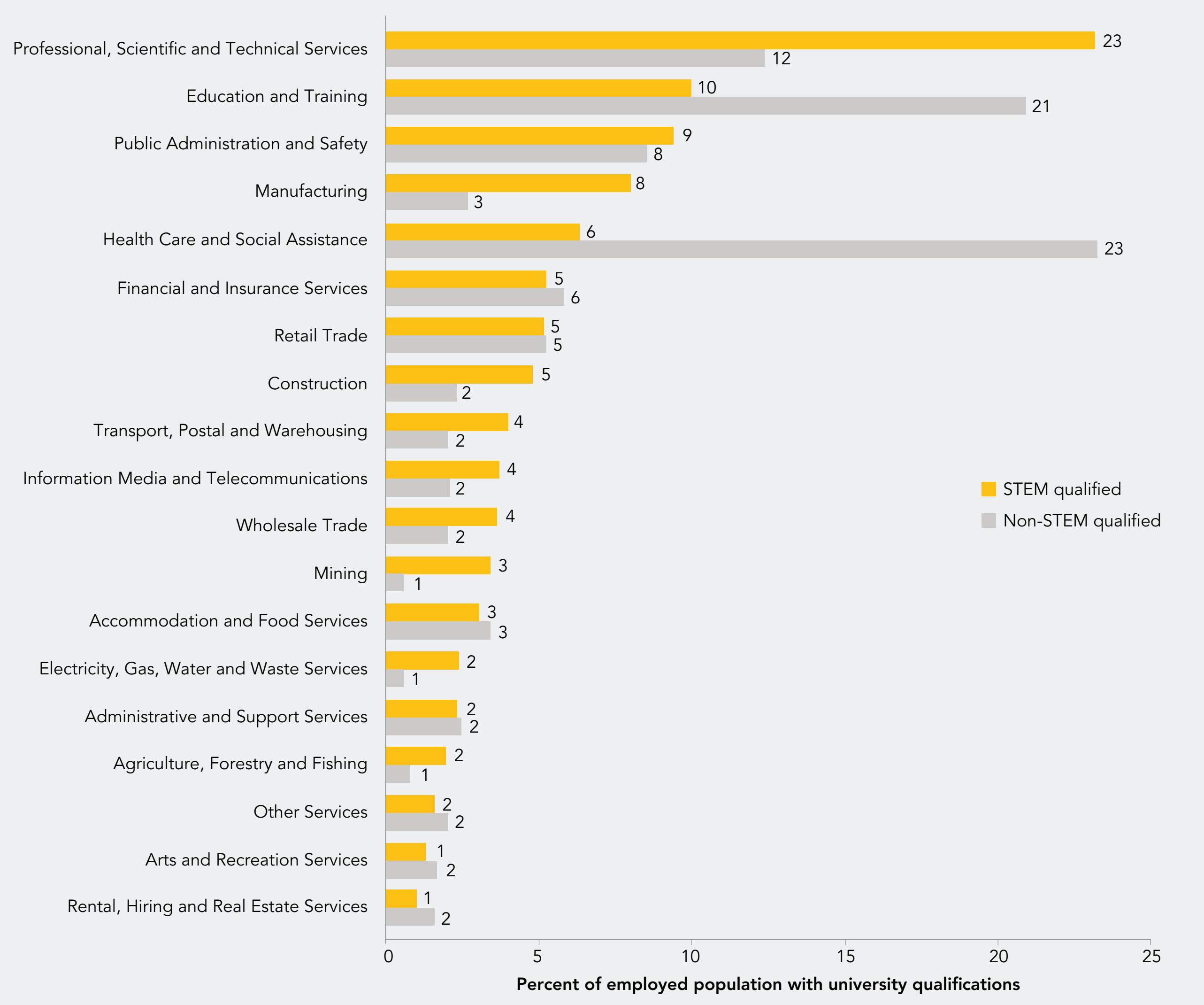
> Industries are classified at four levels:
>
> - Divisions (the broadest level)
> - Subdivisions
> - Groups
> - Classes (the most detailed level)

Figure 3.19: Industry divisions of employment of VET qualified population, by field



For people with university STEM qualifications, the top three industry divisions of employment in 2016 were Professional, Scientific and Technical Services (23%), Education and Training (10%), and Public Administration and Safety (9%; Figure 3.20). Between 2011 and 2016, there was little change in the distribution of workers across industries, however the proportion of people working in Manufacturing and Professional, Scientific and Technical Services each decreased by 2 percentage points (data not shown).

Figure 3.20: Industry divisions of employment of university qualified population, by field



The most common industries of employment differed depending on the STEM field of qualification, as shown in Table 3.3.

In 2016, the majority of people with post-secondary qualifications worked in the private sector[14] (Table 3.4). Among those with VET qualifications, 90% of people with STEM qualifications and 86% of people with non-STEM qualifications worked in the private sector. Across STEM fields, those with Engineering qualifications had the highest proportion working in the private sector (91%), while those with Science qualifications had the lowest (80%).

Among those with university qualifications, 79% of people with STEM qualifications and 72% of people with non-STEM qualifications worked in the private sector. Across STEM fields, those with Engineering qualifications had the highest proportion working in the private sector (85%), while those with Science qualifications had the lowest (68%).

Table 3.3: Top industry division of employment, by level of education and field of education

	VET qualified	University qualified
Science	Health Care and Social Assistance (25%)	Education and Training (19%)
Ag. and Enviro. Science	Agriculture, Forestry and Fishing (25%)	Public Administration and Safety (19%)
Information Technology	Professional, Scientific and Technical Services (20%)	Professional, Scientific and Technical Services (32%)
Engineering	Construction (18%) and Manufacturing (18%)	Professional, Scientific and Technical Services (24%)
Mathematics	Professional, Scientific and Technical Services (11%)	Education and Training (24%)

Table 3.4: Sector of employment by field of education

VET qualified							
	Science	Ag & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
National Government	5	2	6	3	9	3	3
State/Territory Government	14	5	8	4	7	5	9
Local Government	1	6	2	1	0	2	2
Private sector	80	87	84	91	84	90	86

University qualified							
	Science	Ag & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
National Government	16	9	9	7	17	10	6
State/Territory Government	15	16	7	6	12	10	21
Local Government	1	5	1	2	1	2	1
Private sector	68	70	84	85	71	79	72

14 For a description of public and private sectors, see: Australian Bureau of Statistics, 2901.0—Census of Population and Housing: Census Dictionary, 2016.

STEM in the Defence Force

A STEM-skilled workforce is required to ensure that Australia's Defence Force can respond to rapidly changing military requirements (Department of Defence 2019). The defence industry requires people with STEM skills to fulfil a variety of roles across manufacturing, information technology, construction, and research and development.

An overview of people with STEM qualifications working in the ANZSIC industry class of Defence[15] is shown in Table 3.5. The vast majority (97%) of these people worked in the public sector, suggesting they were employed by the Australian Defence Force or the Australian Government Department of Defence. Using Census data, it was not possible to explore the STEM capabilities of the broader private sector who support the work of the Defence force, and our analysis excludes people who worked in other industries, such as Manufacturing, who may have supplied goods or services to support Australia's Defence capabilities.

The proportion of people working in the Defence industry who were STEM qualified has not increased substantially over the last decade. In 2006, 21% of people working in the Defence industry had a VET STEM qualification, decreasing to 19% in 2016. In 2006, 10% of people working in the Defence industry had a university STEM qualification, increasing to 11% in 2016.

15 While there are a considerable number of people who work in private sector organisations to provide goods and services to the Defence force, the analyses in this report only capture people who indicated that they worked in the ANZSIC industry class of Defence.

Table 3.5: Overview of STEM qualified people working in the ANZSIC industry class of Defence

	VET qualified	University qualified
Number of STEM qualified people in defence industry	14 609	8 107
Type of qualification held	Natural and Physical Sciences (1%), Information Technology (7%), Engineering (90%), Ag. and Enviro. Science (2%)	Natural and Physical Sciences (25%), Information Technology (16%), Engineering (56%), Ag. and Enviro. Science (2%)
Percent female	5% of STEM qualified people were female, compared to 35% of non-STEM qualified	15% of STEM qualified people were female, compared to 36% of non-STEM qualified
Top fields of Engineering	Amongst those with Engineering qualifications, the top narrow fields of qualification were Aerospace Engineering and Technology (29%), Electrical and Electronic Engineering and Technology (26%), and Engineering and Related Technologies, nfd (17%)	Amongst those with Engineering qualifications, the top narrow fields of qualification were Engineering and Related Technologies, nfd (53%), Aerospace Engineering and Technology (16%), and Electrical and Electronic Engineering and Technology (15%)
Industry class	Defence was the 11th largest industry class of employment for people with VET STEM skills	Defence was the 14th largest industry class of employment for people with university STEM skills
Proportion with STEM qualifications	In 2006, 21% of the defence workforce had a VET STEM qualification, which dropped to 19% in 2016	In 2006, 10% of the defence workforce had a university STEM qualification, which increased to 11% in 2016
Born overseas	14% of people with VET STEM qualifications in the defence force were born overseas	27% of people with university STEM qualifications in the defence force were born overseas
Occupation	The top occupation class was Technicians and Trades Workers (53%), followed by Community and Personal Service Workers (15%), Professionals (12%) and Managers (12%).	The top occupation class was Professionals (55%), followed by Managers (28%), Clerical and Administrative Workers (7%) and Technicians and Trades Workers (6%).
Gender pay gap	The gender pay gap for full-time workers was 8%	The gender pay gap for full-time workers was 11%
Average income	The average income for full-time workers was \$86 696 for males and \$79 532 for females	The average income for full-time workers was \$110 975 for males and \$99 178 for females
Income distribution	4% earned less than \$41 600, 77% earned between \$41 600 and \$103 999, and 19% earned \$104 000 or above	2% earned less than \$41 600, 47% earned between \$41 600 and \$103 999, and 51% earned \$104 000 or above

What are the occupations of STEM qualified people?

In 2016, major group occupations of STEM and non-STEM qualified people differed depending on level of qualification, as shown in Figure 3.21 and Figure 3.22.

Occupations are classified into five levels using the ANZSCO classification scheme:

- Major group (broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (most detailed level)

The analyses in this section look at occupations at the unit group level rather than the more detailed 'occupation' level, as this is the most detailed level available for analysis.

There are 358 unit group (4-digit level) occupations in the ANZSCO classification scheme.

Technicians and Trade Workers was the most common major group occupation for people with VET STEM qualifications across most fields, except for those with VET qualifications in Information Technology and Mathematics, where the leading major group occupation was Professionals in both cases. The leading occupations of people with VET STEM qualifications were unchanged between 2011 and 2016 (data not shown).

Figure 3.21: Major group occupations of people with a VET qualification, by field

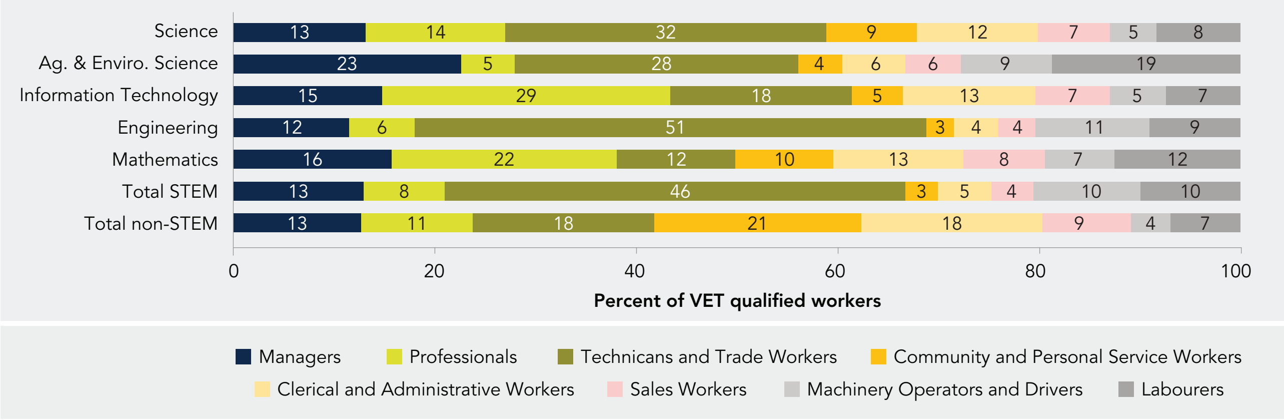
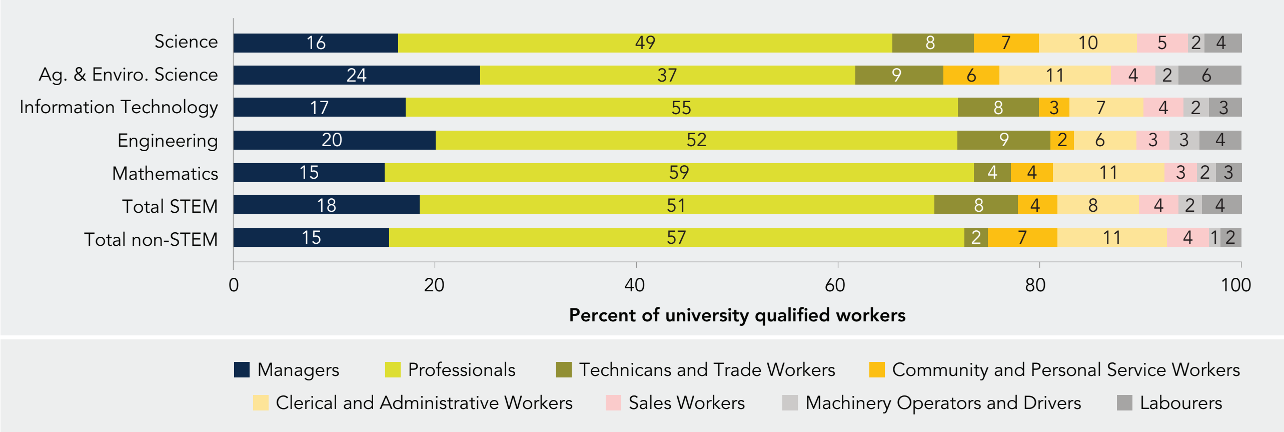


Figure 3.22: Major group occupations of people with a university qualification, by field



The top major group occupation for those with university qualifications across all STEM fields was Professionals in both 2011 and 2016. The proportion of the total STEM university qualified population working as Professionals dropped by 4 percentage points between 2011 and 2016 (data not shown).

Several distinct differences can be seen in the occupations of the STEM qualified population when analysed by gender and level of qualification (Table 3.6). Among those with VET STEM qualifications, the top two most common occupations for males were Technicians and Trades Workers (48%) followed by Managers (13%). The top two most common occupations for females with VET STEM qualifications were Technicians and Trades Workers (20%) followed by Clerical and Administrative Workers (19%). The remaining occupation major groups each represented around 10% of the female population.

For those with university STEM qualifications, just over half (52%) of males and just under half (48%) of females were employed as Professionals. The second highest occupation major group for males was Managers (20%), whereas for females were Managers (14%) or Clerical and Administrative Workers (14%).

Table 3.6: Occupations of people with STEM qualifications, percentage by gender and level of highest post-secondary qualification

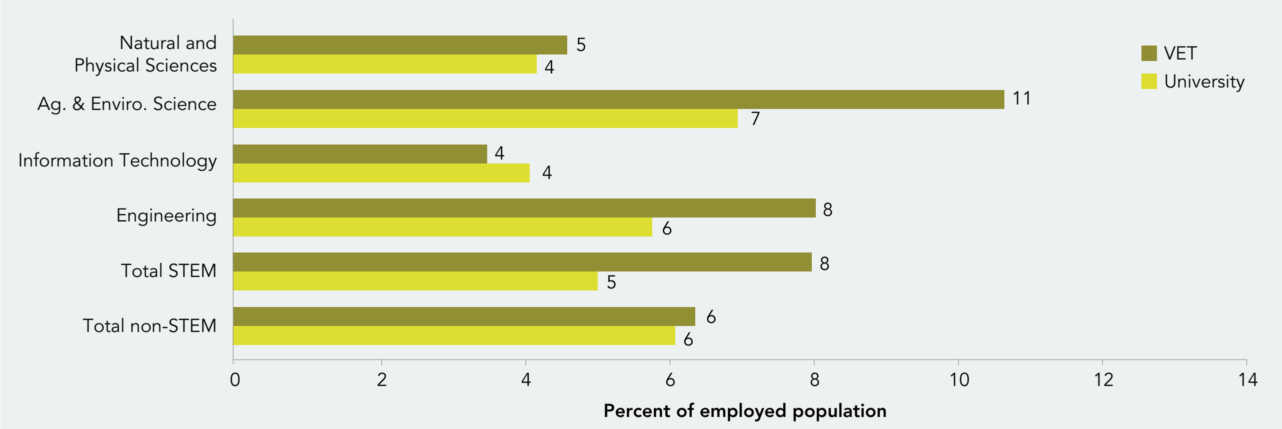
	VET qualified		University qualified	
	Male	Female	Male	Female
Managers	13	11	20	14
Professionals	8	11	52	48
Technicians and Trades Workers	48	20	9	7
Community and Personal Service Workers	3	9	3	7
Clerical and Administrative Workers	4	19	6	14
Sales Workers	4	10	3	5
Machinery Operators and Drivers	11	5	3	1
Labourers	10	14	4	4

What proportion of STEM qualified people own a business that employs people?

The percentage of the employed population who worked as owner-managers (and can be considered as owning a business) and employed at least one person is shown in Figure 3.23. In 2016, 8% of people with a VET STEM qualification and 5% of people with a university STEM qualification owned a business that employed people.

For people with VET STEM qualifications and for graduates with university STEM qualifications, ownership of a business that employed people was most common amongst those with Agricultural and Environmental Sciences qualifications and least common among those with Information Technology qualifications.

Figure 3.23: Percent of employed population that owned a business employing at least one person, by field and level of education[16]



16 Due to the small number of business owners with qualifications in Mathematics, this field has been combined with Science in the field Natural and Physical Sciences.

Are personal incomes different for STEM and non-STEM qualified people?

Overall, a greater proportion of people with STEM qualifications than those with non-STEM qualifications had an income in the highest bracket of $104 000 or above, at the VET and university levels of qualification (Figure 3.24 and Figure 3.25).

The Census collects information on the total income that a person usually receives each week. These weekly figures have been converted to the equivalent annual amounts and divided into income brackets. These brackets allow for the comparison of personal income across various populations.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

For those with VET STEM qualifications, the population with Engineering qualifications has the highest percentage of people who earned $104 000 or above (19% of the employed workforce). The population with Agriculture and Environmental Science qualifications had the lowest percentage of people who earned $104 000 or above (7%).

For those with university STEM qualifications, the population with Engineering qualifications has the highest percentage of people who earned $104 000 or above (41% of employed workforce). The population with Agriculture and Environmental Science qualifications had the lowest percentage of people who earned $104 000 or above (21%).

Figure 3.24: Personal income of people with VET qualifications, by field

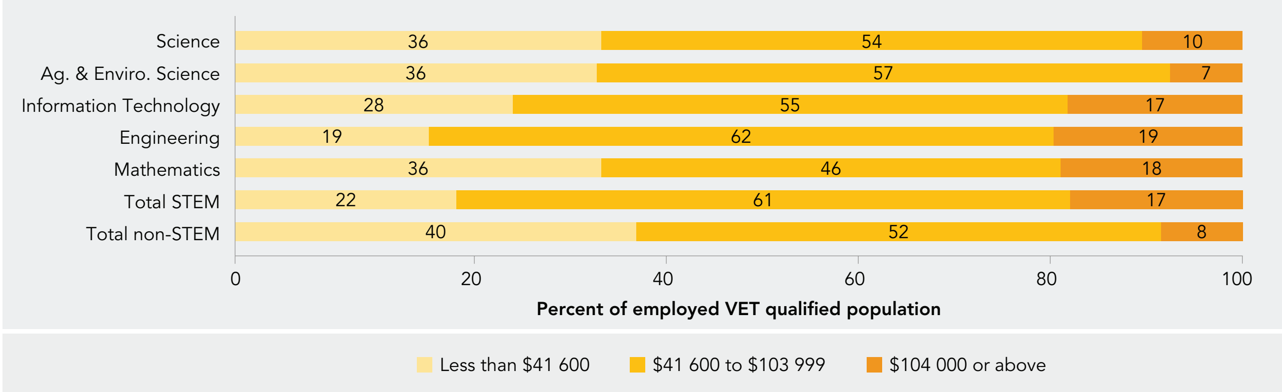
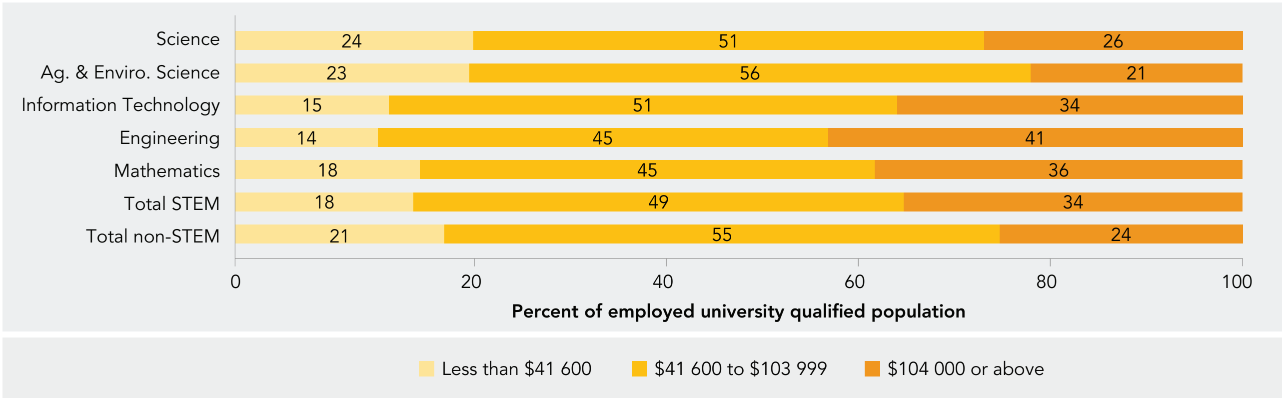


Figure 3.25: Personal income of people with university qualifications, by field



There was some change in the income distribution of the STEM qualified workforce between 2011 and 2016, across all fields and levels of qualification (data not shown). For people with VET STEM qualifications, between 2011 and 2016 there was a decrease in the percentage of people in the lowest income bracket and an increase in the percentage of people in the highest income bracket. For people with university STEM qualifications, between 2011 and 2016 there were increases in the percentages of people in the lowest and highest income brackets. The incomes of STEM university graduates are explored in greater detail in Chapters 4 to 14.

PART 2

PATHWAYS OF UNIVERSITY STEM GRADUATES IN AUSTRALIA

The previous STEM workforce report provided, for the first time, detailed analysis of the workforce destinations of people with university STEM qualifications and the contribution they make to Australia's economy. This report provides an updated snapshot using 2016 Census data, allowing comparison with 2006 and 2011 data and highlighting workforce trends over the intervening periods.

This analysis provides evidence for policy makers on how STEM graduates are deployed throughout the economy. It also provides data (such as the industries of employment and occupations of graduates from each field of education) to guide tertiary curriculum development and to inform student subject and career choices. **Part One** (Chapters 1-3) of this report analysed the demographic characteristics and employment outcomes of people with STEM qualifications at all post-secondary education levels.

Part Two (Chapters 4-14) of this report focuses on STEM university graduates and investigates their employment outcomes in more detail, including their income, industry sectors of employment, and occupations.

Chapter 4 presents:

- Two tables summarising the key data points explored in this chapter, by field of education (Table 4.1 and Table 4.2);
- A detailed analysis of these data points. The outcomes for university graduates are compared across the different STEM fields, with comparisons to non-STEM qualified graduates;
- A comprehensive analysis of the demographics and workforce outcomes of STEM doctoral graduates.

Chapters 5 to 14 then provide the workforce destinations and outcomes for each STEM field of education in detail.

The fields of education analysed in this report have been categorised slightly differently to those in the previous STEM workforce report. These changes have been made to more accurately capture the full breadth of the STEM qualified population. A summary of the categorisation differences is shown in Table 4.A.

Chapters 5 to 14 are structured with the same headings and data analyses to allow comparison across fields and with the total STEM and non-STEM qualified graduate populations. This includes analysis of:

- Demographics
- Industries of employment
- Occupations
- Income

Table 4.A: Comparison of fields analysed in 2016 and 2020 reports

<table>
<tr><th>2016</th><th>2020</th></tr>
<tr><td>Physics and Astronomy (4 digit)</td><td>Physics and Astronomy (4 digit)</td></tr>
<tr><td>Chemical Sciences (4 digit)</td><td>Chemical Sciences (4 digit)</td></tr>
<tr><td>Earth Sciences (4 digit)</td><td>Earth Sciences (4 digit)</td></tr>
<tr><td>Biological Sciences (4 digit)</td><td>Biological Sciences (4 digit)</td></tr>
<tr><td>Other Natural and Physical Sciences (4 digit)</td><td>Other Natural and Physical Sciences (4 digit)
This field includes the 6 digit fields of Medical Science; Forensic Science; Food Science and Biotechnology; Pharmacology; Laboratory Technology; Natural and Physical Sciences not elsewhere classified; and Other Natural and Physical Sciences not further defined."</td></tr>
<tr><td></td><td>Natural and Physical Sciences not further defined (4 digit)</td></tr>
<tr><td>Agriculture, Horticulture and Viticulture
Combined 4 digit fields of Agriculture and Horticulture and Viticulture.</td><td rowspan="3">Agricultural Studies
Combines 4 digit fields of Agriculture, Horticulture and Viticulture; Fisheries Studies; Forestry Studies; Other Agriculture, Environment and Related Studies; and Agriculture, Environment and Related Studies not further defined."</td></tr>
<tr><td>Fisheries Studies (4 digit)</td></tr>
<tr><td>Forestry Studies (4 digit)</td></tr>
<tr><td>Environmental Studies (4 digit)</td><td>Environmental Studies (4 digit)</td></tr>
<tr><td>Information Technology (2 digit)</td><td>Information Technology (2 digit)</td></tr>
<tr><td>Engineering and Related Technologies (2 digit)</td><td>Engineering and Related Technologies (2 digit)</td></tr>
<tr><td>Mathematical Sciences (4 digit)</td><td>Mathematical Sciences (4 digit)</td></tr>
<tr><td>Total STEM</td><td>Total STEM</td></tr>
<tr><td>Total non-STEM</td><td>Total non-STEM</td></tr>
</table>

CHAPTER 4

4

STEM PATHWAYS: OVERVIEW

HIGHLIGHTS

STEM qualified university graduates (STEM graduates)

- In 2016, there were 738 056 STEM graduates in the labour force.
- Between 2011 and 2016, the number of STEM graduates in the labour force increased by 148 547 people (25%).
- The most common type of university qualification for STEM graduates was a bachelor degree, which was held by 70% of STEM graduates in the labour force. 19% of STEM graduates in the labour force held a masters degree, and 7% held a doctoral degree.
- The majority (71%) of STEM graduates in the labour force were male. The proportion of female STEM graduates increased from 27% in 2006 to 29% in 2016.
- The majority (79%) of STEM graduates were employed in the private sector.
- The largest industry of employment was the Professional, Scientific and Technical Services (PSTS) industry division, which employed almost one-quarter (23%) of working STEM graduates.
- Across all of the 19 industry divisions, only one—Healthcare and Social Assistance—employed more female than male STEM graduates.
- The proportion of STEM graduates who earned $104 000 or above increased with level of qualification—32% of bachelor graduates, 34% of masters graduates, and 45% of doctoral graduates had a personal income of $104 000 or above.
- A lower proportion of female STEM graduates than male STEM graduates had an income of $104 000 or above.

STEM doctoral graduates

- In 2016, there were 66 776 STEM doctoral graduates in Australia. People with doctorates in Science accounted for 62% of STEM doctoral graduates.
- Around one-third (34%) of STEM doctoral graduates in the labour force were female, compared to half of non-STEM doctoral graduates.
- The greater number of males with doctorates reflects the gender imbalance in STEM at the undergraduate level. Once they have a university qualification, similar proportions of males and females gain a doctoral degree.
- A minority (44%) of people with a STEM doctorate were born in Australia. Of those born outside Australia, the most common countries of birth were China and England.
- The unemployment rate for people with a STEM doctorate (4.3%) was lower than the unemployment rate for the total STEM qualified graduate population (5.7%). Those with a non-STEM doctorate had an unemployment rate of 2.6%.
- Female doctorate holders had a higher unemployment rate than their male counterparts in almost every STEM field.
- Education and Training was the leading industry of employment for people with STEM doctorates, employing 43% of the cohort.

Table 4.1: Demographic summary of the STEM graduate labour force

	Number of graduates in labour force				Employment status		Qualification				Gender distribution		Age			
STEM field of education	% of population in the labour force	Total size of labour force in 2016	% increase 2011–16	Absolute change 2011–16	% Working full-time	% Unemployed	% Bachelors	% Masters	% Doctorates	% Other[1]	% Female	% increase in females 2011-16	% Males aged 45+	% Females aged 45+	% Increase in males aged 45+ 2011–16	% Increase in females aged 45+ 2011-16
Physics and Astronomy	69	10 071	13	1 175	74	5.6	46	18	34	2	20	2	52	36	1	1
Chemical Sciences	69	17963	6	1 003	72	5.8	61	12	25	2	38	2	56	44	2	6
Earth Sciences	76	15 905	5	690	72	7.5	59	21	16	4	27	3	51	30	0	5
Biological Sciences	75	40590	19	6 601	64	5.6	54	13	31	2	56	3	46	32	1	2
Agricultural Studies	79	25 541	12	2 665	73	3.5	78	11	7	5	34	3	52	32	5	4
Environmental Studies	86	26 551	21	4 563	67	5.6	64	23	5	8	50	1	33	21	4	5
Other Natural and Physical Sciences	78	32 836	37	8 796	63	6.0	67	15	14	4	62	1	29	22	-1	0
Natural and Physical Sciences Not Further Defined	79	75 072	18	11 697	66	4.5	81	9	7	3	52	3	41	31	2	3
Information Technology	88	193 239	33	48 423	81	5.8	65	28	2	6	23	1	22	24	2	1
Engineering and Related Technologies	82	277 798	28	60 030	81	6.1	76	17	4	3	15	2	37	22	-2	0
Mathematical Sciences	72	22 500	15	2 902	71	5.6	66	17	12	5	39	2	53	47	2	4
Total STEM	**81**	**738 075**	**25**	**148 560**	**76**	**5.7**	**70**	**19**	**7**	**4**	**29**	**1**	**35**	**27**	**-1**	**2**
Total non-STEM	**81**	**2 564 581**	**25**	**518 816**	**66**	**3.8**	**67**	**19**	**3**	**11**	**61**	**1**	**39**	**34**	**-1**	**0**

1 "Other" includes Postgraduate Degree Level nfd, as well as Graduate Diploma and Graduate Certificate qualifications.

Table 4.2: Summary of employed STEM graduates

STEM field	Industry of employment		Occupations		Income							
	Top industry division for all graduates (%)	Top industry division for doctorates (%)	Top unit group occupation for all graduates (%)	Top unit group occupation for doctorates (%)	Percent bachelors in highest income bracket		Percentage point increase of bachelors in highest income bracket 2011–2016		Percent doctorates in highest income bracket		Percentage point increase of doctorates in highest income bracket 2011–2016	
					Males	Females	Males	Females	Males	Females	Males	Females
Physics and Astronomy	Education and Training (28)	Education and Training (47)	University Lecturers and Tutors (9)	University Lecturers and Tutors (17)	34	14	4	4	55	36	10	7
Chemical Sciences	Education and Training (20)	Education and Training (42)	Chemists, and Food and Wine Scientists (10)	University Lecturers and Tutors (15)	32	14	5	4	50	29	7	9
Earth Sciences	Mining (30)	Education and Training (32)	Geologists, Geophysicists and Hydrogeologists (35)	Geologists, Geophysicists and Hydrogeologists (32)	47	27	-6	-1	59	38	0	6
Biological Sciences	Education and Training (26)	Education and Training (47)	Medical Laboratory Scientists (7)	University Lecturers and Tutors (15)	21	9	3	3	47	28	10	10
Agricultural Studies	Agriculture, Forestry and Fishing (28)	Education and Training (29)	Agricultural and Forestry Scientists (9)	Agricultural and Forestry Scientists (18)	24	7	7	3	44	24	8	10
Environmental Studies	Public Administration and Safety (27)	Education and Training (39)	Environmental Scientists (21)	Environmental Scientists (19)	24	10	5	2	45	29	8	13
Other Natural and Physical Sciences	Health Care and Social Assistance (32)	Education and Training (43)	Medical Laboratory Scientists (19)	Medical Laboratory Scientists (24)	19	9	4	4	49	31	10	11
Natural and Physical Sciences Not Further Defined	Education and Training (17)	Education and Training (32)	Secondary School Teachers (5)	Natural and Physical Science Professionals, nfd (16)	30	13	5	4	52	30	10	10
Information Technology	Professional, Scientific and Technical Services (32)	Education and Training (46)	Software and Applications Programmers (22)	University Lecturers and Tutors (28)	38	23	8	5	54	42	10	10
Engineering and Related Technologies	Professional, Scientific and Technical Services (24)	Education and Training (40)	Civil Engineering Professionals (10)	University Lecturers and Tutors (21)	42	22	1	3	56	35	6	7
Mathematical Sciences	Education and Training (24)	Education and Training (56)	Secondary School Teachers (8)	University Lecturers and Tutors (34)	40	22	5	4	61	43	9	8
Total STEM	**Professional, Scientific and Technical Services (23)**	**Education and Training (43)**	**Software and Applications Programmers (8)**	**University Lecturers and Tutors (18)**	**38**	**16**	**4**	**4**	**53**	**31**	**8**	**10**
Total non-STEM	**Health Care and Social Assistance (23)**	**Education and Training (41)**	**Registered Nurses (7)**	**University Lecturers and Tutors (25)**	**33**	**13**	**3**	**4**	**65**	**46**	**6**	**9**

Demographics of Australia's STEM qualified university graduates

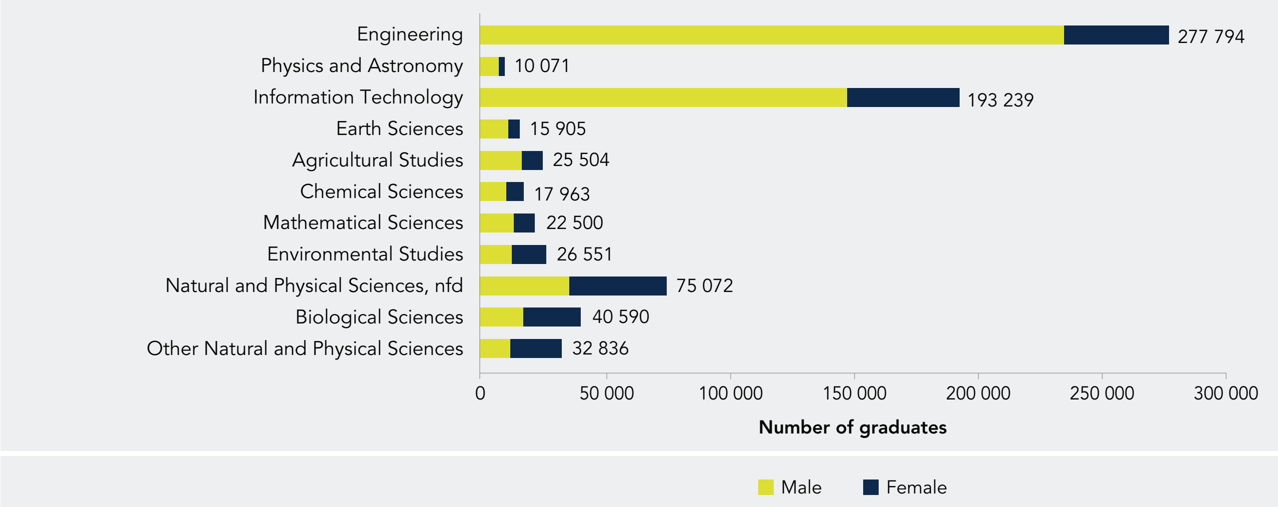
HOW MANY STEM QUALIFIED UNIVERSITY GRADUATES ARE IN THE AUSTRALIAN LABOUR FORCE?

There were 907 651 people with university STEM qualifications living in Australia in 2016, of whom 738 056 were in the labour force. The term 'graduates' in this chapter is used to describe those with university qualifications (bachelor degree or above).

Between 2011 and 2016, the number of STEM graduates in the labour force grew by 148 547, or 25%. While there was a much larger number of graduates in the labour force with qualifications in non-STEM fields (2 564 652 in 2016), the percentage growth in this labour force between 2011 and 2016 was the same, at 25%.

In 2016, the largest STEM field was Engineering (277 794 graduates in the labour force), followed by Information Technology (193 239; Figure 4.1, Table 4.3). There were also 192 442 Science graduates in the labour force, displayed in Figure 4.1 by narrow field. Of the Science narrow fields, the largest was Natural and Physical Sciences nfd (75 072) and the smallest was Earth Sciences (15 905).

Figure 4.1: Number of graduates in the labour force, by field and gender. Data labels show the total number of graduates[17]



The most common type of university qualification for graduates was a bachelor degree, which was held by 70% of the STEM graduate labour force (and 67% of non-STEM graduates). The most common postgraduate degree across both the STEM and non-STEM qualified graduate labour forces was a masters degree—19% of both graduate cohorts held this as their highest qualification. Within STEM, the proportion of graduates with a masters degree varied between fields, from 12% of Science graduates to 28% of Information Technology graduates.

In 2011, 7% of STEM graduates in the labour force held doctoral qualifications as did 2% of non-STEM graduates. In 2016, the proportion of STEM graduates in the labour force with doctoral qualifications was unchanged at 7%, while the proportion of non-STEM graduates with doctoral qualifications had increased to 3%. In 2016, of the STEM fields, Science graduates had the highest proportion holding a doctoral degree (17%) while Information Technology had the lowest (2%).

17 STEM fields have been ordered here from lowest to highest female representation.

Table 4.3: Number of STEM qualified graduates in the labour force, by field and highest qualification

	Highest level of qualification							
Post-secondary Qualification: Field of Study	Bachelor Degree	Graduate Certificate	Graduate Diploma	Graduate Diploma and Graduate Certificate, nfd	Masters Degree	Doctoral Degree	Postgraduate Degree, nfd	Total
Science, total	**130 248**	**966**	**3 771**	**559**	**23 732**	**32 754**	**412**	**192 442**
Natural and Physical Sciences, not further defined	61 020	389	1 529	304	6 396	5 270	166	75 074
Physics and Astronomy	4 628	41	115	33	1 844	3 392	15	10 068
Chemical Sciences	10 978	34	199	50	2 183	4 494	30	17 968
Earth Sciences	9 432	40	469	43	3 301	2 593	29	15 907
Biological Sciences	22 035	126	603	56	5 213	12 466	89	40 588
Other Natural and Physical Sciences	22 155	336	856	73	4 795	4 539	83	32 837
Agriculture, Environmental and Related Studies, total	**36 789**	**911**	**2 195**	**149**	**8 950**	**2 989**	**128**	**52 111**
Agriculture, Environmental and Related Studies, not further defined	67	3	7	0	34	13	0	124
Agriculture	14 894	182	483	54	1 914	1 411	31	18 969
Horticulture and Viticulture	2 788	79	174	0	383	130	14	3 568
Forestry Studies	1 253	18	35	0	214	117	3	1 640
Fisheries Studies	794	16	87	0	201	91	4	1 193
Environmental Studies	16 966	598	1 404	95	6 190	1 224	76	26 553
Other Agriculture, Environmental and Related Studies	27	15	5	0	14	3	0	64
Information Technology, total	**124 904**	**1 290**	**7 482**	**1 637**	**53 739**	**3 700**	**491**	**193 243**
Information Technology, not further defined	75 444	951	5 123	1 211	34 144	1 069	337	118 279
Computer Science	42 934	191	1 666	270	14 221	2 309	117	61 708
Information Systems	6 272	103	671	149	5 071	289	37	12 592
Other Information Technology	254	45	22	7	303	33	0	664

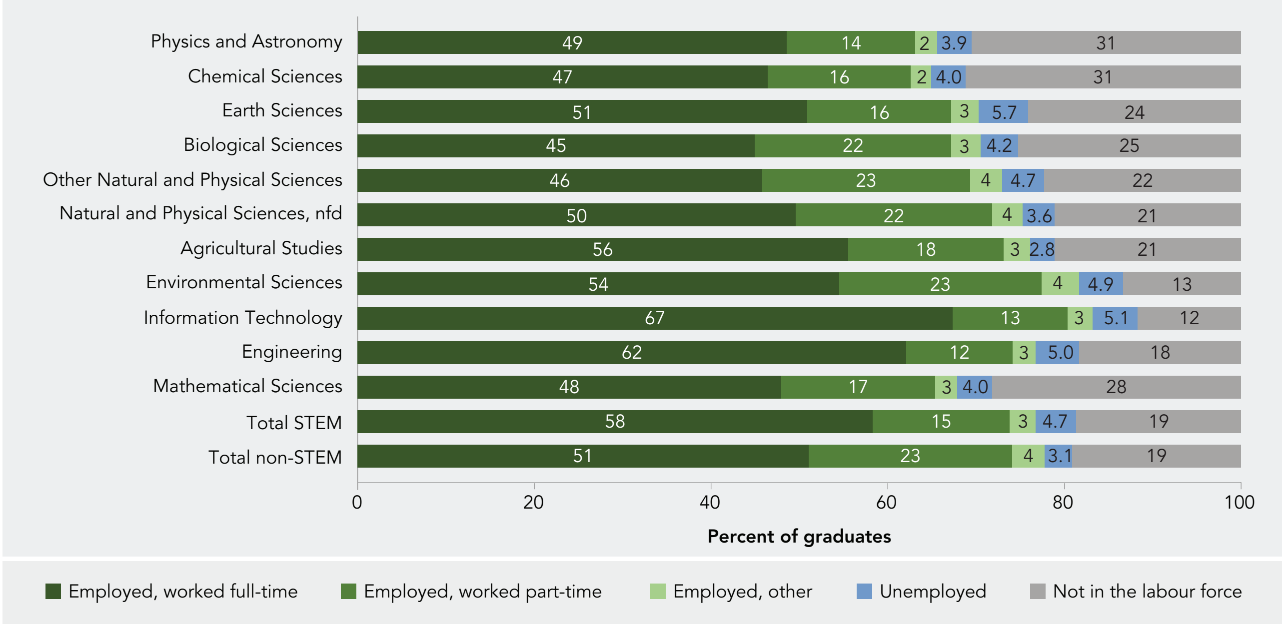
Post-secondary Qualification: Field of Study	Highest level of qualification							
	Bachelor Degree	Graduate Certificate	Graduate Diploma	Graduate Diploma and Graduate Certificate, nfd	Masters Degree	Doctoral Degree	Postgraduate Degree, nfd	Total
Engineering and Related Technologies, total	**212 138**	**1 475**	**4 508**	**784**	**46 884**	**11 547**	**429**	**277 765**
Engineering and Related Technologies, not further defined	93 051	524	1 431	478	20 601	4 636	168	120 889
Manufacturing Engineering and Technology	3 366	41	133	0	817	138	7	4 502
Process and Resources Engineering	14 701	80	552	0	3 780	2 283	29	21 425
Automotive Engineering and Technology	603	0	0	0	0	0	0	603
Mechanical and Industrial Engineering and Technology	20 470	170	370	64	3 699	719	27	25 519
Civil Engineering	24 839	88	450	74	5 152	1 093	69	31 765
Geomatic Engineering	6 242	147	511	26	869	238	17	8 050
Electrical and Electronic Engineering and Technology	39 137	124	640	142	8 969	1 615	85	50 712
Aerospace Engineering and Technology	5 435	140	205	0	877	196	8	6 861
Maritime Engineering and Technology	1 795	9	25	0	70	12	0	1 911
Other Engineering and Related Technologies	2 499	152	191	0	2 050	617	19	5 528
Mathematical Sciences, total	**14 841**	**267**	**672**	**117**	**3 931**	**2 610**	**57**	**22 495**
Total STEM	**518 920**	**4 909**	**18 628**	**3 246**	**137 236**	**53 600**	**1 517**	**738 056**
Total non-STEM	**1 730 395**	**50 103**	**199 533**	**24 324**	**483 145**	**64 247**	**12 905**	**2 564 652**

WHAT IS THE LABOUR FORCE STATUS OF STEM GRADUATES?

In 2016, 81% of university qualified STEM graduates were in the labour force (either working or looking for work; Figure 4.2). Information Technology graduates had the highest labour force participation rate, with 88% of the qualified population in the labour force, while those with qualifications in Physics and Astronomy or Chemical Sciences had the lowest labour force participation rate (69%).

The STEM graduate labour force participation rate decreased by 3 percentage points between 2011 and 2016. This difference reflects the ageing of the STEM graduate population, with many people moving into retirement age over this period. Earth Sciences graduates experienced the largest decrease in labour force participation, from 83% in 2011 to 76% in 2016.

Figure 4.2: Labour force status of STEM graduates, by field

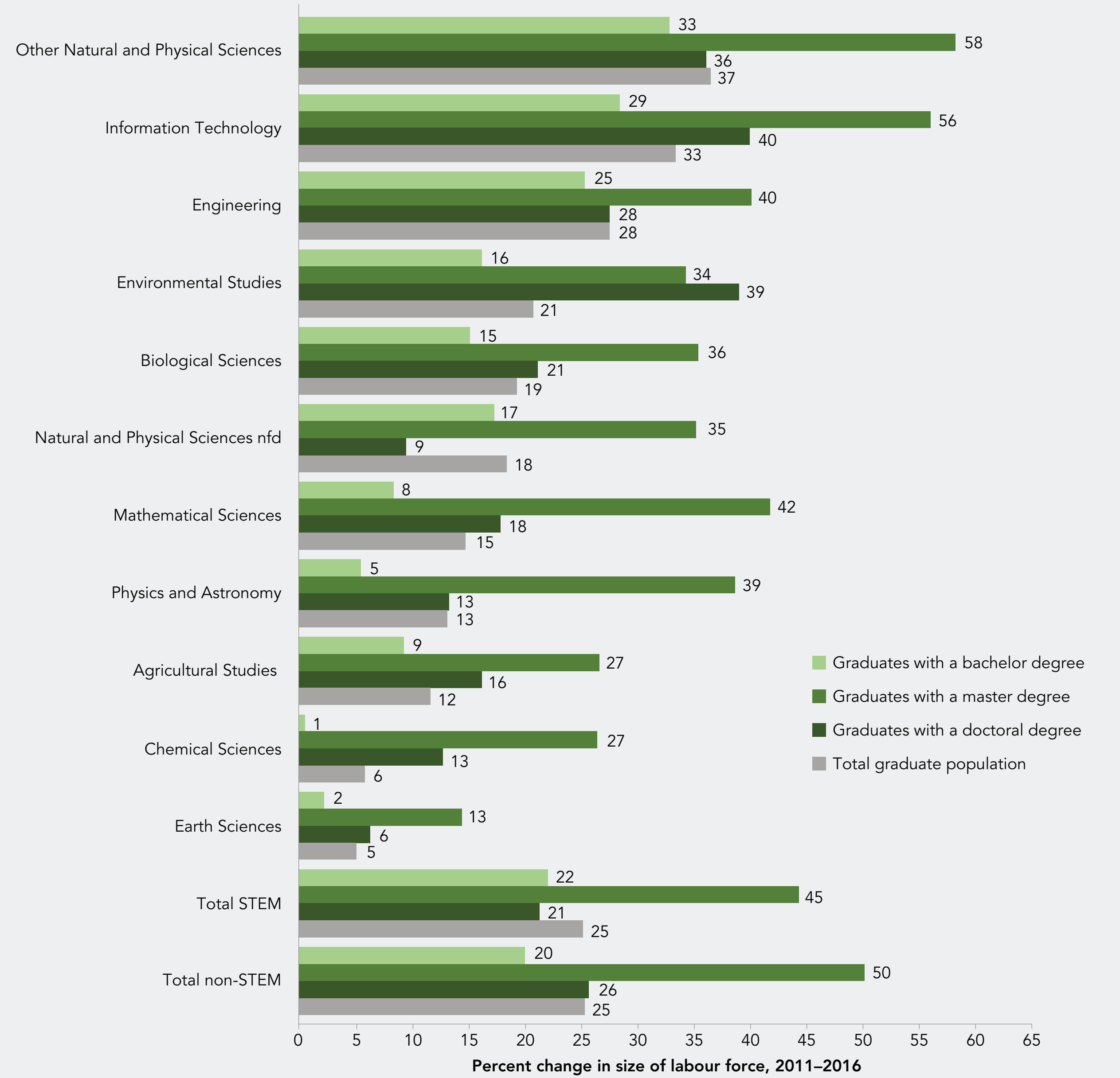


HOW HAS THE SIZE OF THE GRADUATE LABOUR FORCE CHANGED IN RECENT YEARS?

Between 2011 and 2016, the size of the STEM graduate labour force increased by 25% (Figure 4.3). The STEM field with the largest proportional growth in population size was Other Natural and Physical Sciences, which had a 37% increase in the number of graduates (8 796 people). Earth Sciences had the smallest proportional growth, at 5% (690 people).

By qualification level (Figure 4.3), the population with masters degrees had the highest percentage increase for total STEM (45%), total non-STEM (50%), and all STEM fields except Environmental Studies. Although there was a large numerical increase in the number of people holding STEM bachelor degrees (93 795 more graduates than in 2011), the percentage increase of this cohort was relatively small at 22%—almost the same as STEM doctorates at 21%.

Figure 4.3: Labour force status of STEM graduates, by field



WHAT IS THE GENDER DISTRIBUTION OF THE STEM GRADUATE LABOUR FORCE?

In 2011, 73% of STEM graduates in the labour force were male. This decreased to 71% in 2016. Correspondingly, the proportion of female STEM graduates in the labour force rose from 27% in 2011 to 29% in 2016. This small shift in the gender split of the total STEM graduate labour force reflected a 74% increase in the number of female graduates in the STEM labour force, driven by an increase of approximately 50 000 females in the 30 to 44 age bracket between 2011 and 2016 (data not shown).

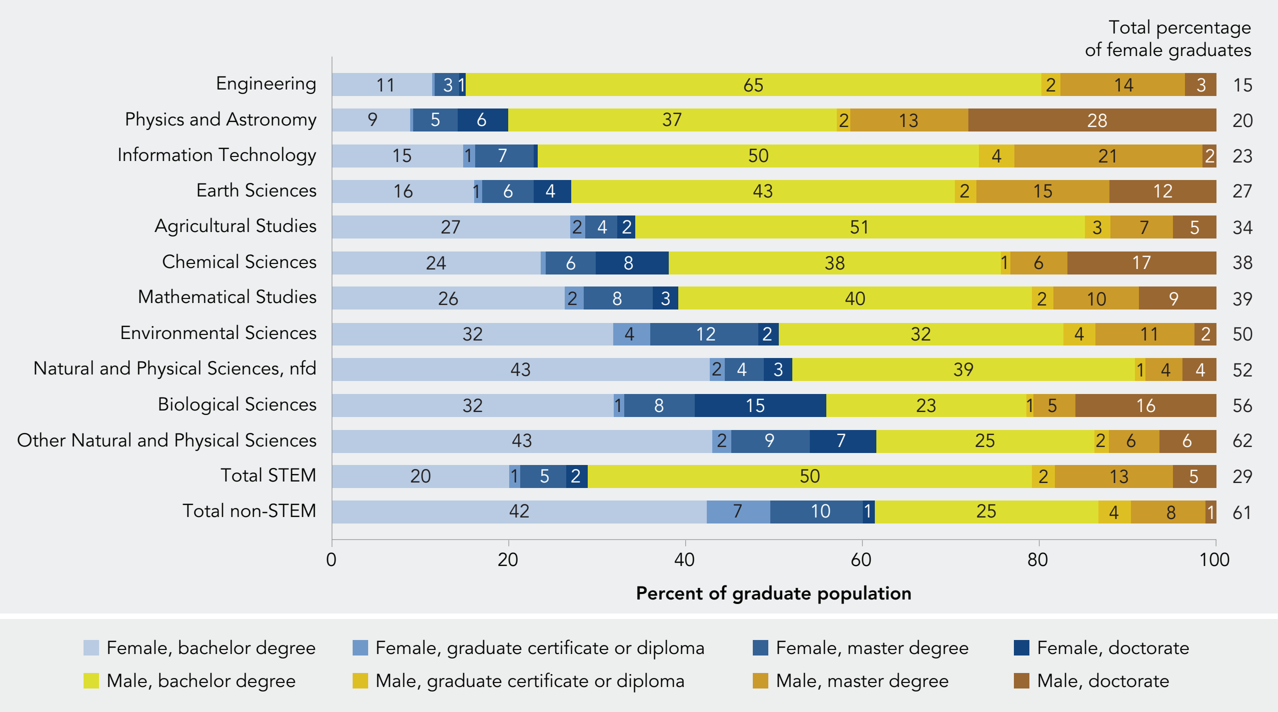
In 2016, Engineering was the STEM field with the highest proportion of male graduates, at 85%, followed by Physics and Astronomy at 80% (Figure 4.4).

Of the broad STEM fields, Science was the only one close to gender parity—51% of the labour force with a university qualification in Science were male and 49% were female (data not shown). More detailed analysis shows that females made up the majority of the graduate labour force in three of the six narrow fields of Science—Other Natural and Physical Sciences (62% female),[18] Biological Sciences (56%), and Natural and Physical Sciences not further defined (52%; Figure 4.4). Environmental Studies also had a gender balance with females making up half (50%) of the labour force.

In 2016, the majority (61%) of non-STEM graduates in Australia were female (Figure 4.4).

18 The detailed fields within this grouping include: Medical Science, Forensic Science, Food Science and Biotechnology, Pharmacology, Laboratory Technology, Natural and Physical Sciences not elsewhere classified, and Other Natural and Physical Sciences not further defined.

Figure 4.4: Gender distribution of graduates in the labour force, by field and level of qualification



HOW OLD ARE THE EMPLOYED STEM GRADUATE POPULATIONS?

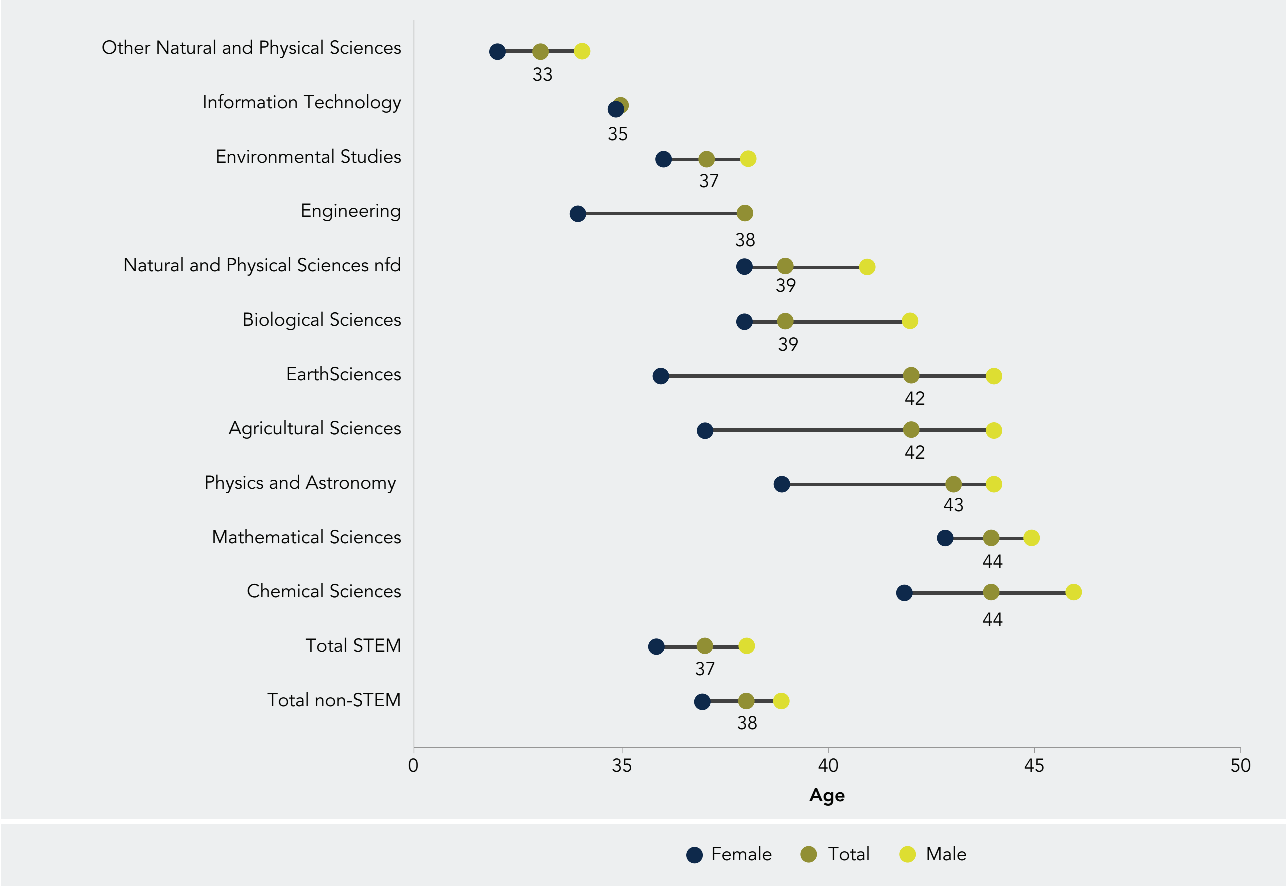
In 2016, the employed STEM graduate population was younger than the employed non-STEM graduate population overall. Employed female STEM graduates were, on average, two years younger than male STEM graduates, at 36 and 38 years old respectively (data not shown).

The employed female graduate population was younger than the male graduate population across all STEM fields, with the exception of Information Technology where females and males both had a median age of 35 (Figure 4.5).

The STEM field with the youngest median age of graduates was Other Natural and Physical Sciences, at 33 years—32 for females, and 34 for males. The STEM field with the oldest median age of graduates was Chemical Sciences, at 44 years—42 for females, and 46 for males.

The STEM field with the largest variation in median age between genders was Earth Sciences, where there was an eight year age gap between the median age for female graduates (36 years) and male graduates (44 years).

Figure 4.5: Median age of employed graduates, by field and gender



The age of the employed graduate population can also be investigated by looking at the distribution of people across age groups, by gender, as shown in Figure 4.6 and Figure 4.7. The STEM graduate cohorts with the largest proportion aged under 45 were Environmental Studies for women (79% of women aged under 45) and Information Technology for men (78% of men aged under 45).

The STEM graduate cohorts with the smallest proportion aged under 45 were Mathematical Sciences for women (51% of women aged under 45) and Chemical Sciences for men (44% of men aged under 45). In four other fields, less than half of male graduates were aged under 45—Mathematical Sciences (47%), Physics and Astronomy (48%), Agricultural Studies (48%), and Earth Sciences (49%).

Figure 4.6: Age distribution of employed male graduates, by field

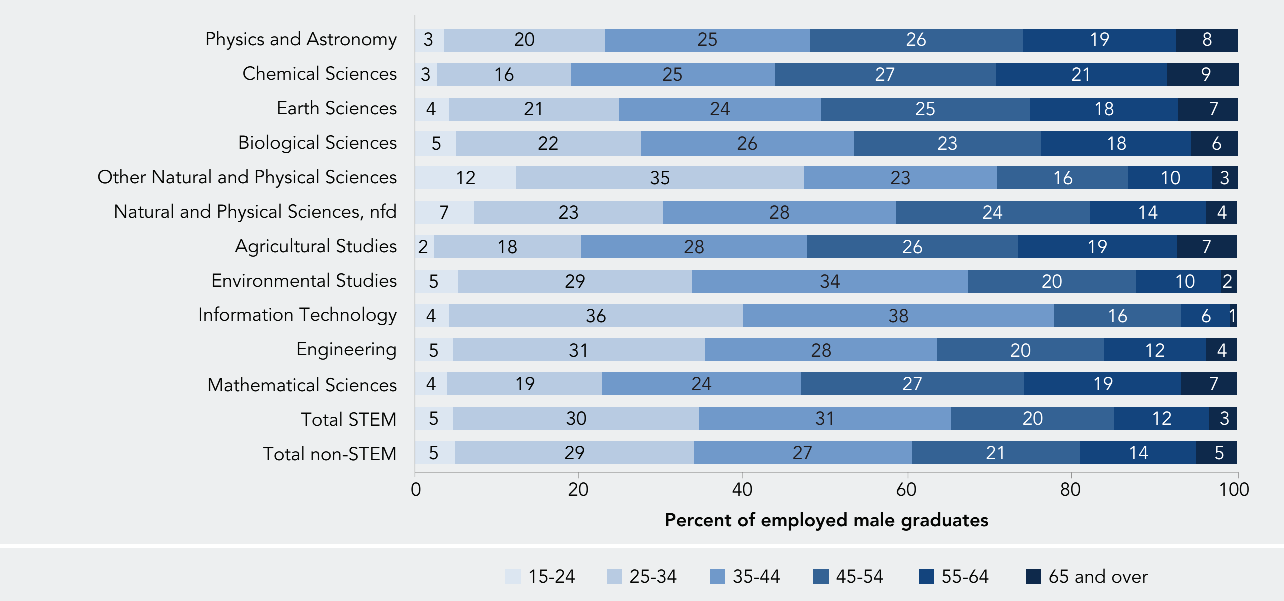
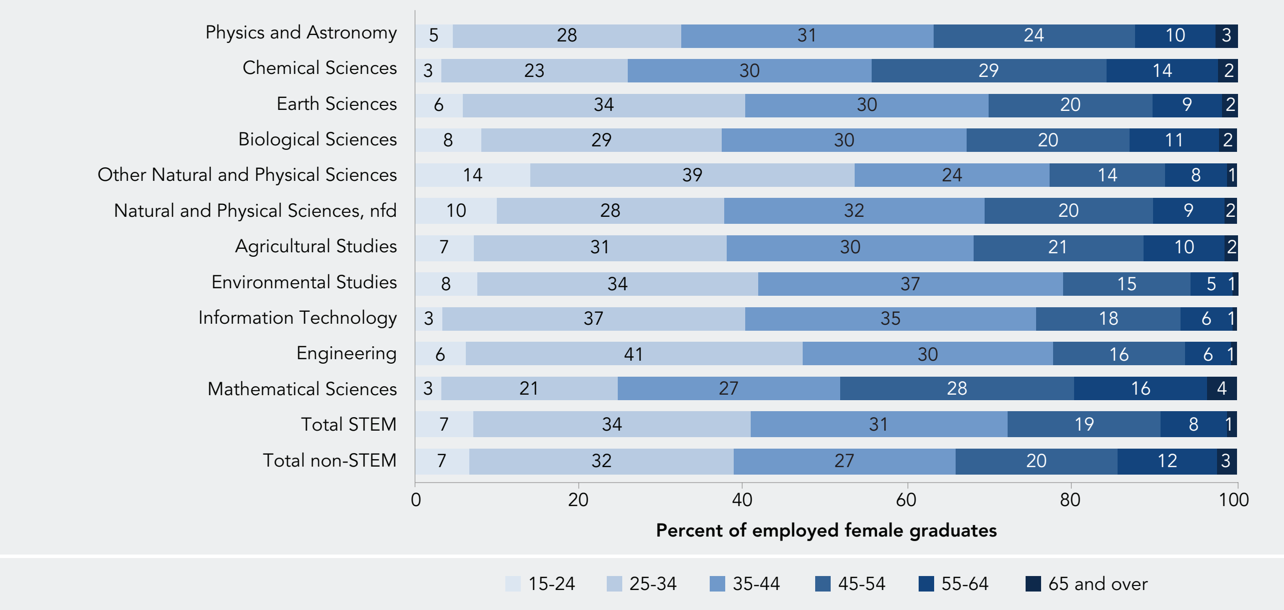


Figure 4.7: Age distribution of employed female graduates, by field



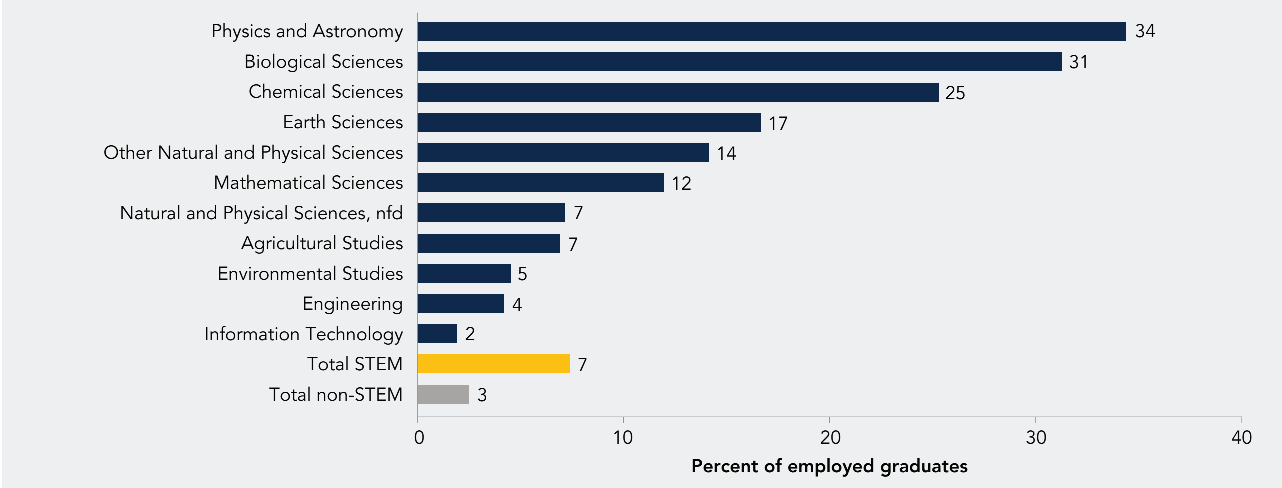
HOW COMMON ARE DOCTORATE DEGREES IN THE STEM GRADUATE WORKFORCE?

In 2016, 7% of employed STEM graduates and 3% of employed non-STEM graduates had a doctoral degree. There was a large variation in the proportion of doctoral holders across the STEM fields (Figure 4.8).

Graduates from Science fields had the highest proportion of doctoral holders—34% of employed Physics and Astronomy graduates and 31% of employed Biological Sciences graduates held doctoral degrees. The fields of Information Technology and Engineering had the lowest proportion of doctorates, at 2% and 4% respectively.

The *Careers of STEM doctoral graduates* section of this report (p.79) provides a more detailed analysis of STEM doctoral graduates.

Figure 4.8: Percent of employed graduates with doctorates, by field



Employment outcomes of Australia's STEM qualified university graduates

WHAT PROPORTION OF THE STEM GRADUATE WORKFORCE WAS EMPLOYED IN THE PRIVATE SECTOR?

In 2016, the majority (79%) of STEM graduates were employed in the private sector (Figure 4.9). Engineering graduates had the highest proportion working in the private sector (85%), while graduates with qualifications in Biological Sciences or Environmental Sciences had the lowest proportion working in the private sector (60%).

A lower proportion of doctoral holders than the overall STEM graduate population worked in the private sector (Figure 4.10), largely due to their higher levels of employment in public education. For example, 84% of all Information Technology graduates, but just 44% of Information Technology doctoral graduates worked in the private sector.

Figure 4.9: Percent of university graduates employed in the private sector, by field

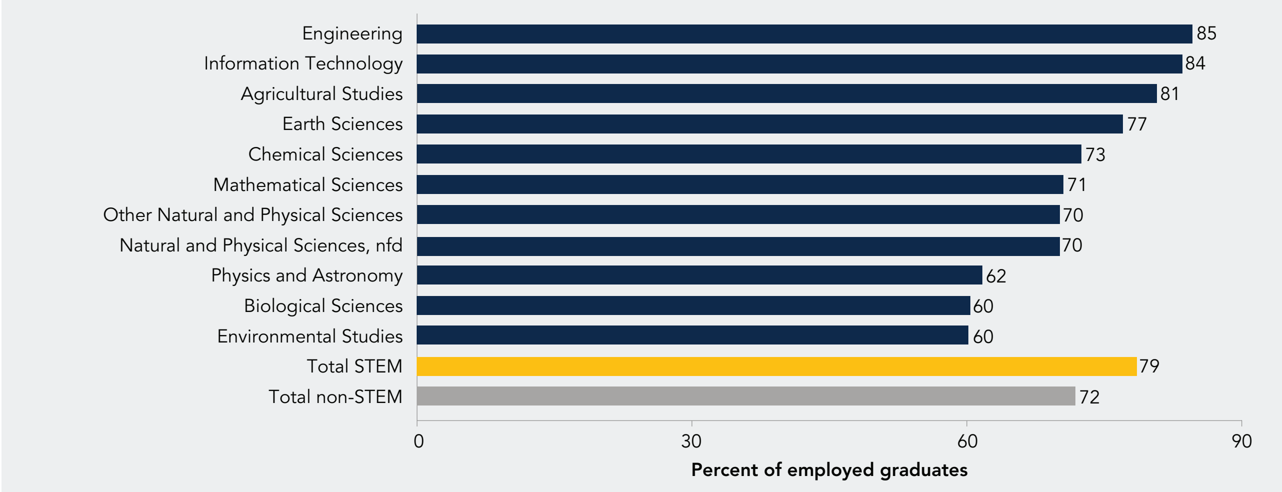
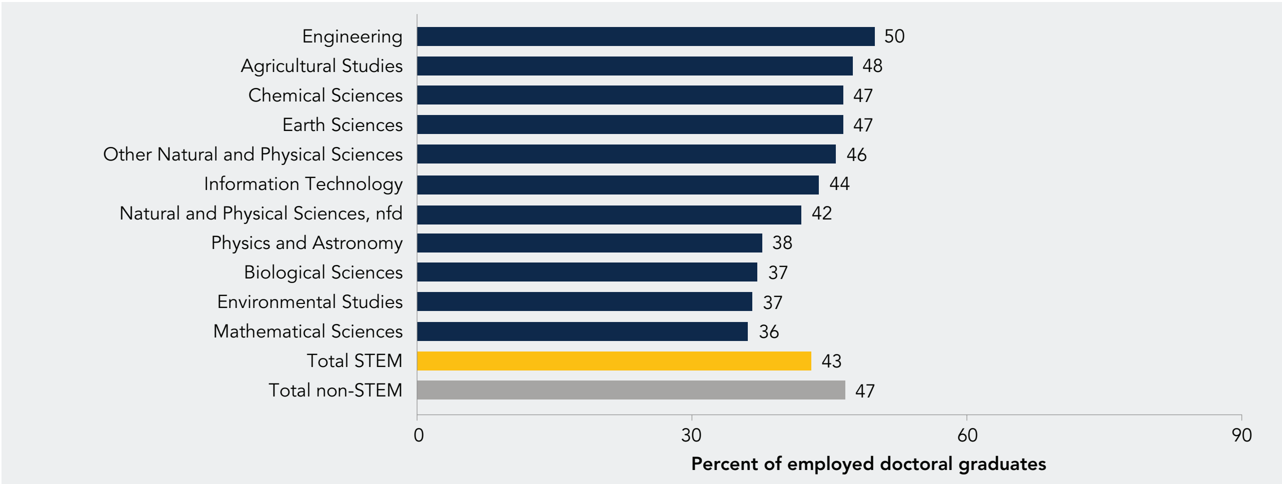


Figure 4.10: Percent of doctoral graduates employed in the private sector, by field



WHICH INDUSTRIES EMPLOY STEM GRADUATES?

STEM graduates were employed in a diverse range of industries across the Australian economy (Figure 4.11).

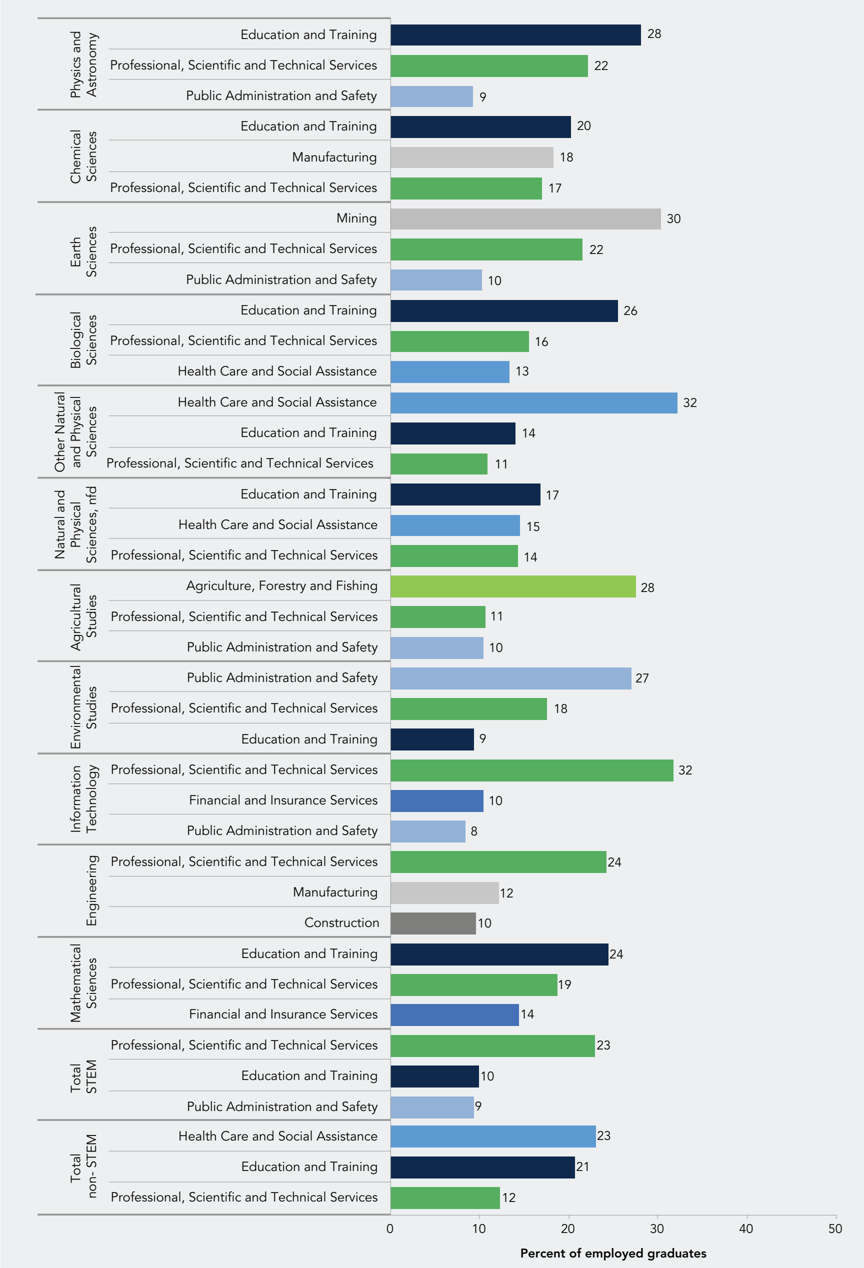
The Professional, Scientific and Technical Services (PSTS) industry division employed almost one-quarter (23%) of all working STEM graduates. PSTS featured in the top three industries of employment for all of the individual STEM fields, and was the top industry of employment for graduates with qualifications in Information Technology and Engineering—employing 32% and 24% of graduates from these fields, respectively.

The industry division that employed the second largest percentage of STEM graduates overall was Education and Training, at 10%. It was in the top three industries of employment for seven of the 11 STEM fields, and was the most common industry of employment for five fields: Physics and Astronomy, Biological Sciences, Mathematical Sciences, Chemical Sciences and Natural and Physical Sciences not further defined.

Other top industries of employment included those where graduates were employed based on specific skills, such as:

- 30% of Earth Sciences graduates worked in the Mining industry;
- 32% of Other Natural and Physical Sciences graduates (57% of whom had qualifications in the narrow field of Medical Sciences) worked in the Health Care and Social Assistance industry

Figure 4.11: Top three industry divisions for graduate employment, by field



Industries are classified at four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

WHAT IS THE GENDER DISTRIBUTION OF STEM GRADUATES ACROSS INDUSTRY DIVISIONS?

In 2016, 28% of the employed STEM graduate population were female. These female workers were unevenly distributed across the economy, with some industries employing a higher proportion of female STEM graduates than others. Table 4.4 shows the proportion of female workers in each industry division, by the field of education of their qualification. For example, of all the graduates who worked in Mining and had an Information Technology qualification, 16% were female and 84% were male.

Across the 19 industry divisions, nine had workforces composed of more than 28% women, showing that they had greater female representation than in the total STEM graduate workforce. The highest of these—Healthcare and Social Assistance—employed more female than male STEM graduates (60% female). Of the STEM qualified population working in Healthcare and Social Assistance, female representation varied based on the field of qualification, from 72% of those with Natural and Physical Sciences not further defined qualifications, to 37% of those with Engineering qualifications.

At the lower end of female representation, females made up just 12% of STEM graduates working in the Construction industry, 15% in Transport, Postal and Warehousing, and 17% in Mining.

Table 4.4: Percentage of females in each industry division by field of qualification. Yellow cells indicate a lower proportion of females, while blue cells indicate a higher proportion of females

Industry division of employment	Field of qualification												
	Physics and Astronomy	Chemical Sciences	Earth Sciences	Biological Sciences	Natural and Physical Sciences, nfd	Other Natural and Physical Sciences	Agricultural Studies	Environmental Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
Agriculture, Forestry and Fishing	18	23	24	43	42	47	24	43	24	13	52	28	56
Mining	13	22	23	42	31	45	19	41	16	12	26	17	41
Manufacturing	14	32	27	49	44	49	27	43	20	12	36	22	45
Electricity, Gas, Water and Waste Services	14	28	24	47	39	51	29	44	24	15	41	21	45
Construction	11	20	16	38	31	40	15	33	17	8	34	12	36
Wholesale Trade	15	32	24	51	47	58	26	38	20	13	32	24	48
Retail Trade	28	42	31	61	57	61	44	56	24	19	45	34	59
Accommodation and Food Services	22	47	41	60	55	58	43	57	27	22	45	35	56
Transport, Postal and Warehousing	13	23	14	36	28	38	14	40	15	10	26	15	37
Information Media and Telecommunications	18	33	32	44	38	47	43	51	19	14	28	20	53
Financial and Insurance Services	18	39	20	49	47	61	37	53	26	21	37	29	45
Rental, Hiring and Real Estate Services	10	43	32	53	52	56	28	50	26	16	41	28	49
Professional, Scientific and Technical Services	13	36	24	52	45	63	41	46	18	14	32	22	50
Administrative and Support Services	26	41	32	53	53	62	30	45	26	20	37	30	61
Public Administration and Safety	19	38	34	52	48	58	36	53	24	16	39	32	59
Education and Training	23	43	38	57	60	62	51	61	31	23	44	43	73
Health Care and Social Assistance	39	61	54	70	72	70	64	68	42	37	63	60	75
Arts and Recreation Services	26	42	28	61	53	62	47	51	19	19	25	38	54
Other Services	21	43	34	64	57	63	51	55	25	13	46	32	57
All industries	20	38	27	56	52	61	34	50	22	15	39	28	61

WHAT PROPORTION OF STEM QUALIFIED GRADUATES OWN A BUSINESS?

In 2016, 12% of employed STEM graduates were business owners, compared to 13% of non-STEM graduates (Figure 4.12). The proportion of STEM graduates who were business owners varied from almost one-quarter (23%) of Agricultural Studies graduates to just 7% of graduates with a qualification in Other Natural and Physical Sciences. These proportions were largely unchanged from 2011.

In this analysis, the status of employment—as an owner manager of an enterprise with or without employees—was used as a proxy for business ownership.

This section looks at all people that owned a business. The following section analyses people that owned large businesses employing more than 20 people.

AMONG BUSINESS OWNERS, WHAT PERCENTAGE EMPLOY MORE THAN 20 EMPLOYEES?

Only 5% of STEM graduates who owned a business in 2016 had a business that employed more than 20 employees, compared to 7% of non-STEM graduate business owners (Figure 4.13). Business owners with Engineering qualifications had the highest percentage employing more than 20 employees (7% of business owners with Engineering qualifications). Business owners with Environmental Studies, Earth Sciences or Biological Sciences qualifications had the lowest percentage employing more than 20 employees (3%).

Figure 4.12: Business ownership among employed graduates with university qualifications, by field of qualification

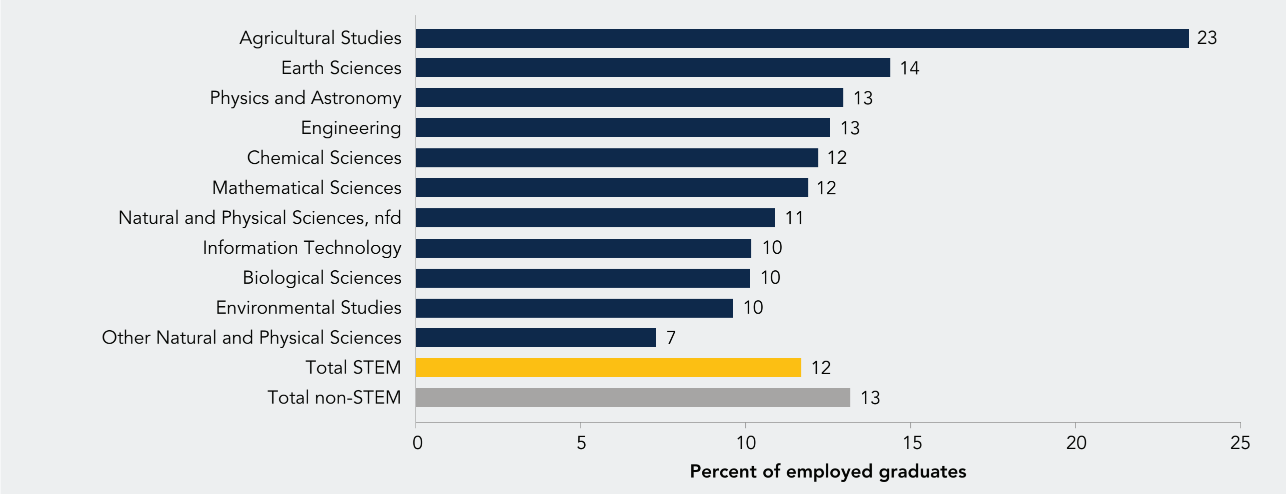
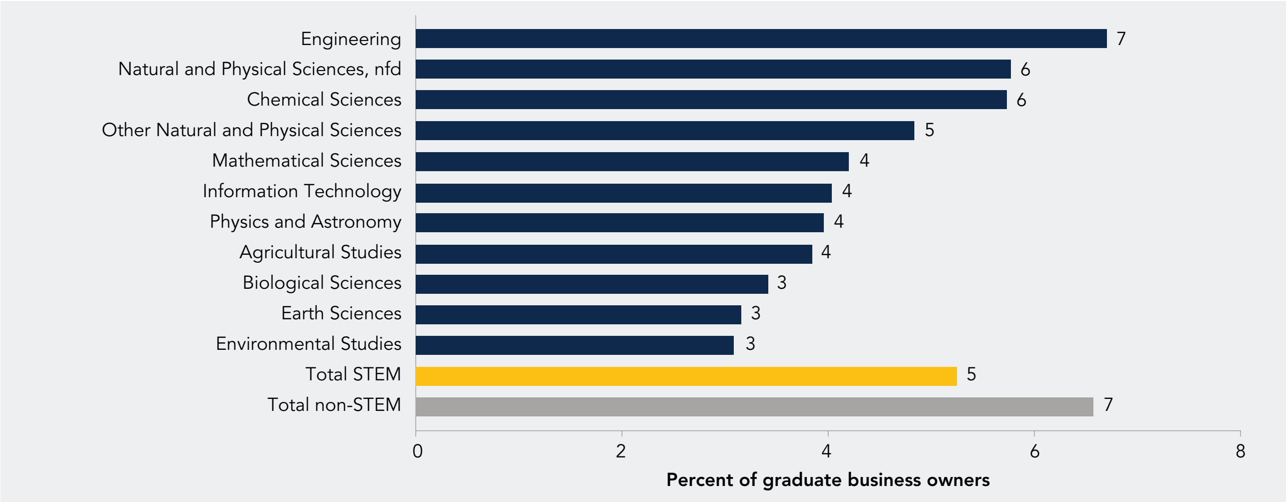


Figure 4.13: Percentage of graduate business owners employing more than 20 individuals, by field of qualification



WHAT ARE THE OCCUPATIONS OF STEM GRADUATES?

Overall, the most common unit group occupations of all employed STEM university graduates combined were Software and Applications Programmers (56 479), Civil Engineering Professionals (26 458), and ICT Managers (23 895; data not shown).

Table 4.5 shows the top three unit group level occupations for graduates from each STEM field, along with the percentage of graduates working in that occupation. A number of occupations were in the top three for more than one STEM field—University Lecturers and Tutors was listed five times, Software and Applications Programmers four times, and Medical Laboratory Scientists three times.

Occupations are classified into five levels using the ANZSCO classification scheme:

- Major group (broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (most detailed level)

The analyses in this section look at occupations at the unit group level rather than the more detailed 'occupation' level, as this is the most detailed level available for analysis.

There are 358 unit group (4-digit level) occupations in the ANZSCO classification scheme.

Table 4.5: Top three unit group level occupations, by field

	Top three occupations					
Industry	**1st**	**%**	**2nd**	**%**	**3rd**	**%**
Physics and Astronomy	University Lecturers and Tutors	9	Other Natural and Physical Science Professionals	8	Software and Applications Programmers	7
Chemical Sciences	Chemists, and Food and Wine Scientists	10	University Lecturers and Tutors	5	Other Specialist Managers	5
Earth Sciences	Geologists, Geophysicists and Hydrogeologists	35	Environmental Scientists	3	University Lecturers and Tutors	3
Biological Sciences	Medical Laboratory Scientists	7	University Lecturers and Tutors	6	Life Scientists	6
Other Natural and Physical Sciences	Medical Laboratory Scientists	19	Medical Technicians	5	Chemists, and Food and Wine Scientists	4
Natural and Physical Sciences, nfd	Secondary School Teachers	5	Medical Laboratory Scientists	5	Sales Assistants (General)	3
Agricultural Studies	Agricultural and Forestry Scientists	10	Livestock Farmers	6	Crop Farmers	5
Environmental Studies	Environmental Scientists	21	Other Specialist Managers	5	Contract, Program and Project Administrators	4
Information Technology	Software and Applications Programmers	22	ICT Managers	9	ICT Support Technicians	5
Engineering	Civil Engineering Professionals	10	Industrial, Mechanical and Production Engineers	6	Software and Applications Programmers	5
Mathematical Sciences	Secondary School Teachers	8	Software and Applications Programmers	8	University Lecturers and Tutors	6

Earning potential of Australia's STEM qualified university graduates

ARE STEM GRADUATES HIGH EARNERS?

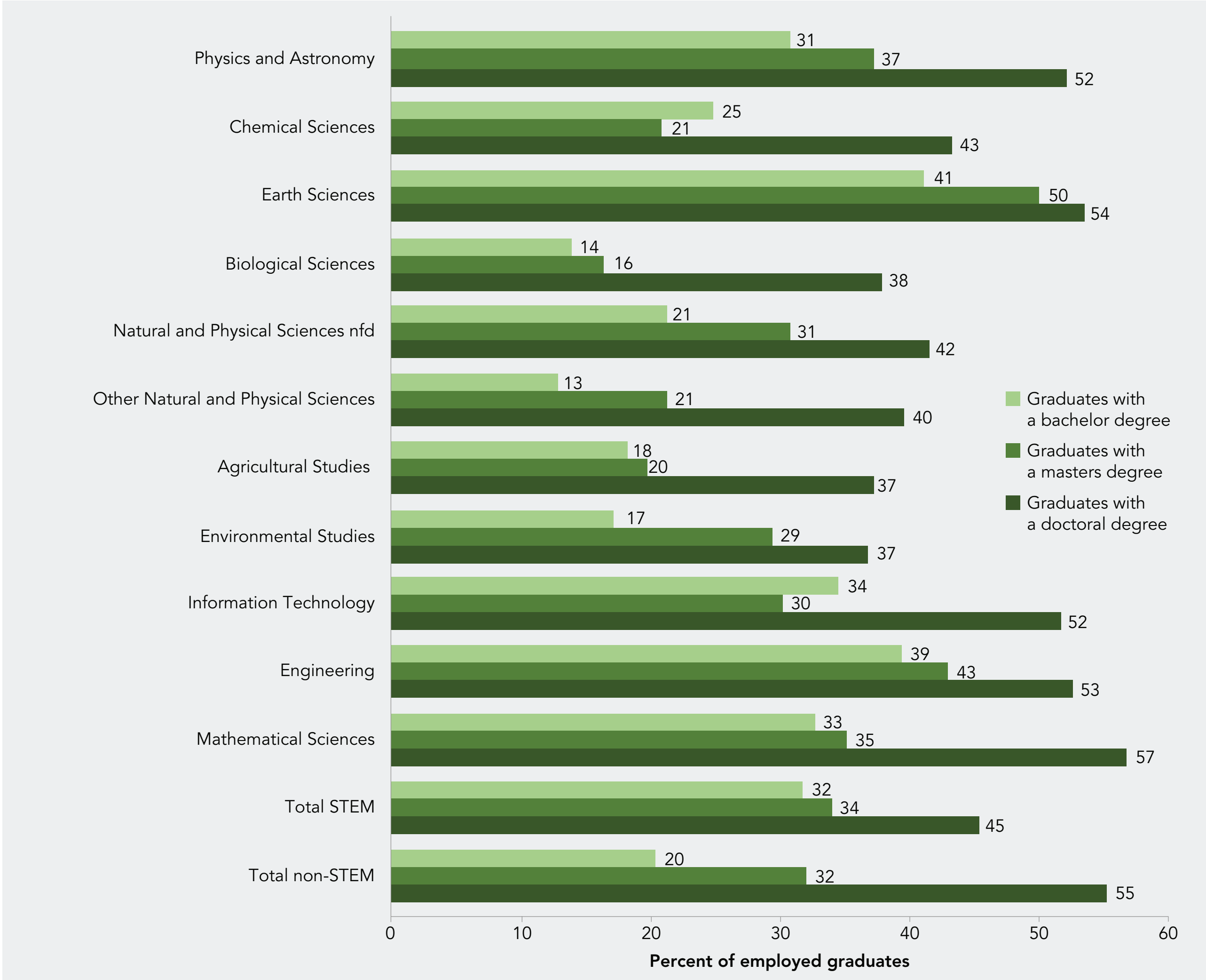
As shown in Figure 3.25 (Chapter 3, pg 61), in 2016 a higher proportion of employed STEM graduates had personal incomes in the highest bracket ($104 000 or above) than non-STEM graduates (34% and 24% respectively).

This section further investigates differences in income across fields of education, level of qualification, and gender.

WHICH STEM FIELD HAS THE MOST HIGH EARNERS?

Earth Science graduates had the largest proportion of bachelor graduates (41%) and masters graduates (50%) earning in the highest income bracket of $104 000 or above. Mathematical Sciences had the largest proportion of doctoral graduates (57%) earning in the highest income bracket (Figure 4.14).

Figure 4.14: Percentage of employed STEM graduates with an income of $104 000 or above, by level and field



Among those with bachelor qualifications, Other Natural and Physical Sciences graduates had the lowest proportion earning in the highest income bracket (13%), while for those with masters, Biological Sciences had the lowest proportion of graduates earning in the highest income bracket (16%). Of the STEM doctoral graduates, those qualified in Agricultural Sciences and Environmental Sciences had the lowest proportion earning in the highest income bracket (37%).

IS THERE A FINANCIAL ADVANTAGE TO COMPLETING POSTGRADUATE STUDIES?

Completing further study beyond a bachelor degree conferred a financial advantage across most STEM fields of education.

In 2016, across all STEM fields of education, a higher proportion of graduates who had completed a doctorate degree had an income in the highest bracket compared to those with masters or bachelor qualifications. Over half of all doctoral graduates from Physics and Astronomy, Earth Sciences, Information Technology, Engineering, and Mathematics had an income in the highest bracket. The largest percentage point difference between the proportion of bachelor and doctoral graduates earning in the highest bracket was for Other Natural and Physical Sciences, where 13% of bachelor and 40% of doctorate graduates had a personal income of $104 000 or above (Figure 4.14).

There were generally more masters graduates than bachelor graduates with an income in the highest bracket with the exception of bachelor graduates in the fields of Chemical Sciences and Information Technology.

There was also a large income difference among non-STEM graduates across qualification level. One-fifth (20%) of non-STEM bachelor graduates had a personal income of $104 000 or above, compared to over half (55%) of non-STEM doctoral graduates.

The Census collects information on the total income that a person usually receives each week. These weekly figures have been converted to the equivalent annual amounts and divided into income brackets. These brackets allow for the comparison of personal income across various populations.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

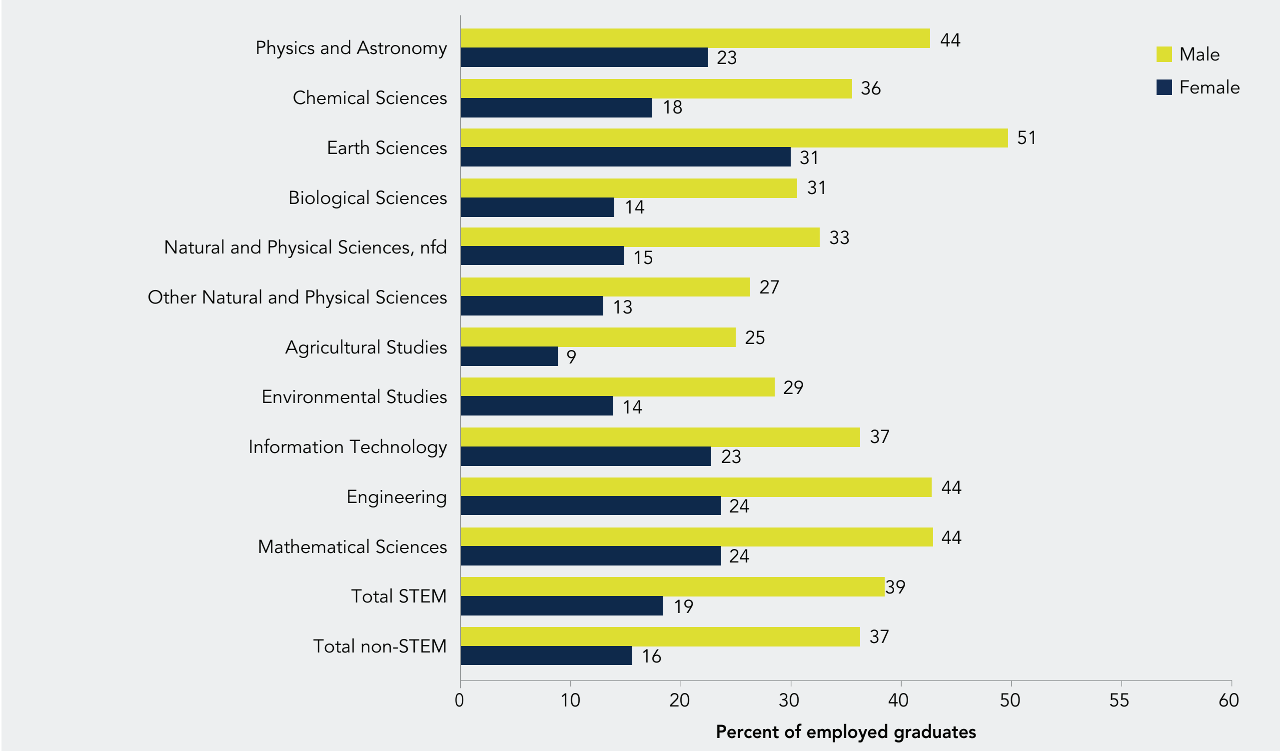
ARE FEMALE STEM GRADUATES PAID AS HIGHLY AS THEIR MALE EQUIVALENTS?

A higher proportion of male STEM graduates than female STEM graduates had an income in the highest bracket. Across the total STEM graduate population, 39% of male graduates had an income in the highest bracket, compared to 19% of female graduates. This difference was comparable to that among non-STEM graduates. The largest percentage point difference between the proportion of males and females with an income in the highest bracket was in Physics and Astronomy, at 21 percentage points, while the smallest difference, of 14 percentage points, was in Other Natural and Physical Sciences and Information Technology (Figure 4.15).

Earth Sciences was the field with the largest proportion of males (51%) and females (31%) with an income in the highest bracket, while Agricultural Studies had the lowest proportion of high income earners, at 25% of male graduates and 9% of female graduates.

For more analysis of the differences in employment outcomes between STEM qualified women and men, refer to Chapter 15, *Women in STEM*.

Figure 4.15: Percentage of graduates with an income of $104 000 or above, by gender and field[19]



19 Note this analysis includes people working full-time and part-time.

DO FEMALES EARN LESS BECAUSE MORE FEMALES WORK PART-TIME AND FEWER HAVE DOCTORATES?

As shown in Figure 4.16 to Figure 4.19, in 2016 there was a greater proportion of males compared to females who earned $104 000 or above, even when looking only at those working part-time (fewer than 35 hours per week) or at those working full-time across different levels of qualification.

Of the STEM bachelor graduates who worked full-time, between 1.5 and 2.1 times as many males had an income in the highest income bracket compared to females (Figure 4.16). Males aged 45 to 49 had the highest percentage earning $104 000 or above (56% of male STEM bachelor graduates in this age group). Females aged 40 to 44 had the highest percentage earning $104 000 or above (34% of female STEM bachelor graduates in this age group).

The gender differences in income were smaller when looking at STEM doctoral graduates who worked full-time (Figure 4.17). The largest difference in income was in the 30 to 34 age bracket, where 1.7 times more males than females had an income of $104 000 or above. The smallest difference was in the 65 and over age bracket, where a similar percentage of men and women had an income in the highest bracket. The highest earners were in the 55 to 59 age bracket, where 62% of females and 73% of males earned $104 000 or above.

Figure 4.16: Percentage of bachelor STEM graduates working full-time with an annual income of $104 000 or above, by age group and gender

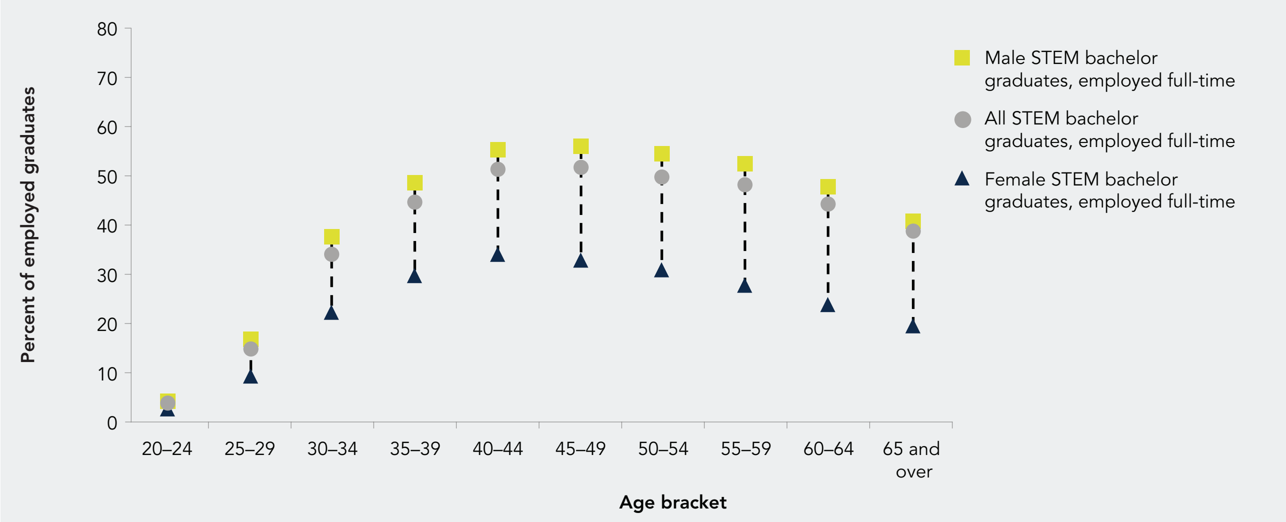
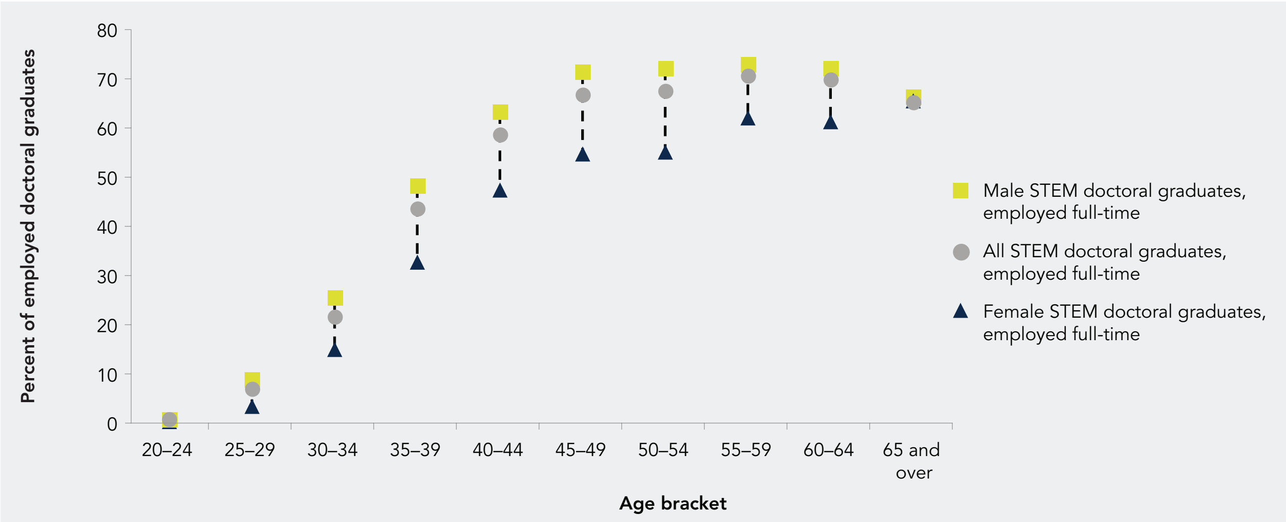


Figure 4.17: Percentage of doctorate STEM graduates working full-time with an annual income of $104 000 or above, by age group and gender



The gender differences in income were more substantial for graduates who worked part-time than those who worked full-time, for both bachelor and doctorate graduates. For bachelor graduates, at least twice as many males than females had an income in the highest bracket for all age brackets except those aged 25 to 29 (Figure 4.18). For doctorate graduates, the gender difference in income was highest for those aged 45 to 49, where 2.5 times more males than females had an income in the highest bracket (Figure 4.19).

While a greater proportion of STEM qualified females than STEM qualified males worked part time across most STEM fields (Chapter 3, Figure 3.8), the differences in hours worked does not fully explain the gender differences in income. The gender difference in part-time income cannot be accounted for by females working fewer hours than males. Analysis of the number of hours worked by part-time employed STEM graduates indicated that males and females worked almost the same number of hours per week (data not shown). Similarly, while a higher percentage of men held doctorate qualifications across most STEM fields (Figure 4.23), this also does not account for the difference in income overall.

Figure 4.18: Percentage of bachelor STEM graduates working part-time with an annual income of $104 000 or above, by age group and gender

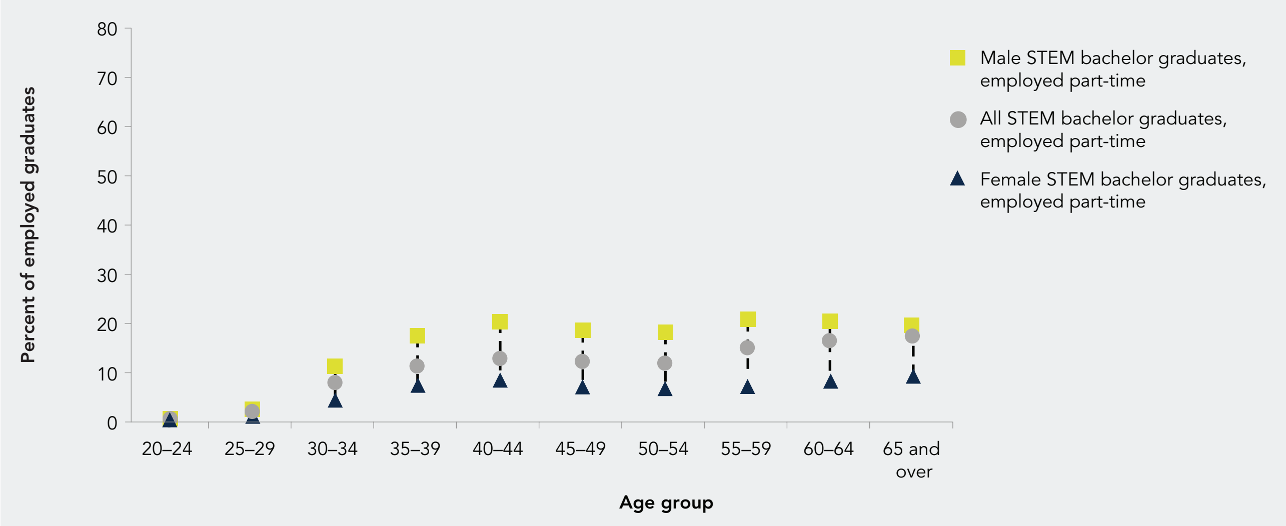
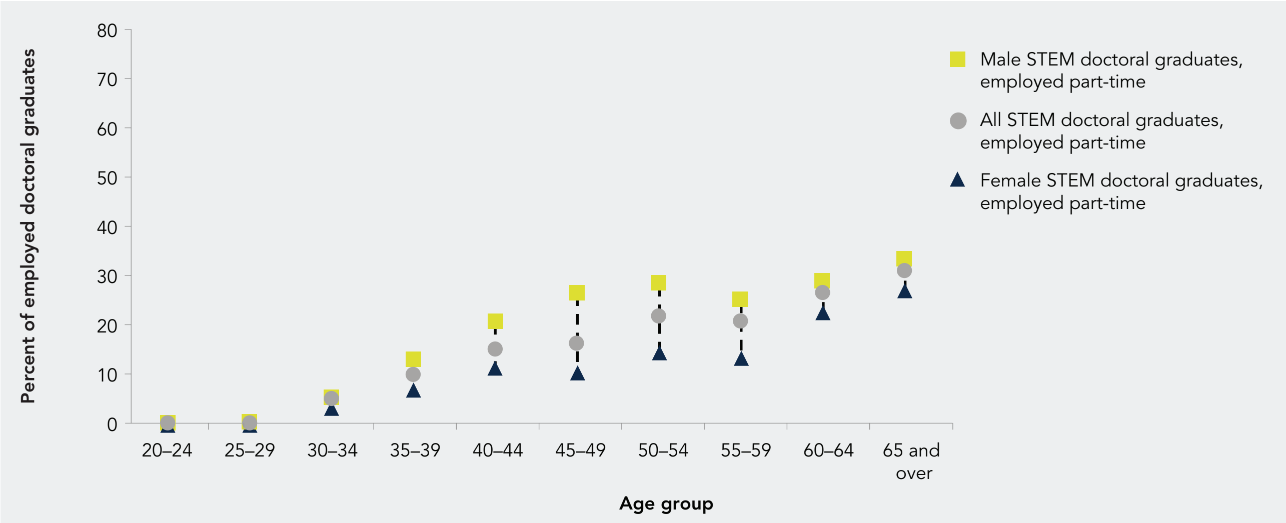


Figure 4.19: Percentage of doctorate STEM graduates working part-time with an annual income of $104 000 or above, by age group and gender



DOES HAVING CHILDREN AFFECT THE INCOMES OF FEMALE STEM GRADUATES?

Figure 4.20 and Figure 4.21 investigate the impact of having children on the incomes of employed female STEM graduates. Only full-time workers were analysed to improve comparability between genders.

Among those with STEM bachelor qualifications, a higher percentage of females with no children than females with children had an income of $104 000 or above, a trend that was persistent across all age brackets (Figure 4.20). For those with STEM doctoral qualifications there was no consistent pattern across female earnings—in some age brackets, a greater percentage of women with children than women without children had an income in the highest bracket (Figure 4.21).

At both levels of education, a lower percentage of women than men earned $104 000 and above across all age groups.

The Census collects data on the number of children ever born (live births) to each female, and these data were analysed along with the field of qualification and age group to investigate income differences. This data does not include adopted, step or fostered children, and does not indicate if those children are currently living.

For ease of discussion in this report, females who had never given birth to a live child are termed 'females with no children.'

Data was not available to directly compare the incomes of male graduates with and without children.

20 Note that the data points for STEM doctorate females in the age group 20-24 have been removed due to small sample sizes.

Figure 4.20: Percentage of full-time employed STEM bachelor graduates with an annual income of $104 000 or above, by age group, gender and number of children

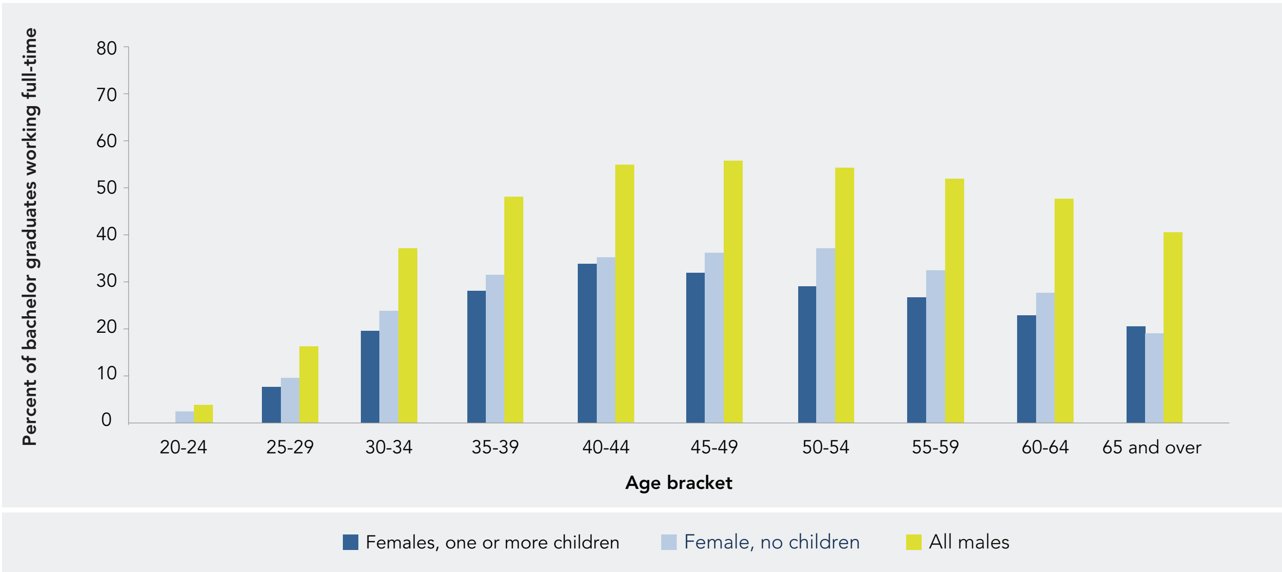
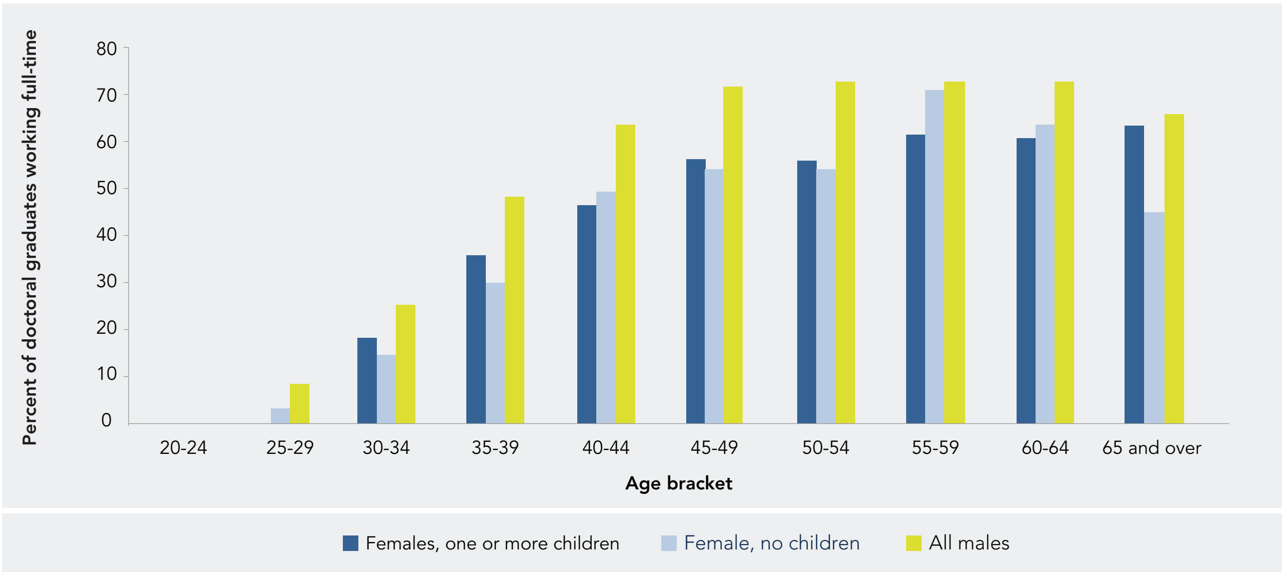


Figure 4.21: Percentage of full-time employed STEM doctoral graduates with an annual income of $104 000 or above by age group, gender and number of children[20]



STEM doctorates: is it all academic?

A doctoral degree, or PhD, is the highest qualification that can be awarded by Australian universities. Completing a doctorate is a significant investment in time and money for both the individual and the institution, and the research performed towards a doctorate provides one of the key avenues for original research to be performed.

Doctoral holders graduate with deep discipline knowledge and high level skills, such as research design and critical analysis. Graduates with doctorates are not confined to careers in academia and apply their skills across the economy, with a 2019 report finding that 51% of Australian doctoral students hoped to enter business or the public sector once they graduated (McCarthy & Wienk 2019).

This section contains an in-depth look at the destinations of STEM doctoral graduates in the Australian labour force.

Doctoral degrees include five degree types:

- higher doctorate;
- doctorate by research;
- doctorate by coursework;
- professional specialist qualification at doctoral degree level; and
- doctoral degree level nfd (not further defined).

HOW MANY PEOPLE IN THE STEM LABOUR FORCE HAVE A DOCTORATE?

In 2016, 7% of male STEM graduates and 8% of female STEM graduates in the labour force held a doctorate.

Between 2006 and 2016, the number of STEM doctoral graduates rose 56% from 34 307 to 53 600. Over the same period, the number of non-STEM doctoral graduates rose 68% from 38 342 to 64 247 (Table 4.4).

In 2016, 61% of the STEM doctoral graduates had a doctoral qualification in Science. Within the broad field of Science, the largest narrow field of education was Biological Sciences, which accounted for 38% of Science doctorates, and 23% of STEM doctorates.

The broad STEM field with largest absolute growth in the number of doctoral holders between 2006 and 2016 was also Science, which increased by 10 640 people over the decade, 4 577 of whom had a doctorate in Biological Sciences. The narrow STEM field with the largest percentage growth was Environmental Studies, where the number of doctoral graduates more than doubled over the decade, from 503 to 1 224.

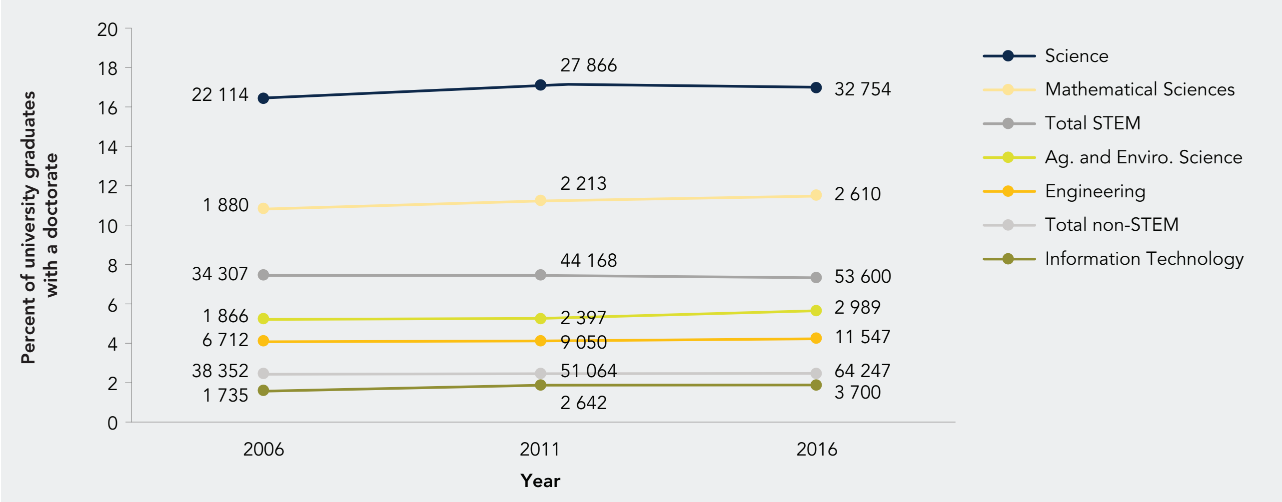
Table 4.6: Number of people in the labour force with a doctorate, by field and year

	2006	2011	2016
Science (Total)	22 114	27 866	32 754
Physics and Astronomy	2 549	2 995	3 392
Chemical Sciences	3 464	3 982	4 494
Earth Sciences	1 972	2 456	2 593
Biological Sciences	7 889	10 285	12 466
Other Natural and Physical Sciences	2 156	3 334	4 539
Natural and Physical Sciences, nfd	4 084	4 814	5 270
Agriculture, Environment and Related Studies (total)	1 866	2 397	2 989
Agricultural Studies*	1 363	1 517	1 765
Environmental Studies	503	880	1 224
Information Technology	**1 735**	**2 642**	**3 700**
Engineering	**6 712**	**9 050**	**11 547**
Mathematics	**1 880**	**2 213**	**2 610**
Total STEM	34 307	44 168	53 600
Total non-STEM	38 342	51 057	64 247

* Includes Agriculture, Horticulture and Viticulture, Fisheries Studies, Forestry Studies, Other Agriculture, Environment and Related Studies, and Agriculture, Environment and Related Studies not further defined.

Although the number of doctoral graduates increased dramatically in some fields over the decade to 2016, for the most part this growth matched the increases in the size of the university qualified populations in each field. For the total STEM and total non-STEM qualified populations, the vast increases in the number of doctoral holders (Table 4.6), translates to proportional changes of just 1 percentage point (Figure 4.22). For example, despite an increase of over 10 000 Science doctoral graduates between 2006 and 2016, the proportion of university Science graduates with a doctorate increased by just 1 percentage point, from 16% to 17%.

Figure 4.22: Proportion of university graduates in the Australian labour force who hold a doctorate, by field. The data labels show the total number of doctoral graduates in each field



WHAT IS THE GENDER DISTRIBUTION OF DOCTORAL GRADUATES?

In 2016 one-third (34%) of STEM doctoral graduates in the labour force were female, compared to half (50%) of non-STEM doctoral graduates (Figure 4.23). For context, 29% of the total university qualified STEM labour force and 61% of the university qualified non-STEM labour force were female.

The broad STEM field with the most doctoral graduates in the labour force was Science, which comprised 13 610 females (42%) and 19 143 males (58%; data not shown). The narrow (4-digit) fields of Natural and Physical Sciences (NPS) show substantial variation in gender distribution (Figure 4.24). The narrow STEM field with the lowest proportion of females was Physics and Astronomy (at 17% female), while Other Natural and Physical Sciences[21] was the only NPS narrow field with more females (54%) than males (46%). This was largely due to the 6-digit detailed field Medical Science where females made up 57% of the 3 021 doctoral graduates in the labour force.

21 The detailed fields within this grouping include: Medical Science, Forensic Science, Food Science and Biotechnology, Pharmacology, Laboratory Technology, Natural and Physical Sciences not elsewhere classified, and Other Natural and Physical Sciences not further defined.

Figure 4.23: Gender distribution of doctoral graduates in the labour force, by field. The data labels show the number of graduates

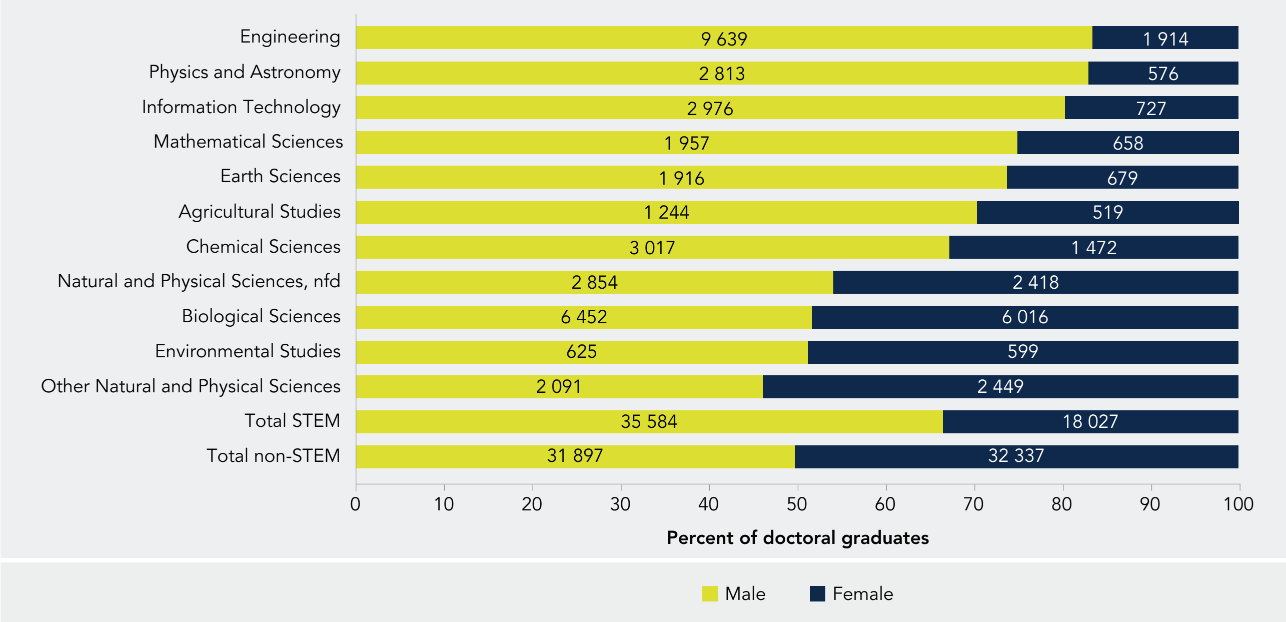
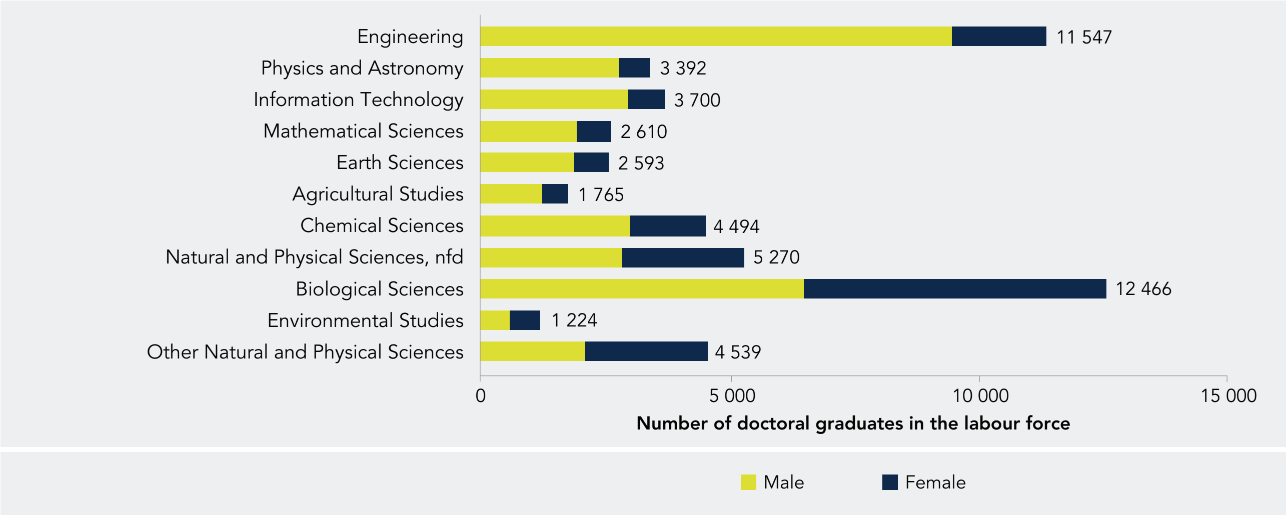


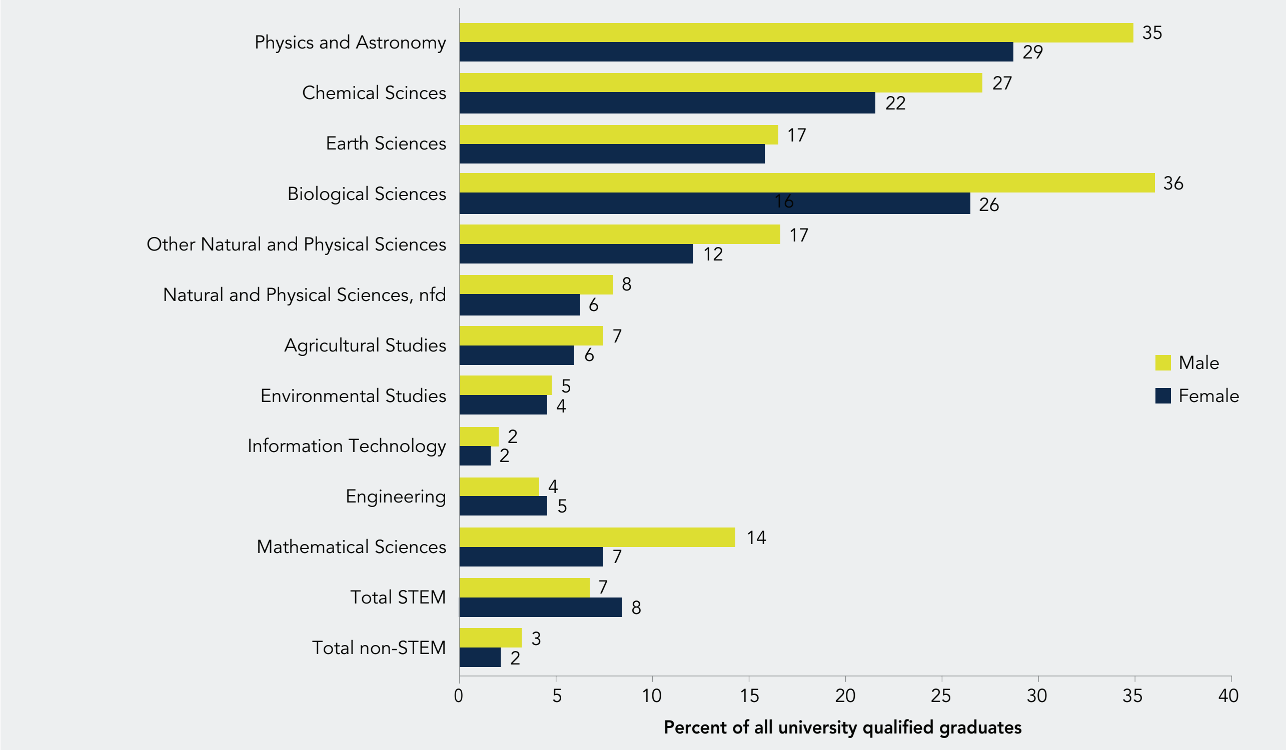
Figure 4.24: Number of doctoral graduates in the labour force, by field and gender. Data labels show the total number of doctoral graduates in each field



ARE FEMALES OR MALES MORE LIKELY TO GAIN A DOCTORATE IN A STEM FIELD?

In 2016, males and females had a similar likelihood of gaining a STEM doctorate once they held a university qualification (Figure 4.25). 7% of total male STEM graduates and 8% of total female STEM graduates in the labour force held a doctorate. However, a higher percentage of males than females held a PhD in all STEM fields except Engineering (Figure 4.25).

Figure 4.25: Percentage of male and female graduates in the labour force who held doctoral degrees, by field



WHERE WERE AUSTRALIA'S STEM DOCTORAL GRADUATES BORN?

In 2016, the majority of STEM doctoral graduates in the labour force (57%) were born outside Australia.[22] In comparison, just under half (49%) of the non-STEM doctoral qualified labour force was born outside Australia (Figure 4.26).

The proportions of doctoral graduates born outside Australia varied across STEM fields. Around half of the people in the labour force with doctorates in a Natural and Physical Sciences narrow field were born outside Australia, while around three-quarters of the doctoral qualified labour force in Engineering (72%) and Information Technology (74%) were born outside Australia.

The most common countries of birth for STEM doctoral graduates who were born outside Australia were China, England, and India (Figure 4.27).

Figure 4.26: Proportion of doctoral graduates in the labour force born in and outside Australia, by field

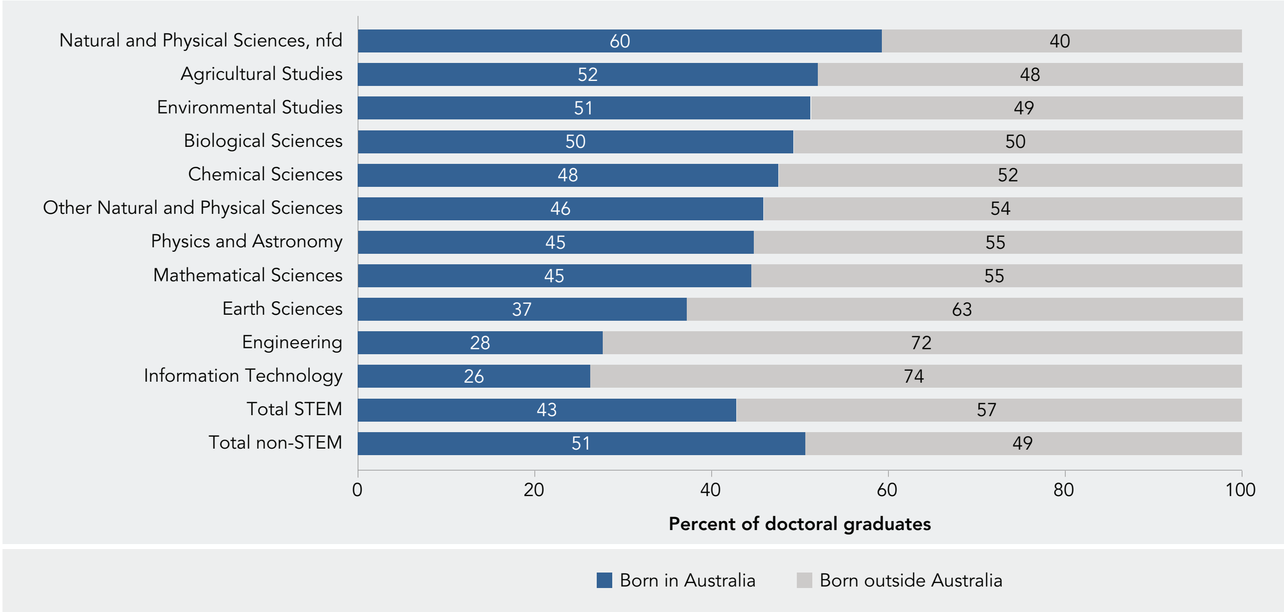
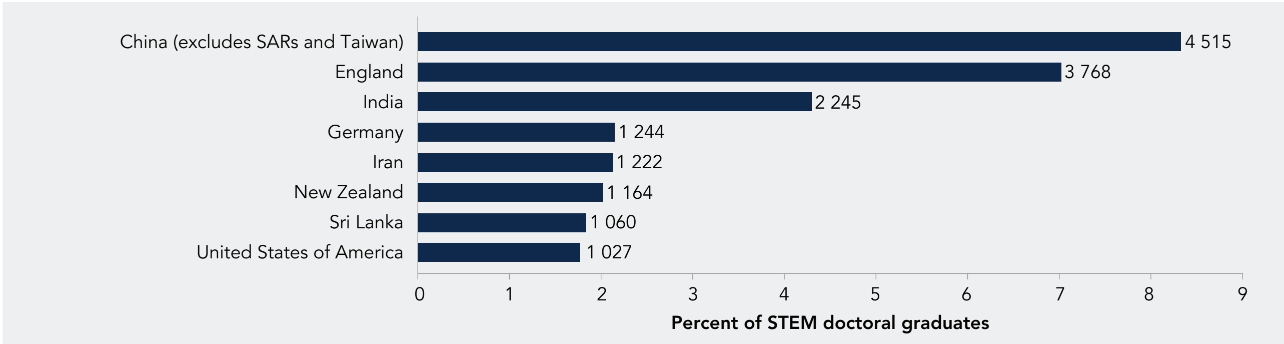


Figure 4.27: Top ten countries of birth of STEM doctoral graduates in the Australian labour force born outside of Australia. Data labels show the number of doctoral graduates born in each country[23]



22 These graduates include both those born and educated outside of Australia, and those born outside of Australia and awarded a doctorate from an Australian university.

23 The Special Administrative Regions (SARs) excluded from the China population here are Hong Kong and Macau.

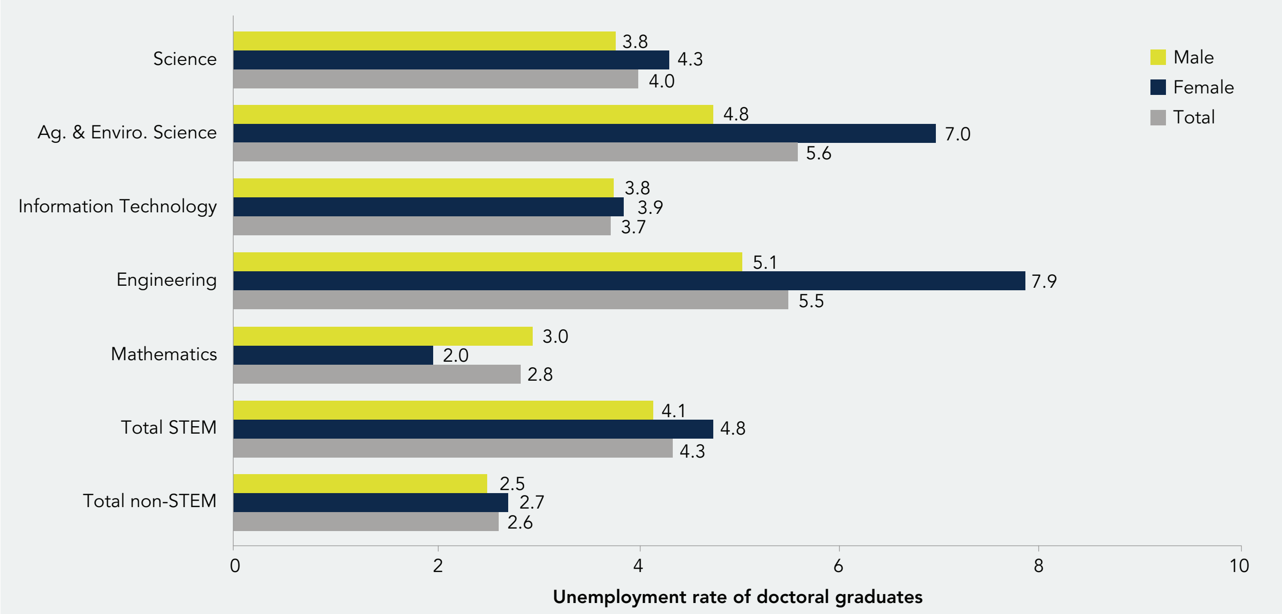
WHAT IS THE UNEMPLOYMENT RATE OF STEM DOCTORAL GRADUATES?

Doctoral graduates had a lower unemployment rate compared to all university graduates. Of the 53 619 STEM doctoral graduates in the labour force, 4.3% (2 331) were unemployed (Figure 4.28). Only 2.6% of non-STEM doctoral graduates were unemployed. For context, the unemployment rates of the total university qualified STEM and non-STEM populations were 5.7% and 3.8%, respectively (data not shown).

The STEM field with the highest unemployment rate for doctoral graduates was Engineering, where 7.9% of females and 5.1% of males were unemployed. Agriculture and Environmental Science followed closely behind with 7.0% of female and 4.8% of male doctoral graduates unemployed.

Female doctoral graduates had a higher unemployment rate than male doctoral graduates in every STEM field except Mathematics, where just 2.0% of female doctoral graduates were unemployed, compared to 3.0% of male doctoral graduates. It should be noted that in 2016, there were only 658 females with Mathematics doctorates in the labour force and 1 952 males.

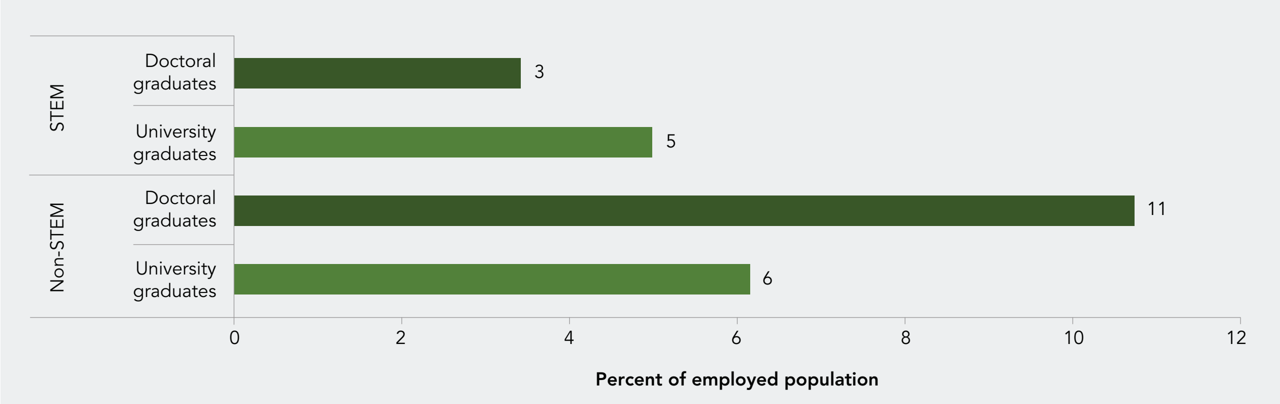
Figure 4.28: Unemployment rates of doctoral graduates, by field and gender



HOW MANY STEM DOCTORAL GRADUATES OWN THEIR OWN BUSINESS?

In 2016, 3% of employed STEM doctoral graduates owned a business that had at least one employee, compared to 11% of non-STEM doctoral graduates (Figure 4.29). A greater proportion of non-STEM doctorate holders than the general non-STEM graduate population owned a business with at least one employee, while for those with STEM qualifications, a lower proportion of doctoral holders than total university graduates owned a business with at least one employee.

Figure 4.29: Percentage of employed graduates who owned a business, by field and level, 2016

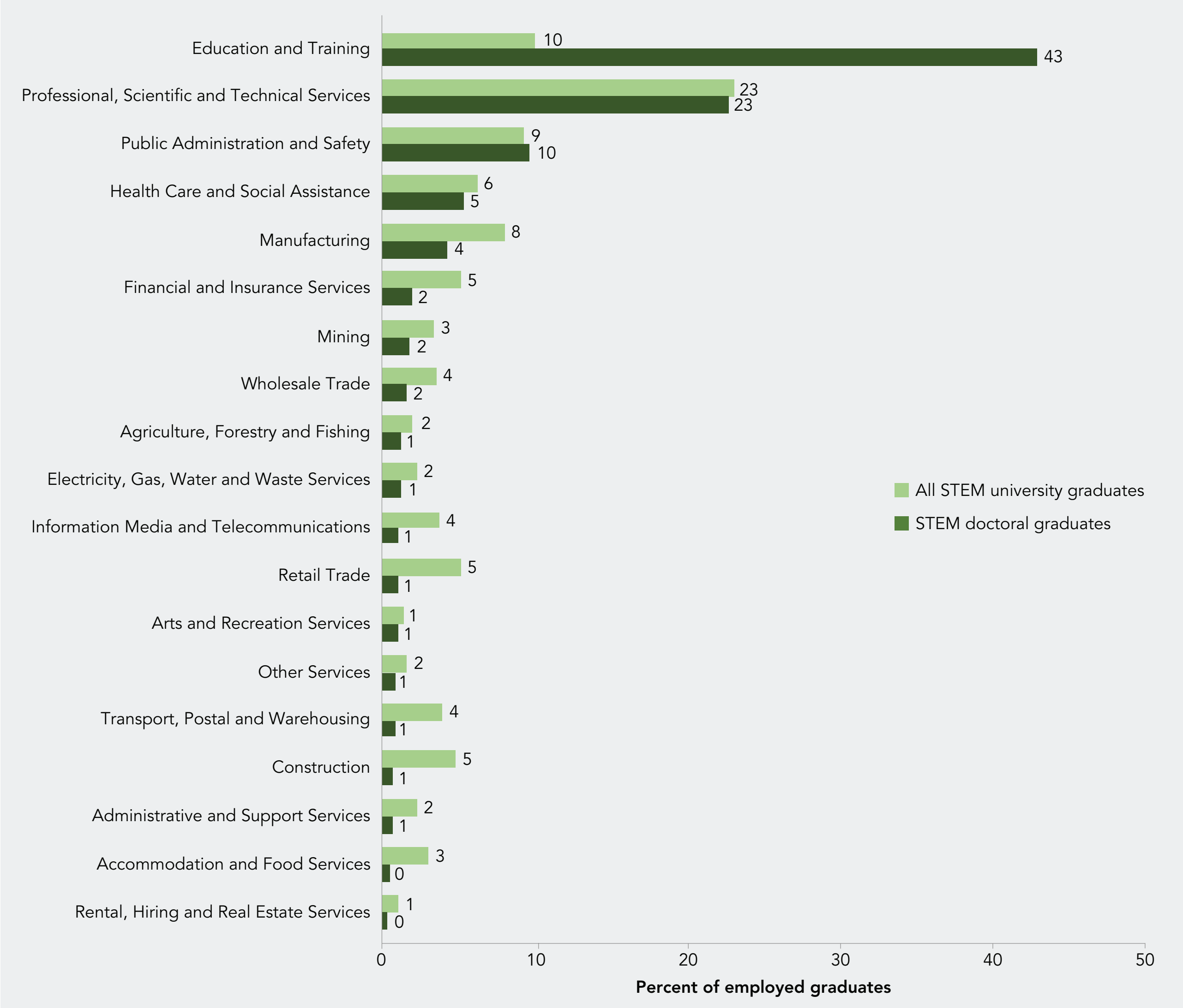


WHICH INDUSTRIES EMPLOY STEM DOCTORAL GRADUATES?

The majority of STEM doctoral graduates were employed in the industry divisions of Education and Training, and Professional, Scientific and Technical Services at 43% and 23%, respectively (Figure 4.30). Education and Training was the top industry division of employment for all STEM doctoral graduates across all fields of education.

More detailed analyses of the industries that employ doctoral graduates are included by field in Chapters 5 to 14 of this report.

Figure 4.30: Industry division of employment of STEM graduates, by level of education

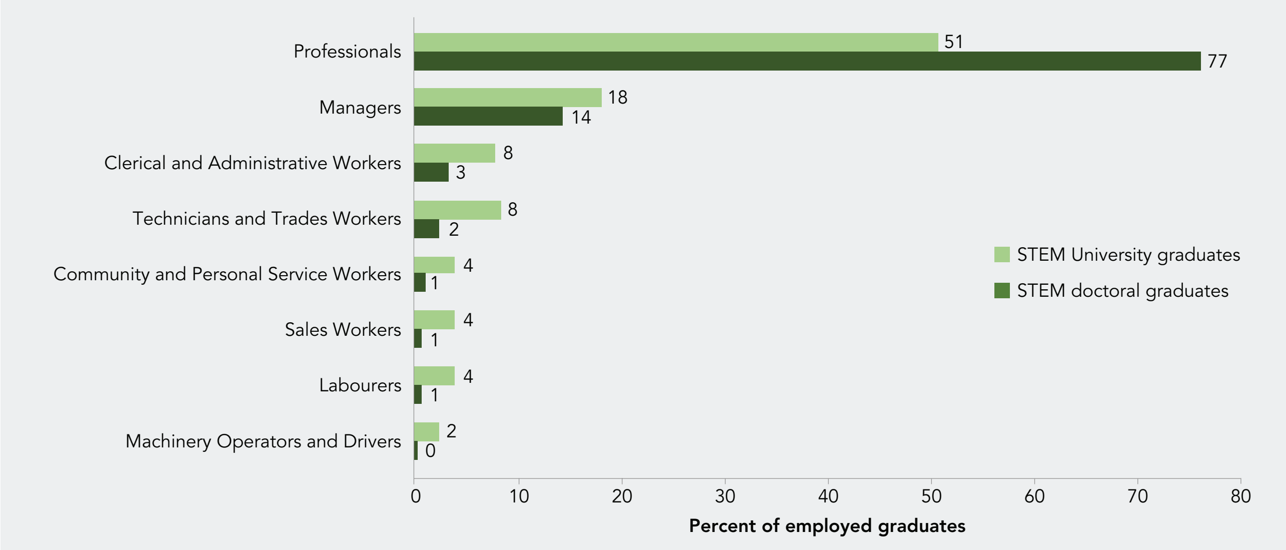


HOW DO THE OCCUPATIONS OF STEM DOCTORAL GRADUATES COMPARE TO THE GENERAL STEM QUALIFIED GRADUATE POPULATION?

The majority of STEM doctoral graduates (77%) worked in the major group occupation of Professionals (Figure 4.31). A further 14% were employed as Managers. For the general STEM qualified graduate population, there was a greater distribution amongst the different occupation classes, although just over half (51%) of workers were employed as Professionals.

At the more detailed minor group level of occupation classification, the most common occupations for STEM doctoral graduates were Natural and Physical Sciences Professionals (26%) and Tertiary Education Teachers (18%) (data not shown).

Figure 4.31: Occupation class of STEM qualified graduates, by level



CHAPTER 5

5

STEM PATHWAYS: PHYSICS AND ASTRONOMY

What is Physics and Astronomy?

Physics and Astronomy is the study of the laws governing the structure of the universe and the forms of matter and energy. The main purpose of this narrow field of education is to develop an understanding of the fundamental properties of the universe and the laws which govern its behaviour and to assess and validate physical phenomena.

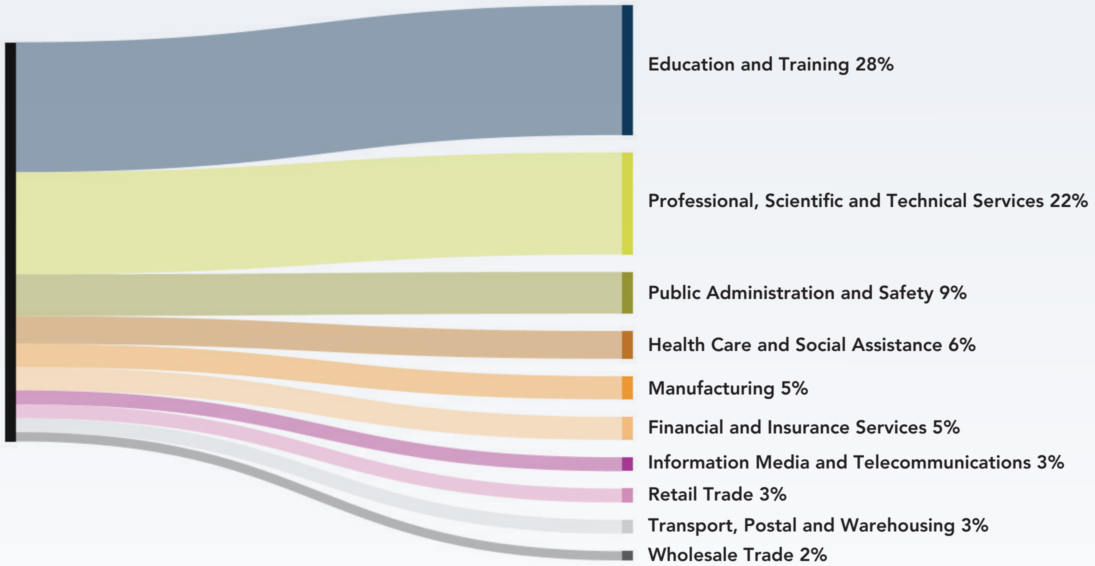
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Physics and Astronomy. Comparisons to STEM and non-STEM populations are also restricted to those with university qualifications.

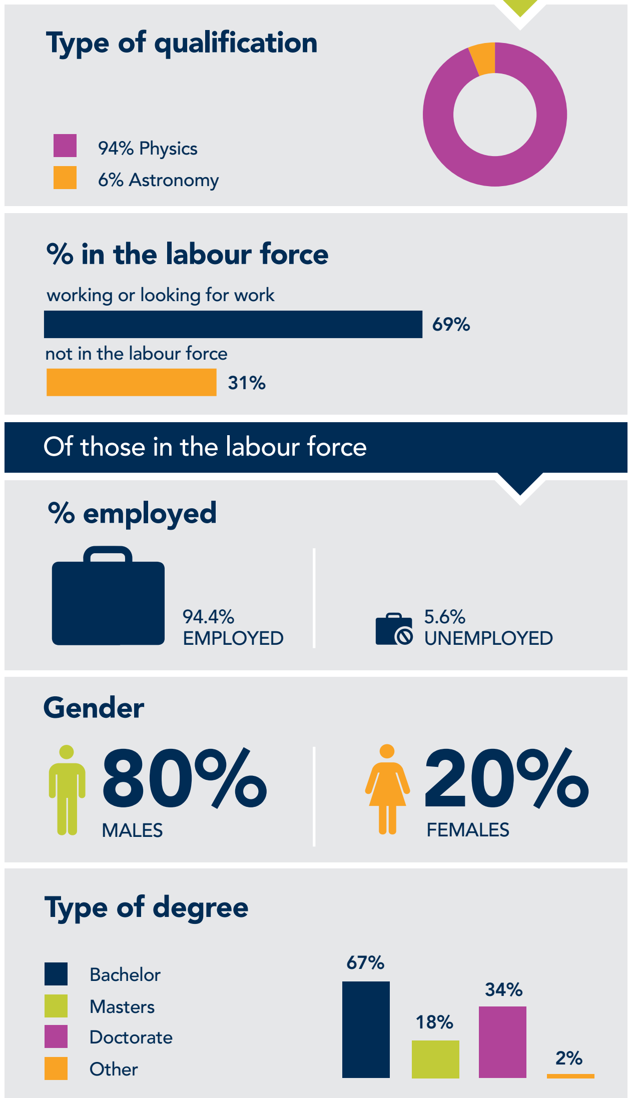
HIGHLIGHTS

- In 2016, there were 14 519 people with university Physics and Astronomy qualifications in Australia. Of these, 10 069 people were in the labour force, of whom 9 502 were employed.
- 20% of Physics and Astronomy graduates in the labour force were female, an increase of 2 percentage points since 2011.
- Employed male Physics and Astronomy graduates were older than employed female Physics and Astronomy graduates, and older than the overall employed STEM qualified graduates.
- Three-quarters of employed graduates with a Physics and Astronomy bachelor degree worked in the private sector, compared to half of those with a masters or a doctorate.
- Half of all Physics and Astronomy graduates were employed in two industry divisions: Education and Training (28%), and Professional, Scientific and Technical Services (22%).
- The most common occupation for Physics and Astronomy graduates was University Lecturers and Tutors, the role held by 9% of graduates.
- Nearly a third (31%) of Physics and Astronomy bachelor graduates and over half (52%) of doctoral graduates had an income of $104 000 or above.

Top ten industries of employment for Physics and Astronomy graduates



14 519 people in Australia had a university qualification in Physics and Astronomy



The Physics and Astronomy qualified population

In 2016, there were 14 519 people in Australia with university qualifications in the field of Physics and Astronomy, an increase of over 2 300 people from 2011.

94% were Physics graduates and 6% were Astronomy graduates.

The Physics and Astronomy labour force

Of the qualified population, 69% (10 069 people) were in the labour force, either working or looking for work. In 2016, females made up 20% of the Physics and Astronomy labour force, an increase of 2 percentage points from 2011.

The unemployment rate in this field was 5.0% for males and 7.9% for females, up from 4.1% and 6.5% in 2011.

Just over one-third (34%) of Physics and Astronomy graduates in the labour force had a doctorate—the highest percentage of doctorates in all of the narrow fields of Natural and Physical Sciences. In comparison, only 7% of STEM graduates in the labour force and 3% of non-STEM graduates in the labour force had doctorates.

The gender split of Physics and Astronomy doctorate holders in the labour force (85% male, 15% female) was unchanged from 2011.

Employed Physics and Astronomy graduates

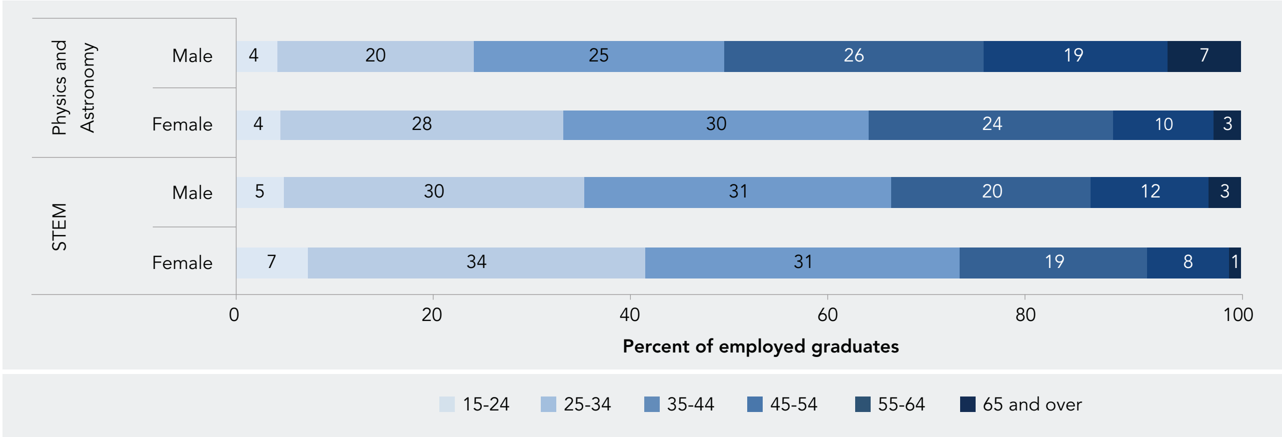
In 2016, on Census night, 9 502 university qualified Physics and Astronomy graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Physics and Astronomy graduate workforce?

In 2016, male Physics and Astronomy graduates were noticeably older than the comparative populations of female Physics and Astronomy graduates, and the overall STEM populations of both genders.

While the majority of employed male Physics and Astronomy graduates were aged 45 and over (52%), the majority of employed female graduates were younger than 45 (63%; Figure 5.1). The majority of the overall employed STEM populations of both genders were also younger than 45.

Figure 5.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Physics and Astronomy graduates work?

In 2016, 75% of employed people with a Physics and Astronomy bachelor degree worked in the private sector, compared to 50% of those with a masters or a doctorate (data not shown).

INDUSTRIES OF EMPLOYMENT

As was outlined in Figure 4.11 (Chapter 4), half of employed Physics and Astronomy graduates worked in two industry divisions in 2016: Education and Training (28% of graduates) and Professional, Scientific and Technical Services (22%). The remainder were spread across the other 17 industry divisions (Figure 5.2). This distribution is similar to that in 2011, when 26% of employed graduates worked in Education and Training, and 24% in Professional, Scientific and Technical Services.

> Industries are classified in four levels:
> - Divisions (the broadest level)
> - Subdivisions
> - Groups
> - Classes (the most detailed level)

Compared to the whole cohort, doctoral graduates were more concentrated in Education and Training, with almost half of those who were working employed in this division (47%; Figure 5.3). These industries and proportions were similar in 2011.

Figure 5.2: Top ten industry divisions of employment for Physics and Astronomy graduates with university qualifications, by gender

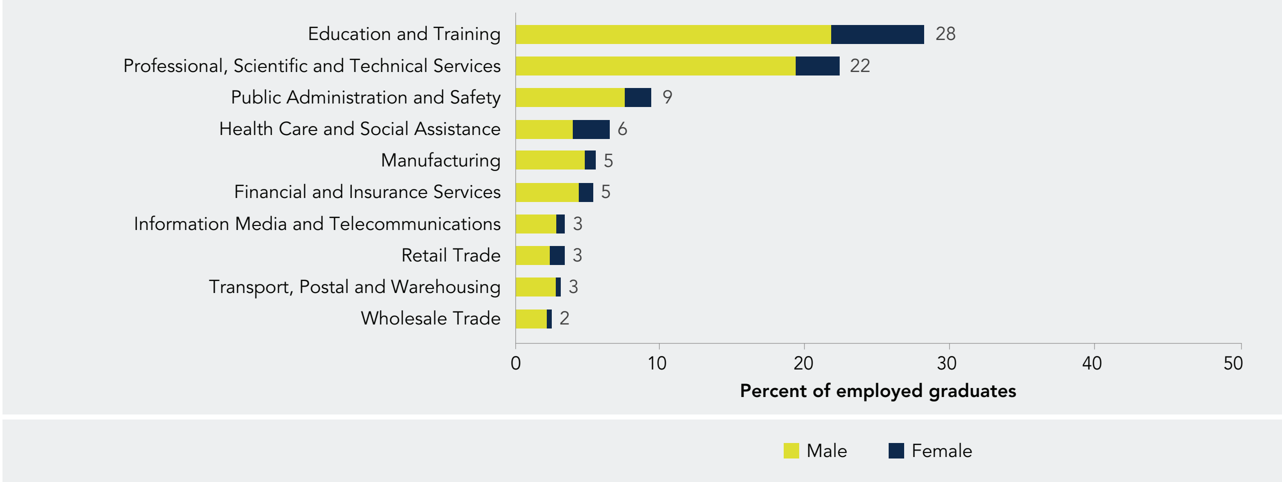
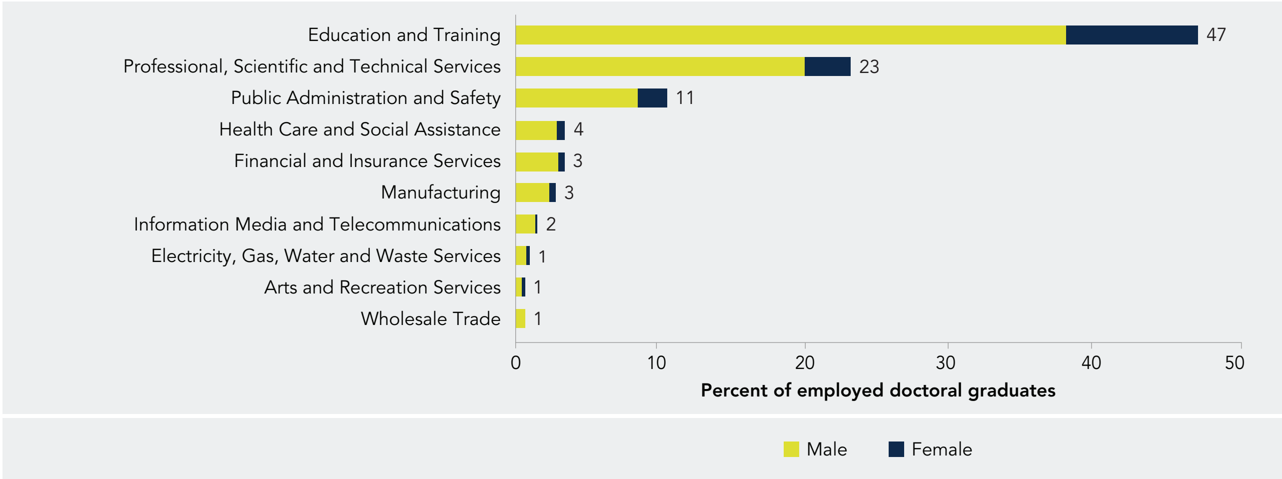


Figure 5.3: Top ten industry divisions of employment for Physics and Astronomy doctoral graduates, by gender



Further analysis showed that a greater proportion of female graduates than male graduates were employed in the Education and Training division, which employed around one-third of working females with Physics and Astronomy qualifications, and one-quarter of working males (32% and 27% respectively). In comparison, the Professional, Scientific and Technical Services division employed 15% of female graduates and around one-quarter of male graduates (data not shown).

At the most detailed industry level, the largest industry class was Higher Education, where one-fifth of employed graduates (20%; Figure 5.4) and 41% of doctoral graduates (Figure 5.5) worked. The next most popular industry class for doctoral graduates was Scientific Research Services, which employed 11% of this cohort.

Figure 5.4: Top ten industry classes of employment of Physics and Astronomy graduates with university qualifications, by gender

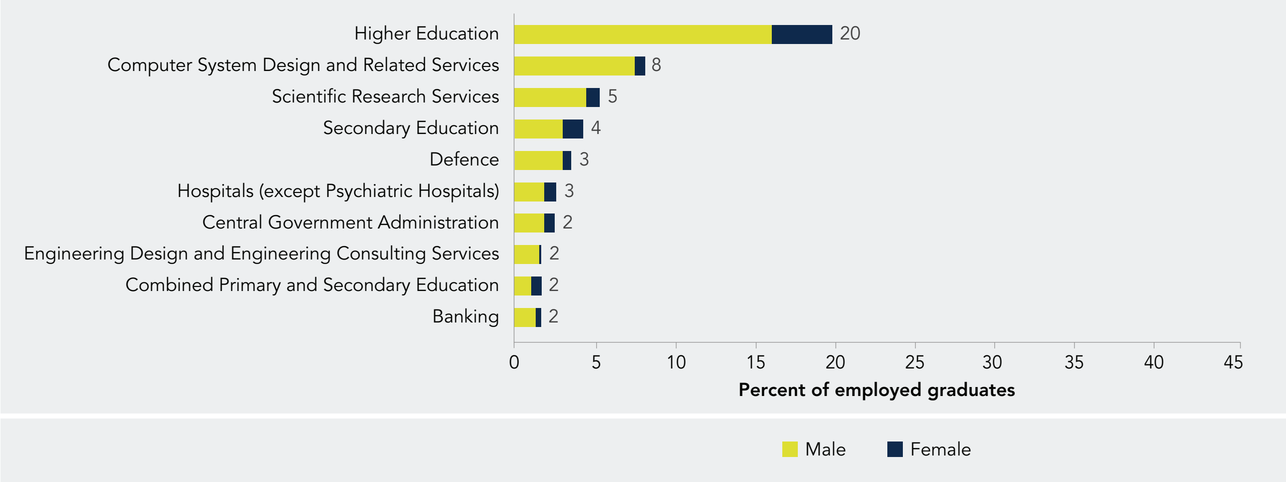
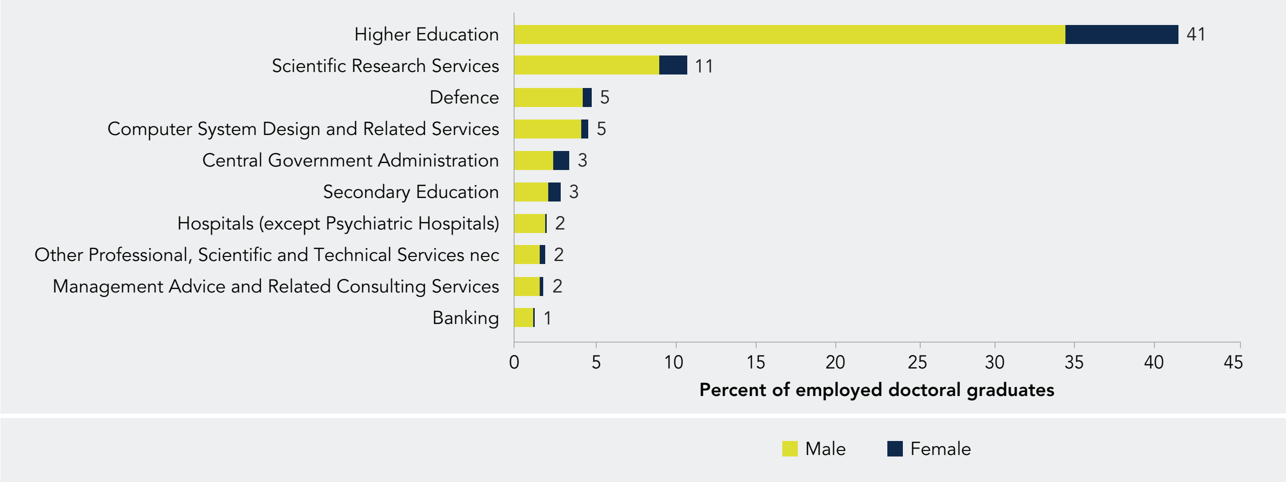


Figure 5.5: Top ten industry classes of employment of Physics and Astronomy doctoral graduates, by gender



What are the occupations of Physics and Astronomy graduates?

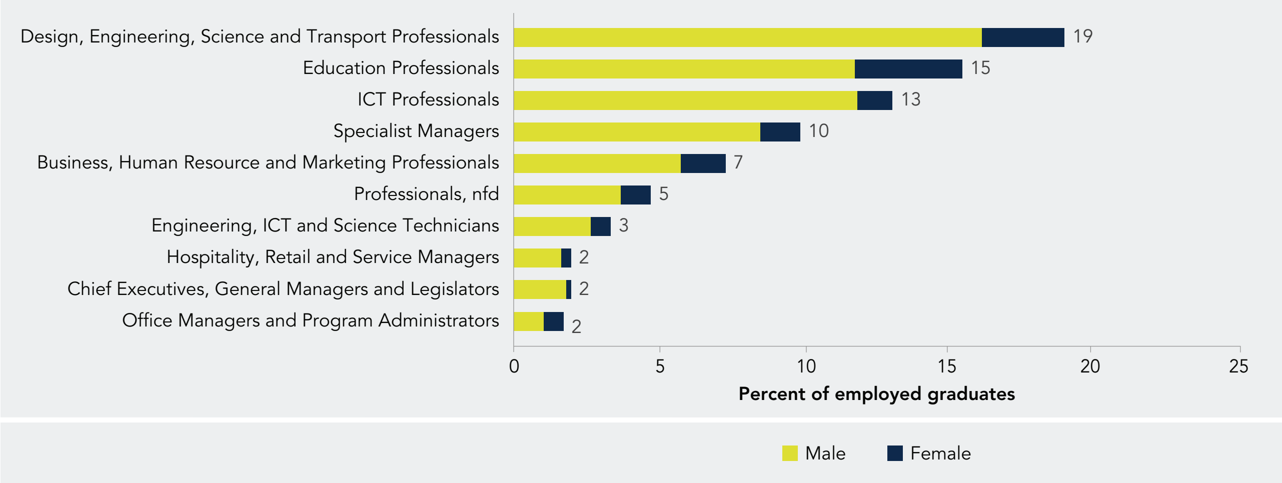
In 2016, the majority of Physics and Astronomy graduates were employed in the major occupational group of Professionals (61%), while Managers was the second most common occupation, at 15% (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

The more detailed sub-major occupations reflect this distribution of graduates, with almost half of all working graduates employed as professionals in three sub-major occupations: Design, Engineering, Science and Transport Professionals (19%), Education Professionals (15%), and ICT Professionals (13%; Figure 5.6). The most common sub-major occupation for females was Education Professionals (18% of females), while for males was Design, Engineering, Science and Transport Professionals (20% of males).

Figure 5.6: Top ten sub-major group level occupations of Physics and Astronomy graduates with university qualifications, by gender



Analysis of occupations at the unit group level gives an even more detailed picture. In 2016, the most common unit group occupation for both bachelor and doctoral graduates was University Lecturers and Tutors (Figure 5.7 and Figure 5.8).

Are Physics and Astronomy graduates high earners?

In 2016, Physics and Astronomy bachelor graduates earned less than STEM qualified bachelor graduates, while those with a doctorate earned more than STEM qualified doctoral graduates.

> The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

Nearly a third (31%) of employed Physics and Astronomy bachelor graduates had an income in the highest bracket of $104 000 or above, which was a larger percentage than the non-STEM qualified cohort, but less than the STEM qualified graduate cohort (Figure 5.9). At the other end of the income scale, approximately a quarter (26%) of employed Physics and Astronomy bachelor graduates had an income in the lowest bracket (less than $41 600), an increase of 1 percentage point since 2011.

Figure 5.7: Top ten unit group level occupations of Physics and Astronomy graduates with university qualifications, by gender

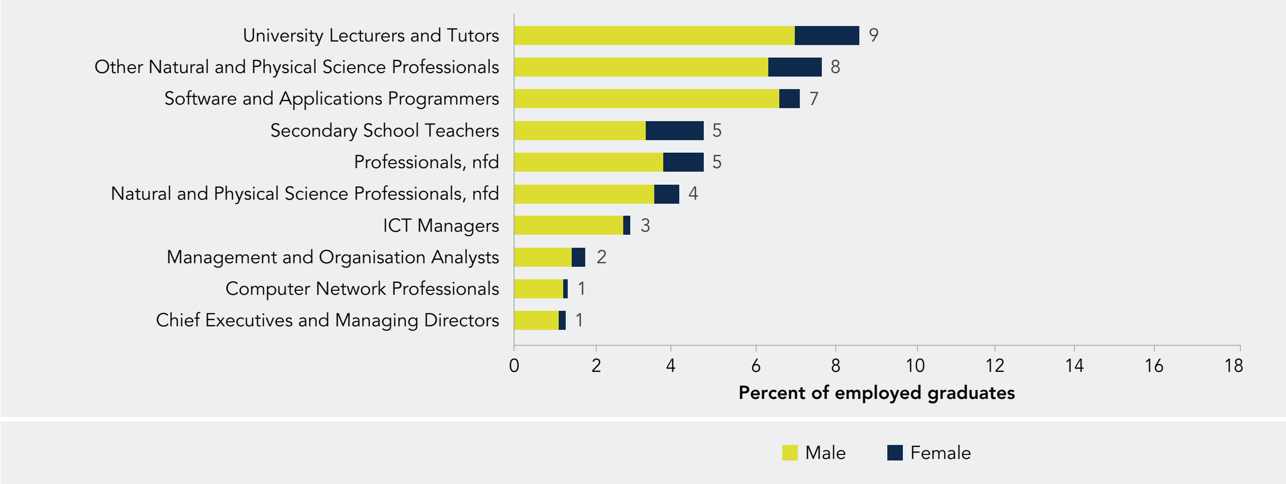
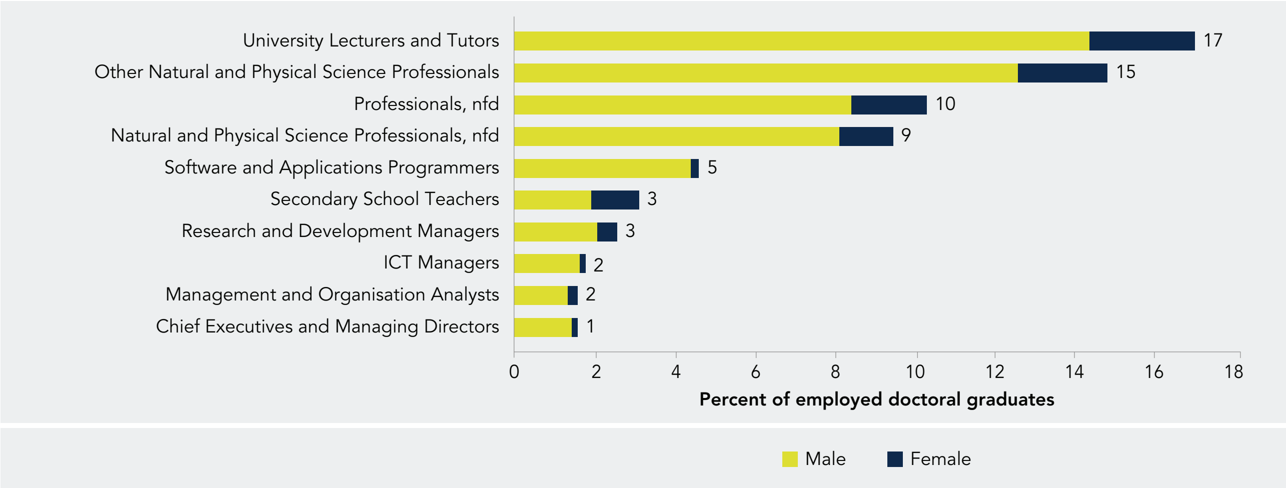


Figure 5.8: Top ten unit group level occupations of Physics and Astronomy doctoral graduates, by gender



Income is closely related to gender and full-time or part-time employment (Figure 5.10). Substantially more male than female bachelor graduates had an income in the highest bracket, at 35% and 14%, respectively. Of those with doctoral degrees, over half of males (56%) were in the highest bracket, compared to just 37% of females with the same level of qualification. A greater proportion of males worked full-time than females, increasing their capacity to earn in the highest bracket. 78% of male bachelor graduates and 85% of male doctoral graduates worked full-time, compared to 57% of female bachelor graduates and 74% of female doctoral graduates.

Figure 5.9: Personal annual income of graduates, by field and level of qualification

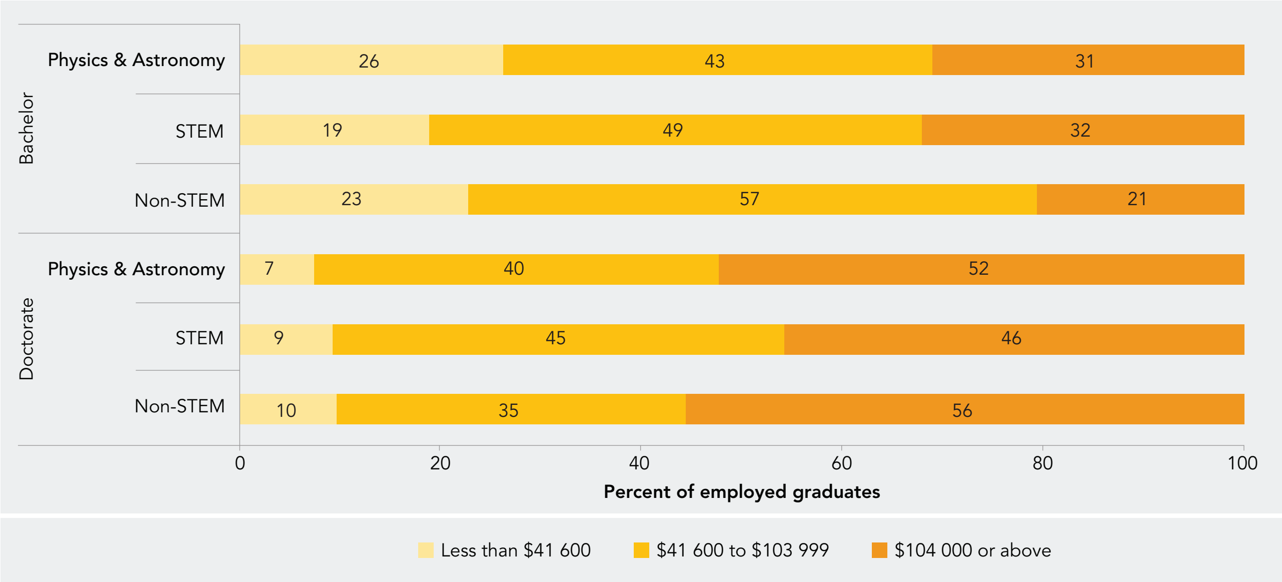
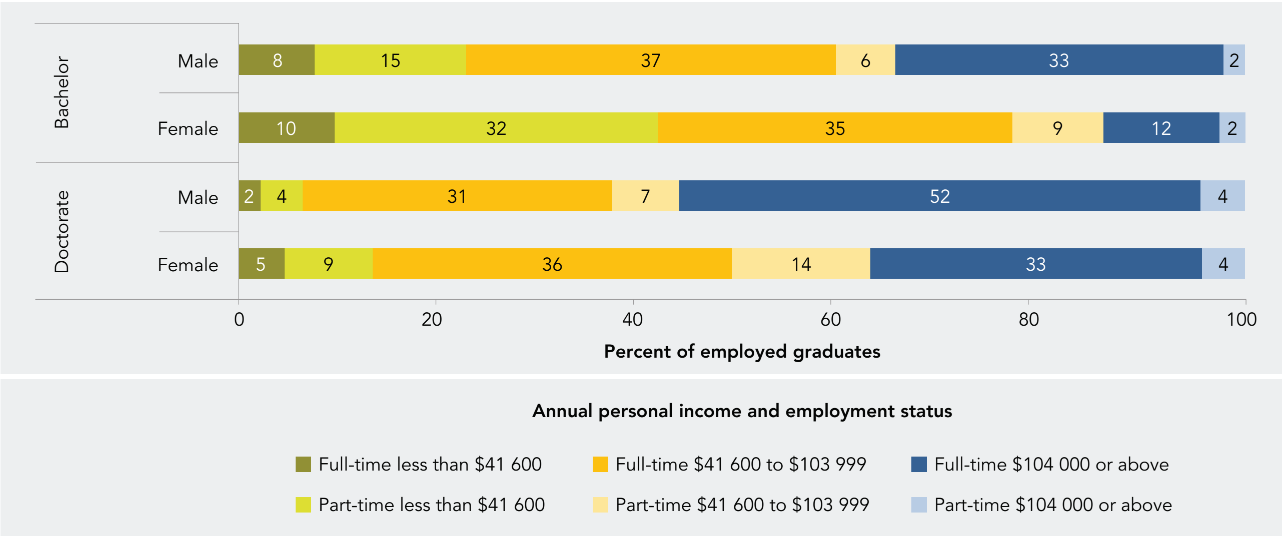


Figure 5.10: Personal annual income of Physics and Astronomy graduates working full-time and part-time, by gender and level of qualification



Along with gender, age is also an important factor in the income levels of graduates. Among bachelor graduates, those aged 45 to 49 had the largest percentage of workers earning in the highest income bracket (49% of males and 24% of females; Figure 5.11). For all age brackets over age 35, more than double the percentage of males than females were in the highest income bracket.

For those with doctoral qualifications, the proportion of males earning in the highest bracket peaked at the same age as for bachelor graduates (45 to 49). The female peak was at age 50 to 54, where a similar proportion of males and females earned $104 000 or above (Figure 5.12). The differences between the proportions of males and females in the highest bracket across all age groups were generally smaller for those with doctoral qualifications compared to those with bachelor qualifications.

Figure 5.11: Percentage of bachelor degree graduates with an income of $104 000 or above, by field, age group and gender

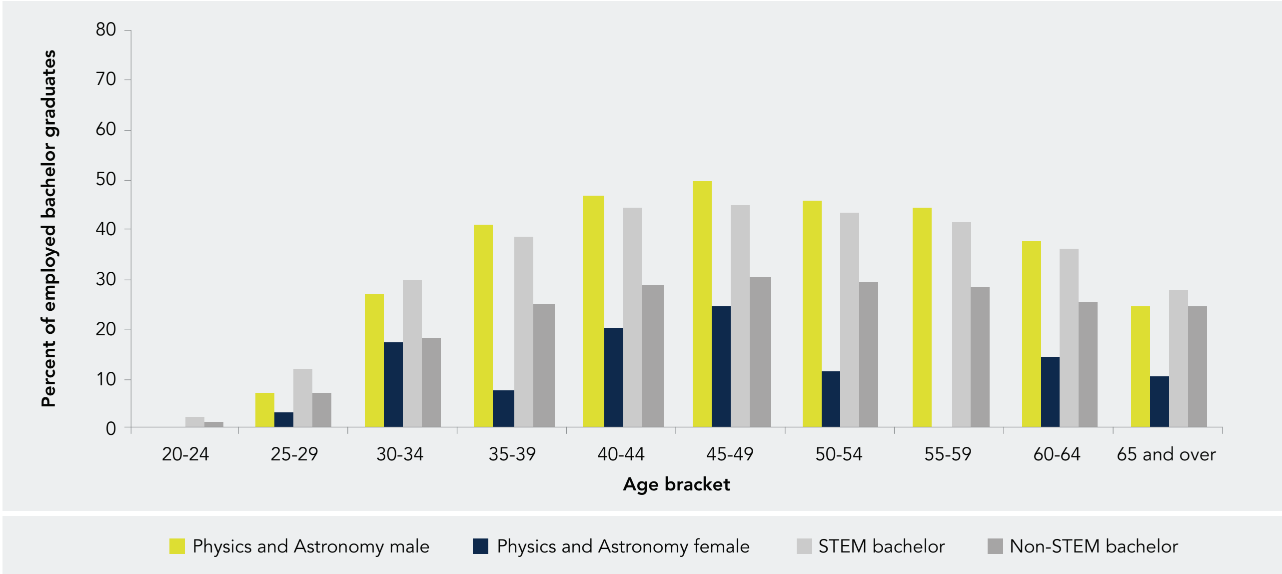
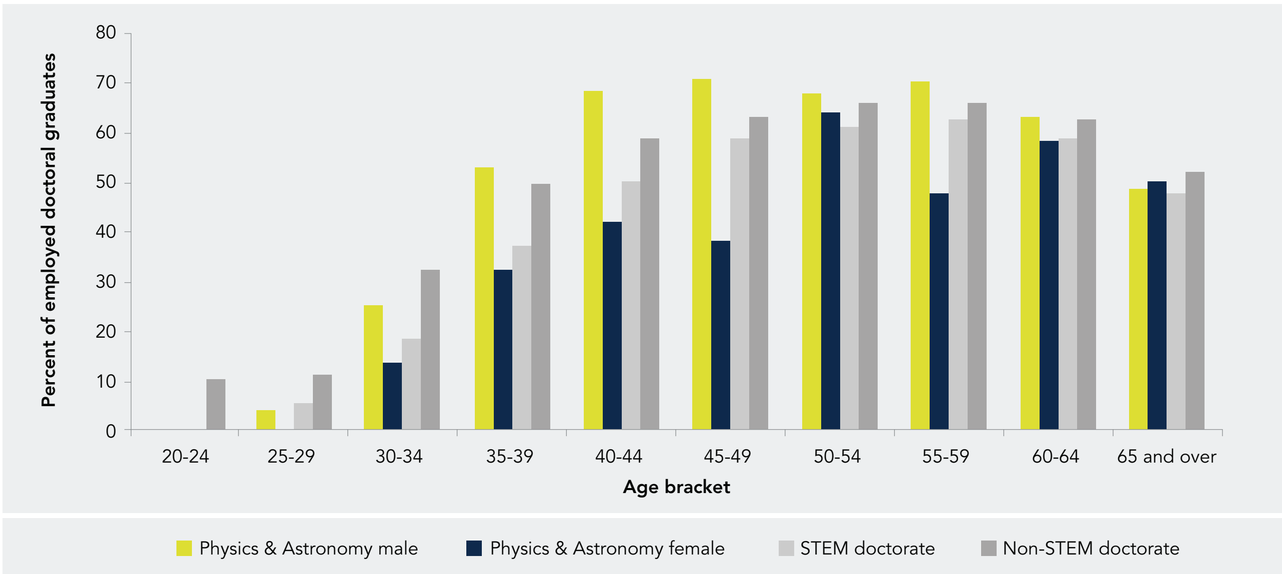


Figure 5.12: Percentage of doctoral degree graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 6

6

STEM PATHWAYS: CHEMICAL SCIENCES

What is Chemical Sciences?

Chemical Sciences is the study of the composition, structure, and the chemical transformations of matter. The main purpose of this narrow field of education is to develop an understanding of the fundamental properties of elements, compounds and materials, and their reactions and transformations.

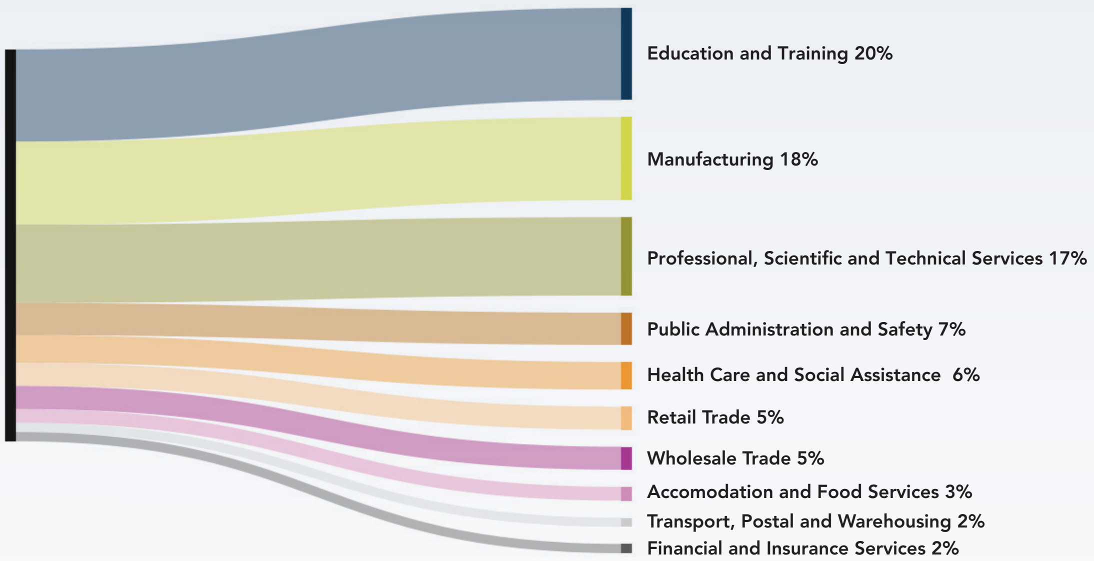
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Chemical Sciences. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

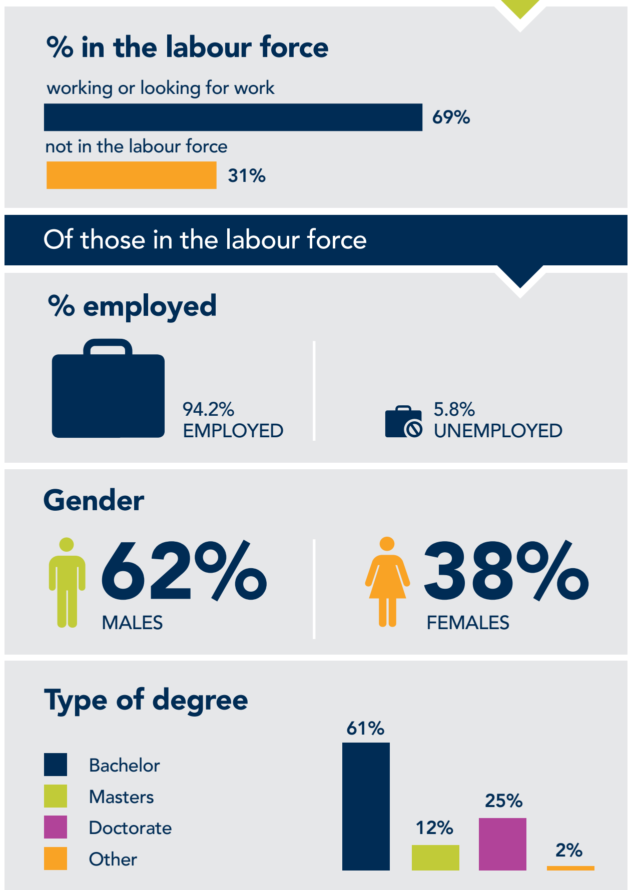
HIGHLIGHTS

- In 2016, there were 26 127 people with university qualifications in the field of Chemical Sciences. Of these, 17 690 people were in the labour force, of whom 16 919 were employed.
- Nearly two-thirds (62%) of Chemical Sciences graduates in the labour force were male, a decrease of 2 percentage points since 2011.
- The Chemical Sciences workforce was older than the general STEM qualified workforce, with 56% of males and 45% of females aged over 45.
- The private sector employed 73% of all Chemical Sciences graduates, with Education and Training and Manufacturing the top two industries of employment.
- Almost two-thirds of working Chemical Sciences graduates were employed as either Professionals (41%) or Managers (22%), and one in ten were employed as Chemists and Food and Wine Scientists.
- A lower proportion of Chemical Sciences graduates had an income in the top bracket than the overall STEM workforce. One-quarter of Chemical Sciences bachelor graduates and 44% of doctorates earned an income of $104 000 or above.

Top ten industries of employment for Chemical Sciences graduates



26 127 people in Australia had a university qualification in Chemical Sciences



The Chemical Sciences qualified population

In 2016, there were 26 127 people in Australia with university-level qualifications in the field of Chemical Sciences, an increase of over 3 000 people since 2011.

The Chemical Sciences labour force

Of the qualified population, 69% (17 960 people) were in the labour force, either working or looking for work. Females made up 38% of the Chemical Sciences labour force, an increase of 2 percentage points since 2011.

The unemployment rate in this field was 5.2% for males and 6.8% for females, up from 3.5% and 5.1% in 2011.

One quarter of Chemical Sciences graduates in the labour force had a doctoral degree, a higher proportion than the average across all STEM graduates, at 7%, and non-STEM graduates, at 3%.

Males made up 70% of those with Chemical Sciences doctorates in the labour force, a 3 percentage point decrease from 2011.

Employed Chemical Sciences graduates

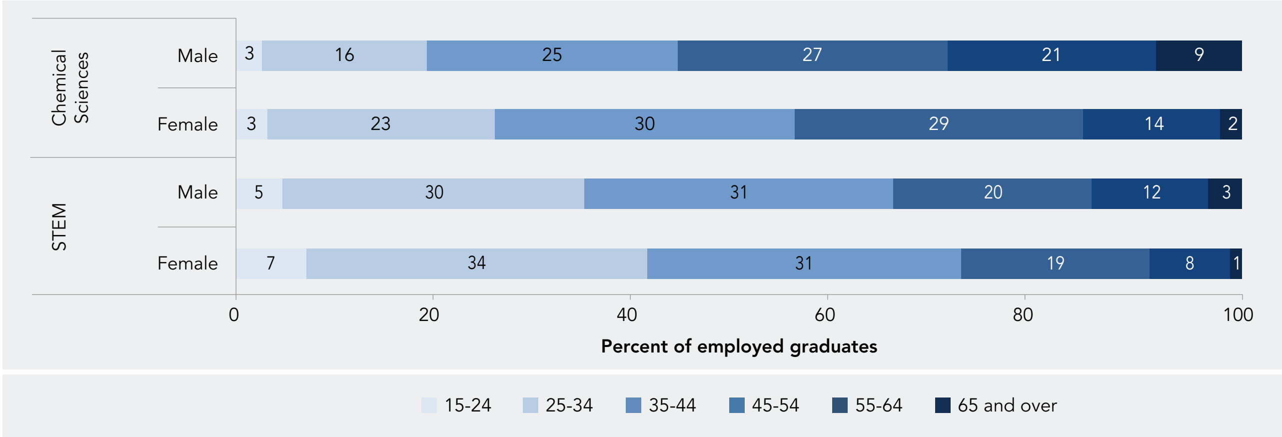
In 2016, on Census night, 16 919 university qualified Chemical Sciences graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old are employed Chemical Sciences graduates?

Employed graduates with Chemical Sciences qualifications were older than average STEM graduates, and the male cohort was older than the female (Figure 6.1). In 2016, the majority of employed male Chemical Sciences graduates were aged 45 or older (56%), compared to 35% of all working males with STEM qualifications. The male Chemical Sciences workforce is ageing. In 2011, 54% of males were aged 45 and over.

The female Chemical Sciences workforce is also ageing. In 2011, only 38% of females were aged 45 and over. In 2016, this had increased to 45% of females. The 2016 female Chemical Sciences workforce was younger than the male workforce. However, female Chemical Sciences graduates were older than the total female STEM qualified graduate workforce, where just 28% were aged 45 and over.

Figure 6.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Chemical Sciences graduates work?

In 2016, the private sector employed 73% of all Chemical Sciences graduates: 82% of bachelor, 79% of masters and 47% of doctorate graduates (data not shown).

INDUSTRIES OF EMPLOYMENT

The top industry division of employment for Chemical Sciences graduates was Education and Training, which employed 20% of the cohort. The second largest industry was Manufacturing (18%), followed by Professional, Scientific and Technical Services (17%; Figure 6.2).

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

Further analysis showed that while the majority of Chemical Sciences graduates working in Education and Training were male, it was the most common industry of employment for both males and females, employing 23% of females and 20% of males.

42% of Chemical Sciences doctoral graduates were employed in Education and Training—representing 44% of female doctorate holders and 40% of male doctorate holders (Figure 6.3).

Figure 6.2: Top ten industry divisions of employment for Chemical Sciences graduates with university qualifications, by gender

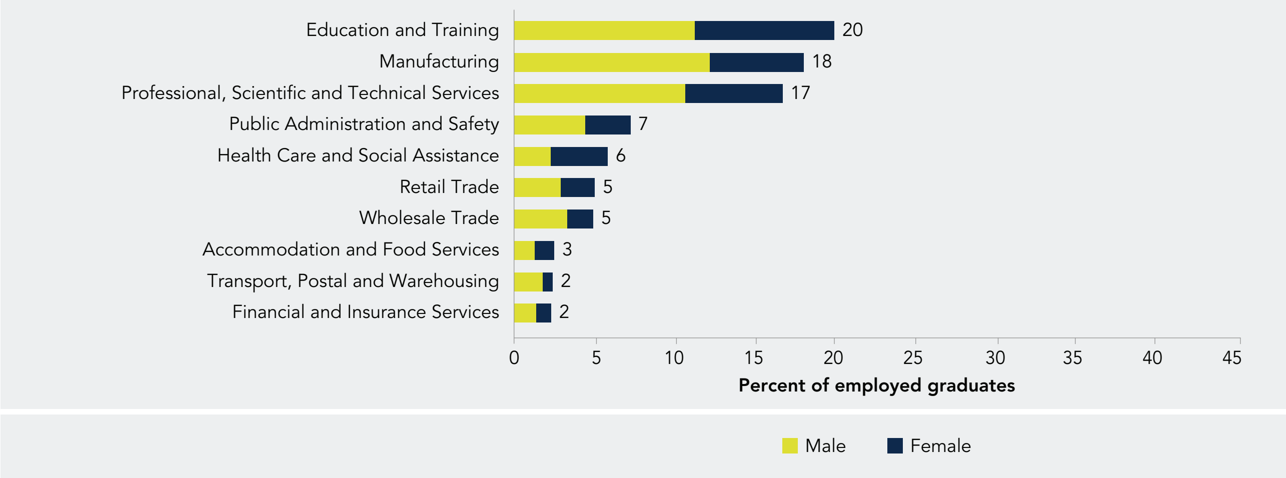
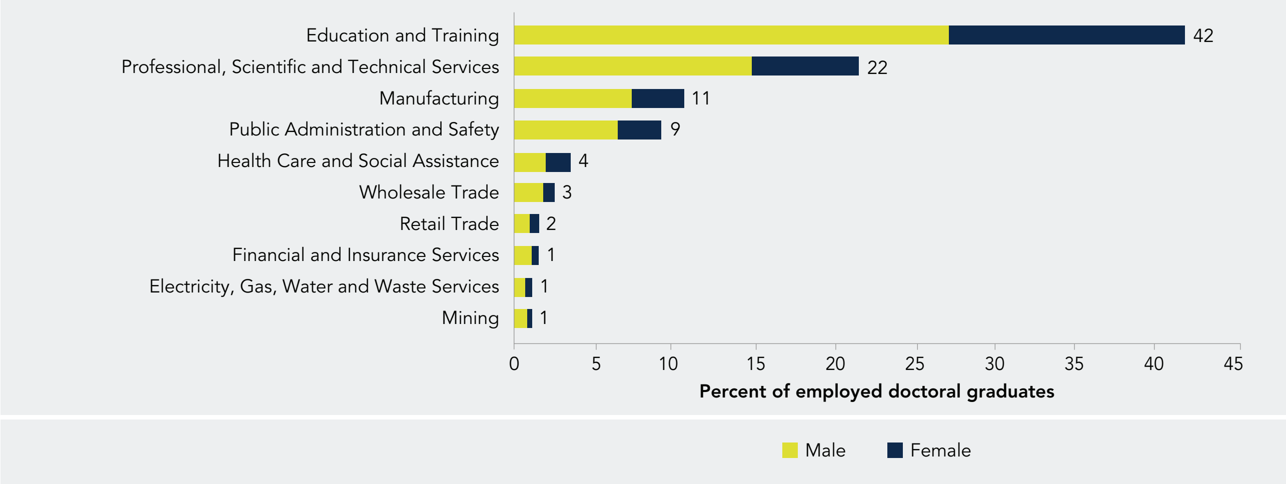


Figure 6.3: Top ten industry divisions of employment for Chemical Sciences doctoral graduates, by gender



At the most detailed level of industry class, the most common industry was Higher Education for both graduates and doctoral graduates, employing 13% and 35% of these cohorts, respectively. Scientific Research Services was the second most common industry class for both cohorts (Figure 6.4 and Figure 6.5).

Figure 6.4: Top ten industry classes of employment of Chemical Sciences graduates with university qualifications, by gender

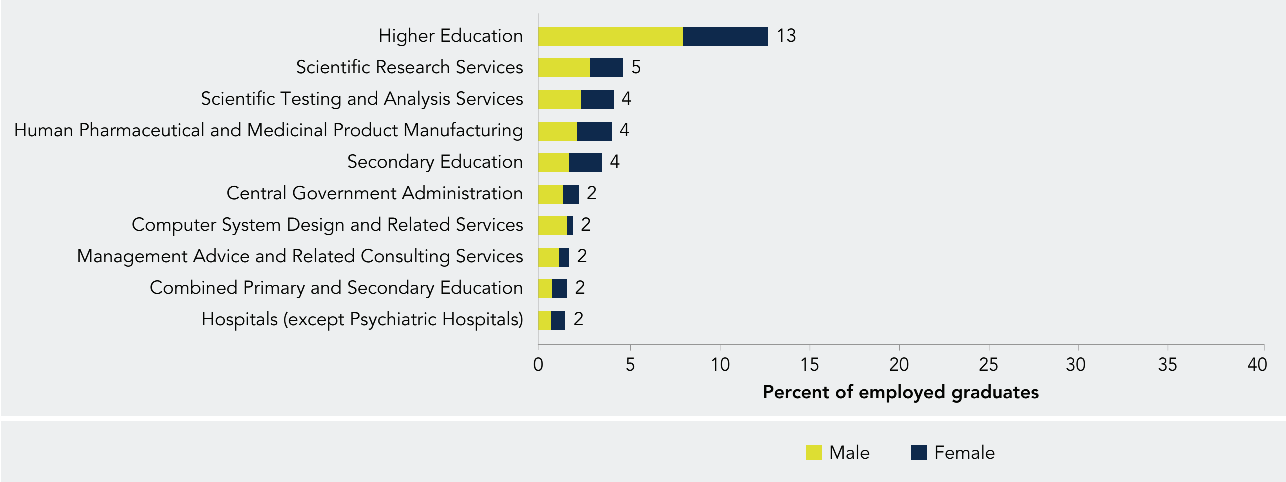
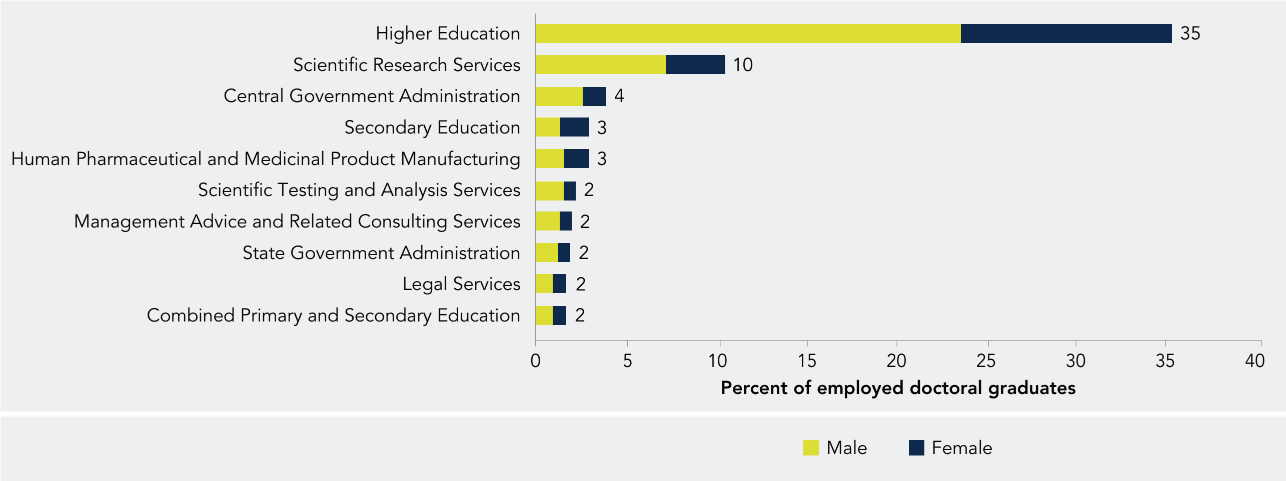


Figure 6.5: Top ten industry classes of employment of Chemical Sciences doctoral graduates, by gender



What are the occupations of Chemical Sciences graduates?

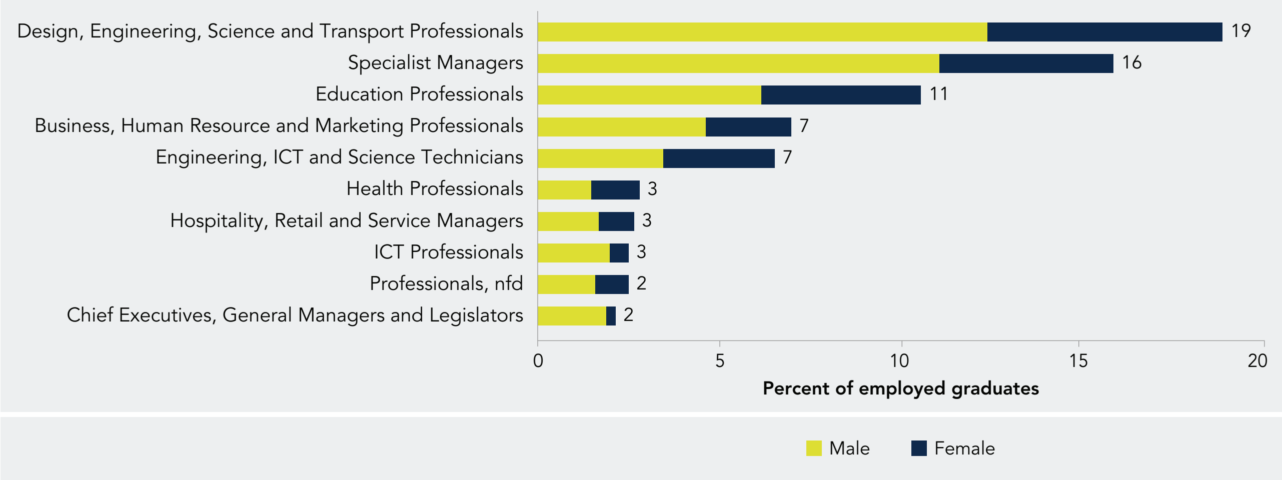
In 2016, almost two-thirds of employed Chemical Sciences graduates were working either as Professionals (41%) or Managers (22%). This was the highest percentage of graduates working as Managers out of all of the Natural and Physical Science fields (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

At the sub-major level of occupation classification, the most common occupation was Design, Engineering, Science and Transport Professionals, where 19% of graduates were employed, followed by Specialist Managers, at 16% (Figure 6.6).

Figure 6.6: Top ten sub-major group level occupations of Chemical Sciences graduates with university qualifications, by gender



At the more detailed unit group level, the top two occupations were both from the major occupation group of Professionals. These top two occupations were Chemists, and Food and Wine Scientists (employing 10% of Chemicals Sciences graduates), and University Lecturers and Tutors (5%; Figure 6.7). The proportion of graduates who worked as Chemists, and Food and Wine Scientists had decreased by 3 percentage points from 13% in 2011, while the proportion of graduates in most other occupations was similar in 2011 and 2016.

The top unit group occupation for Chemical Sciences doctoral holders was University Lecturers and Tutors—the occupation of 16% of male and 13% of female doctoral graduates (Figure 6.8). The top 10 occupations of doctoral graduates were the same in 2011 and 2016.

Are Chemical Sciences graduates high earners?

In 2011, 20% of graduates with Chemical Sciences bachelor degrees had an income in the highest bracket ($104 000 or above). In 2016, this had increased to one-quarter of the cohort. A lower proportion of Chemical Sciences graduates than the total STEM qualified population (but a higher proportion than the non-STEM qualified graduate population) had an income in the highest bracket (Figure 6.9).

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

Figure 6.7: Top ten unit group level occupations of Chemical Sciences graduates with university qualifications, by gender

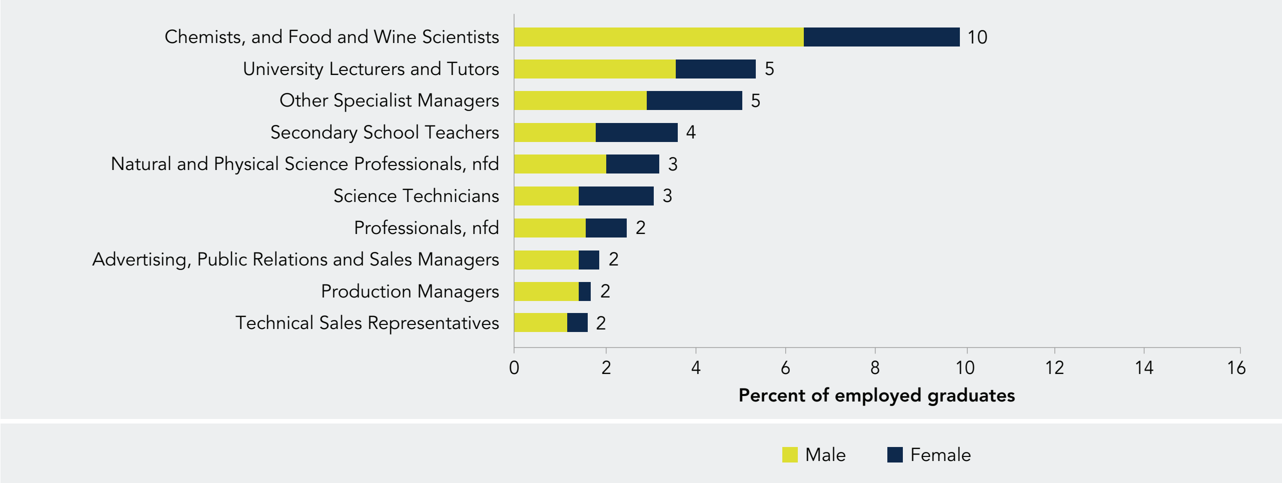
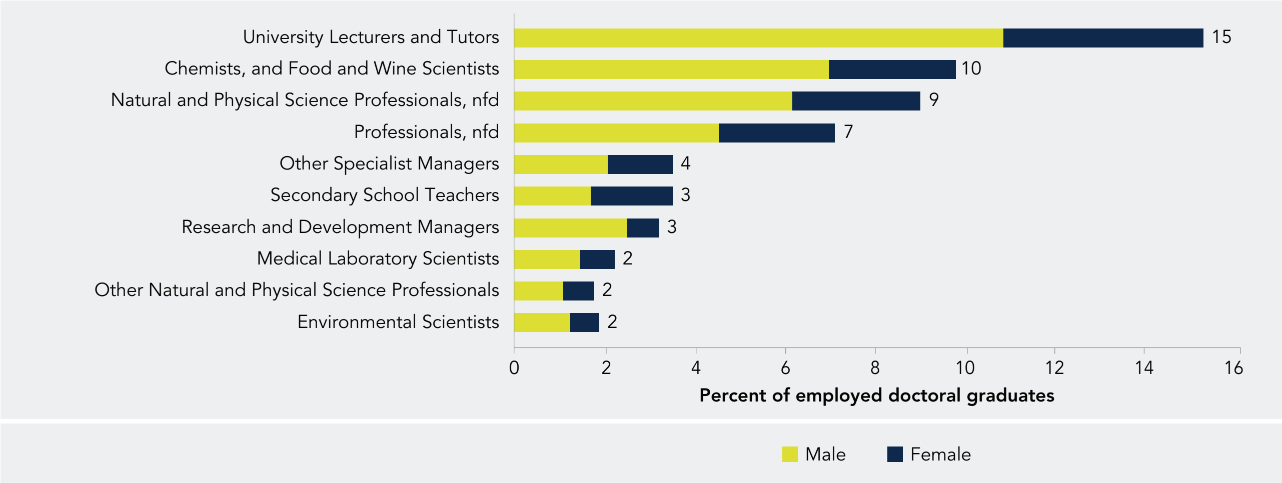


Figure 6.8: Top ten unit group level occupations of Chemical Sciences doctoral graduates, by gender



For those with doctoral degrees, 44% of Chemical Sciences graduates had an income in the highest bracket in 2016 (Figure 6.9). Between 2011 and 2016, the proportion of doctoral graduates with an income in the highest bracket increased by 7 percentage points, while the proportion of graduates in the lowest bracket increased by 1 percentage point.

Similar trends were seen in the total STEM graduate cohort—the proportion of doctoral graduates with an income in the highest bracket increased by 8 percentage points between 2011 and 2016, while the proportion of graduates who earned less than $41 600 remained stable.

A lower proportion of Chemical Sciences doctoral graduates than the total STEM doctorate holders and non-STEM doctorate holders had an income in the highest bracket.

The incomes of Chemical Sciences graduates varied with gender and full-time or part-time employment—a greater percentage of males and of those who worked full-time had an income in the highest bracket (Figure 6.10). For those with bachelor degrees, almost one-third (32%) of males were in the highest income bracket, which was more than double the proportion of females, at 14%. While the percentage difference was smaller for those with doctoral qualifications, it was still substantial, with half of males (50%) and less than one-third (29%) of females in the highest income bracket.

Figure 6.9: Personal annual income of graduates, by field and level of qualification

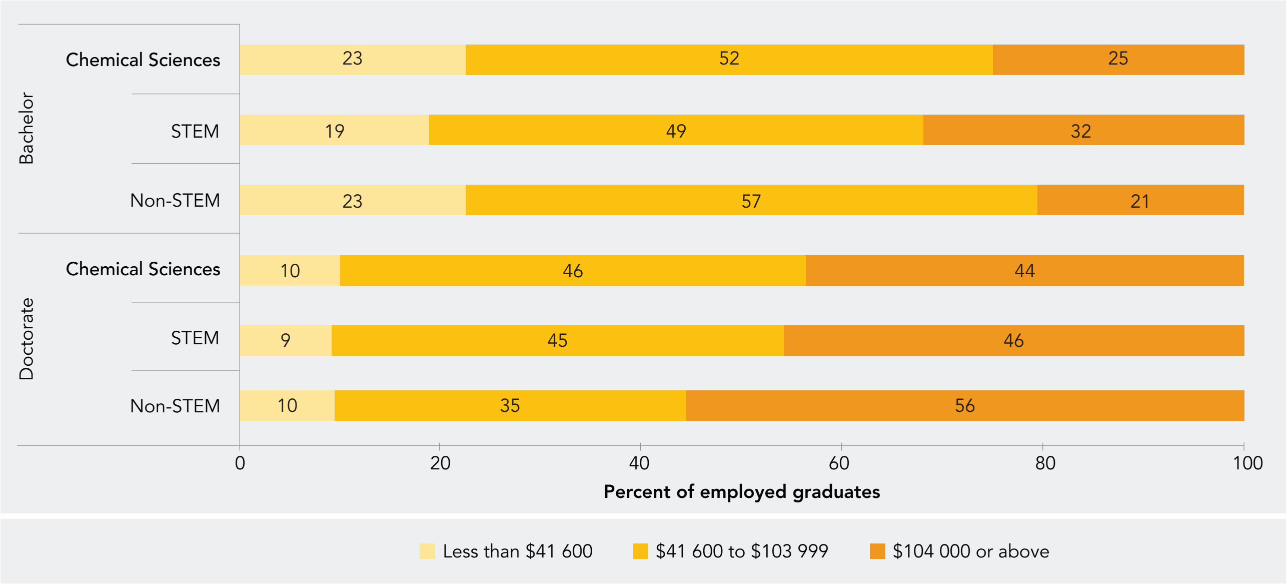
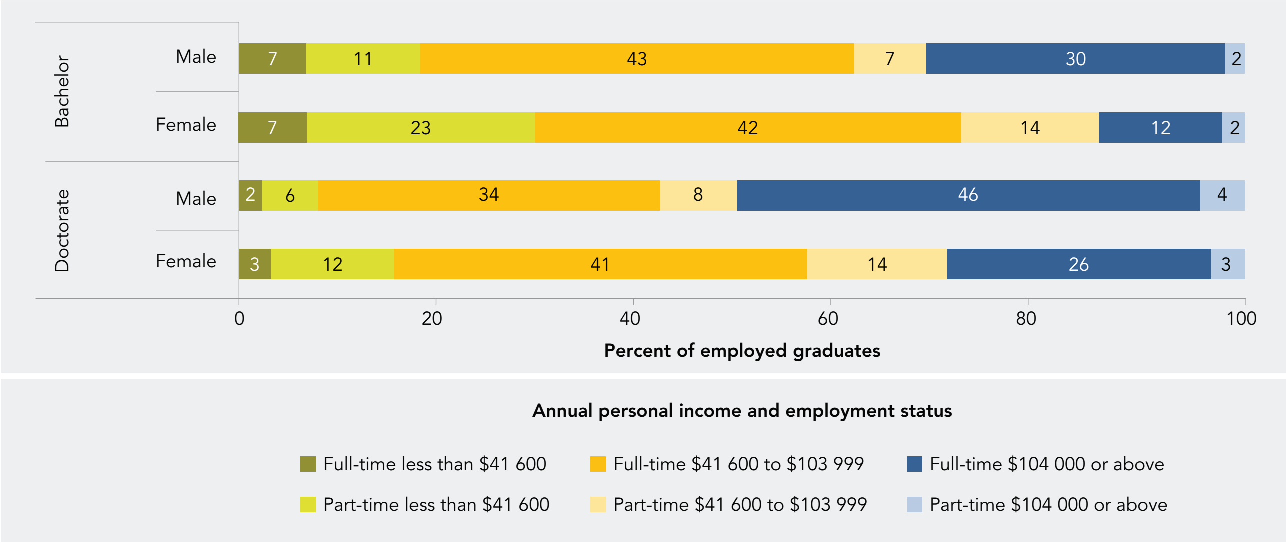


Figure 6.10: Personal annual income of Chemical Sciences graduates working full-time and part-time, by field, gender and level of qualification



Age is another important factor in the income level of graduates (Figure 6.11 and Figure 6.12). Bachelor graduates aged 45 to 49 had the largest percentage of people with an income in the highest bracket—43% of males and 21% of females in this bracket earned $104 000 or above. Around twice as many males as females had an income in the highest bracket across all age groups.

The income for doctorate graduates peaked at the slightly older age of 50 to 54 for both males and females—68% of males and 54% of females in this age group were in the highest bracket. Compared to bachelor graduates, the differences between the proportions of males and females in the highest bracket were smaller for those with doctorates across all age groups.

Figure 6.11: Percentage of bachelor degree graduates with an income of $104 000 or above, by field, age group and gender

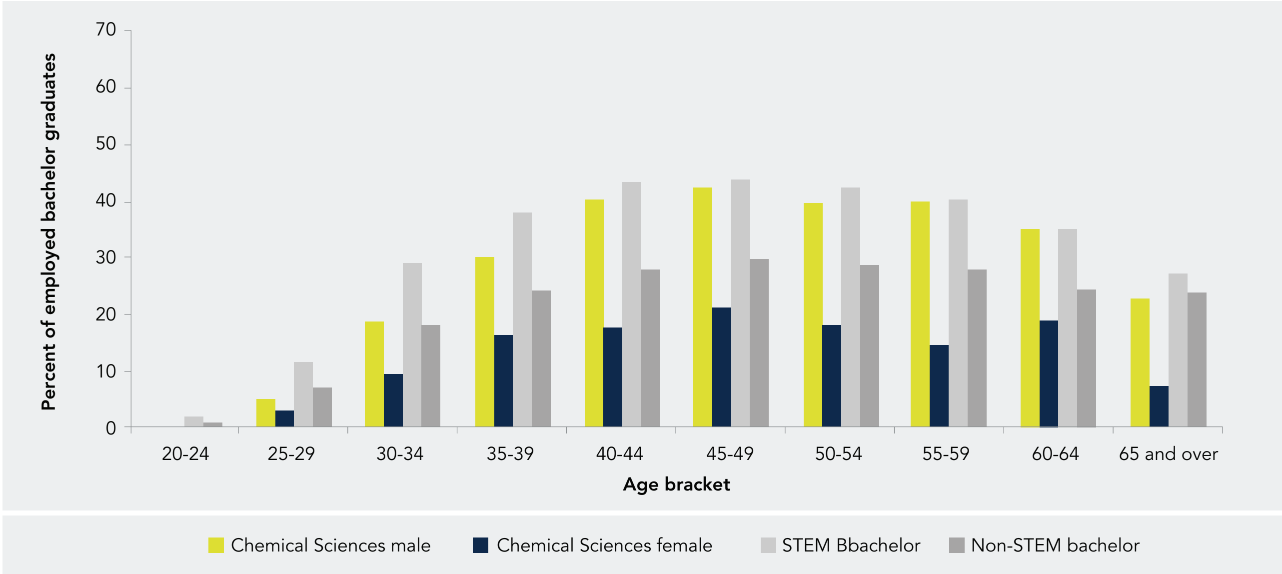
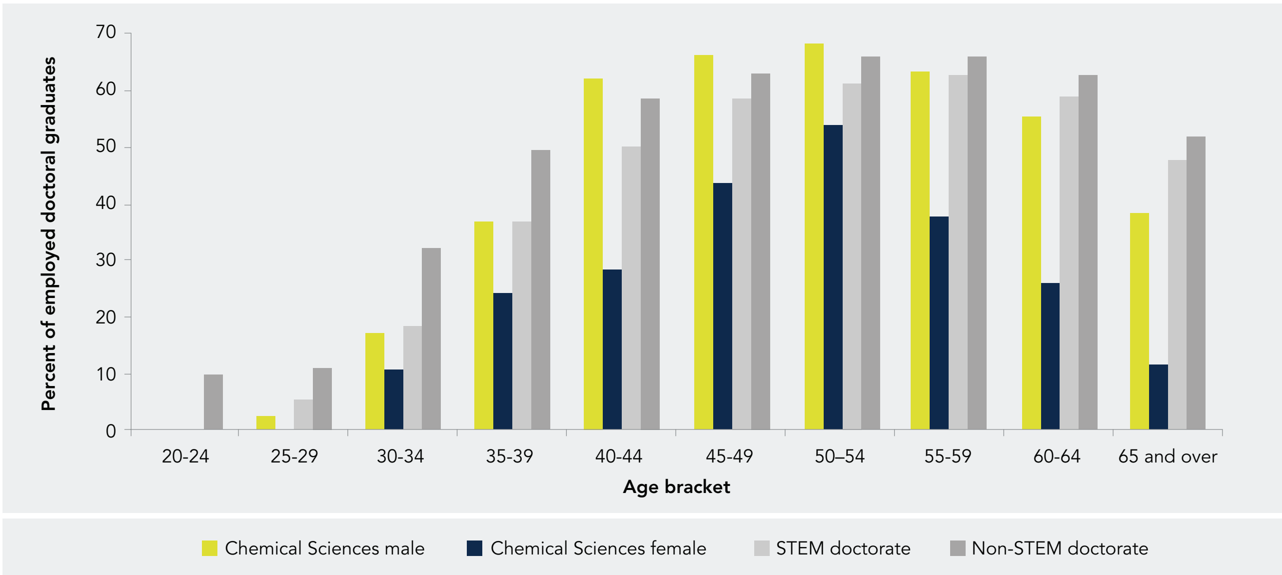


Figure 6.12: Percentage of doctoral degree graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 7

7

STEM PATHWAYS: EARTH SCIENCES

What is Earth Sciences?

Earth Sciences is the study of the nature, composition and structure of the Earth including its atmosphere and hydrosphere. The main purpose of this narrow field of education is to develop an understanding of the physical properties of the Earth's crust and the characteristics of its soil, landforms, climate, hydrosphere and atmosphere.

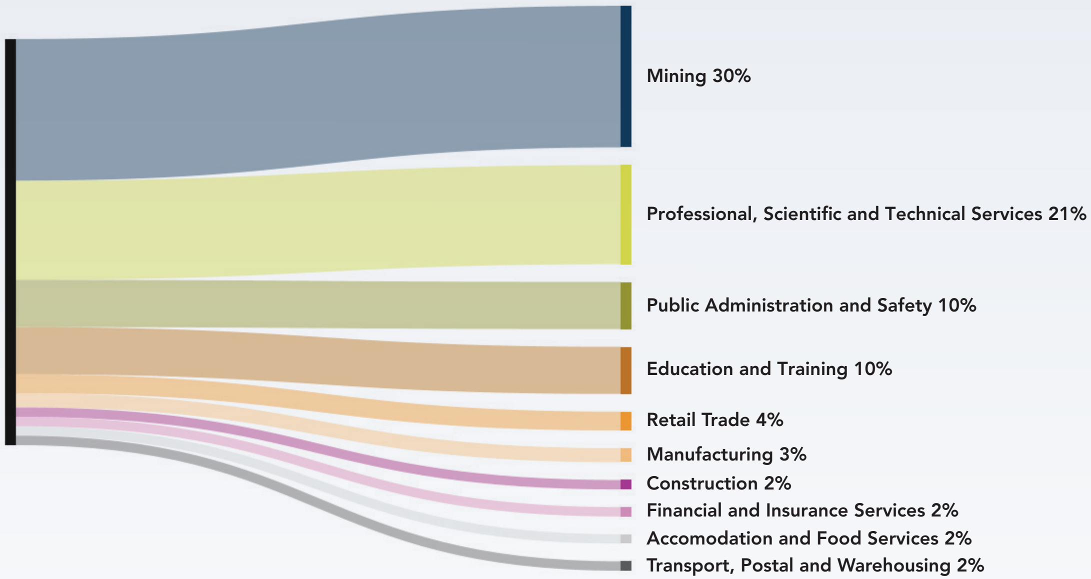
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Earth Sciences. Comparisons to STEM and to non-STEM populations are also restricted to those qualified with university qualifications.

HIGHLIGHTS

- In 2016 there were 20 955 people with university qualifications in Earth Sciences. Of these, 15 902 people were in the labour force, of whom 14 717 were employed.
- Earth Sciences graduates had the highest rate of unemployment across all the subfields of Natural and Physical Sciences, at 7.5%.
- Nearly three-quarters (73%) of Earth Sciences graduates in the labour force were male. In 2016, 27% of graduates were female, up from 24% in 2011.
- The top industry division of employment for Earth Sciences graduates was Mining, employing nearly a third (30%) of the working population.
- In 2016, the most common major (broad-level) occupation group for Earth Sciences graduates was Professionals, employing 57% of the cohort. However, this was a substantial drop from the 72% of graduates working as Professionals in 2011.
- At the most detailed level, the top occupation by a large margin was Geologists, Geophysicists and Hydrogeologists, accounting for 35% of all working Earth Science graduates.
- A greater percentage of Earth Sciences graduates had high incomes than the overall STEM graduate population— 41% of Earth Sciences bachelor graduates and 54% of doctoral graduates had an income in the highest bracket of $104 000 or above, compared to 32% and 46% respectively for STEM graduates.

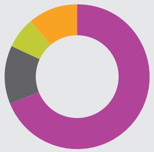
Top ten industries of employment for Earth Sciences graduates



20 955 people in Australia had a university qualification in Earth Sciences

Type of qualification

- 69% Geology
- 11% Earth Sciences, nfd
- 7% Geophysics
- 13% Other fields*



% in the labour force

working or looking for work 76%

not in the labour force 24%

Of those in the labour force

% employed

92.5 % EMPLOYED

7.5% UNEMPLOYED

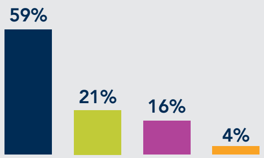
Gender

73% MALES

27% FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



* Other fields include Atmospheric Sciences (5%), Soil Science (2%), Hydrology (2%), Oceanography (2%), Geochemistry (1%) and Earth Sciences not elsewhere classified (1%).

The Earth Sciences qualified population

In 2016, there were 20 955 people in Australia with a university qualification in Earth Sciences, an increase of over 2 500 people from 2011. The majority (69%) had qualifications in Geology, while a further 11% of graduates did not specify a narrow field of education and were classified as holding a qualification in Earth Sciences not further defined.

The Earth Sciences labour force

Of the Earth Sciences qualified population, 76% (15 902 people) were in the labour force, either working or looking for work. Females made up 27% of the Earth Sciences labour force in 2016, an increase of 3 percentage points from 2011.

In 2016, the unemployment rate for Earth Sciences graduates was 7.7% for males and 6.9% for females, up from 2.1% and 2.5% in 2011.

Over one-fifth (21%) of Earth Sciences graduates in the labour force held a masters qualification—the largest proportion of the Natural and Physical Sciences sub-fields. The percentage of graduates who held doctorate degrees (16%), was higher than the STEM average (7%).

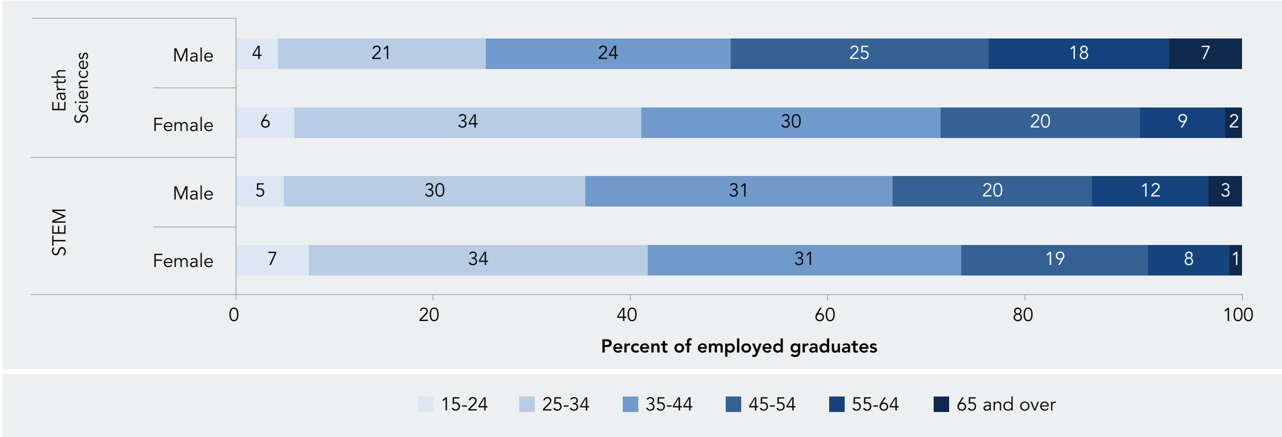
Employed Earth Sciences graduates

In 2016, on Census night, 14 717 university qualified Earth Sciences graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Earth Sciences graduate workforce?

In 2016 Earth Sciences graduates were, on average, older than the total STEM graduate workforce, where 35% of males and 28% of females were aged 45 years or older. The male Earth Sciences graduate workforce was substantially older than the female workforce; over half (51%) of employed male graduates were aged 45 or older, compared to just 30% of females.

Figure 7.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Earth Sciences graduates work?

In 2016, over three-quarters of all Earth Sciences graduates worked in the private sector (77%), varying from 47% of graduates with doctoral degrees to 85% of those with bachelor degrees (data not shown).

INDUSTRIES OF EMPLOYMENT

Almost three-quarters of all Earth Sciences graduates were employed in just four industry divisions (Figure 7.2), with around one-third in Mining (30%), and a further 22% in Professional, Scientific and Technical Services. 10% of graduates were employed in each of the Public Administration and Safety and the Education and Training sectors.

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

Further analysis shows that while the top four sectors were the same for both male and female graduates, male graduates were more concentrated in the Mining sector, which employed approximately one-third (32%) of male graduates compared to one-quarter (25%) of female graduates. A greater percentage of females than males were employed in both the Public Administration and Safety, and Education and Training sectors.

Figure 7.2: Top ten industry divisions of employment for Earth Sciences graduates with university qualifications, by gender

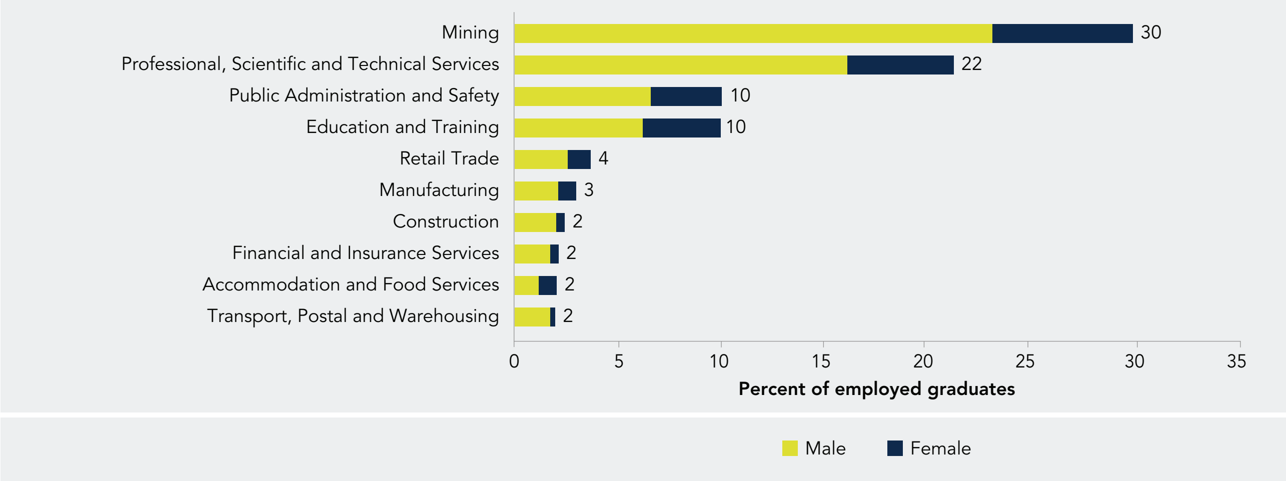
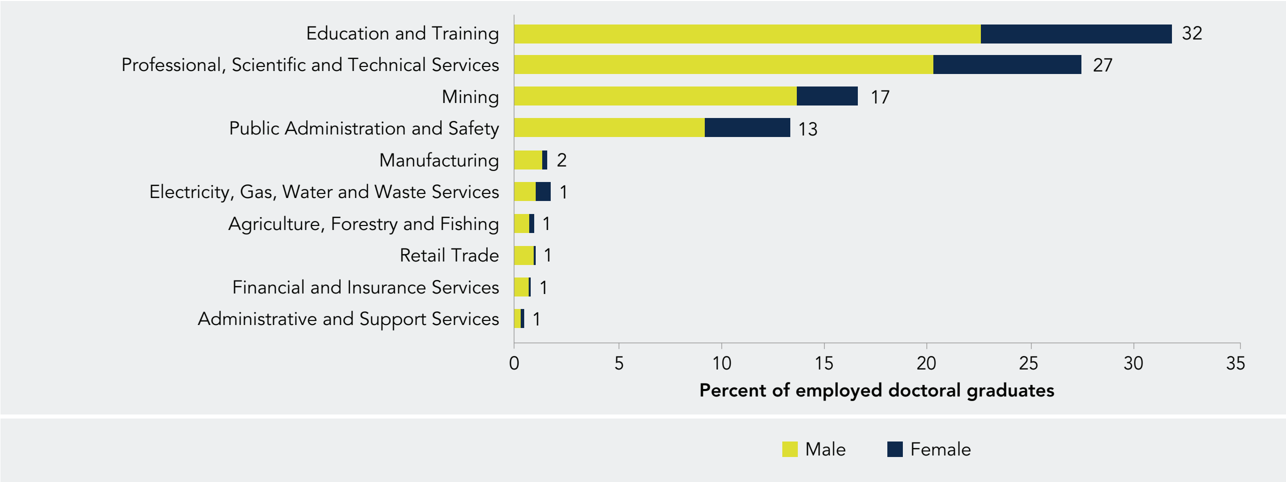


Figure 7.3: Top ten industry divisions of employment for Earth Sciences doctoral graduates, by gender



The distribution of Earth Sciences doctoral graduates was even more concentrated, with 89% employed in the same top four industry sectors (Figure 7.3). The top industry of employment for doctoral holders was Education and Training (32%).

At a more detailed level of industry classification, Earth Sciences graduates were employed across a range of industry classes (Figure 7.4) with no particular area of concentration, unlike many of the other STEM fields. Higher Education and Gold Ore Mining were the top two industry classes of employment for all graduates, each representing 7% of the working population. The top four industry classes of employment were the same in 2016 as in 2011; however in 2011 they were in reverse order, with Engineering Design and Engineering Consulting Services the most common industry class.

When looking only at Earth Sciences doctoral graduates, the top industry class of employment was Higher Education, which employed 26% of these graduates in 2011 and 29% in 2016 (Figure 7.5).

Figure 7.4: Top ten industry classes of employment of Earth Sciences graduates with university qualifications, by gender

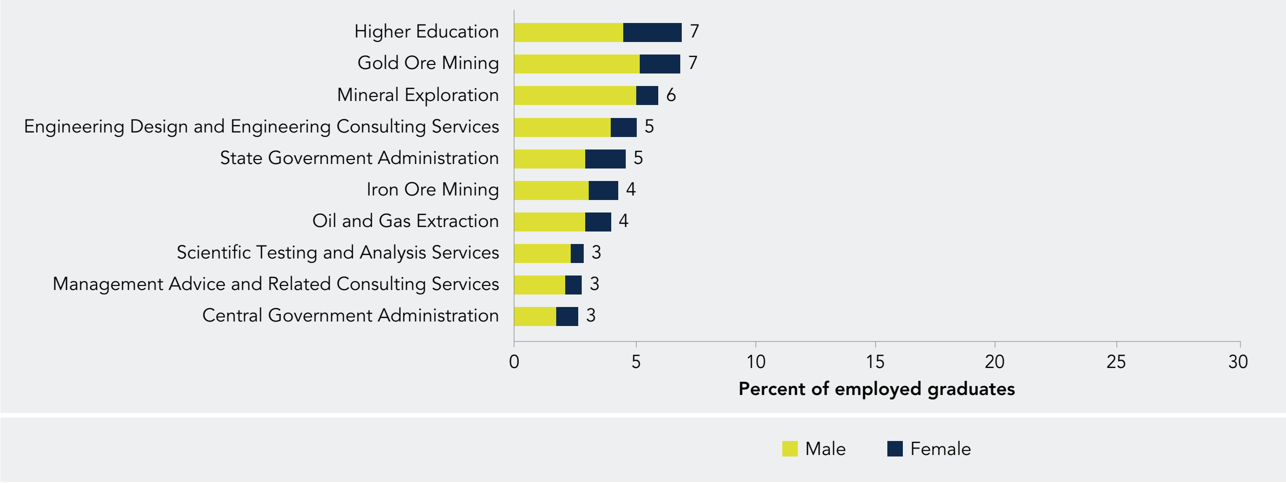
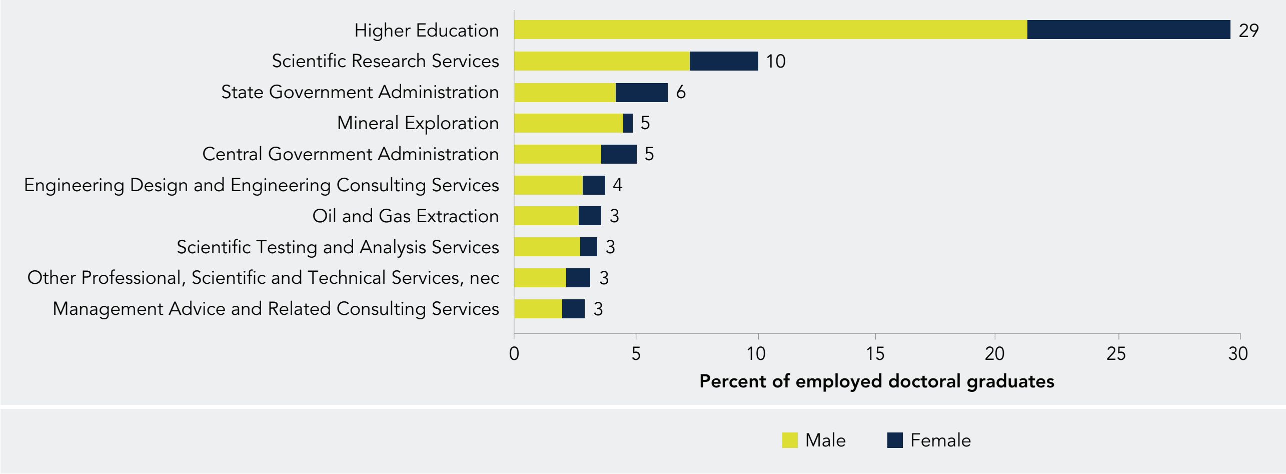


Figure 7.5: Top ten industry classes of employment of Earth Sciences doctoral graduates, by gender



What are the occupations of Earth Sciences graduates?

The most common major group occupation for Earth Sciences graduates was Professionals, followed by Managers. The proportion of graduates employed as Professionals decreased from 72% in 2011 to 57% in 2016, while the proportion of graduates employed as Managers increased from 15% in 2011 to 17% in 2016 (data not shown).

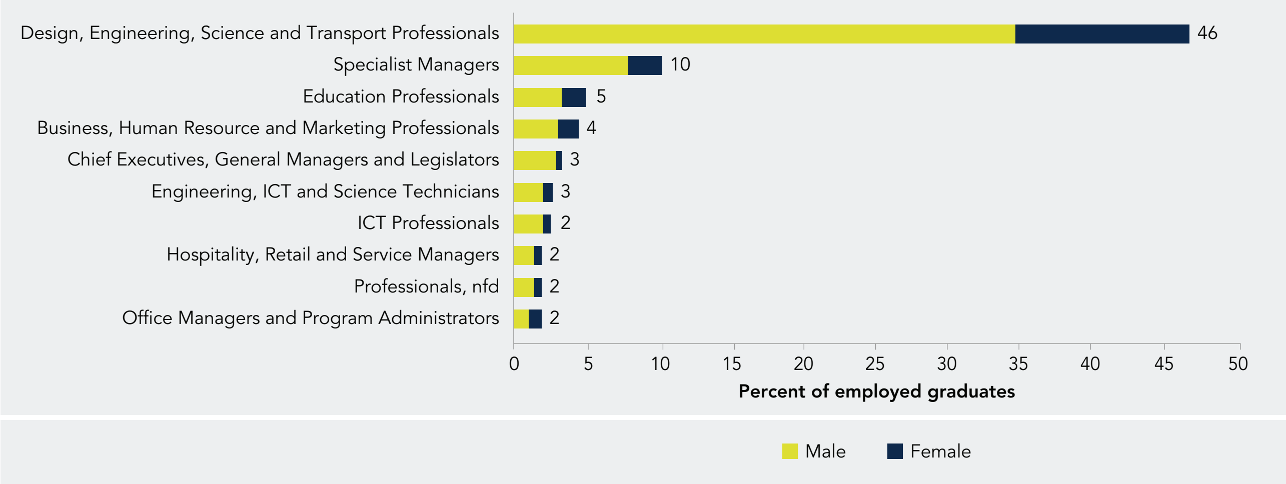
Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (most detailed level)

Analysis of the more detailed sub-major occupation groups (Figure 7.6) indicates that a large proportion of all Earth Sciences graduates worked as Design, Engineering, Science and Transport Professionals—however, this proportion decreased from 57% in 2011 to 46% in 2016.

At this sub-major group level, similar percentages of males and females were employed in each occupation, except for Education Professionals, which in 2016 was the occupation of 8% of females compared to 4% of males, and Chief Executives, General Managers and Legislators, which was the occupation of 4% of males compared to just over 1% of females.

Figure 7.6: Top ten sub-major group level occupations of Earth Sciences graduates with university qualifications, by gender



An even more detailed analysis was conducted at the unit group occupation level (Figure 7.7). The top occupation by a large margin was Geologists, Geophysicists and Hydrogeologists, which accounted for 45% of Earth Sciences graduates in 2011 and 35% in 2016.

The top unit group occupations for doctoral graduates are shown in Figure 7.8. Earth Sciences doctoral graduates were also most commonly employed as Geologists, Geophysicists and Hydrogeologists, with 37% of doctoral graduates holding this role in 2011, decreasing to 32% in 2016. The second most common occupation for doctoral graduates was University Lecturers and Tutors, representing 12% of the labour force in 2011 and 14% in 2016.

Are Earth Sciences graduates high earners?

In 2011, 46% of Earth Sciences bachelor graduates had an income in the highest bracket, earning \$104 000 or above (date not shown). In 2016, despite a decrease to 41% of the cohort earning in the highest bracket, Earth Sciences bachelor graduates were more likely than the total STEM and non-STEM cohorts to be high earners (Figure 7.9).

The highest annual income bracket in the 2011 Census was \$104 000 or above. In the 2016 Census, the highest income bracket was increased to \$156 000 or above. To enable comparisons to the previous report, the \$104 000 or above income bracket is maintained in this report.

Figure 7.7: Top ten unit group level occupations of Earth Sciences graduates with university qualifications, by gender

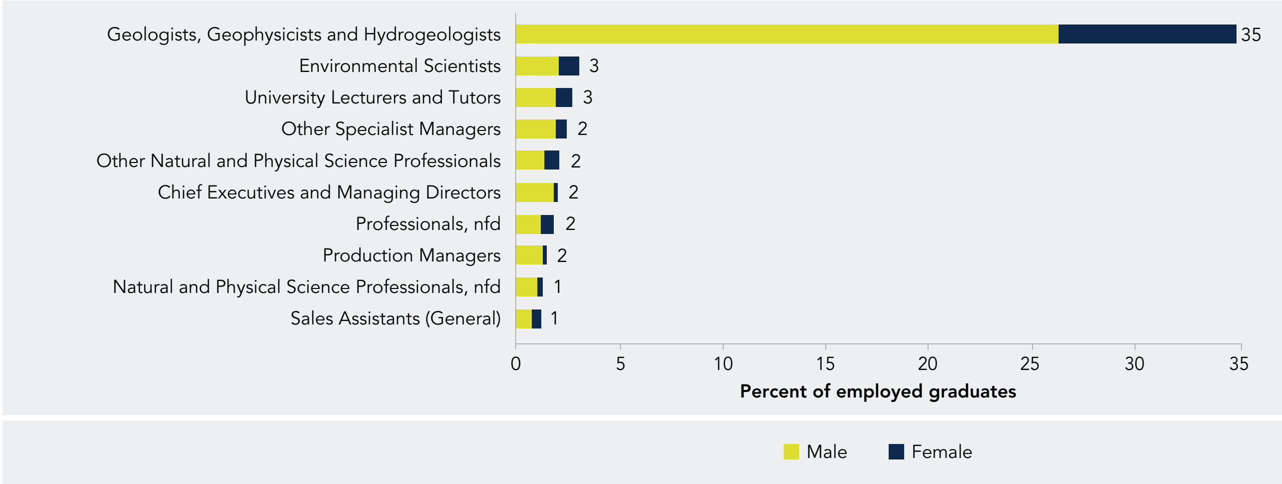
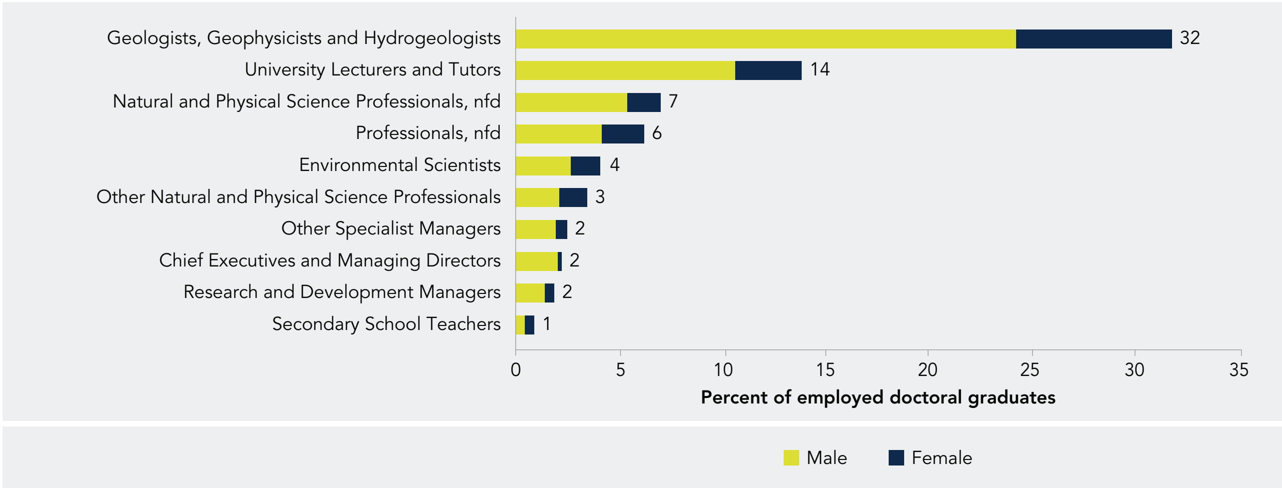


Figure 7.8: Top ten unit group level occupations of Earth Sciences doctoral graduates, by gender



The proportion of Earth Sciences bachelor graduates in the lowest income bracket was 13% in 2011, increasing to 19% in 2016. In comparison, the proportion of total STEM bachelor graduates in this lowest income bracket remained stable, while the proportion of non-STEM bachelor graduates in the lowest bracket decreased by 3 percentage points over this period.

For those with doctoral qualifications, over half (54%) of Earth Sciences graduates had an income of $104 000 or above. While completing an Earth Sciences doctorate can be financially rewarding, the difference between the proportion of bachelor and doctoral graduates in the highest income bracket—at 12 percentage points—was the smallest difference for all of the STEM fields, indicating that a doctoral qualification does not have as large of a financial advantage as it does in other STEM fields.

A greater percentage of male graduates and of those who worked full-time had an income in the highest bracket (Figure 7.10). Almost half (47%) of all male Earth Sciences bachelor graduates had an income in the highest bracket, compared to 27% of females. This difference between genders was maintained for those with doctoral degrees, where 59% of males and 39% of females had an income in the highest bracket.

Figure 7.9: Personal annual income of graduates, by field and level of qualification

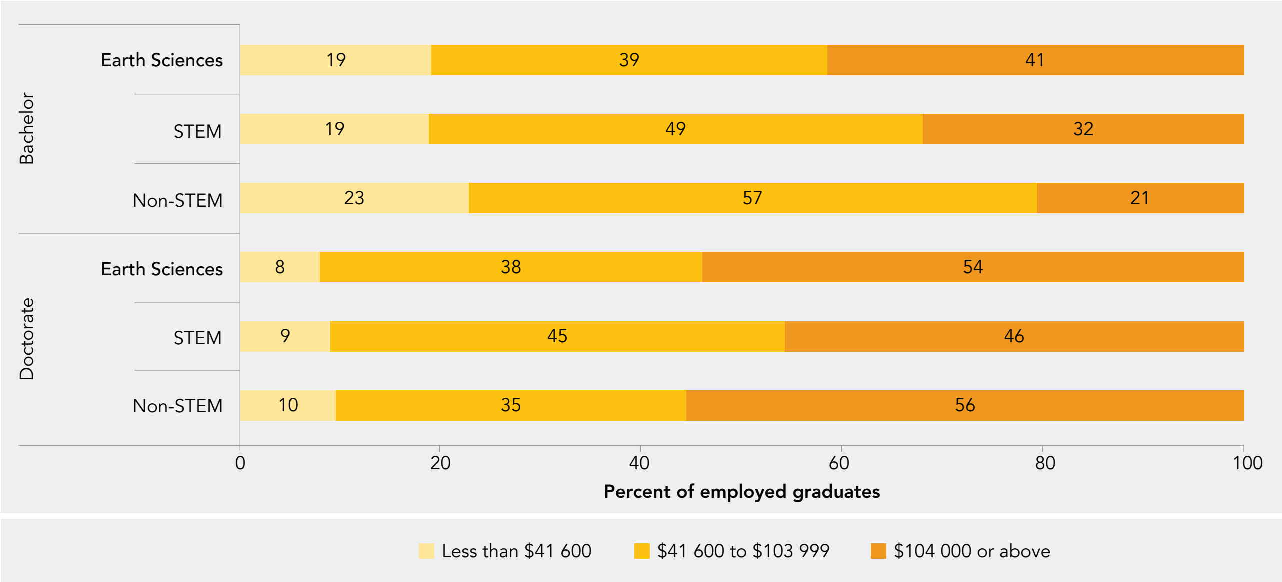
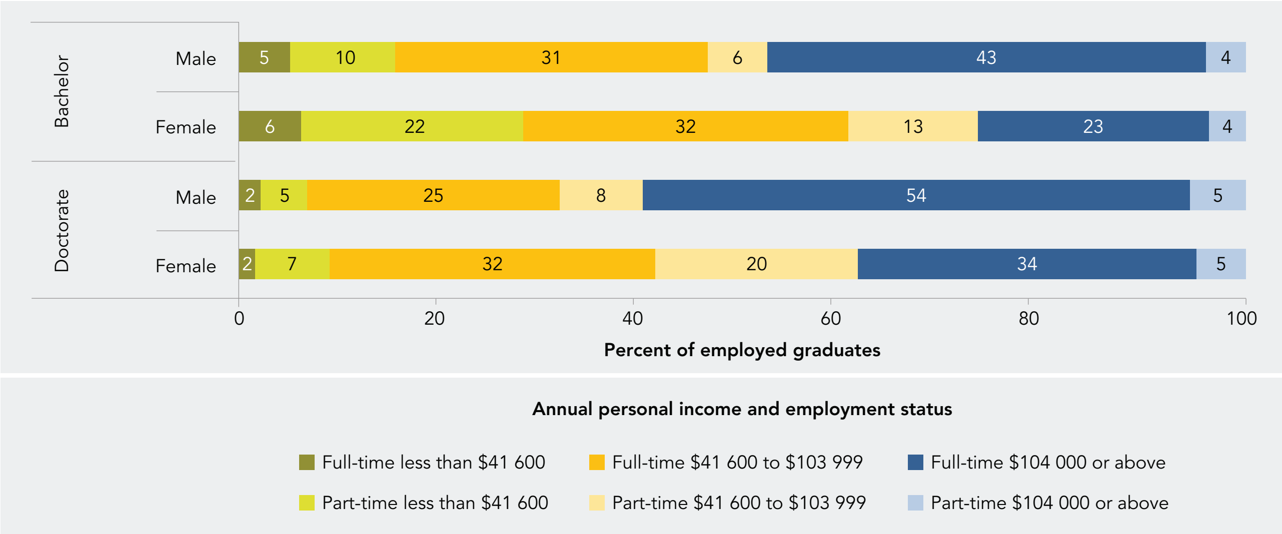


Figure 7.10: Personal annual income of Earth Sciences graduates working full-time and part-time, by gender and level of qualification



Along with gender and employment status, age is an important factor in the income levels of graduates (Figure 7.11 and Figure 7.12). For those with bachelor degrees, males aged 40 to 44 had the highest percentage of people earning in the highest income bracket (60%). For females, the peak was at age 30 to 34, where 39% had an income in the highest bracket. Around double the proportion of males than females had an income in the highest bracket for all ages from 35 and over.

For those with doctoral qualifications, both men and women had the largest percentage earning in the highest bracket at the age of 50 to 54, with 74% of males and 67% for females in this age group earning $104 000 or above. The gender gap in the proportions of top income earners was much smaller for doctoral than bachelor graduates.

Figure 7.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

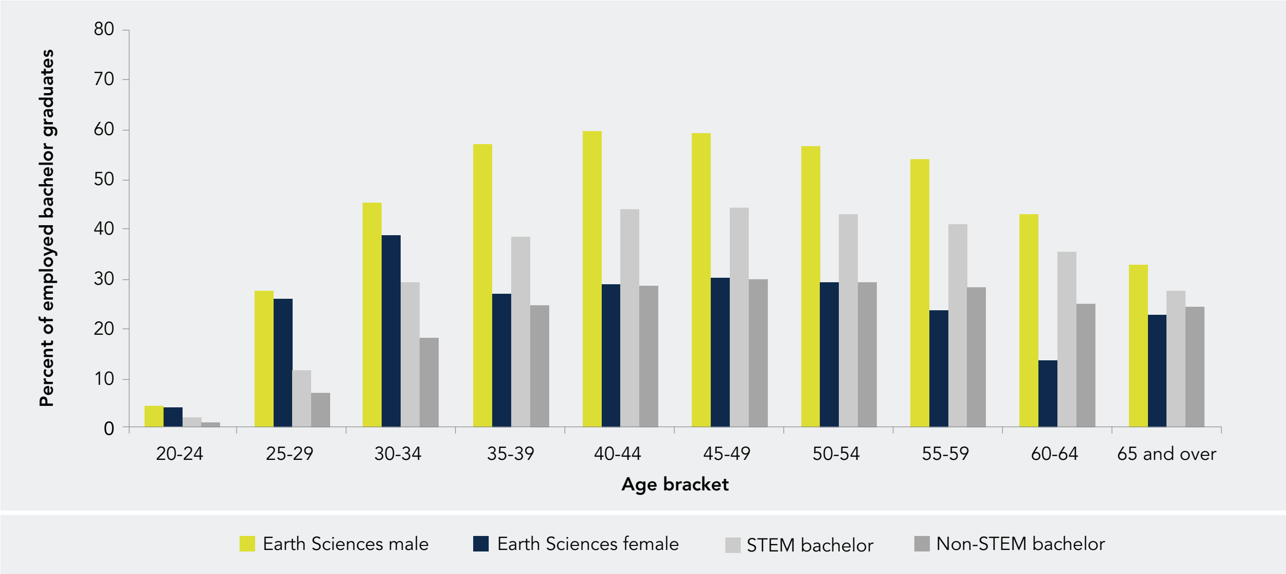
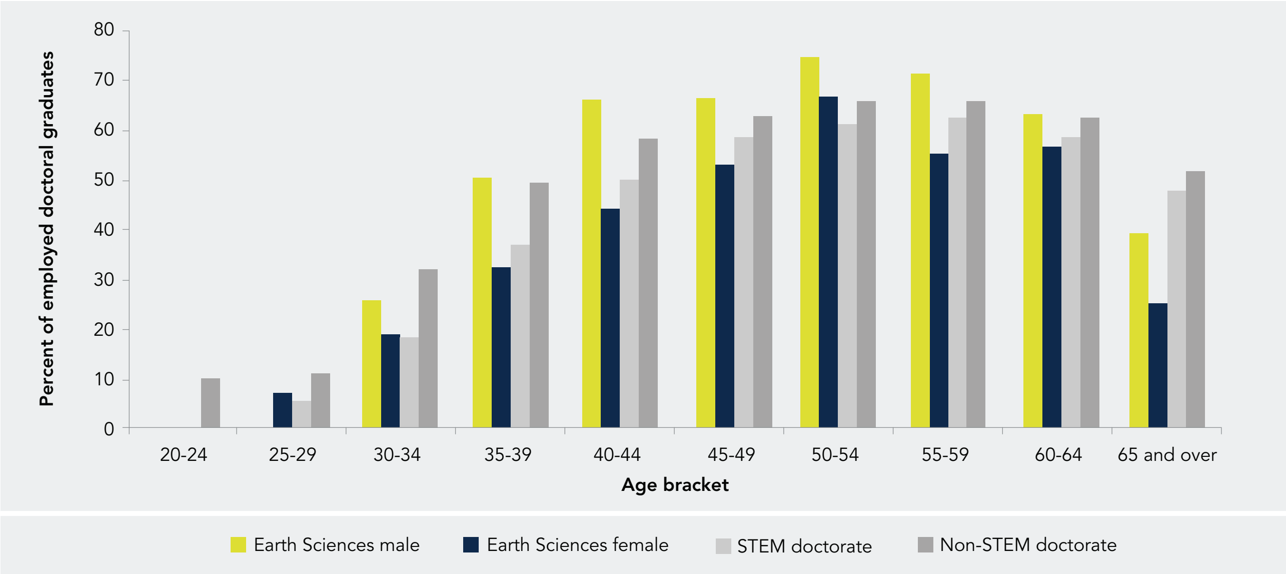


Figure 7.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 8

8

STEM PATHWAYS: BIOLOGICAL SCIENCES

What is Biological Sciences?

Biological Sciences is the study of the structure, function, reproduction, growth, evolution and behaviour of living organisms. The main purpose of this narrow field of education is to develop an understanding of the genetics and physiology of living organisms and of the relationship of living organisms to one another as well as the physical environment.

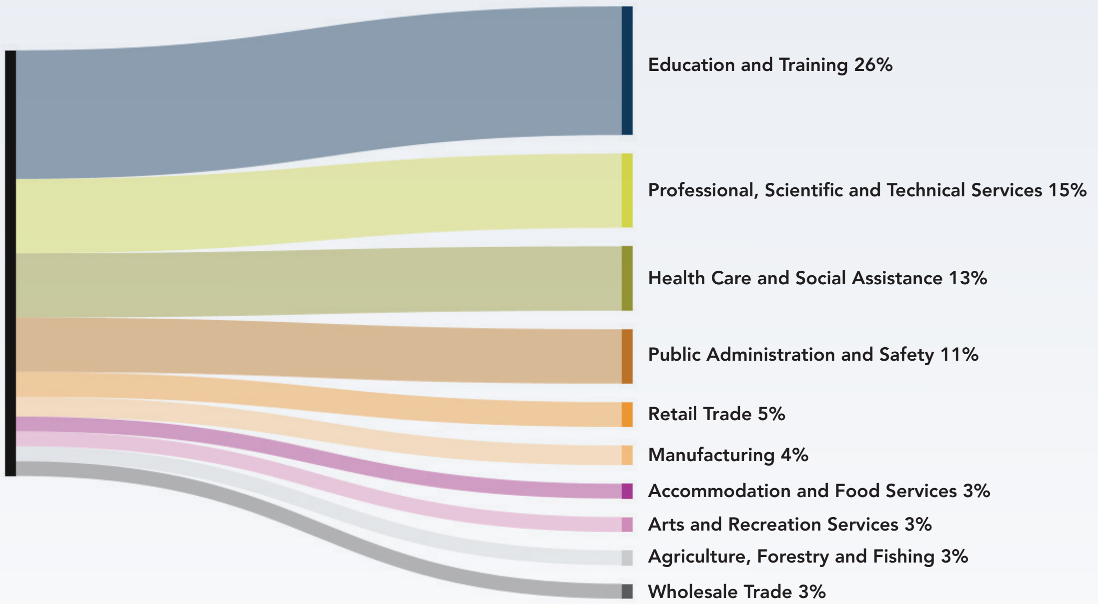
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Biological Sciences. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016, there were 54 352 people with university qualifications in the field of Biological Sciences. Of these, 40 589 people were in the labour force, of whom 38 314 were employed.
- Nearly a third (31%) of Biological Sciences graduates in the labour force had a doctoral qualification, which was the second highest rate among the Science fields.
- The majority of Biological Sciences graduates in the labour force were female (57%). The majority of Biological Sciences doctoral holders were male (54%).
- Employed Biological Sciences graduates were slightly older than the total STEM graduate workforce, and female graduates were younger than male graduates.
- Biological Sciences had the equal highest proportion of people working in the public sector across the STEM fields, at 40% (along with Environmental Studies).
- The top industry of employment for Biological Sciences graduates was Education and Training, employing over a quarter (26%) of all working graduates.
- In 2016, almost half (49%) of the Biological Sciences workforce were employed as Professionals, a decrease from 55% in 2011.
- There were fewer Biological Science graduates who earned in the top income bracket ($104 000 or above) compared to the STEM graduate cohort overall. 14% of employed Biological Sciences bachelor graduates and 38% of doctoral graduates had an income in the top bracket.

Top ten industries of employment for Biological Sciences graduates



54 352 people in Australia had a university qualification in Biological Sciences

Type of qualification

- 29% Biological Sciences, nfd
- 14% Biochemistry and Cell Biology
- 11% Microbiology
- 41% Other fields*

% in the labour force

working or looking for work
75%

not in the labour force
25%

Of those in the labour force

% employed

94.4 %
EMPLOYED

5.6%
UNEMPLOYED

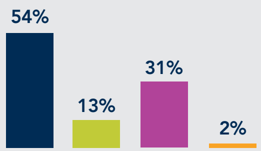
Gender

44%
MALES

56%
FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



* Other fields include Marine Science (9%), Zoology (9%), Ecology and Evolution (8%), Genetics (5%), Human Biology (5%), and Biological Sciences not elsewhere classified (5%).

The Biological Sciences qualified population

In 2016, there were 54 352 people in Australia with university qualifications in the field of Biological Sciences, an increase of over 10 200 people since 2011. Biological Sciences had the highest growth of all of the Natural and Physical Sciences fields over the five years to 2016.

The Biological Sciences labour force

Of the qualified population, 75% (40 589 people) were in the labour force, either working or looking for work. Females made up 56% of the Biological Sciences labour force, an increase of 3 percentage points since 2011. In 2016, the majority of doctoral holders were male (54%).

In 2016, the unemployment rate in this field was 5.0% for males and 6.0% for females, up from 3.7% and 4.7% in 2011.

Across all of the STEM fields, Biological Sciences had the second highest proportion (31%) of graduates in the labour force with a doctoral qualification (behind Physics and Astronomy at 34%).

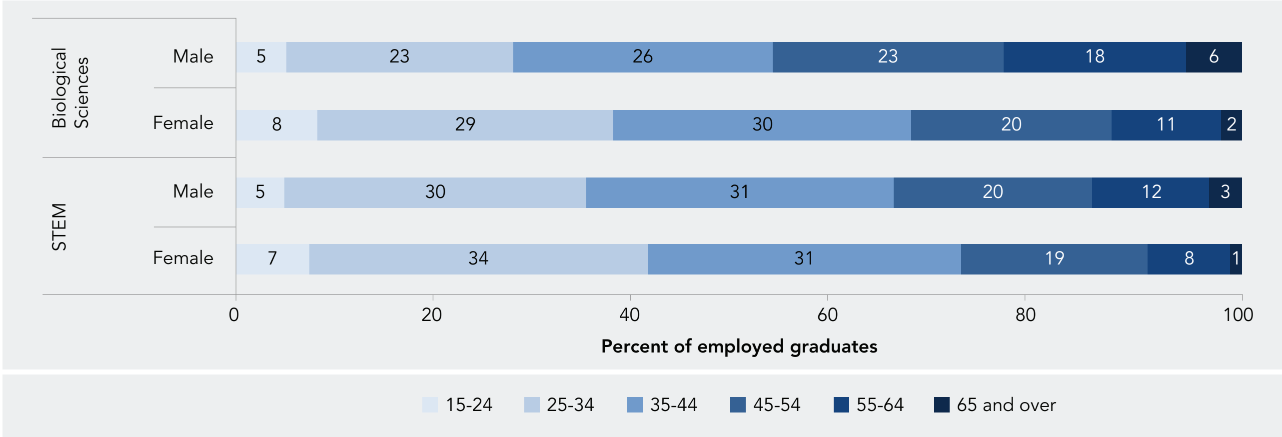
Employed Biological Sciences graduates

In 2016, on Census night, 38 314 university qualified Biological Sciences graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Biological Sciences graduate workforce?

In 2016, Biological Sciences graduates were slightly older than the employed STEM graduate population overall, and female graduates were younger than the male graduates (Figure 8.1). This workforce is ageing—in 2011, 69% of employed female graduates and 55% of employed male graduates with Biological Sciences qualifications were aged under 45. In 2016, 67% of employed female graduates and 53% of employed male graduates were aged under 45.

Figure 8.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Biological Sciences graduates work?

In 2016, while the majority of Biological Sciences graduates worked in the private sector (60%), this was the equal lowest of all STEM fields alongside Environmental Studies. The proportions of graduates in the private sector varied by level of qualification, from 72% of bachelor graduates to just 37% of those with doctoral qualifications (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

In 2016, just over one-quarter of all Biological Sciences graduates worked in the Education and Training sector (26%), with further analysis showing that 25% of males and 26% of female graduates worked in this industry division (Figure 8.2). The second most common industries of employment were different for males and females: for males it was Professional, Scientific and Technical Services (17% of males, 14% of females, and 16% of the total Biological Sciences graduate labour force), while for females it was Health Care and Social Assistance (17% of females, 9% of males, and 13% of the total graduate labour force; Figure 8.2). The top ten industry divisions of employment for Biological Sciences graduates were the same in 2011 and 2016.

Figure 8.2: Top ten industry divisions of employment for Biological Sciences graduates with university qualifications, by gender

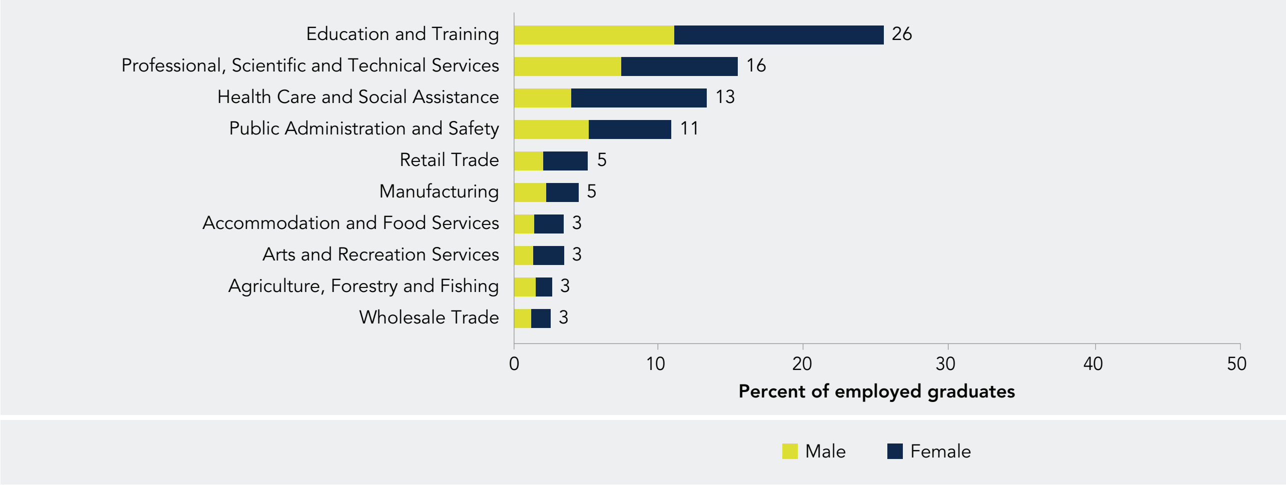
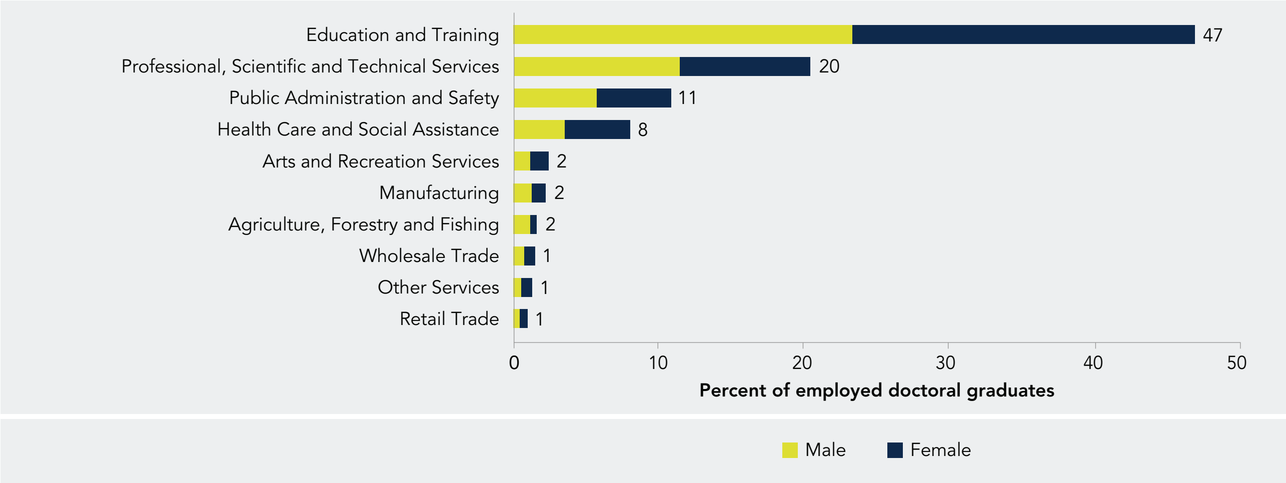


Figure 8.3: Top ten industry divisions of employment for Biological Sciences doctoral graduates, by gender



In 2011, the top two industries of employment for Biological Sciences doctoral graduates were Education and Training (42%) and Professional, Scientific and Technical Services (24%). In 2016, the proportion working in Education and Training had increased to 47% and the proportion working in Professional, Scientific and Technical Services had decreased to 20% (Figure 8.3). The top four industry divisions for doctoral graduates were the same as for all Biological Sciences graduates, however Public Administration and Safety traded places with Healthcare and Social Assistance to be the third most common industry of employment for doctoral graduates.

Analysis of industry sectors at the class level allows for a more detailed assessment of graduate employment. At this level, the top industry of employment for Biological Sciences graduates was Higher Education (19%; Figure 8.4). By a large margin, the second most common industry class was Scientific Research Services, employing 7% of graduates. There have been no substantial changes in the distribution of graduates across industry classes since 2011.

Doctoral graduates were even more concentrated into the Higher Education industry class. In 2011, 38% of graduates were employed in this class, rising to 42% in 2016 (Figure 8.5). The gender split of doctoral graduates in this industry class was almost equal at 51% male and 49% female. The second most common industry class of employment for doctoral graduates was Scientific Research Services (14%).

Figure 8.4: Top ten industry classes of employment of Biological Sciences graduates with university qualifications, by gender

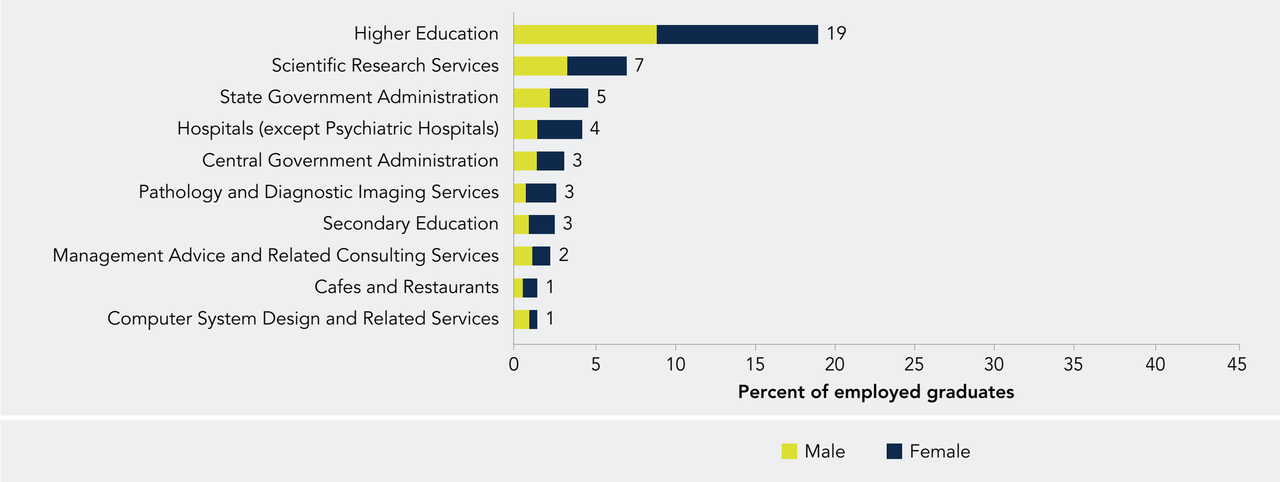
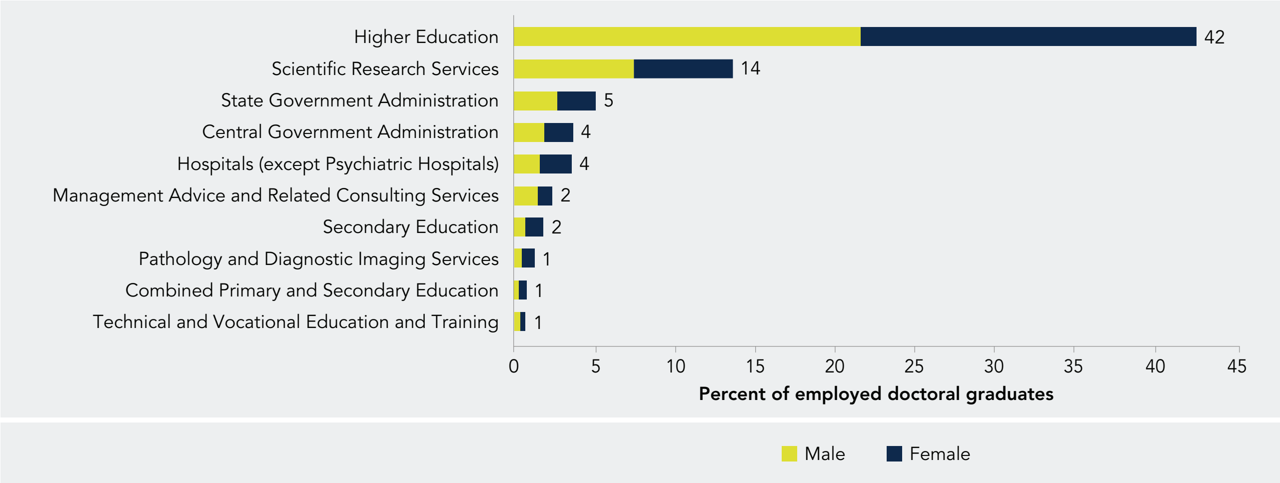


Figure 8.5: Top ten industry classes of employment of Biological Sciences doctoral graduates, by gender



What are the occupations of Biological Sciences graduates?

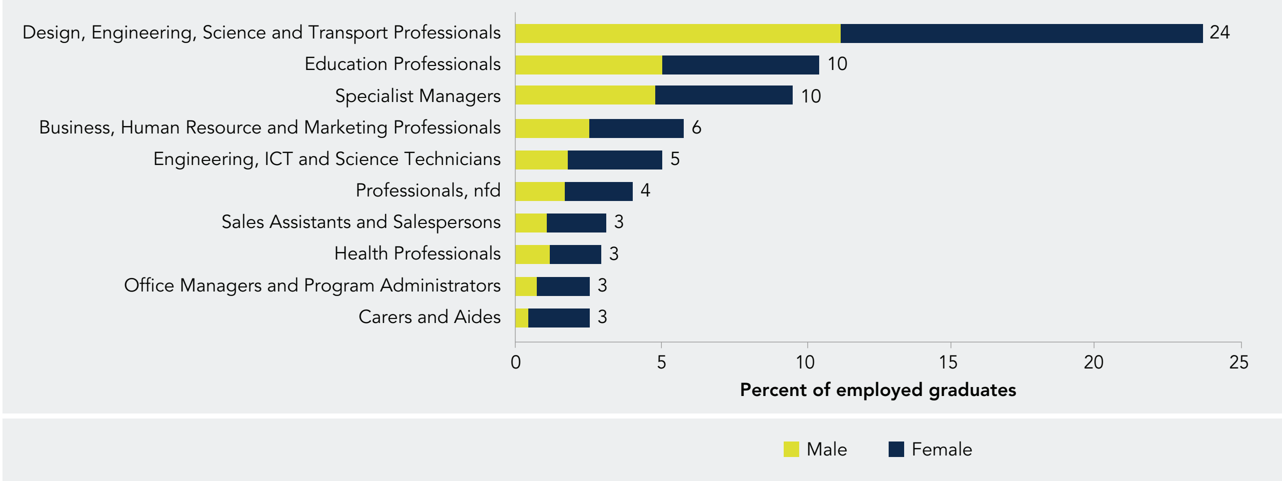
In 2016, nearly half (49%) of all employed Biological Sciences graduates worked as Professionals, down from to 55% in 2011. The next most common occupation classes were Managers (15%) and Clerical and Administrative Workers (10%; data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

The top ten sub-major group occupations for working Biological Sciences graduates are shown in Figure 8.6. Nearly a quarter of all graduates worked as Design, Engineering, Science and Transport Professionals (24%). The next most common occupations were Education Professionals and Specialist Managers, each representing 10% of the cohort. A similar number of males and females were employed in these top three occupations.

Figure 8.6 Top ten sub-major group level occupations of Biological Sciences graduates with university qualifications, by gender



At the more detailed unit group level the most common occupation for Biological Sciences graduates was Medical Laboratory Scientists (7%). The next most common occupations were University Lecturers and Tutors and Life Scientists (each with 6% of graduates).

In comparison to the total Biological Sciences graduate cohort, a greater percentage of doctoral holders were employed as University Lecturers and Tutors (15%; Figure 8.8). The next most common occupation for doctoral graduates was Medical Laboratory Scientists (10%). An additional 10% of Biological Sciences doctoral graduates did not specify their occupation at the unit group level and were classed as Natural and Physical Sciences Professionals not further defined.

Figure 8.7: Top ten unit group level occupations of Biological Sciences graduates with university qualifications, by gender

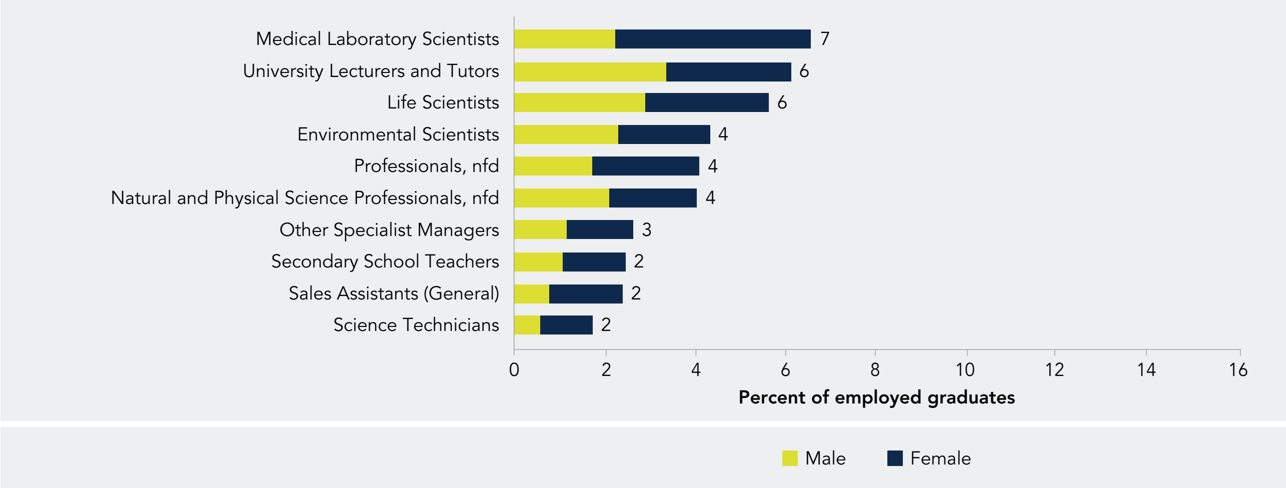
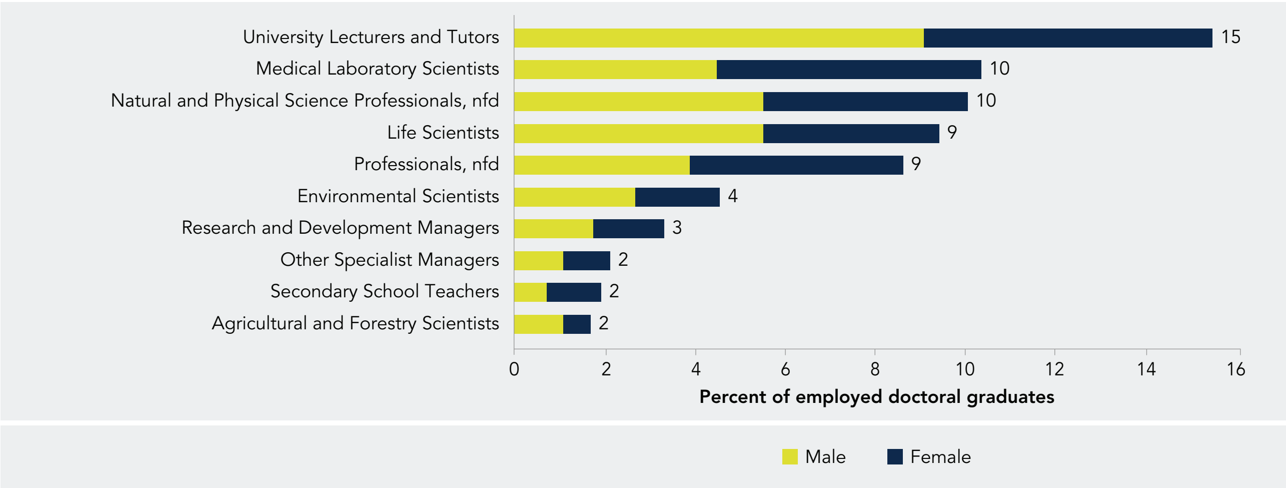


Figure 8.8: Top ten unit group level occupations of Biological Sciences doctoral graduates, by gender



Are Biological Sciences graduates high earners?

Between 2011 and 2016, the proportion of employed Biological Sciences bachelor graduates that had an income in the highest bracket ($104 000 or above) increased by 2 percentage points from 12% to 14%. Despite this increase, Biological Sciences graduates were less likely to have an income in the highest bracket than both the total STEM and non-STEM cohorts (Figure 8.9). Over a third of Biological Sciences bachelor graduates had an income in the lowest bracket of less than $41 600, a substantially larger proportion than the total STEM bachelor (19%) and non-STEM bachelor (23%) cohorts.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

The incomes of Biological Sciences graduates varied by gender and full time or part-time employment. Substantially more males than females and those who worked full-time had an income in the highest bracket (Figure 8.10).

Figure 8.9: Personal annual income of graduates, by field and level of qualification

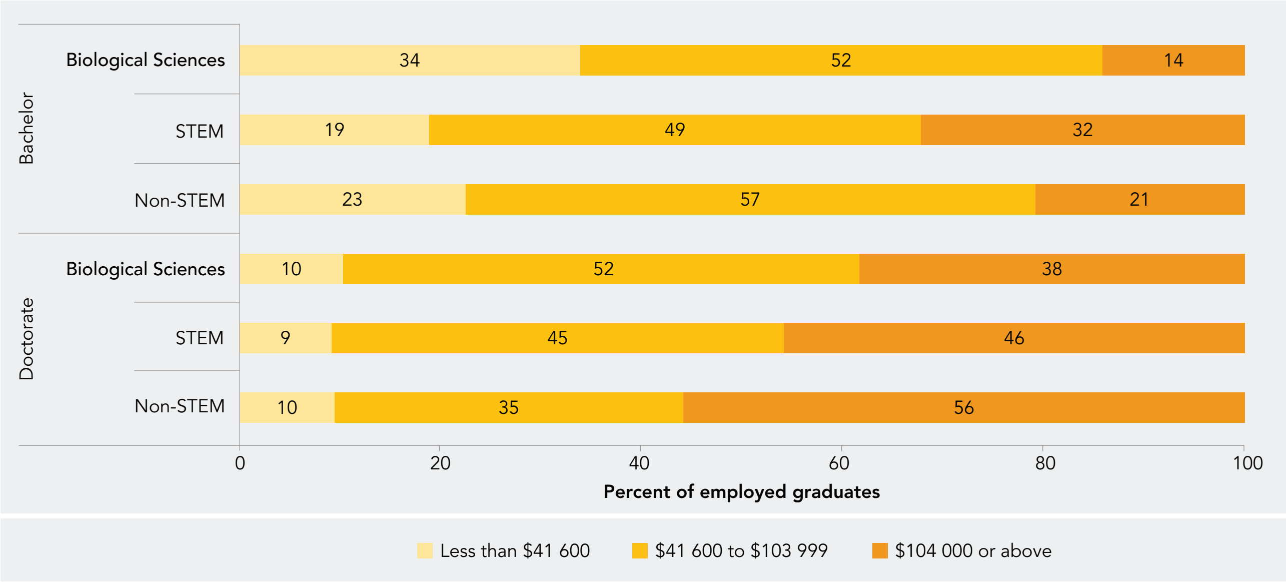
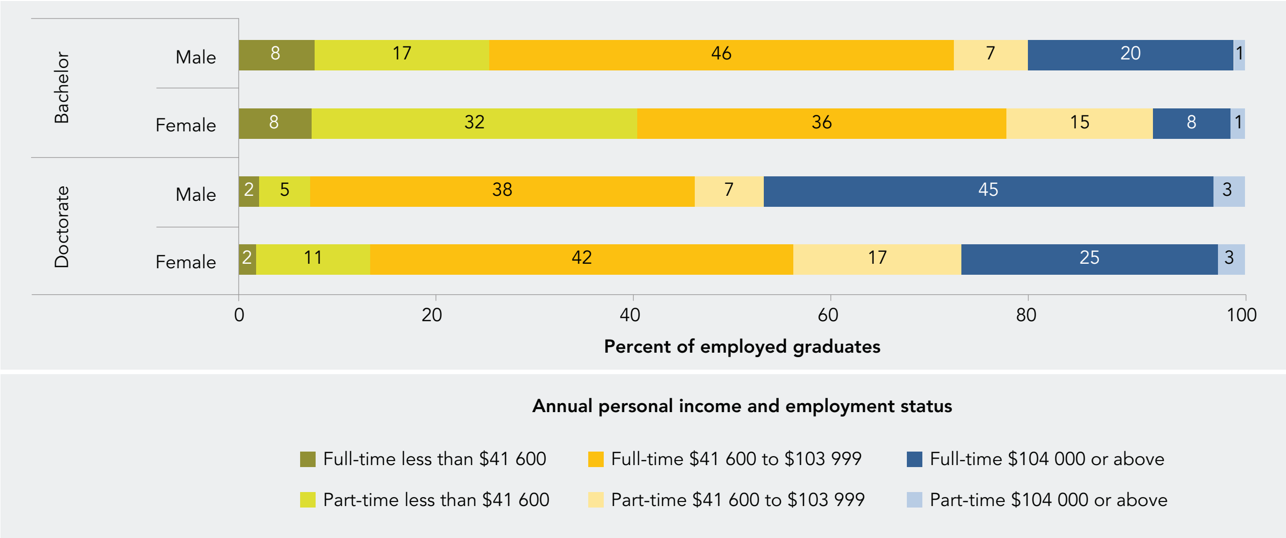


Figure 8.10: Personal annual income of Biological Sciences graduates working full-time and part-time, by field, gender and level of qualification



Age was also an important factor in the income levels of Biological Sciences graduates (Figure 8.11). The largest proportion of male bachelor graduates had an income in the highest bracket between the ages of 55 to 59, with just over a third (34%) of males in this bracket earning $104 000 or above. The proportion of females with an income in the highest income bracket peaked at 15% in three age groups; 40 to 44, 50 to 54 and 55 to 59. The percentage of males with an income in the highest bracket was more than double that of females across most age groups.

Between 2011 and 2016, there was an increase of 9 percentage points in the proportion of Biological Sciences doctoral holders earning in the highest bracket ($104 000 or above), from 29% to 38%. A lower proportion of Biological Sciences doctoral graduates had an income in the highest bracket than both the total STEM and non-STEM doctoral cohorts (Figure 8.9).

The difference between the incomes of males and females was smaller for doctoral graduates than bachelor graduates, but still considerable—45% of males working full-time and 25% of females working full-time had an income of $104 000 or above.

For doctoral graduates, high incomes were most common at an older age for both males and females compared to bachelor graduates (Figure 8.12). Males were most likely to have an income in the highest bracket at age 55 to 59 years, where two-thirds (65%) of males had an income in the highest bracket. The proportion of females in the highest income bracket peaked slightly later at age 60 to 64, where nearly half (48%) of females earned in the highest bracket. The difference between male and female earnings was greatest at age 45 to 49, when there was a difference of 23 percentage points between the proportion of males and females in the highest income bracket.

Figure 8.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

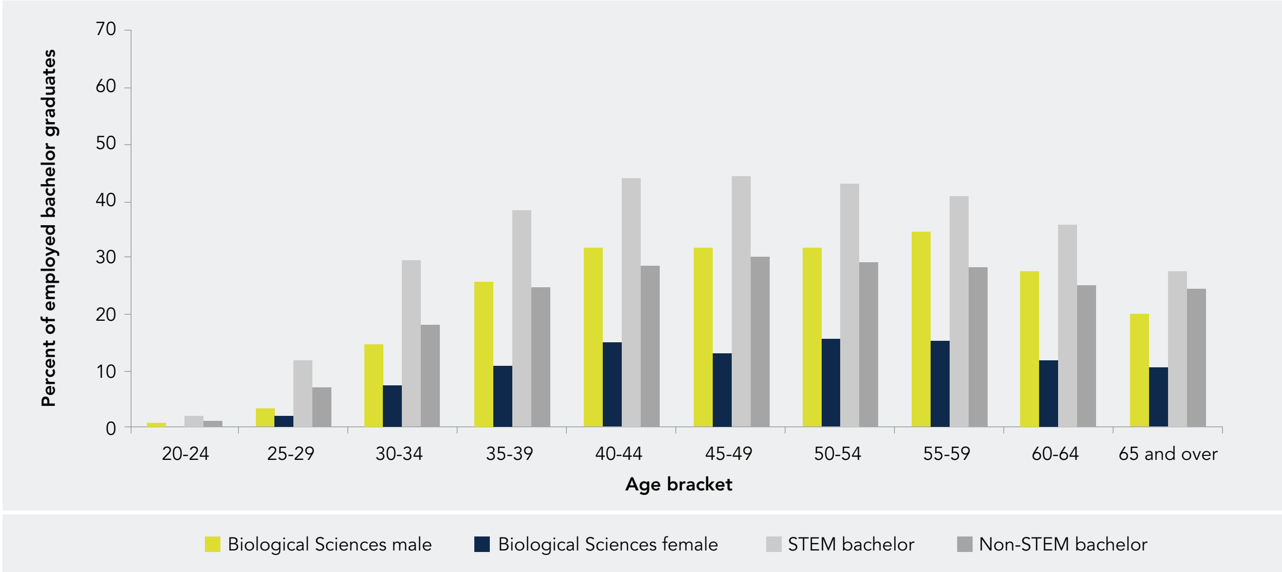
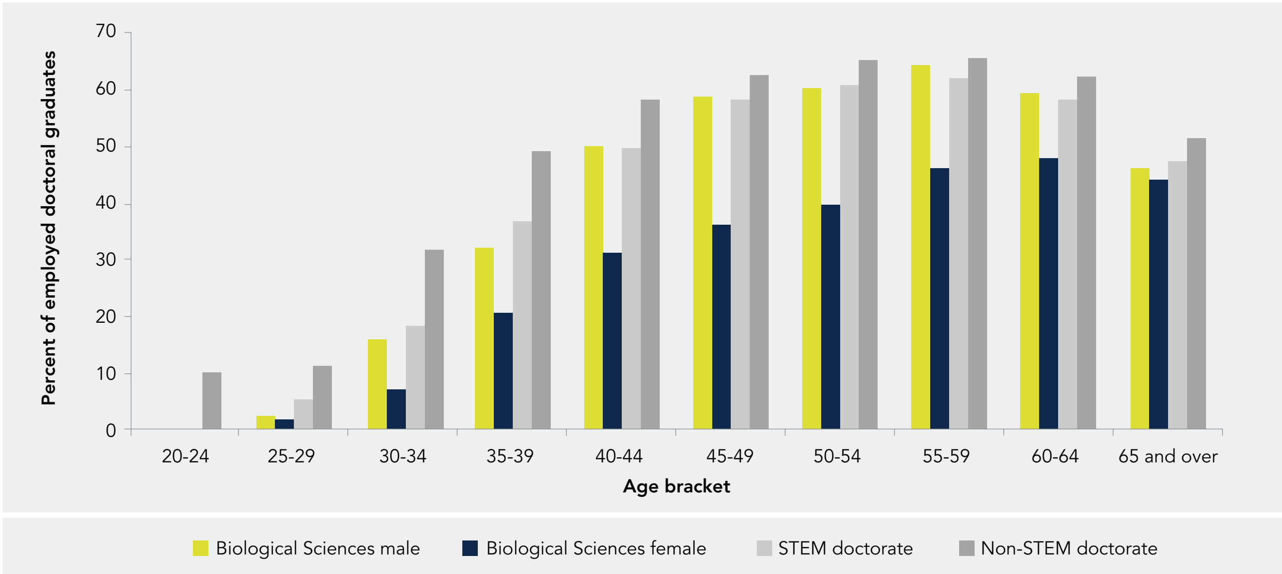


Figure 8.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 9

9

STEM PATHWAYS: AGRICULTURAL STUDIES

This chapter combines analysis of six of the seven ASCED 4-digit fields of Agriculture, Environmental and Related Studies, including:

- **Agriculture**—the study of growing, maintaining and harvesting non-intensively managed crops and pastures, and breeding, grazing and managing animals. It includes the study of farming and producing unprocessed plant and animal products.
- **Horticulture and Viticulture**—the study of cultivating, propagating and producing intensively managed crops such as grapes and other fruits, vegetables, flowers, trees, shrubs and plants.
- **Forestry Studies**—the study of establishing, cultivating, harvesting and managing forests.
- **Fisheries Studies**—the study of breeding, rearing, harvesting, handling, and managing fish and other aquatic resources.
- **Other Agriculture, Environment and Related Studies**—all Agriculture, Environmental and Related Studies not elsewhere classified, including Pest and Weed control and Agriculture, Environmental and Related Studies not elsewhere classified.
- **Agriculture, Environment and Related Studies not further defined.**

Together, these fields are referred to in this report as 'Agricultural Studies'. The field of Environmental Studies is analysed separately in the next chapter of this report.

> *The main purpose of studying and working in Agricultural Studies is to understand and apply knowledge of the management and use of natural resources, and the production of primary agricultural products (ABS, 2001).*

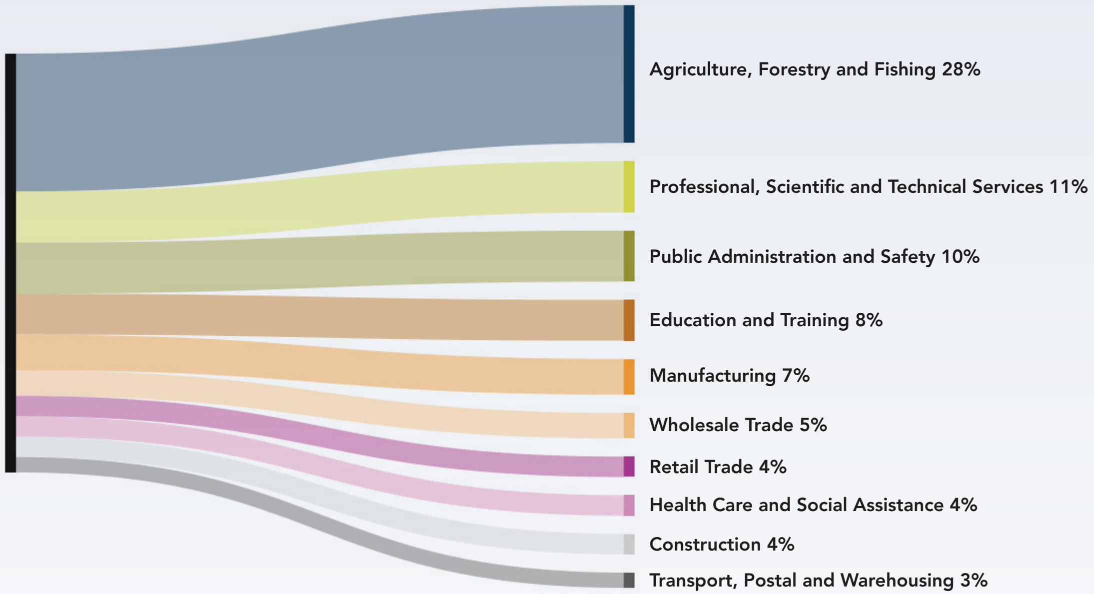
The fields of education analysed in this chapter differ to those that were analysed in the previous STEM Workforce report. The previous report combined the 4-digit fields of Agriculture with Horticulture and Viticulture as 'Agricultural Sciences', and separately investigated Fisheries Studies and Forestry Studies. The two fields of Other Agriculture, Environment and Related Studies, and Agriculture, Environment and Related Studies not further defined, were not examined in detail in the previous report.

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Agricultural Studies. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016 there were 32 418 people with university qualifications in Agricultural Studies. Of these, 25 535 were in the labour force, of whom 24 629 were employed.
- The unemployment rate for Agricultural Studies graduates was 3.5%, lower than the total STEM graduate labour force.
- Employed Agricultural Studies graduates were older than employed STEM graduates as a whole, and male Agricultural Studies graduates were older on average compared to females.
- Over a quarter (28%) of Agricultural Studies graduates were employed in the industry division of Agriculture, Forestry and Fishing, an increase of 5 percentage points since 2011.
- Nearly a third (30%) of Agricultural Studies graduates worked as Managers, 29% as Professionals, and 11% as Technicians and Trades Workers.
- A smaller percentage of Agricultural Studies graduates had an income in the highest bracket than the overall STEM graduate cohort. 18% of bachelor graduates and 38% of doctoral graduates had an income of $104 000 or above.

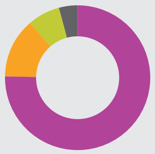
Top ten industries of employment for Agricultural Sciences graduates



32 418 people in Australia had a university qualification in Agricultural Studies

Type of qualification

- 74% Agriculture
- 13% Horticulture and Viticulture
- 7% Forestry Studies
- 4% Other fields*



% in the labour force

working or looking for work

79%

not in the labour force

21%

Of those in the labour force

% employed

96.5 %
EMPLOYED

3.5%
UNEMPLOYED

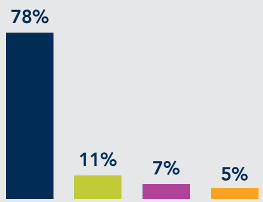
Gender

66%
MALES

34%
FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



* Other fields include Fisheries Studies (4%), Other Agriculture, Environmental and Related Studies (<1%) and Agriculture, Environmental and Related Studies, not further defined (<1%).

The Agricultural Studies qualified population

In 2016, there were 32 418 people in Australia with university qualifications in the field of Agricultural Studies, an increase of 4 200 since 2011. Nearly three-quarters (74%) held a qualification in Agriculture, with Horticulture and Viticulture the second most common narrow field of education (13%).

The Agricultural Studies labour force

Of the qualified population, 79% (25 535 people) were in the labour force, either working or looking for work. Females made up 34% of the Agricultural Studies labour force, an increase of 3 percentage points since 2011.

Over three-quarters (78%) of the Agricultural Studies labour force had a bachelor degree, with postgraduate qualifications less common.

The unemployment rate in this field was 3.1% for males and 4.5% for females, up from 2.5% and 3.5% in 2011.

Employed Agricultural Studies graduates

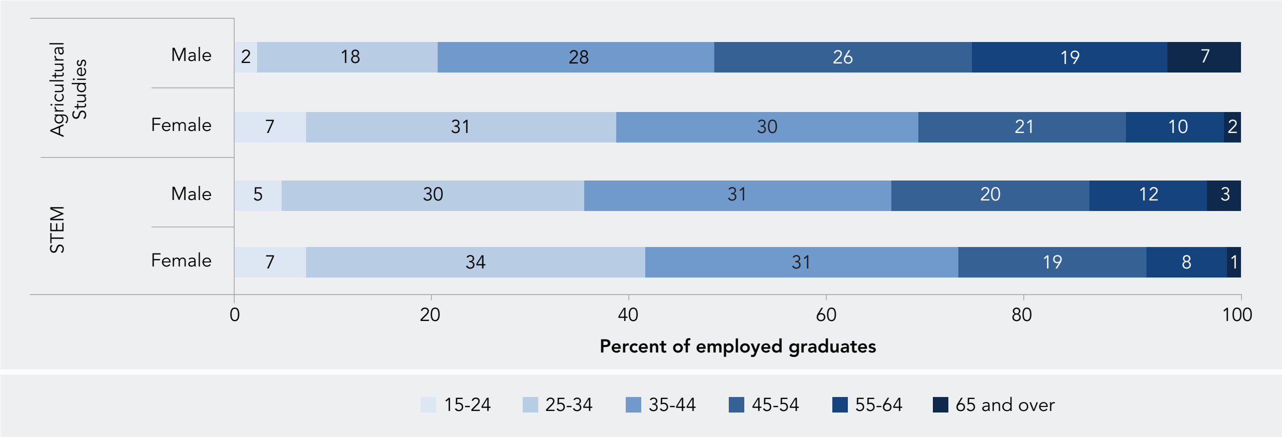
In 2016, on Census night, 24 629 university qualified Agricultural Studies graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Agricultural Studies graduate workforce?

In 2016, both the male and female Agricultural Studies graduate workforce were older than the STEM graduate workforce as a whole (Figure 9.1). Over half of employed male Agricultural Studies graduates were aged over 45 (53%), compared to 35% of all employed male STEM graduates. While a lower proportion of females with Agricultural Studies qualifications were aged over 45 (33%), this was higher than the proportion of the total female STEM graduates aged 45 or over (28%).

The female Agricultural Studies graduate workforce is ageing. In 2011, 30% of females were aged 45 and over. The age of employed male graduates has remained stable, with no change in the percent aged over 45 between 2011 and 2016.

Figure 9.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Agricultural Studies graduates work?

In 2016, the majority (81%) of all Agricultural Studies graduates were employed in the private sector, however the proportion varied by level of qualification; from 85% of bachelor graduates and 76% of those with a masters to less than half (48%) of doctorate holders (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

In 2011, 23% of all Agricultural Studies graduates worked in the Agriculture, Forestry and Fishing industry division, 12% worked in Public Administration and Safety and 11% worked in Professional, Scientific and Technical Services. In 2016, the proportion of graduates working in the Agriculture, Forestry and Fishing industry division had increased to 28%, Public Administration and Safety had decreased to 10% and the proportion of graduates employed in Professional, Scientific and Technical Services (11%) was unchanged from 2011 (Figure 9.2).

Figure 9.2: Top ten industry divisions of employment for Agricultural Studies graduates with university qualifications, by gender

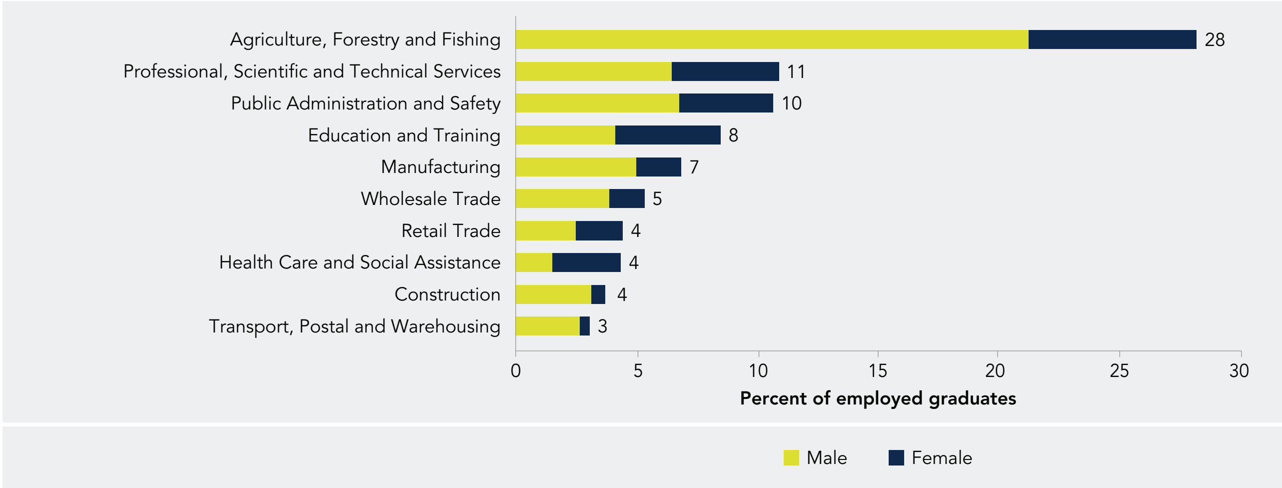
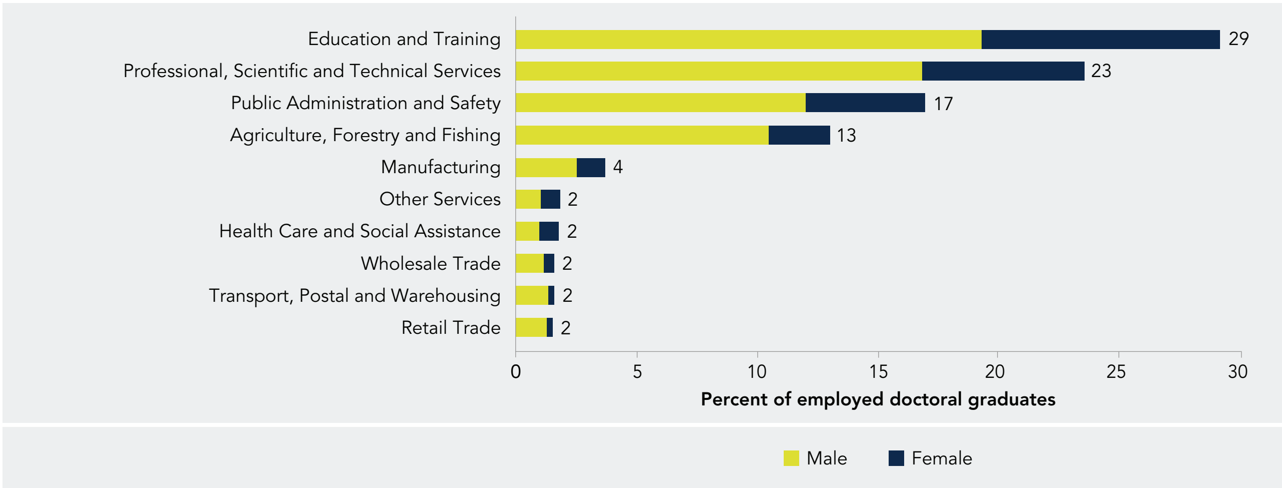


Figure 9.3: Top ten industry divisions of employment for Agricultural Studies doctoral graduates, by gender



While the Agriculture, Forestry and Fishing industry division was the top destination for people with Agricultural Studies qualifications, at the more detailed industry class level, the top three classes were from other divisions (Figure 9.4). In 2016, the top three industry classes of employment for Agricultural Studies graduates were State Government Administration (5%), Higher Education (4%), and Scientific Research Services (4%).

For the 7% of Agricultural Studies graduates with doctoral qualifications, the top industry division of employment was Education and Training, which employed 29% of the working population in 2016 (Figure 9.3), compared to just 8% of bachelor graduates. The Professional, Scientific and Technical Services industry was the second most common division of employment for doctoral graduates (23%), followed by Public Administration and Safety (17%). Just 13% of doctoral graduates were employed in the Agriculture, Forestry and Fishing industry. The only notable change in the destination of Agricultural Studies doctoral graduates between 2011 and 2016 was a decrease in the percentage of graduates employed in the Public Administration and Safety industry—from 21% to 17%.

When looking at the industry classes of those with doctorates in Agricultural Studies, over half were employed in three industry classes: one-quarter in Education and Training, 16% in Scientific Research Services, and 11% in State Government Administration (Figure 9.5). Just four of the top ten industry classes for doctorates were from the broader Agriculture, Forestry and Fishing industry division.

Figure 9.4: Top ten industry classes of employment of Agricultural Studies graduates with university qualifications, by gender

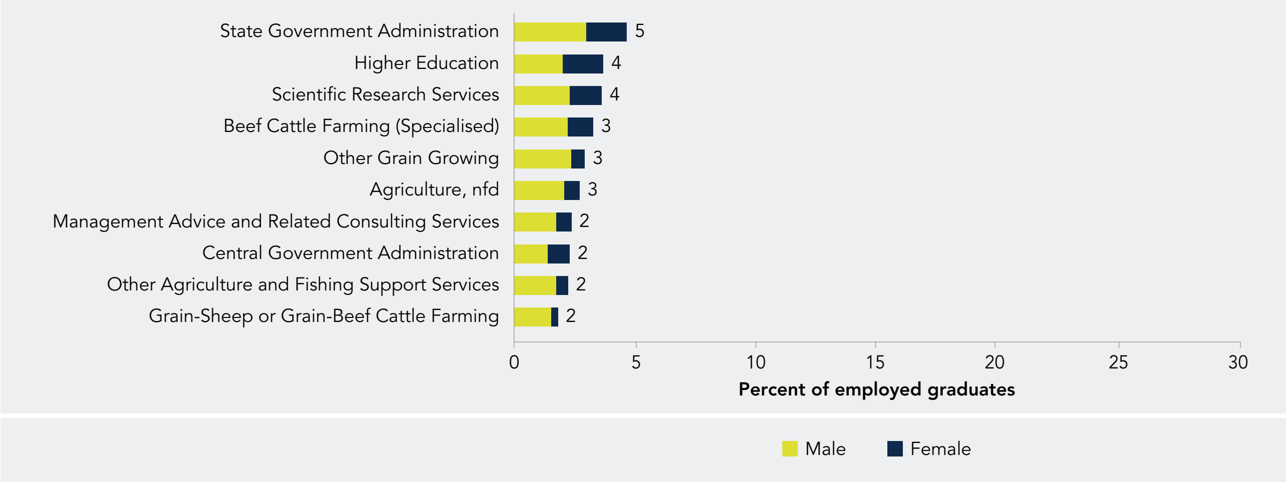
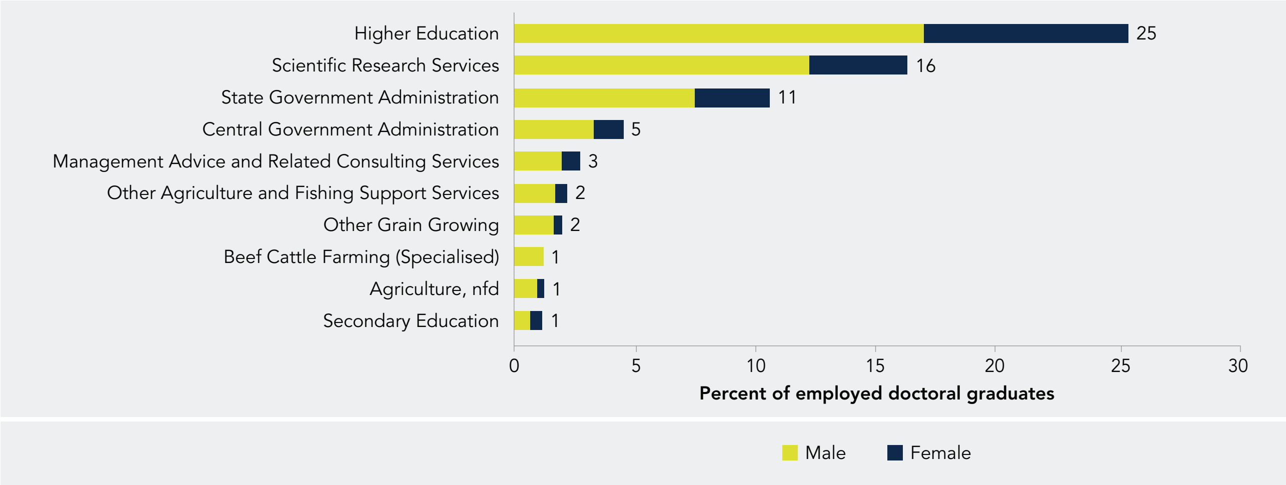


Figure 9.5: Top ten industry classes of employment of Agricultural Studies doctoral graduates, by gender



What are the occupations of Agricultural Studies graduates?

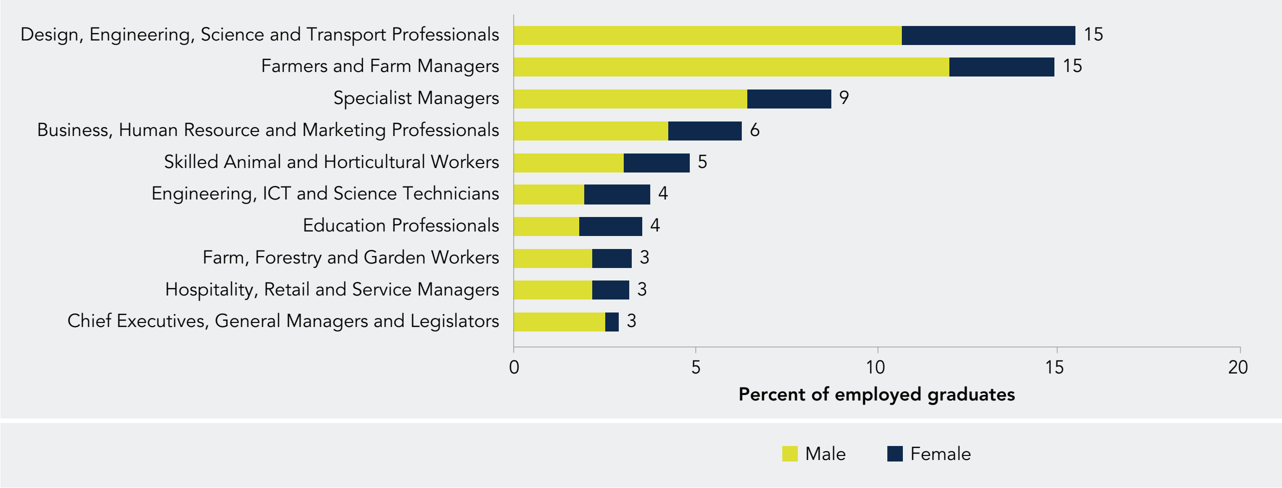
In 2016, at the broadest level of occupation classification, 30% of Agricultural Studies graduates were employed as Managers, 29% as Professionals, and 11% as Technicians and Trades Workers (data not shown).

At the sub-major level of occupation, the top two occupations for Agricultural Studies graduates were Design, Engineering and Transport Professionals and Farmers and Farm Managers, both representing 15% of the cohort (Figure 9.6).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

Figure 9.6: Top ten sub-major group level occupations of Agricultural Studies graduates with university qualifications, by gender



At the more detailed unit group level, the top occupation for Agricultural Studies graduates was Agricultural and Forestry Scientists (Figure 9.7). In 2011, 11% of Agricultural Studies graduates were employed in this unit group occupation, decreasing to 9% in 2016. The next three most common occupations in 2016 all related to farming; Livestock Farmers (6%), Crop Farmers (5%) and Mixed Crop and Livestock Farmers (3%).

For doctoral graduates, the top occupation was also Agricultural and Forestry Scientists (Figure 9.8). In 2011, 24% of Agricultural Studies doctoral graduates were employed in this occupation, decreasing to 18% in 2016. The second most common occupation for Agricultural Studies doctorate holders in 2016 was University Lecturers and Tutors (10%). Farming was only represented once in the top ten occupations.

Figure 9.7: Top ten unit group level occupations of Agricultural Studies graduates with university qualifications, by gender

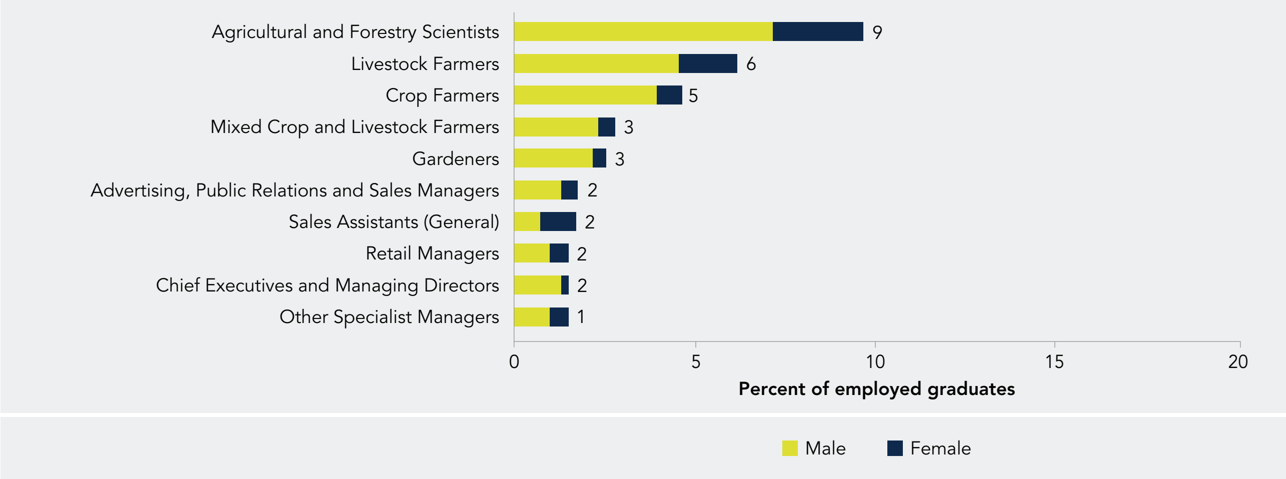
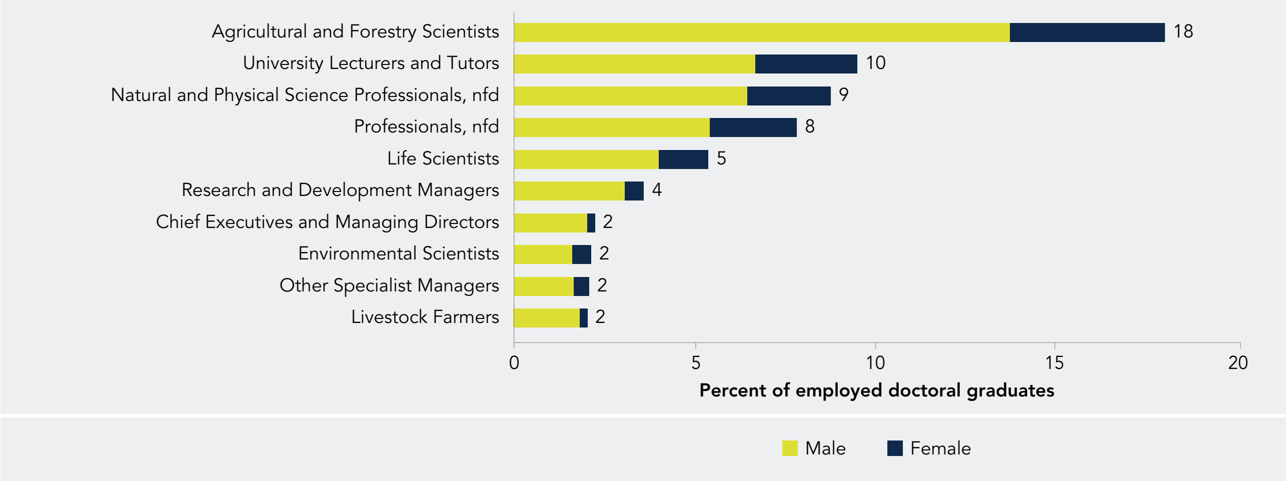


Figure 9.8: Top ten unit group level occupations of Agricultural Studies doctoral graduates, by gender



Are Agricultural Studies graduates high earners?

In 2016, 18% of employed Agricultural Studies bachelor graduates had an income in the highest bracket ($104 000 or above). This was lower than the total STEM (32%) and non-STEM (21%) graduate cohorts (Figure 9.9). Between 2011 and 2016, the proportion of Agricultural Studies graduates in this bracket increased by 5 percentage points, compared to a 4 percentage point increase for both the STEM and non-STEM cohorts.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

Compared to those with a bachelor degree, a much higher proportion of Agricultural Studies doctorate holders earned in the highest income bracket (Figure 9.9). In 2011, 30% were in the highest income bracket, increasing to 38% in 2016. However, a lower percentage of Agricultural Studies doctoral holders had an income in the highest bracket than the total STEM and non-STEM doctoral cohorts highest and 14% of Agricultural Studies doctorates had an income in the lowest bracket (less than $41 600).

For those with doctoral degrees, the differences between the proportions of males and females in the highest and lowest brackets were also substantial. 43% of male doctoral graduates had an income in the highest bracket, compared to just 22% of females with the same level of qualification (Figure 9.10).

Figure 9.9: Personal annual income of graduates, by field and level of qualification

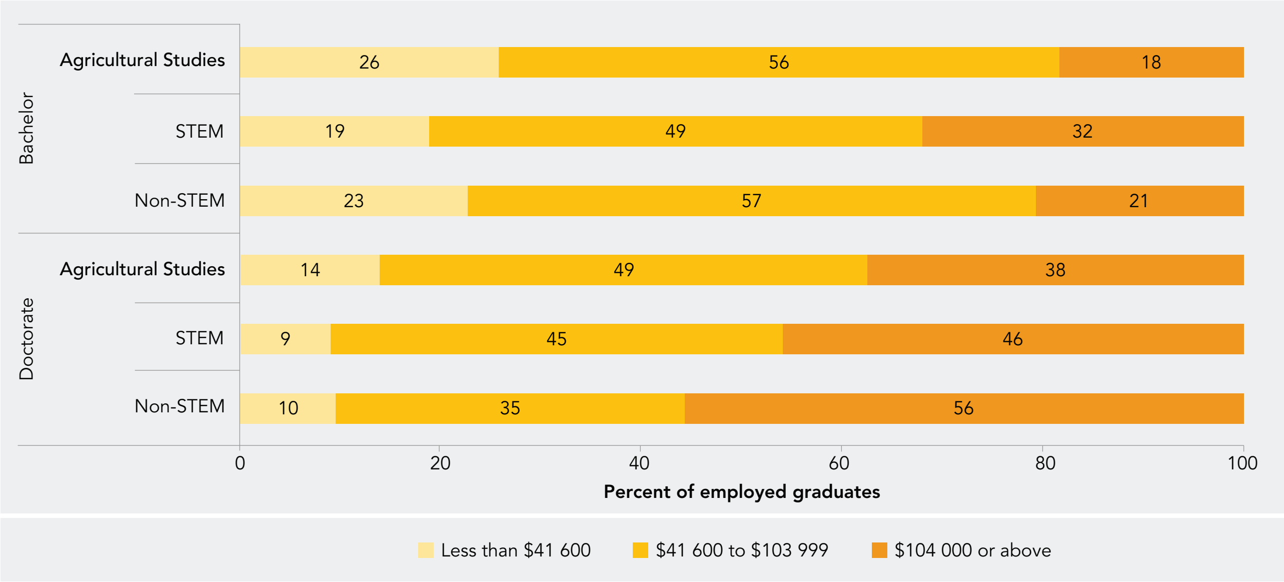
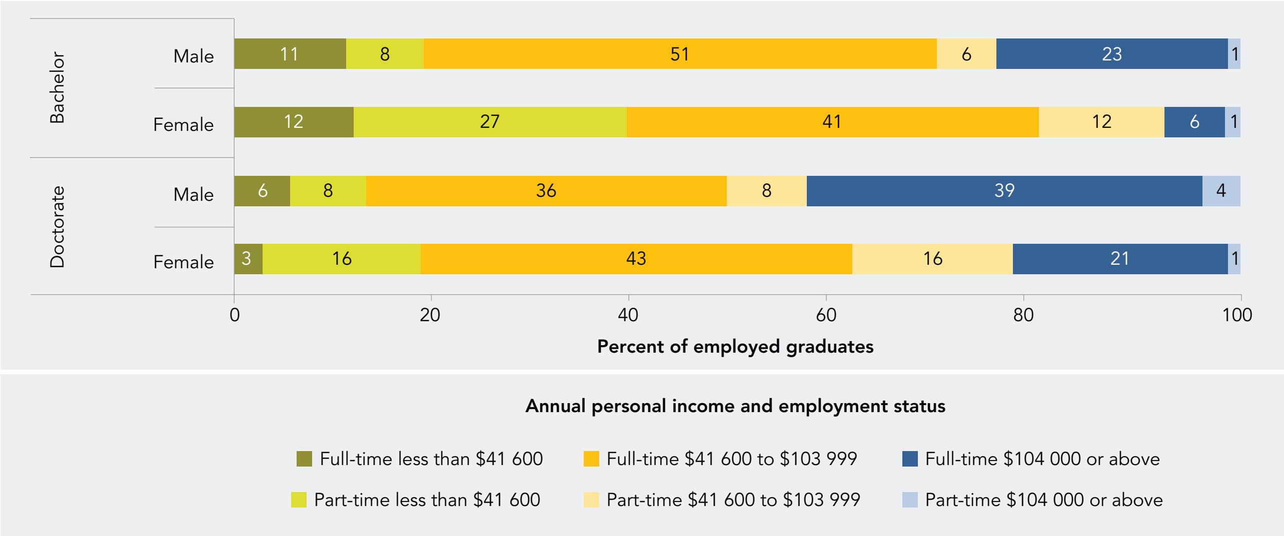


Figure 9.10: Personal annual income of Agricultural Studies graduates working full-time and part-time, by gender and level of qualification



Age is also a factor in the income of Agricultural Studies graduates. The percentage of bachelor holders in the highest income bracket peaked between the ages of 45 to 49, at 33% for males and at 13% for females (Figure 9.11). At least twice the proportion of males compared to females had an income in the highest bracket across all age groups. The proportion of Agricultural Studies bachelor graduates in the highest income bracket was lower than that for all STEM bachelor holders across all age groups.

The income of Agricultural Studies doctorate graduates peaked at the ages of 55 to 59 for both males and females—over half (58%) of males and over one-third (38%) of females in this age group had an income in the highest bracket at that age (Figure 9.12). A lower proportion of Agricultural Studies doctoral graduates than both the STEM qualified and non-STEM qualified cohorts had an income in the highest bracket across all age groups above 35 years of age.

Figure 9.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

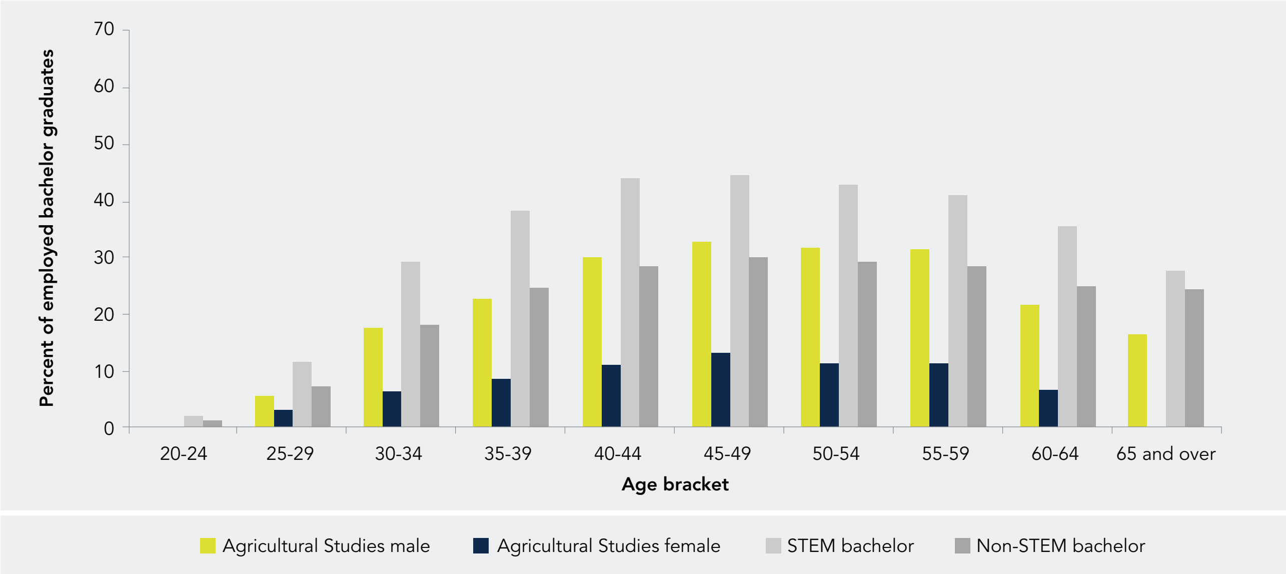
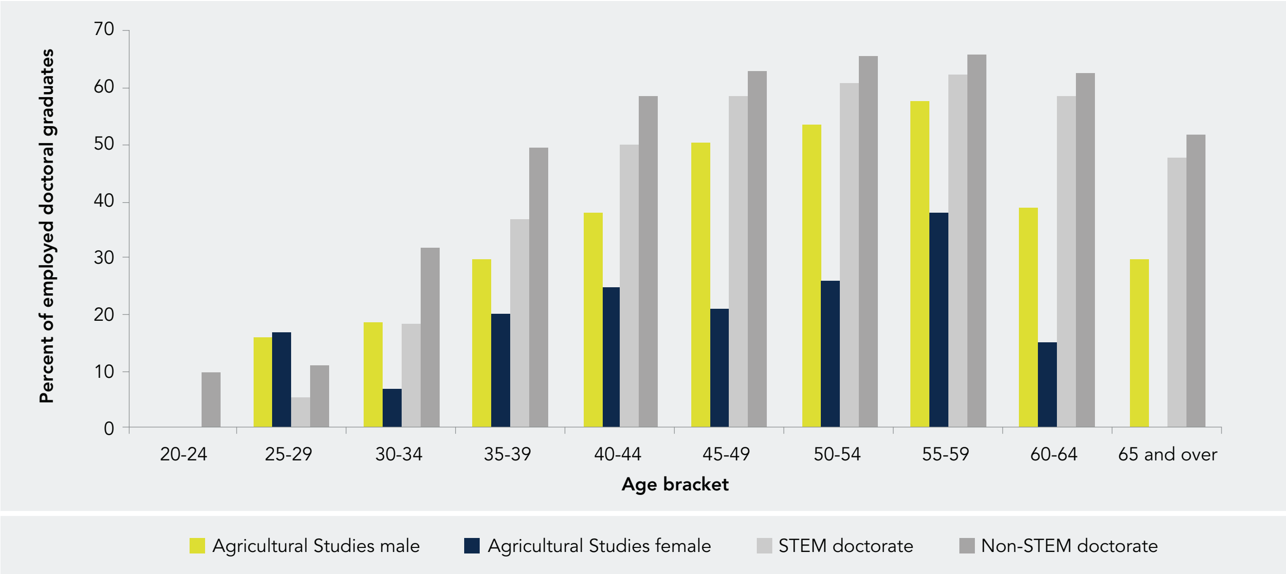


Figure 9.12: Percentage of doctoral with an income of $104 000 or above, by field, age group and gender



CHAPTER 10

10

STEM PATHWAYS: ENVIRONMENTAL STUDIES

What is Environmental Studies?

Environmental Studies is the study of the relationships between living organisms and the natural, rural, industrial and urban environments. It includes the study of the impact humans have upon the natural environment. The main purpose of this narrow field of education is to develop an understanding of the scientific aspects of the environment and the procedures required to establish an environmentally sustainable society. It also involves developing an understanding of how physical, economic, social and technological factors effect the environment.

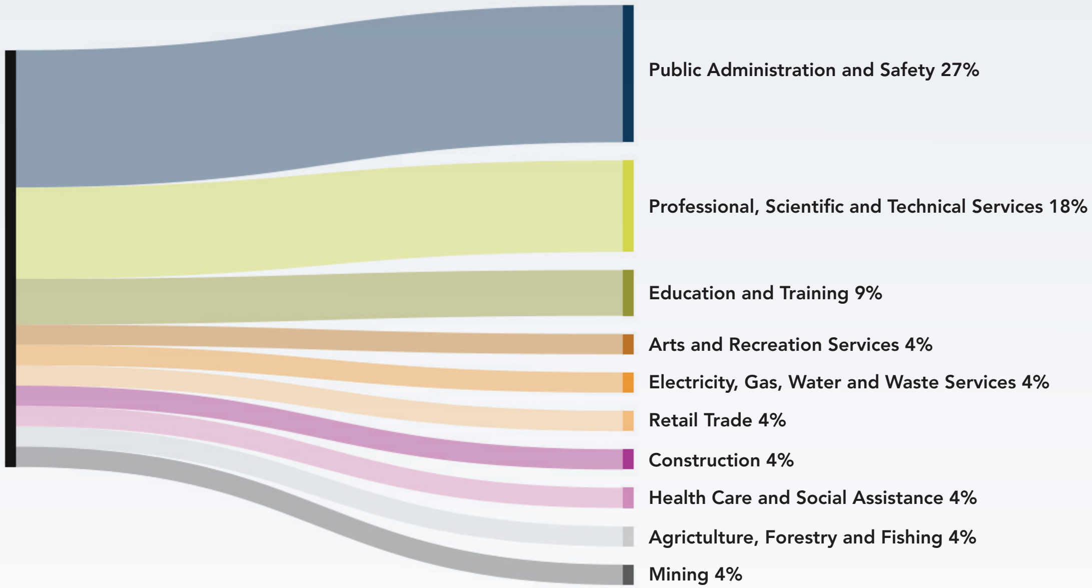
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Environmental Studies. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016, there were 30 716 people with university qualifications in the field of Environmental Studies. Of these, 26 557 were in the labour force, of whom 25 061 were employed.
- Half of the Environmental Studies labour force were female.
- A higher proportion of the Environmental Studies labour force held a masters degree (23% of the labour force) and a lower proportion held a doctorate (5%) than the total STEM graduate cohort.
- Alongside Biological Sciences, Environmental Studies had the highest proportion of graduates working in the public sector, at 40%.
- Over a quarter of Environmental Studies graduates (27%) worked in Public Administration and Safety, which was the top industry of employment.
- At the most detailed level of industry class of employment, all three levels of government were represented: State Government Administration employed the highest proportion of Environmental Studies graduates (11%), followed by Local Government Administration at 8%. Central Government Administration was the industry of employment for a further 5% of graduates.
- A lower proportion of Environmental Studies graduates than the total STEM graduate cohort had an income in the highest bracket. 17% of bachelor graduates and 37% of doctoral graduates in Environmental Studies had an income of $104 000 or above.

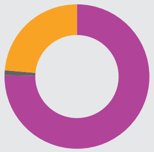
Top ten industries of employment for Environmental Studies graduates



30 716 people in Australia had a university qualification in Environmental Studies

Type of qualification

- 76% Land, Parks and Wildlife Management
- 24% Environmental Studies, nec
- <1% Environmental Studies, nfd



% in the labour force

Of those in the labour force

% employed

94.4 % EMPLOYED

5.6% UNEMPLOYED

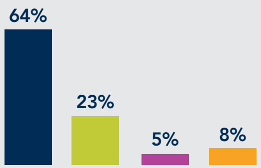
Gender

50% MALES

50% FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



The Environmental Studies qualified population

In 2016, there were 30 716 people in Australia with university qualifications in the field of Environmental Studies, an increase of 5800 since 2011. Approximately three quarters of graduates held qualifications in Land, Parks and Wildlife Management (76%), while the remaining 24% held degrees in Environmental Studies not elsewhere classified.

The Environmental Studies labour force

Of the qualified population, 86% (26 557 people) were in the labour force, either working or looking for work. Females made up 50% of the Environmental Studies labour force, an increase of one 1 percentage point since 2011.

The unemployment rate in this field was 5.3% for males and 6.0% for females, up from 3.5% and 4.0% in 2011.

Employed Environmental Studies graduates

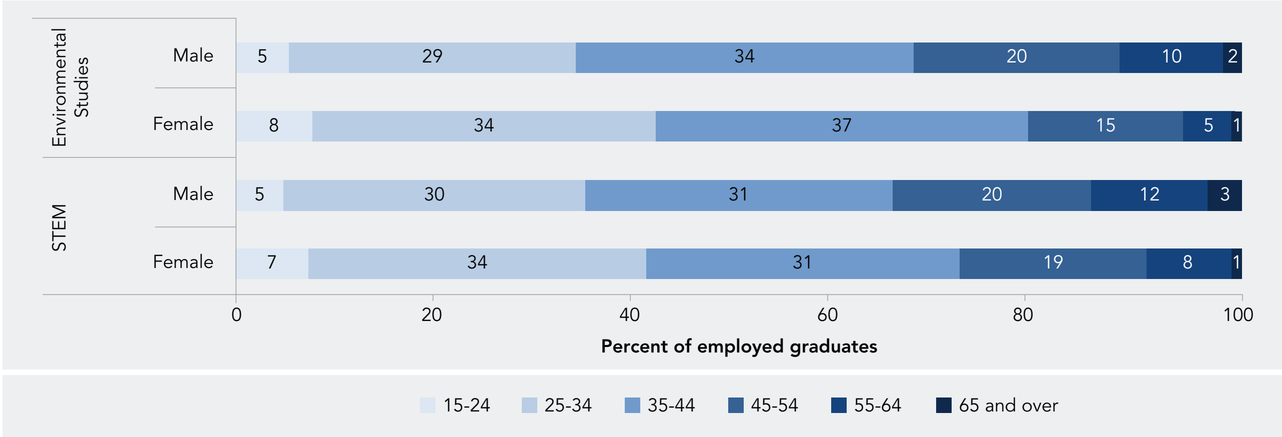
In 2016, on Census night, 25 061 university qualified Environmental Studies graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Environmental Studies graduate workforce?

In 2016, the Environmental Studies workforce was younger than the STEM workforce overall, and the female workforce was younger than the male (Figure 10.1).

In 2011, 17% of employed female Environmental Studies graduates were aged 45 years or older, increasing to 21% in 2016. This percentage was lower than for female STEM graduates overall (28% aged 45 or older). In 2011, 31% of employed male Environmental Studies graduates were aged 45 or older, increasing to 32% in 2016. In comparison, in 2016, 35% of the total male STEM graduate workforce were aged over 45.

Figure 10.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Environmental Studies graduates work?

While the majority of employed Environmental Studies graduates worked in the private sector (60%), this was the equal lowest proportion of all STEM fields alongside the Biological Sciences. The proportions of graduates in the private sector varied from 63% of bachelor graduates, to 59% of masters graduates and just 37% of doctoral graduates (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

The most common industry of employment was Public Administration and Safety, which employed 30% of working Environmental Studies graduates in 2011 and 27% in 2016 (Figure 10.2). In 2016, this was the top industry division of employment for both male (26%) and female (28%) Environmental Studies graduates.

The Professional, Scientific and Technical Services industry division was the second most common destination for Environmental Studies graduates, employing 18% of the working cohort, while Education and Training came in third, at 9%.

Figure 10.2: Top ten industry divisions of employment for Environmental Studies graduates with university qualifications, by gender

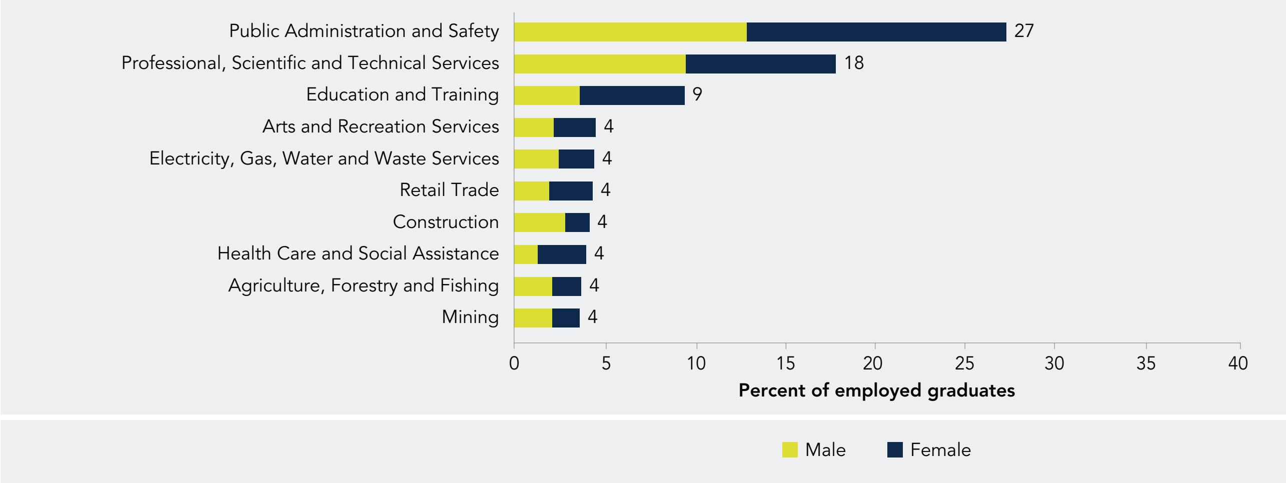
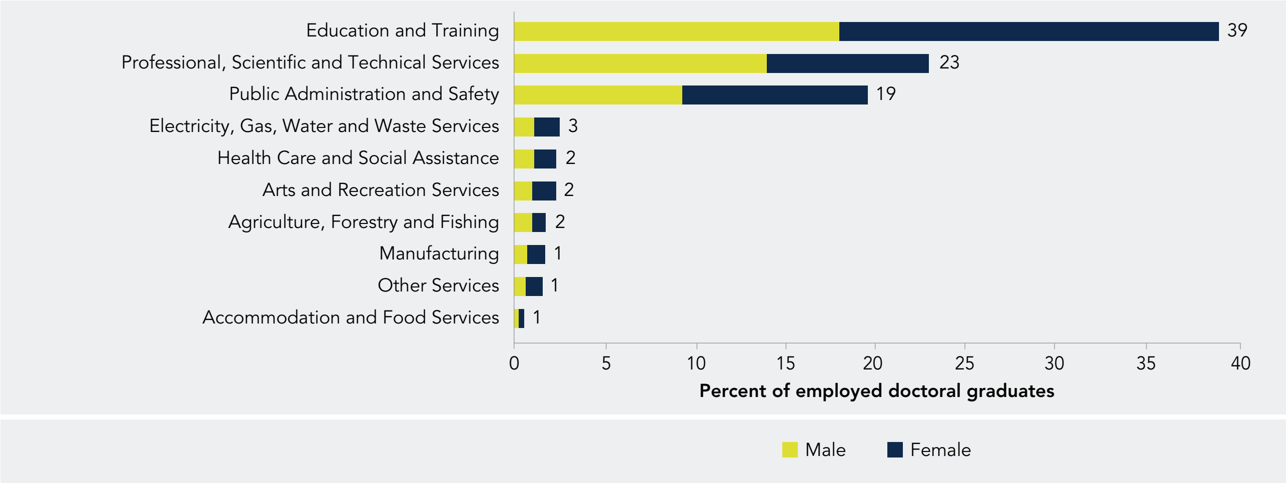


Figure 10.3: Top ten industry divisions of employment for Environmental Studies doctoral graduates, by gender



In 2016, the top three industry divisions of employment for Environmental Studies graduates were the same as those in 2011, but there were some changes in the other top ten industries, which each accounted for 4% of graduates. Mining was the fourth most popular industry of employment in 2011, but was tenth in 2016, and Manufacturing was replaced by Agriculture, Forestry and Fisheries in the top ten for 2016.

When looking only at those with doctoral qualifications, the top three industry destinations were the same as those for the whole Environmental Studies graduate cohort; however the proportions in each were different (Figure 10.3). The top destination for doctoral graduates was Education and Training, which employed 34% of working graduates in 2011, increasing to 39% in 2016. The second most common destination was the Professional, Scientific and Technical Services industry (23%), followed by Public Administration and Safety (19%).

Looking at the more detailed level of industry classification, industry class, Environmental Studies graduates were employed in all levels of public administration. State Government Administration employed the highest proportion of graduates, at 11%, followed by Local Government Administration, at 8%. Central Government Administration was the industry of employment for a further 5% of graduates (Figure 10.4).

For doctoral holders, the most common industry class by a large margin was Higher Education, which employed over a third of this population (36%). The three levels of government were also represented in the top ten industry classes of employment (Figure 10.5).

Figure 10.4: Top ten industry classes of employment of Environmental Studies graduates with university qualifications, by gender

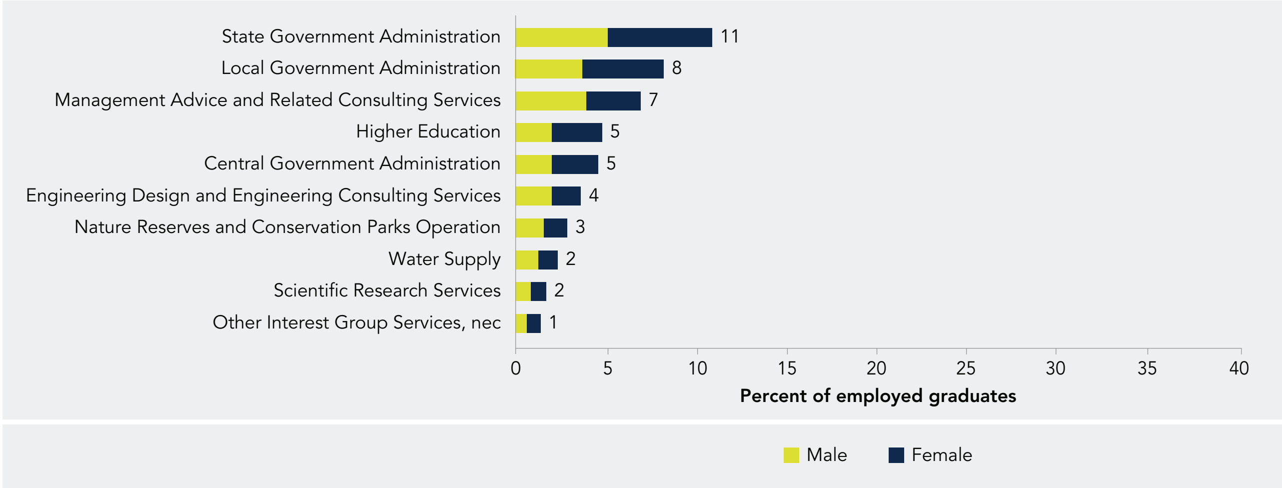
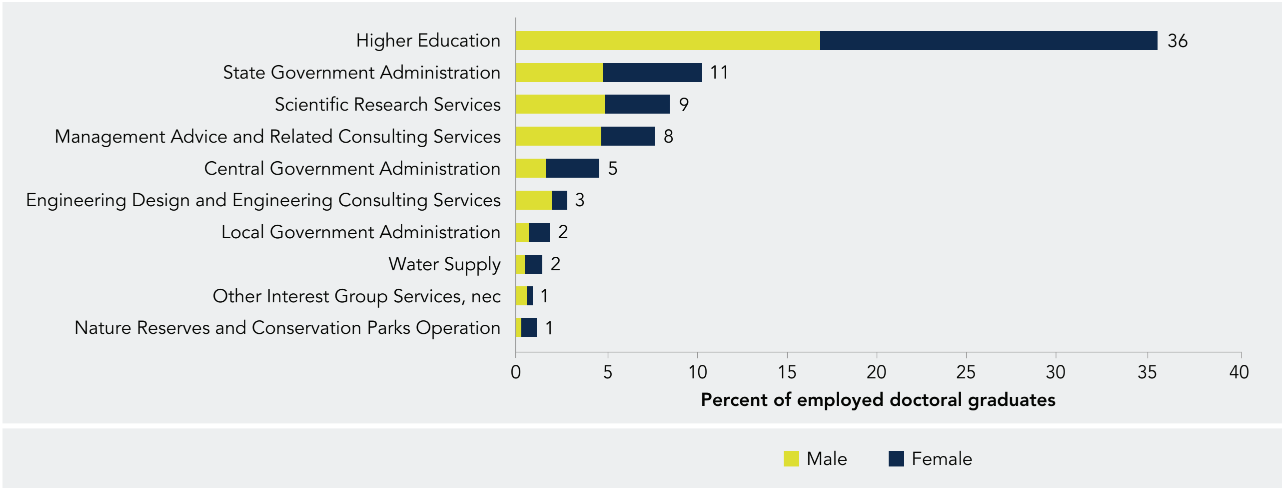


Figure 10.5: Top ten industry classes of employment of Environmental Studies doctoral graduates, by gender



What are the occupations of Environmental Studies graduates?

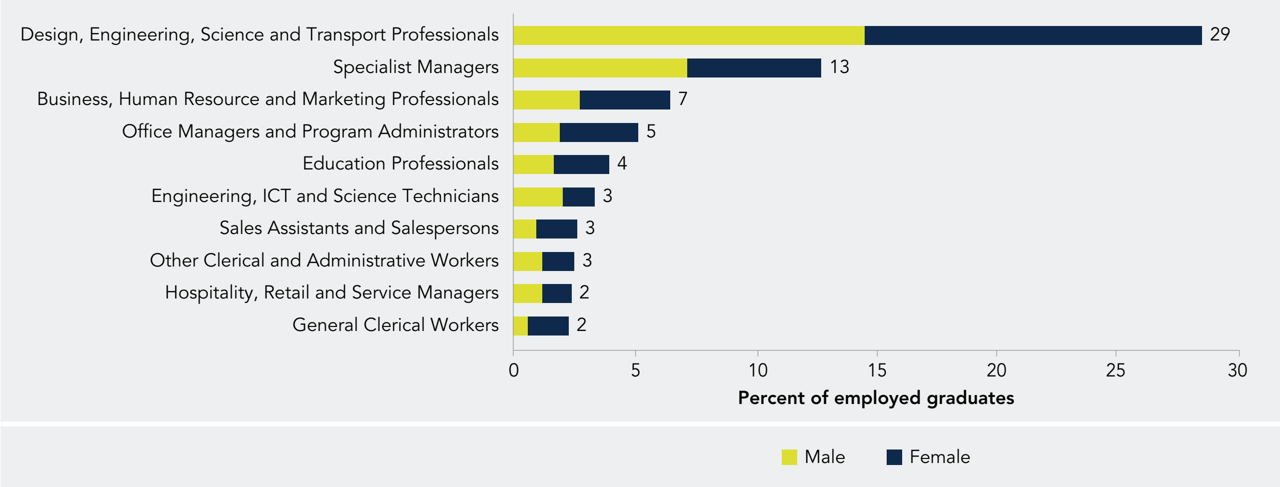
In 2016, over half of working Environmental Studies graduates were employed in the broad occupation group of Professionals (53%), and 17% were Managers (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

The most common sub-major occupation group was Design, Engineering, Science and Transport Professionals, which was the occupation of 29% of Environmental Studies graduates with university qualifications at any level (Figure 10.6). The next most common occupations were Specialist Managers (13%), followed by Business, Human Resource and Marketing Professionals (7%).

Figure 10.6: Top ten sub-major group level occupations of Environmental Studies graduates with university qualifications, by gender



At the more detailed level, the most common unit group occupation for all Environmental Studies graduates, by a large margin, was Environmental Scientists—the occupation of just over one-fifth (21%) of working graduates. The remainder were spread out across a wide range of occupations, with only 43% of graduates represented in the top ten unit group occupations shown in Figure 10.7.

Doctoral graduates were less spread across occupations, with 67% working in the top ten unit group occupations (Figure 10.8). The most common unit group occupations were Environmental Scientists (19%), closely followed by University Lecturers and Tutors (16%), and Professionals not further defined (13%).

Figure 10.7: Top ten unit group level occupations of Environmental Studies graduates with university qualifications, by gender

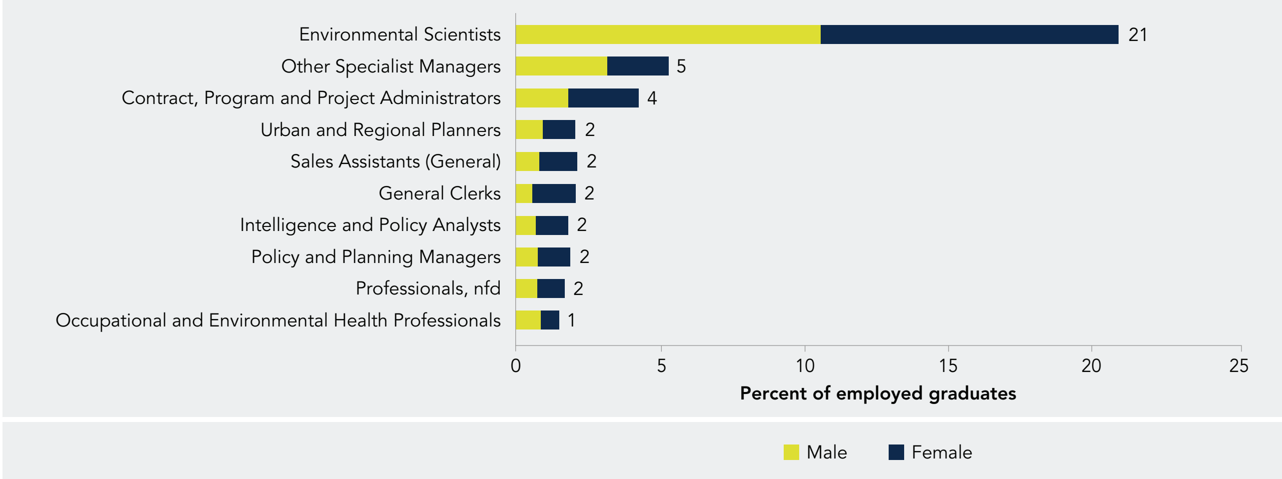
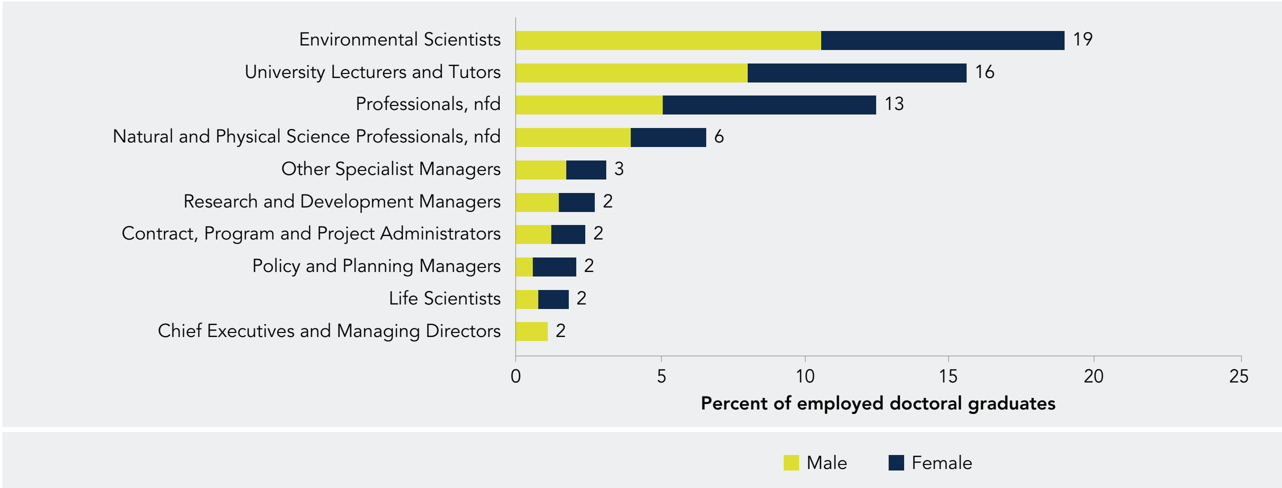


Figure 10.8: Top ten unit group level occupations of Environmental Studies doctoral graduates, by gender



Are Environmental Studies graduates high earners?

In 2016, 17% of Environmental Studies bachelor graduates had an income in the highest bracket ($104 000 or above), up from 13% in 2011 (Figure 10.9). The percentage of Environmental Studies Bachelor graduates in the highest income bracket in 2016 was below the percentage of total STEM bachelor graduates (32%) and non-STEM bachelor graduates (21%).

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

Completing a doctorate in Environmental Studies can be financially rewarding—37% had an income in the highest bracket (Figure 10.9). Between 2011 and 2016, the percentage of Environmental Studies doctorates in this bracket increased by 10 percentage points, a larger increase than the 8 percentage point increase seen across the total STEM doctorate qualified population.

Environmental Studies graduate income levels were dependent on both gender and full-time or part-time employment status, as shown in Figure 10.10. 23% of male bachelor graduates who worked full-time had an income in the highest bracket, compared to just 9% of females who also worked full-time with the same qualification.

Figure 10.9: Personal annual income of graduates, by field and level of qualification

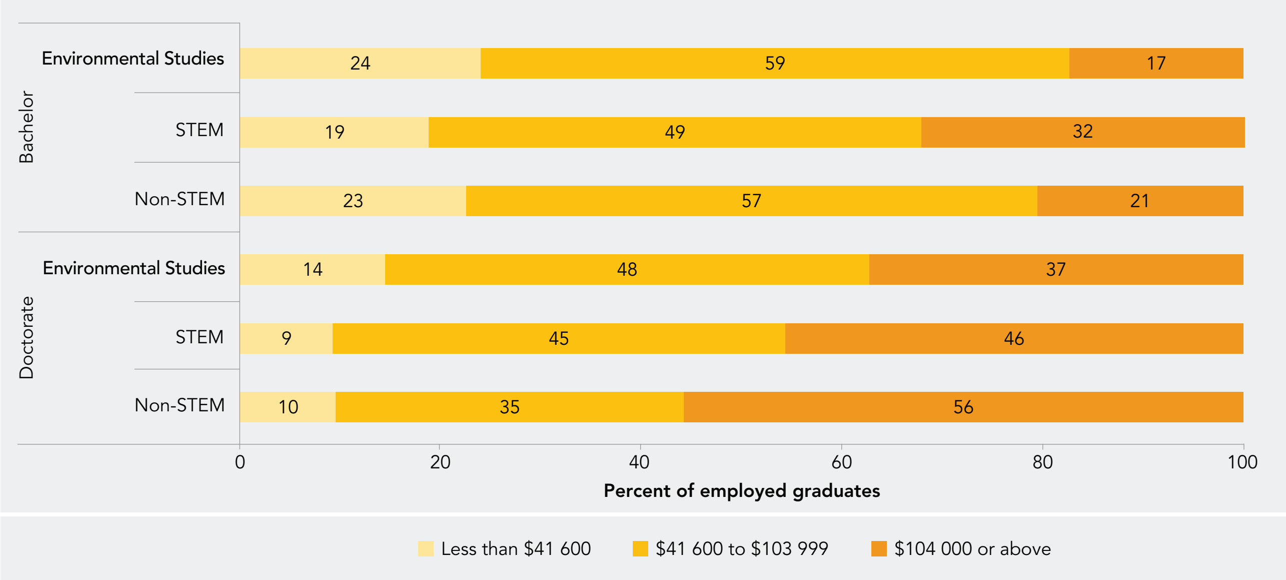
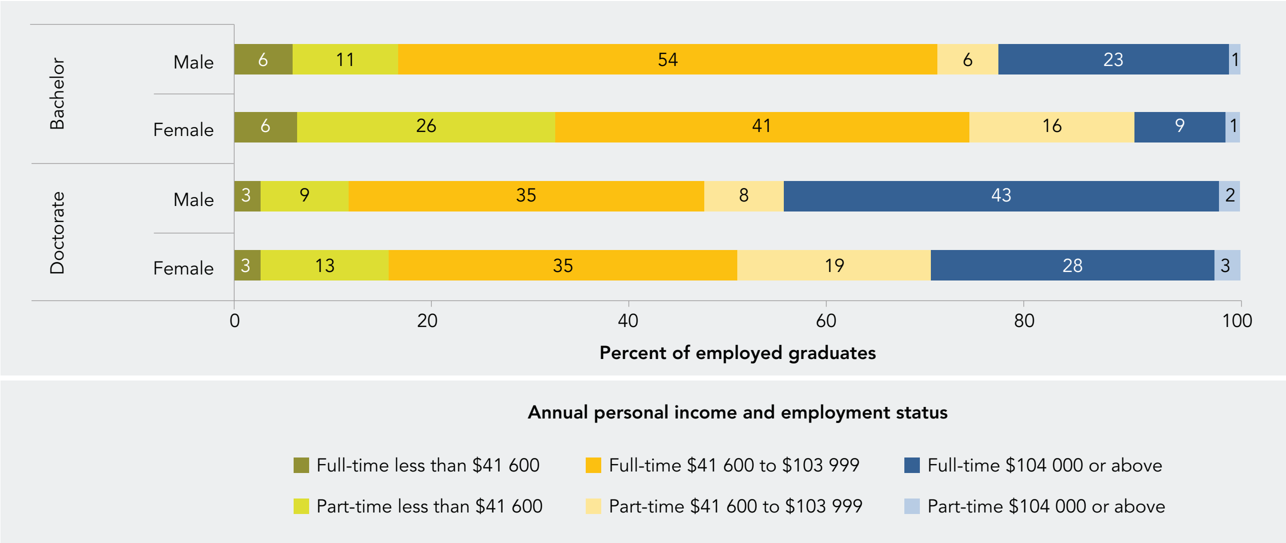


Figure 10.10: Personal annual income of Environmental Studies graduates working full-time and part-time, by gender and level of qualification



Almost one-third (32%) of female bachelor graduates had an income in the lowest bracket, however the vast majority (81%) of these females worked part-time. For those with doctoral degrees, the difference between males and female incomes was smaller, but still substantial: 45% of males had an income in the highest bracket compared to 31% of females.

The percentage of Environmental Studies bachelor graduates with incomes in the highest bracket peaked at the 40 to 44 years age range for both males and females, with 34% of males and 16% of female graduates earning an income of $104 000 or above (Figure 10.11). Males were 1.5 to 2.5 times more likely than females to have an income in the highest bracket, across all age groups. Across most age groups, a smaller proportion of male Environmental Studies bachelor graduates than the total STEM qualified cohort, but a higher proportion than those with non-STEM qualifications, earned in the highest bracket.

For those with doctoral degrees, the percentage of males in the highest income level peaked at 60 to 64 years of age, where over three-quarters (78%) of this population had an income in the highest bracket (Figure 10.12). This was ten years older than the peak for females, which was 53% of those aged 50 to 54 years. The differences between the proportions of males and females in the highest income bracket was not as large for those with doctorates as for those with bachelor degrees.

Figure 10.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

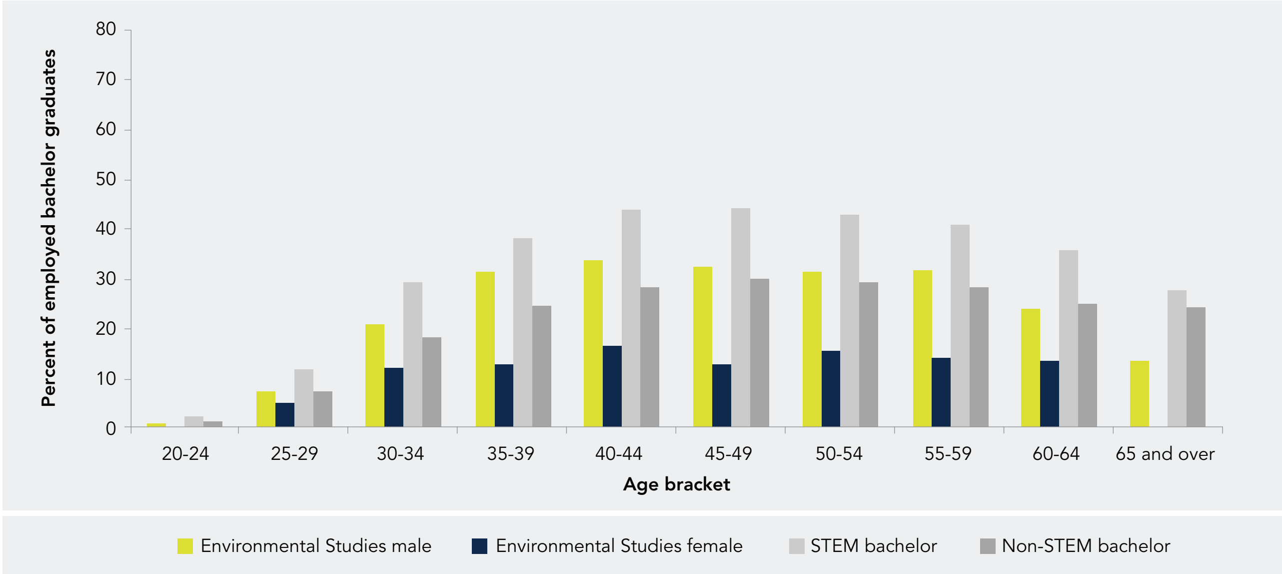
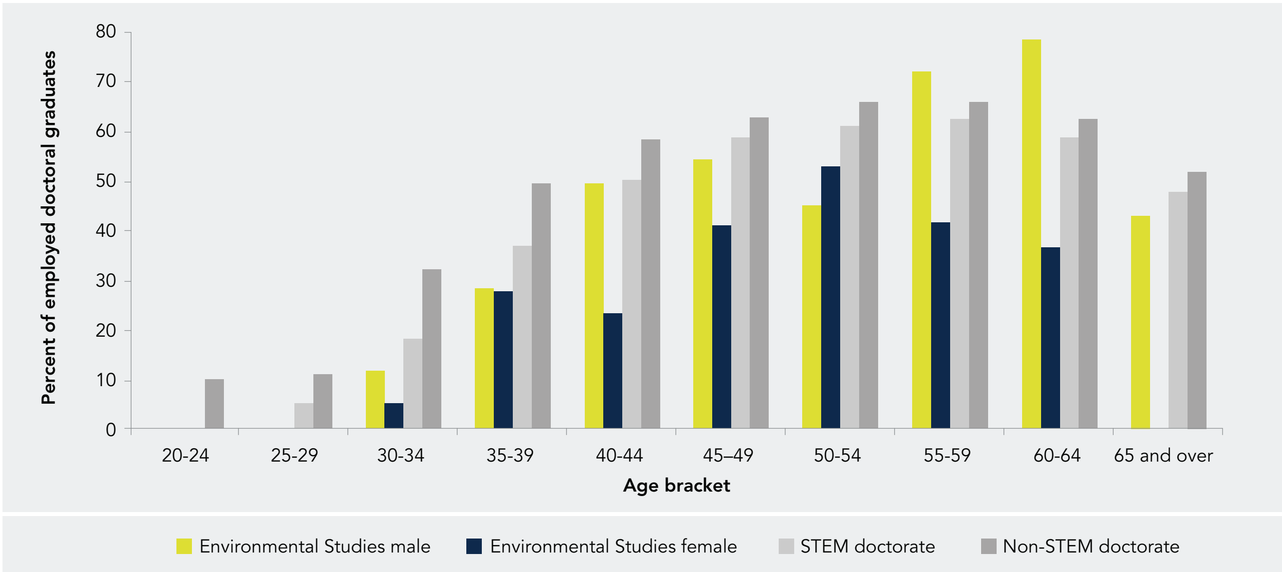


Figure 10.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 11

11

STEM PATHWAYS: INFORMATION TECHNOLOGY

What is Information Technology?

Information Technology is the study of the processing, transmitting and storage of information by computers. The main purpose of this broad field of education is to develop an understanding of information systems, programming languages, information management and artificial intelligence, and the ability to apply them to solve problems.

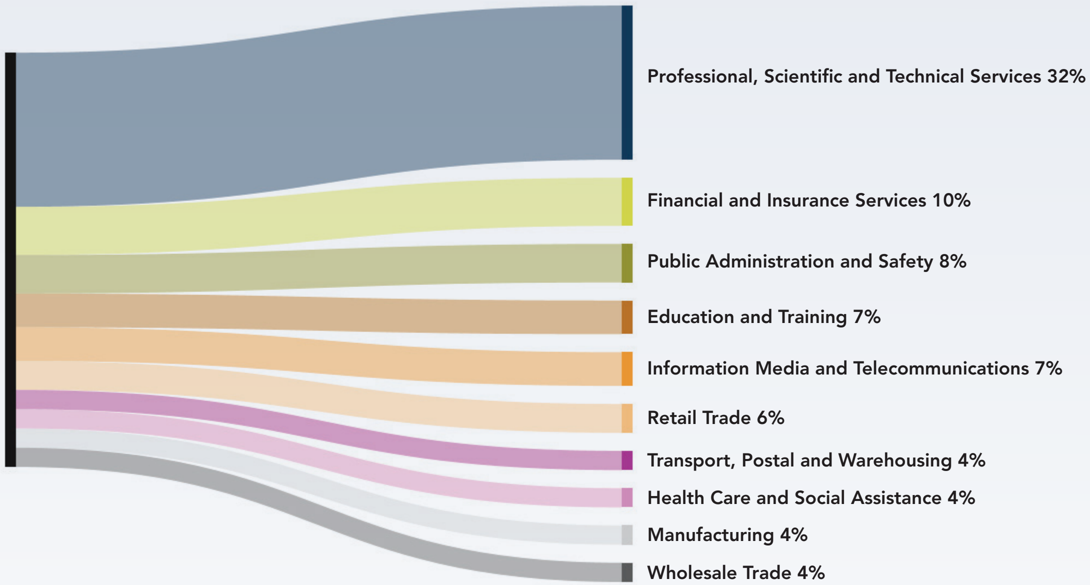
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Information Technology. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016, there were 219 107 people with university qualifications in the field of Information Technology. Of these, 193 244 people were in the labour force, of whom 181 990 were employed.
- Only 2% of the Information Technology labour force held doctoral degrees, which was the lowest proportion across the STEM fields. Conversely, Information Technology graduates had the highest proportion of graduates in the labour force with masters qualifications, at 28%.
- The Information Technology workforce was younger than the overall STEM qualified workforce, with approximately three-quarters of employed graduates aged under 45.
- Computer System Design and Related Services was the top industry class of employment for Information Technology graduates, employing 26% of the cohort.
- The most common occupation for Information Technology graduates was Software and Applications Programmers, representing 22% of employed graduates.
- A higher proportion of Information Technology graduates than the total STEM graduate cohort had an income in the highest bracket—35% of bachelor graduates and 52% of doctoral graduates had an income of $104 000 or above.

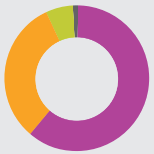
Top ten industries of employment for Information Technology graduates



219 107 people in Australia had a university qualification in Information Technology

Type of qualification

- 61% Information Technology, nfd
- 32% Computer Science
- 6% Information Systems
- <1% Other Information Technology



% in the labour force

working or looking for work
88%

not in the labour force
12%

Of those in the labour force

% employed

94.2 %
EMPLOYED

5.8%
UNEMPLOYED

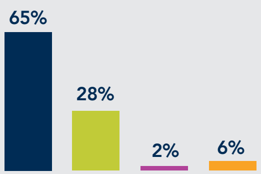
Gender

77%
MALES

23%
FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



The Information Technology qualified population

In 2016, there were 219 107 people in Australia with university qualifications in the field of Information Technology, an increase of 58 188 since 2011.

The Information Technology labour force

Of the qualified population, 88% (193 244 people) were in the labour force, either working or looking for work. Females made up 23% of the Information Technology labour force, an increase of 1 percentage point since 2011.

Only 2% of Information Technology graduates in the labour force had a doctorate—the lowest percentage of doctorates in all STEM fields. Conversely, 28% of the labour force held masters degrees—the highest proportion in any of the STEM fields.

The unemployment rate in Information Technology was 4.9% for males and 8.9% for females, up from 3.9% and 6.2% in 2011.

Employed Information Technology graduates

In 2016, on Census night, 181 990 university qualified Information Technology graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

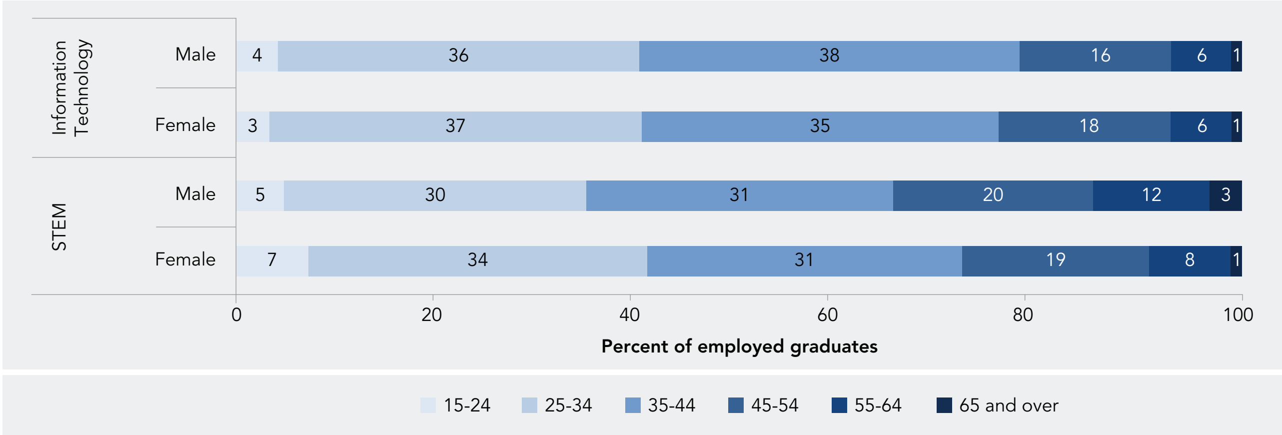
How old is the Information Technology graduate workforce?

In 2016, the Information Technology graduate workforce was younger than the overall STEM qualified workforce. Less than one-quarter (23%) of employed male graduates were aged over 45, compared to 35% of the total STEM graduate population (Figure 11.1).

In comparison to many other STEM fields, where women tend to be younger than their male counterparts, the proportion of male and female Information Technology graduates aged over 45 was similar (23% and 25%, respectively). The proportion of employed graduates under 35 was the same, at 40% for both males and females.

The Information Technology graduate workforce is ageing. In 2011, a larger proportion of the employed population were aged under 35, at 50% of males and 48% of females.

Figure 11.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Information Technology graduates work?

In 2016, the private sector employed 84% of all Information Technology graduates, which was the second highest percentage across all of the STEM fields. The proportion of graduates working in the private sector varied with level of qualification, from 85% of bachelor and masters graduates, to just 44% of those with doctorates (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

In 2016, almost one-third (32%) of Information Technology graduates worked in the Professional, Scientific and Technical Services industry division (Figure 11.2), the greatest proportion of all STEM fields. Further analysis showed that Professional, Scientific and Technical Services was the most common industry of employment for both males and females, employing 34% and 25% of these cohorts, respectively.

A further 10% of Information Technology graduates were employed in the Financial and Insurance Services industry division, and this was one of only two STEM fields where this sector featured in the top three destinations for graduates (alongside Mathematical Sciences).

Figure 11.2: Top ten industry divisions of employment for Information Technology graduates with university qualifications, by gender

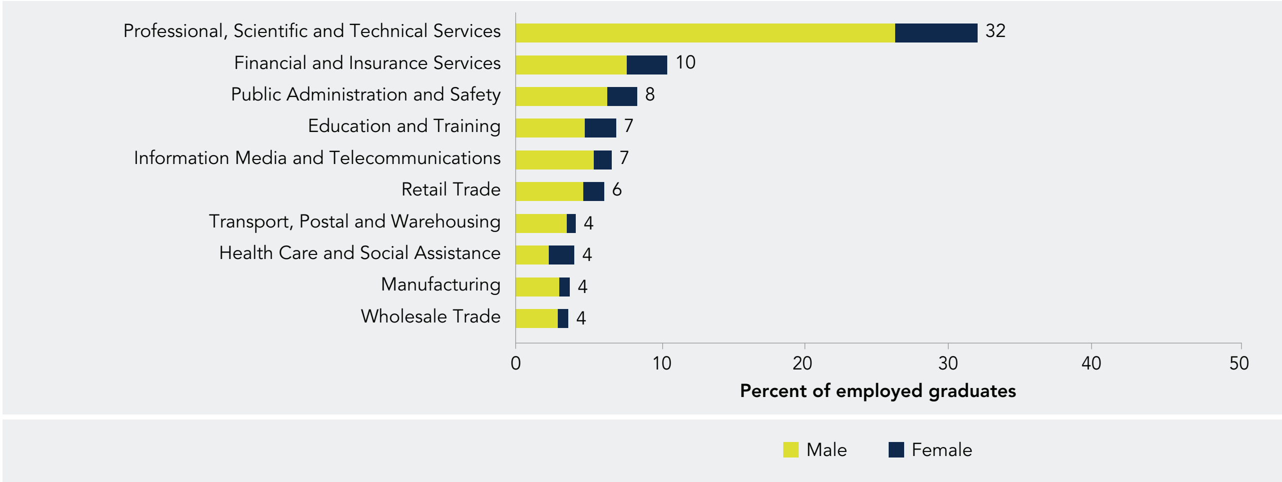
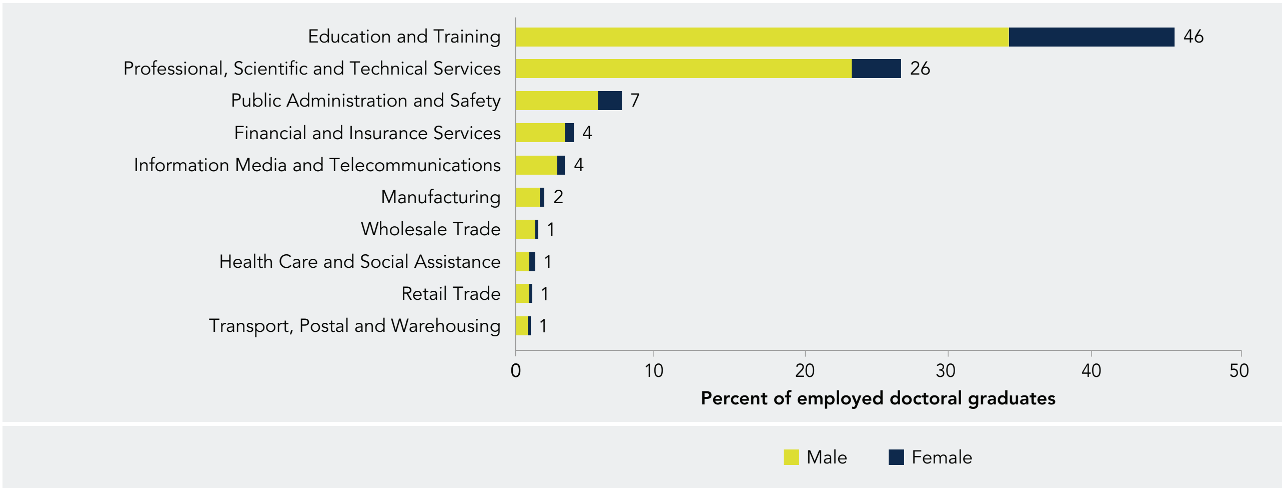


Figure 11.3: Top ten industry divisions of employment for Information Technology doctoral graduates, by gender



For the 2% of Information Technology graduates with doctoral qualifications, almost one-half (46%) worked in Education and Training, compared to just 7% of the total Information Technology graduate workforce (Figure 11.3). A higher percentage of females (58%) than males (42%) worked in the Education and Training sector. The Professional, Scientific and Technical Services industry was the second most common destination for doctoral graduates (24%), but employed a greater percentage of males (29% of males) than females (17% of females).

Industries of employment can be further analysed at the most detailed industry class level, as shown in Figure 11.4. Unlike most other STEM fields, a large proportion of Information Technology graduates were concentrated in just one industry class, with over one-quarter employed in Computer System Design and Related Services (26%; Figure 11.4). The next most common industry class was Banking, which employed just 5% of graduates.

When looking at only those with doctoral qualifications, Information Technology graduates were most commonly employed in the industry class of Higher Education (43%; Figure 11.5). The second most common industry class was Computer System Design and Related Services, at 18%.

There have been no major changes in the industry destinations of Information Technology graduates since 2011.

Figure 11.4: Top ten industry classes of employment of Information Technology graduates with university qualifications, by gender

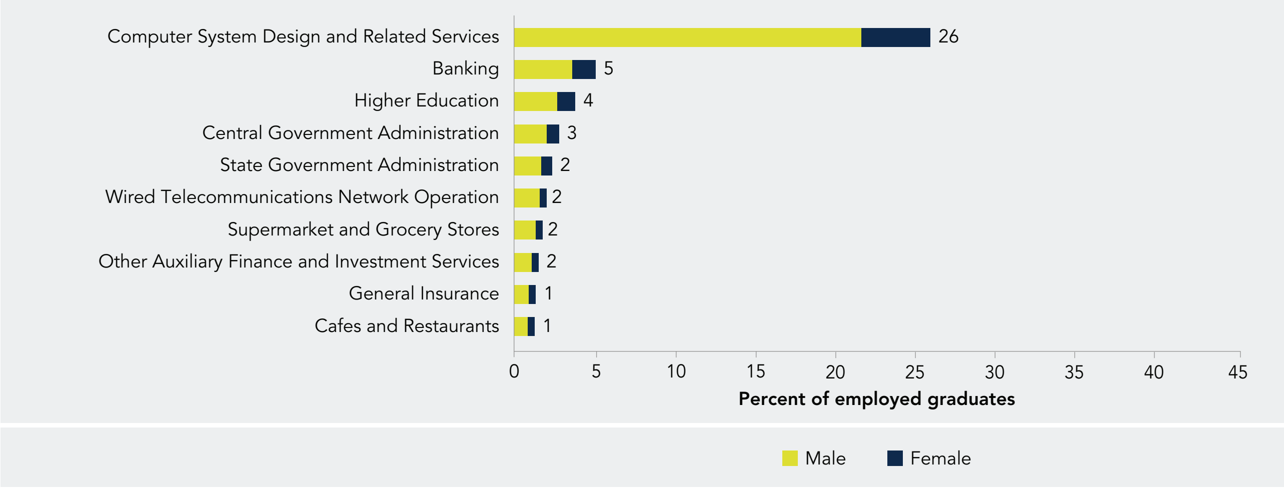
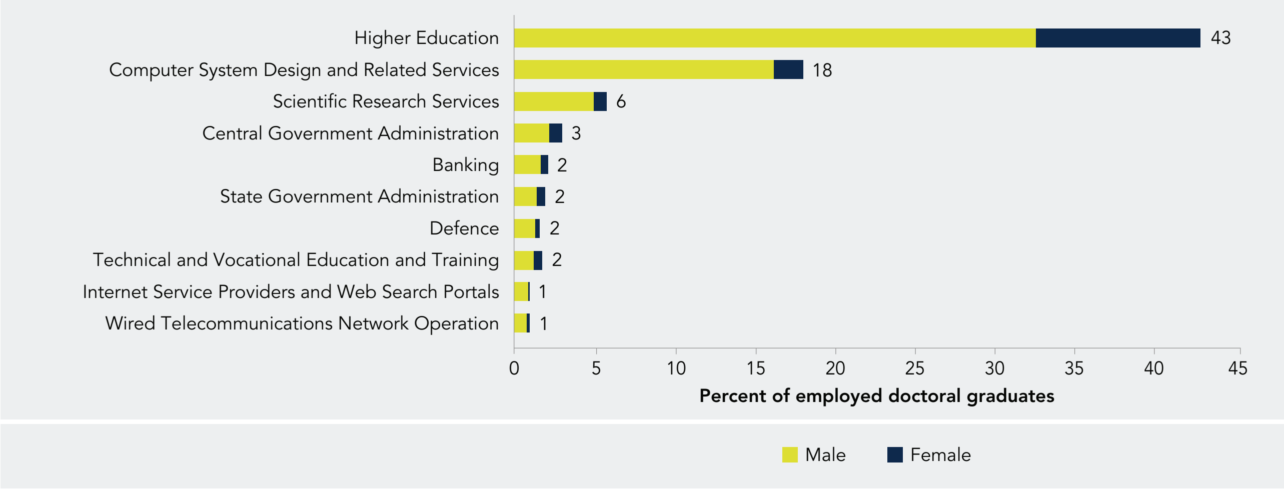


Figure 11.5: Top ten industry classes of employment of Information Technology doctoral graduates, by gender



What are the occupations of Information Technology graduates?

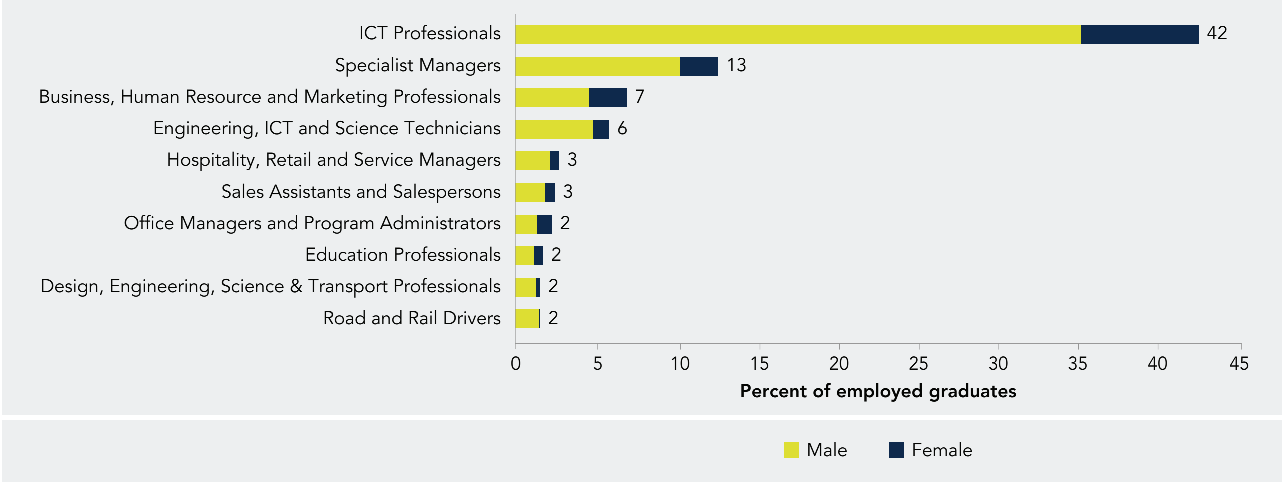
In 2016, the majority of employed Information Technology graduates worked as Professionals (55%). The second most common occupation was as Managers (17%; data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

At the more detailed sub-major group level, the most common occupation for Information Technology graduates was Information and Communications Technology (ICT) Professionals, representing 42% of the working population (Figure 11.6). The next most common occupation was Specialist Managers, representing 13% of all Information Technology graduates.

Figure 11.6: Top ten sub-major group level occupations of Information Technology graduates with university qualifications, by gender



Occupation classifications can be analysed at the unit group level to give more detailed information on the destinations of graduates. At this level, ICT professional, management and technician specialties made up the top ten unit group occupations of all Information Technology graduates (Figure 11.7). The most common occupation, by a large margin, was Software and Applications Programmers, accounting for more than one-fifth of all Information Technology graduates (22%), with ICT managers the next most common occupation (9%).

When looking at the 2% of Information Technology graduates with doctoral qualifications, the top unit group occupation was University Lecturers and Tutors (28%). Other professional and ICT specialist roles filled out the top ten occupations (Figure 11.8).

Figure 11.7: Top ten unit group level occupations of Information Technology graduates with university qualifications, by gender

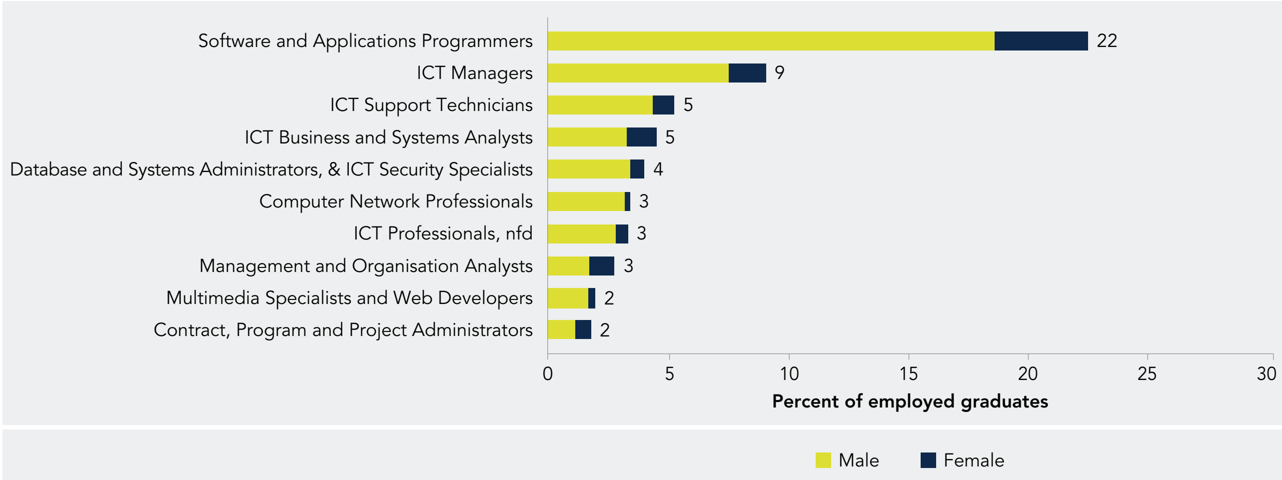
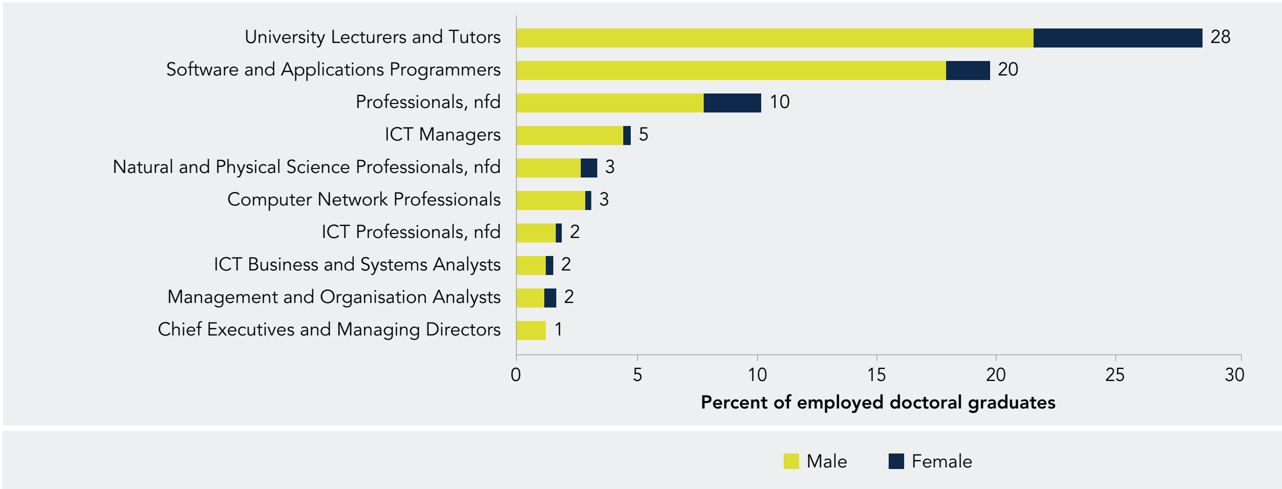


Figure 11.8: Top ten unit group level occupations of Information Technology doctoral graduates, by gender



Are Information Technology graduates high earners?

In 2011, 27% of employed Information Technology graduates with bachelor degrees had an income in the highest bracket ($104 000 or above), increasing to 35% in 2016 (Figure 11.9).

A greater percentage of Information Technology bachelor graduates than total STEM and non-STEM bachelor cohorts had an income in the highest bracket. The proportion of graduates in the lowest income bracket (less than $41 600), was 16% in 2011 and 15% in 2016.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

Completing a doctorate in Information Technology can be financially rewarding—52% had an income in the highest bracket (Figure 11.9). Between 2011 and 2016, the percentage of Information Technology doctorates in this bracket increased by 10 percentage points, a larger increase than the 8 percentage point increase seen across the total STEM doctorate qualified population.

A higher percentage of male graduates and of those who worked full-time had an income in the highest bracket than females and part-time workers (Figure 11.10). At the bachelor level, 38% of males and 24% of females with an Information Technology qualifications had an income of $104 000 or above. This gender gap was the smallest of all of the STEM fields for those with bachelor degrees.

Figure 11.9: Personal annual income of graduates, by field and level of qualification

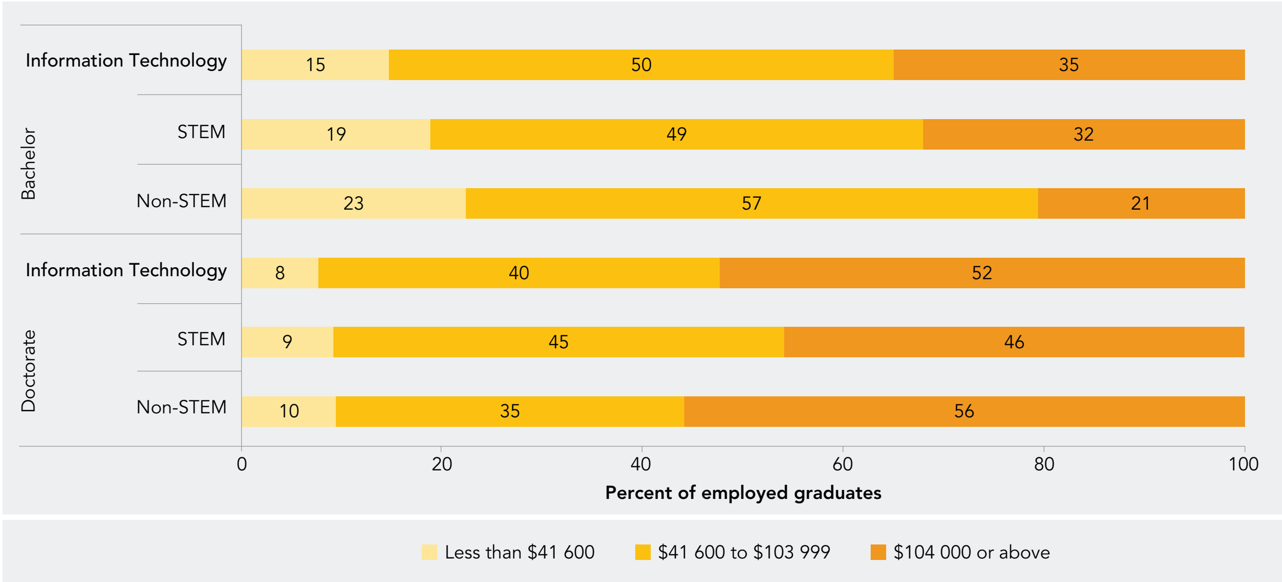
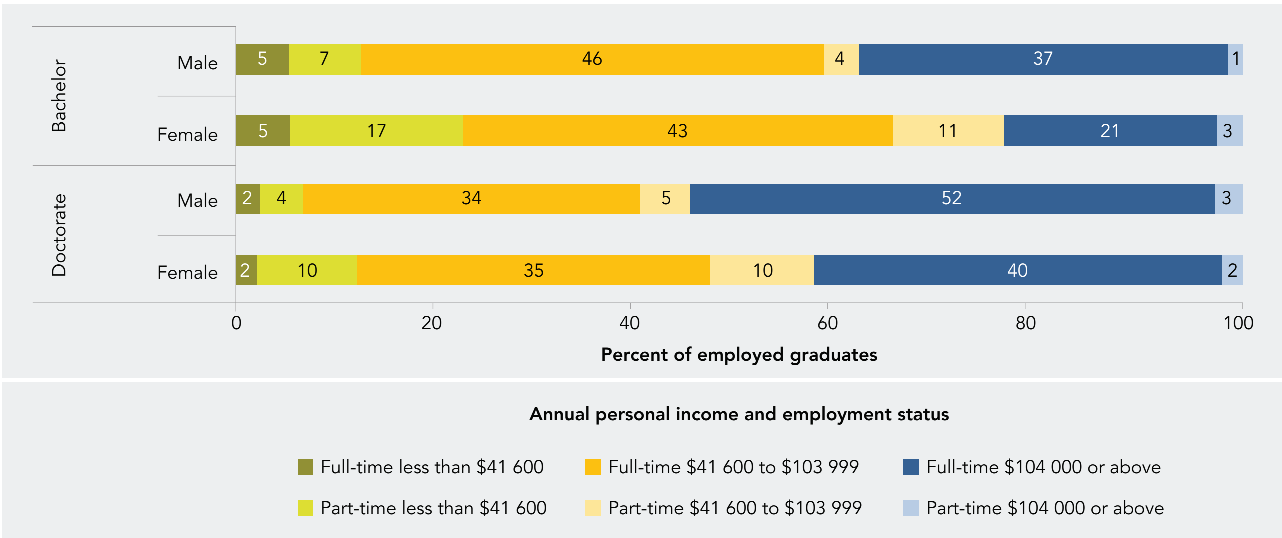


Figure 11.10: Personal annual income of Information Technology graduates working full-time and part-time, by field, gender and level of qualification



In 2011, 45% of males and 32% of females with an Information Technology doctorate had an income in the highest bracket. By 2016, over half of all males with Information Technology doctorate qualifications had an income of $104 000 or above (55%), compared to 42% of females with the same qualification.

Along with gender, level of qualification, and full-time or part-time employment, age is also an important factor in the income level of graduates. For Information Technology bachelor graduates, the percentage of graduates with an income of $104 000 or above peaked between the ages of 50 to 54 for males (when 55% of the cohort earned in the highest bracket), and between the ages of 55 to 59 for females (35%). The percentage of males with Information Technology bachelor qualifications who earned $104 000 or above was higher than that for all STEM bachelor holders across all age groups.

For those with doctoral degrees, the proportions of graduates in each income bracket across the age groups must be analysed with care as just 691 females and 2 860 males are included in this data (See Chapter 1, page 7). With this limitation in mind, over two thirds (68%) of male doctorates had an income in the highest bracket between the ages of 45 to 49. The peak for females was in the 55 to 59 year age bracket, at 72%; however there were only 72 employed females with Information Technology doctorates in this age bracket.

Figure 11.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

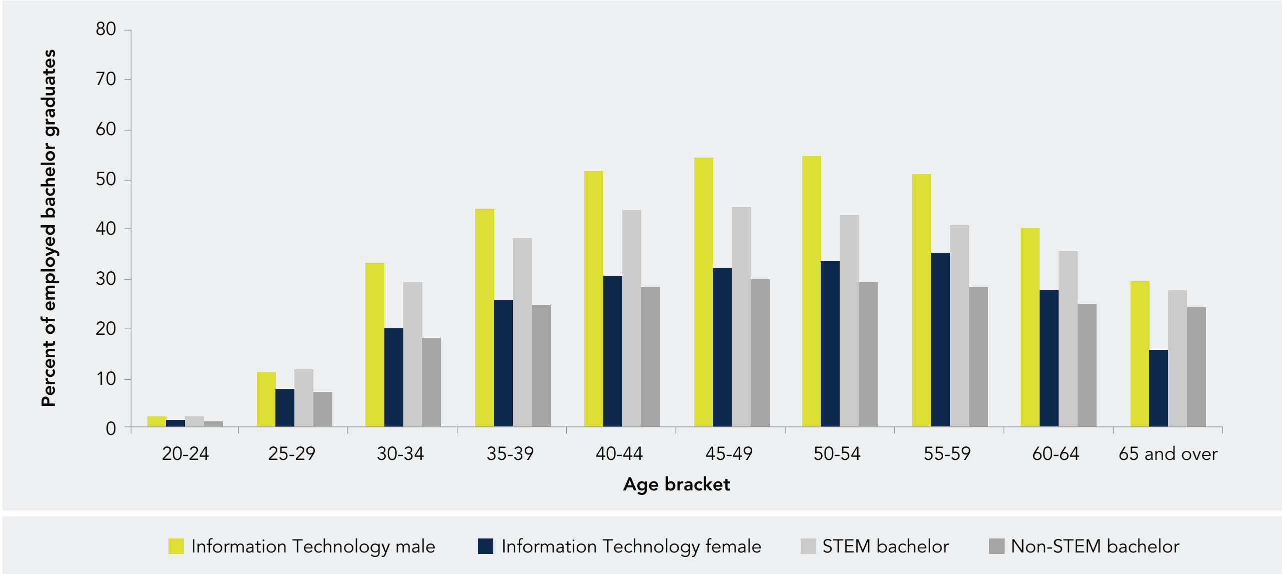
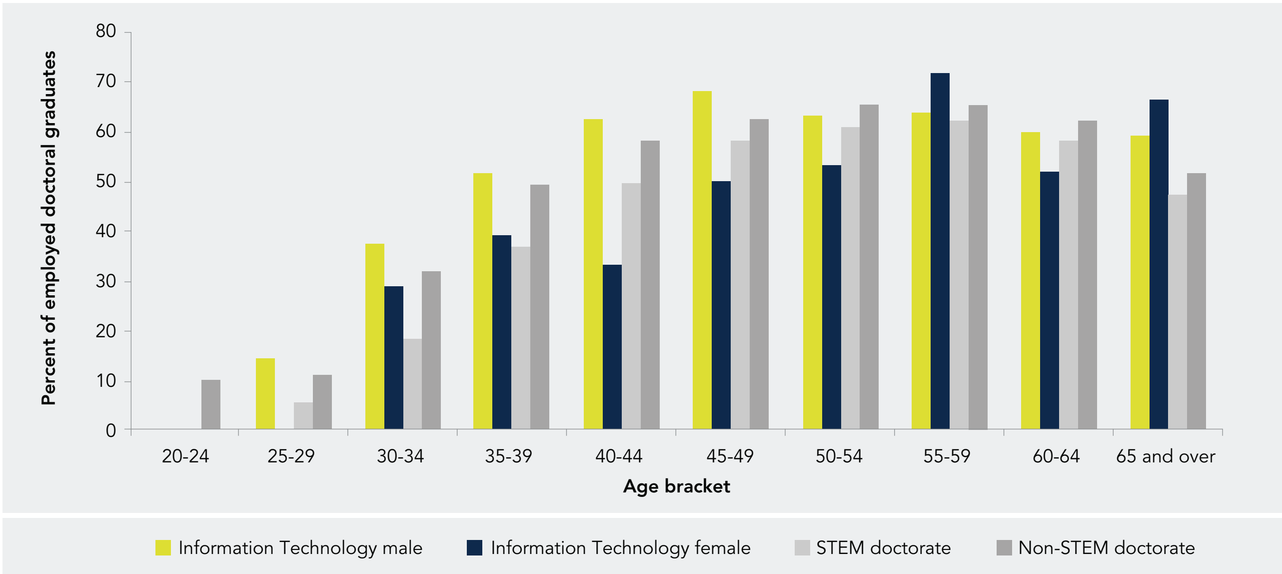


Figure 11.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 12

12

STEM PATHWAYS: ENGINEERING

What is Engineering?

Engineering and Related Technologies is the study of the design, manufacture, installation, maintenance and functioning of machines, systems and structures; and the composition and processing of metals, ceramics, foodstuffs and other materials. It includes the measurement and mapping of the earth's surface and its natural and constructed features. The main purpose of this broad field of education is to develop an understanding of the conversion of materials and energy, the measurement and representation of objects, and the operation of plant, machinery and transport systems.

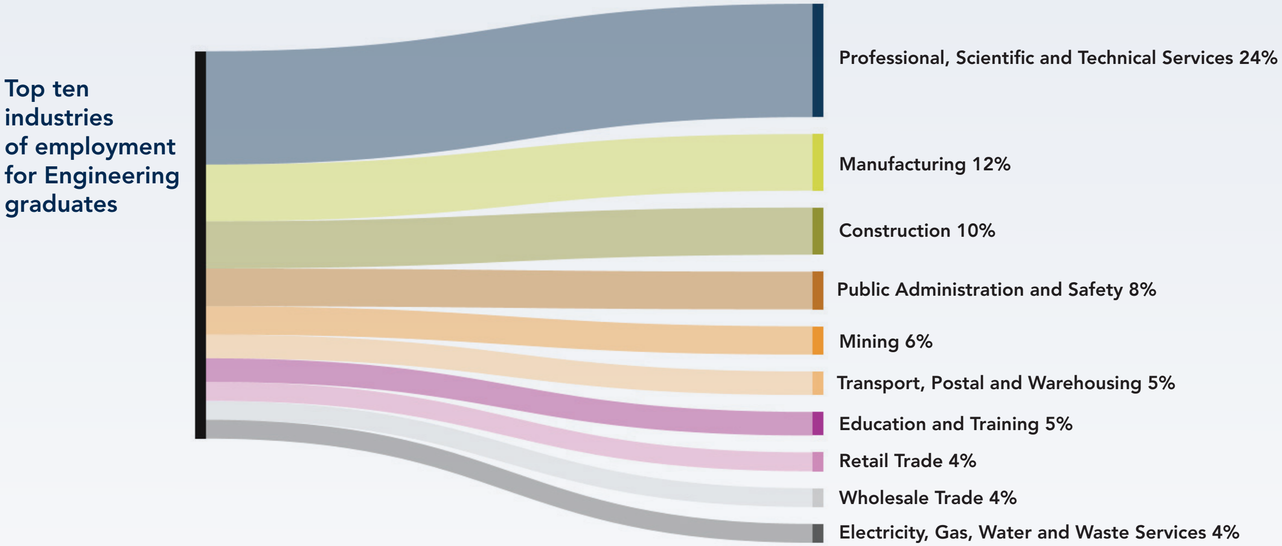
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Engineering and Related Technologies (Engineering). Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

For an in-depth look at the sub-fields of Engineering, see Chapter 17: A Closer Look at Engineering

HIGHLIGHTS

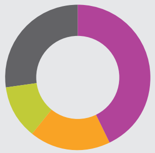
- In 2016, there were 340 536 people with university qualifications in Engineering and Related Technologies (Engineering) in Australia, which was the largest cohort across all STEM fields. Of these, 277 807 people were in the labour force, of whom 260 839 were employed.
- The unemployment rate for Engineering graduates, at 6.1%, was higher than the unemployment rate for the total STEM graduate cohort, at 5.4%.
- The majority (85%) of Engineering graduates worked in the private sector—the highest proportion of all STEM fields.
- Nearly a quarter (24%) of Engineering graduates were employed in the Professional, Scientific and Technical Services industry.
- One in ten Engineering graduates worked in the top occupation of Civil Engineering Professionals.
- A higher proportion of Engineering graduates than the overall STEM cohort had an income in the highest bracket, with 40% of bachelor graduates and 53% of doctoral graduates earning $104 000 or above.



340 536 people in Australia had a university qualification in Engineering

Type of qualification

- 43% Engineering and Related Technologies, nfd
- 18% Electrical and Electronic Engineering and Technology
- 12% Civil Engineering
- 27% Other fields*



% in the labour force

working or looking for work

82%

not in the labour force

18%

Of those in the labour force

% employed

93.9 % EMPLOYED

6.1% UNEMPLOYED

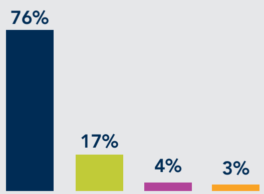
Gender

85% MALES

15% FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



* Other fields include Mechanical and Industrial Engineering and Technology (9%), Process and Resources Engineering (8%), Geomatic Engineering (3%), Aerospace Engineering and Technology (2%), Manufacturing Engineering and Technology (2%), Other Engineering and Related Technologies (2%), Maritime Engineering and Technology (1%), Automotive Engineering and Technology (<1%)

The Engineering qualified population

In 2016, there were 340 536 people in Australia with university qualifications in the field of Engineering, an increase of 83 154 since 2011. Engineering was the largest cohort across all of STEM fields.

The Engineering labour force

Of the qualified population, 82% (277 807 people) were in the labour force, either working or looking for work. Females made up 15% of the Engineering labour force, an increase of 2 percentage points since 2011. Engineering remains the STEM field with the lowest proportion of females.

The unemployment rate in this field was 5.5% for males and 9.2% for females, up from 3.2% and 6.0% in 2011.

Employed Engineering graduates

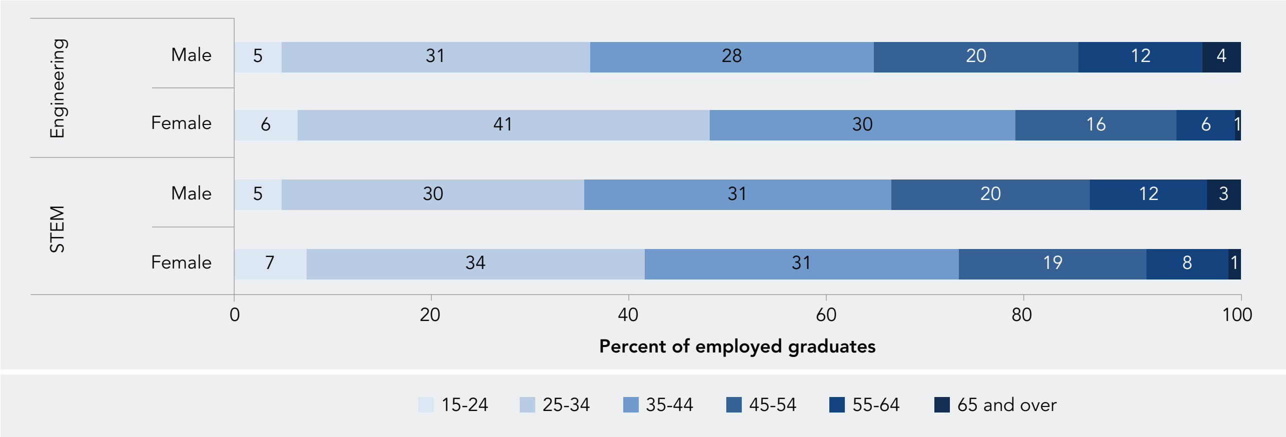
In 2016, on Census night, 260 839 university qualified Engineering graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

How old is the Engineering graduate workforce?

In 2016, the age distribution of the male Engineering graduate workforce was similar to that of the overall male STEM qualified workforce—36% of employed males with Engineering qualifications and 35% of employed males with STEM qualifications were aged 45 or older (Figure 12.1). Only 22% of employed female Engineering graduates were aged 45 or over, compared to 28% of the overall female STEM workforce. Almost half (47%) of female Engineering graduates were younger than 35.

Unlike most other STEM fields that have an ageing workforce, the percentage of Engineering graduates aged 45 years and over decreased between 2011 and 2016. In 2011, 39% of males were aged 45 years and over, compared to 36% in 2016. There was an even greater decline in the number of females aged 45 and over, at 35% in 2011 and 23% in 2016.

Figure 12.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Engineering graduates work?

In 2016, a large majority (85%) of Engineering graduates worked in the private sector—the greatest percentage of all the STEM fields. The proportion of Engineering graduates in the private sector varied across the qualification levels: from 88% of bachelor graduates, to 82% of masters holders, and just 50% of those with doctorates (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

Almost one-quarter of all Engineering graduates worked in the Professional, Scientific and Technical Services industry division (24%; Figure 12.2). Further analysis showed that this was the top destination for both male and female Engineering graduates, employing 25% of male and 22% of female graduates.

The second most common industry division of employment for Engineering graduates was the Manufacturing industry, which employed 12% of graduates. A further 10% of graduates were employed in the Construction industry, and this was the only STEM field where Construction featured in the top three industry divisions of employment for university graduates.

Figure 12.2: Top ten industry divisions of employment for Engineering graduates with university qualifications, by gender

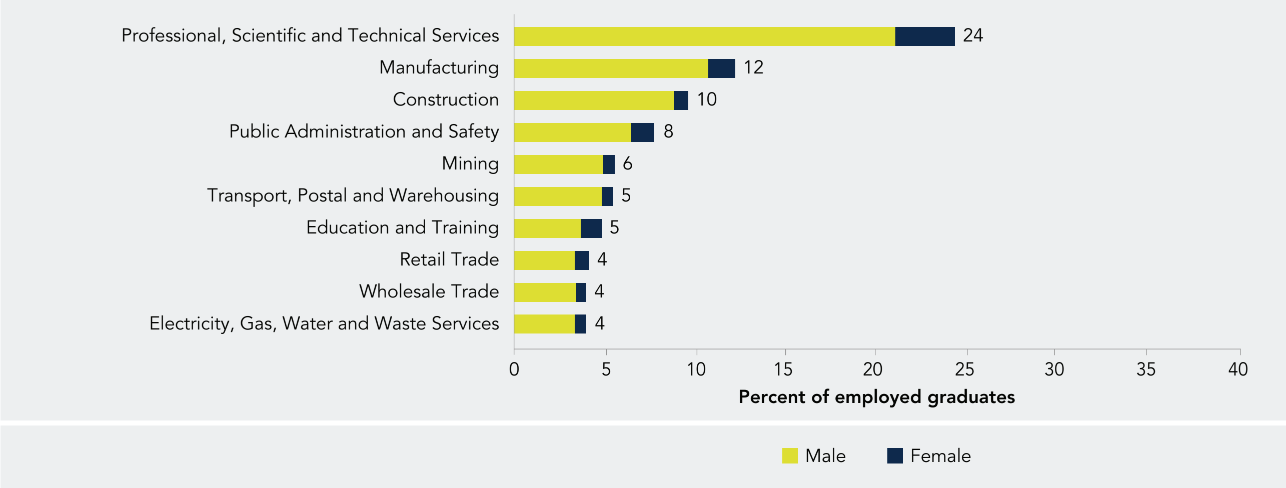
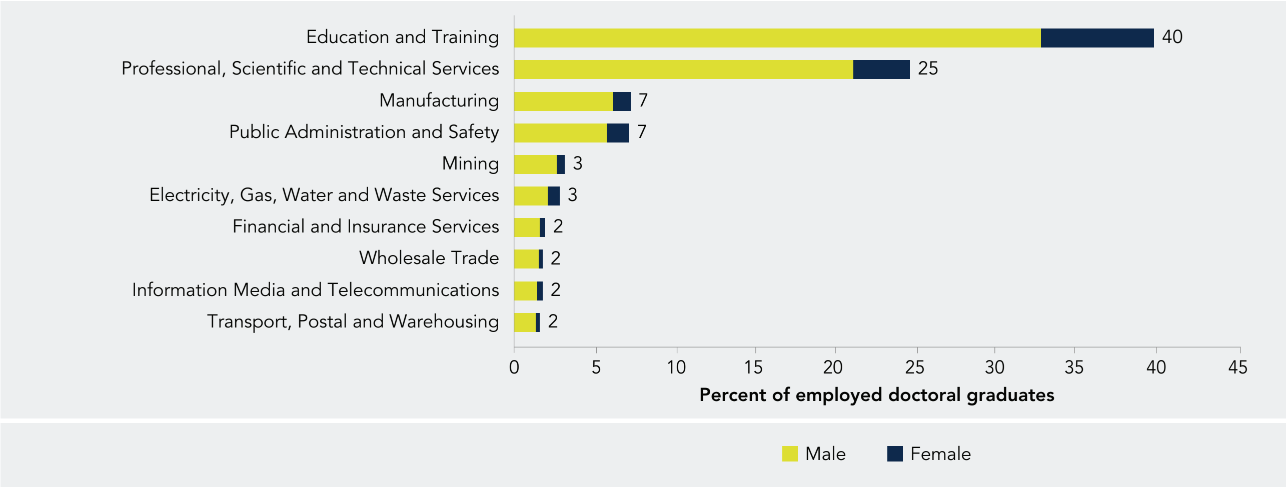


Figure 12.3: Top ten industry divisions of employment for Engineering doctoral graduates, by gender



When looking only at the 4% of Engineering graduates with doctorates, the most common industry division of employment was Education and Training, which was the industry of employment for 35% of Engineering doctoral holders in 2011, increasing to 40% 2016 (Figure 12.3). A further one-quarter worked in Professional, Scientific and Technical Services, and just 7% worked in Manufacturing. These sectors employed similar proportions of male and female doctoral graduates.

Analysis at the more detailed industry class level shows that Engineering graduates were employed across a broad range of sectors (Figure 12.4). The most common industry class of employment was Engineering Design and Engineering Consulting Services, which employed 16% of graduates in 2011, decreasing to 11% in 2016. Computer System Design and Related Services employed 6% of Engineering graduates and was the second most common industry class of employment. The remaining top ten industry classes were spread across a wide range of sectors, including education, government, defence and construction.

In comparison to all Engineering graduates, those with Engineering doctorates were concentrated in a narrower range of industry classes, with almost two-fifths employed in Education and Training (38%; Figure 12.5). The second most common industry class, by a large margin, was Engineering Design and Engineering Consulting Services, which employed 10% of people with Engineering doctorates.

Figure 12.4: Top ten industry classes of employment for Engineering graduates with university qualifications, by gender

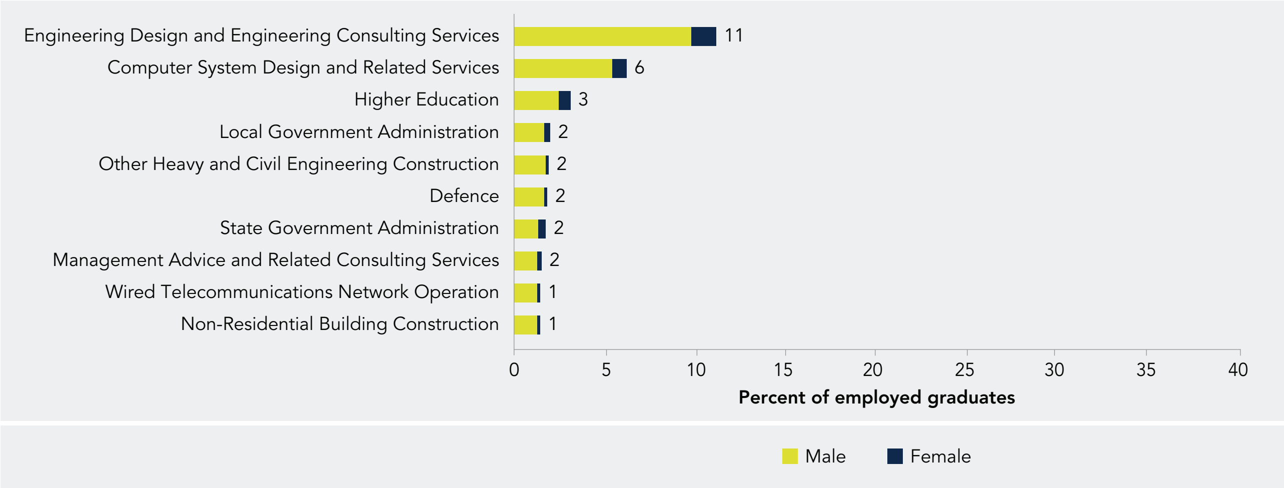
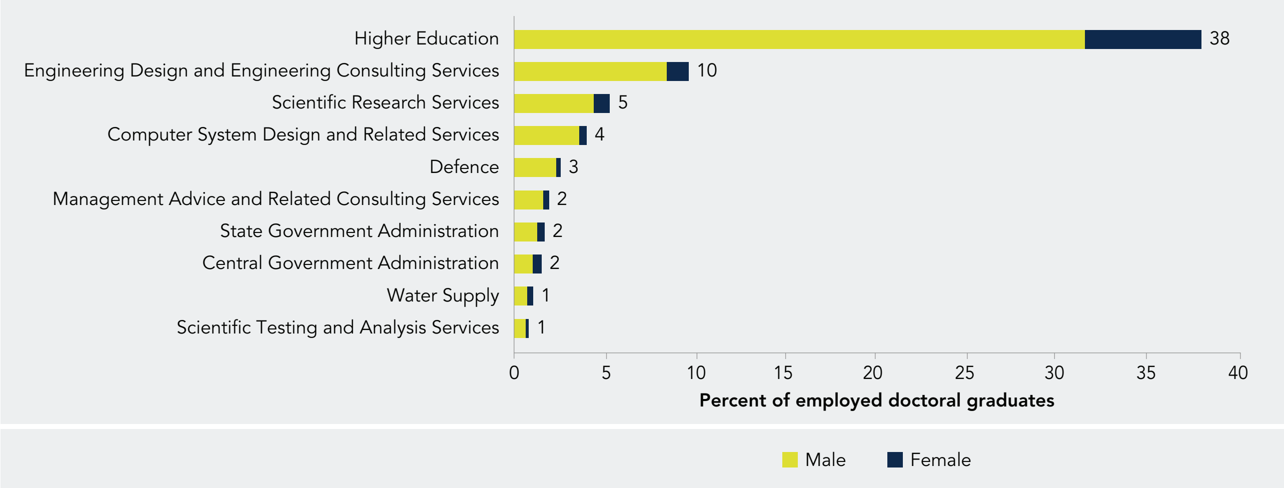


Figure 12.5: Top ten industry classes of employment for Engineering doctoral graduates, by gender



What are the occupations of Engineering graduates?

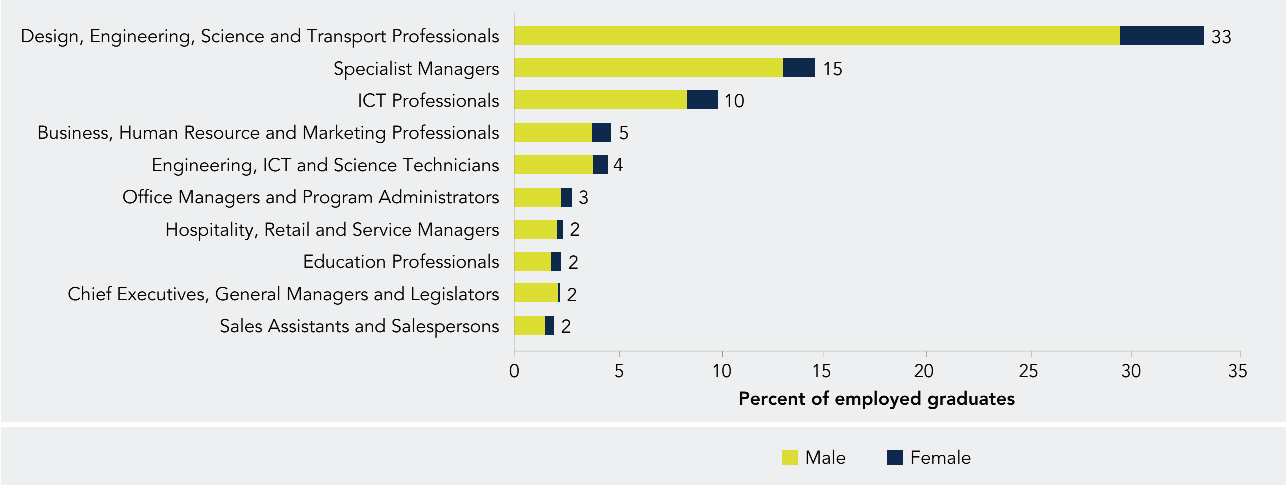
In 2016, just over half of Engineering graduates were employed in the major occupation group of Professionals (52%), while 20% worked as Managers (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

At the more detailed sub-major level, the most common occupation for Engineering graduates was Design, Engineering, Science and Transport Professionals. In 2011, 39% of the cohort worked in this occupations, decreasing to a third (33%) in 2016 (Figure 12.6). In 2016, the next most common occupations were Specialist Managers (15%) and ICT Professionals (10%).

Figure 12.6: Top ten sub-major group level occupations of Engineering graduates with university qualifications, by gender



Analysis of occupations at the unit group level shows that Engineering graduates were employed across a range of specialist occupations, the most common of which was Civil Engineering Professionals (10%; Figure 12.7). Other specialist engineering and managerial occupations populated the top ten occupations.

For the 4% of people with Engineering doctorates, the top unit group occupation was University Lecturers and Tutors, with just over one-fifth of doctoral graduates in this occupation (Figure 12.8). The remaining top ten occupations for Engineering doctorates were similar to that of the whole Engineering graduate cohort.

Figure 12.7: Top ten unit group level occupations of Engineering graduates with university qualifications, by gender

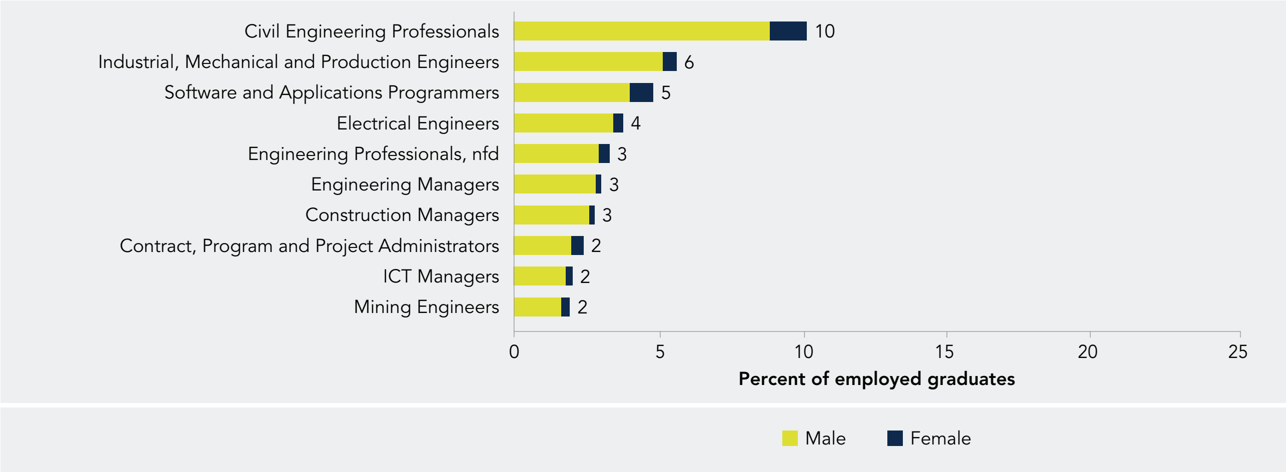
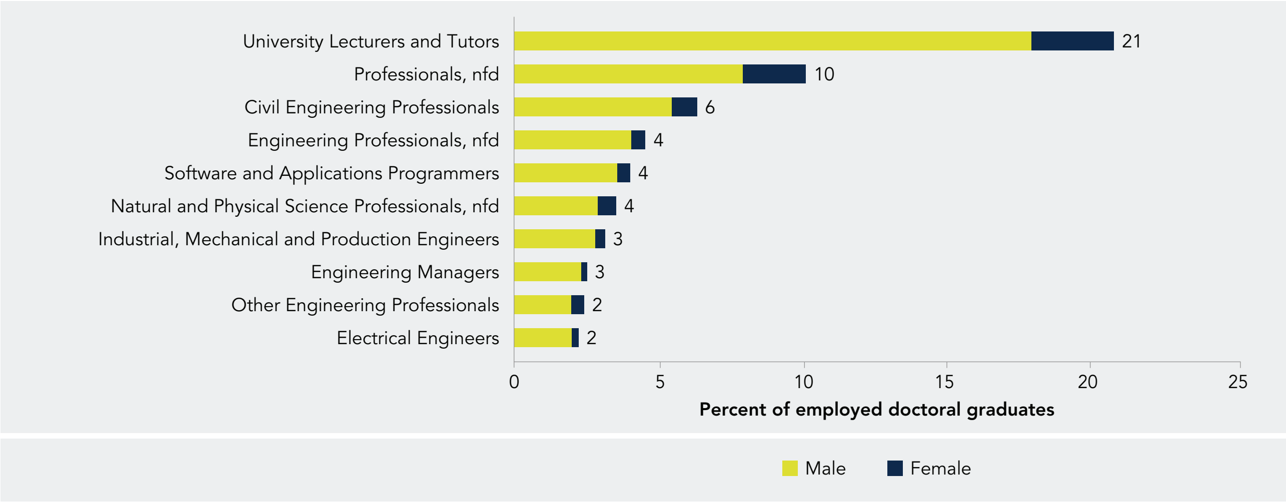


Figure 12.8: Top ten unit group level occupations of Engineering doctoral graduates, by gender



Are Engineering graduates high earners?

In 2016, two-fifths (40%) of employed Engineering bachelor graduates had an income in the highest bracket ($104 000 or above), which was a larger proportion than both the total STEM and non-STEM qualified cohorts (32% and 21%, respectively; Figure 12.9). This percentage increased by 1 percentage point between 2011 and 2016.

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

A larger proportion of doctoral graduates were in the highest income bracket. The percentage of Engineering doctorates in the highest bracket increased from 48% in 2011 to 53% in 2016.

At both levels of qualification, the percentage of Engineering graduates in the lowest income bracket (less than $41 600) was lower than the proportion of the STEM and non-STEM qualified cohorts that were in this income bracket. In 2016, 14% of Engineering bachelor graduates and 8% of Engineering doctoral graduates had an income in this lowest bracket.

Income was related to full-time or part-time employment and to gender: a higher percentage of males and of those who worked full-time had an income in the highest bracket (Figure 12.10). Among Engineering bachelor degree holders, twice the percentage of males (43%) than females (22%) had an income in the highest bracket. At the other end of the scale, almost twice the percentage of females (24%) than males (13%) had an income in the lowest bracket; however 30% of females with Engineering bachelor degrees worked part-time compared to 14% of males.

Figure 12.9: Personal annual income of graduates, by field and level of qualification

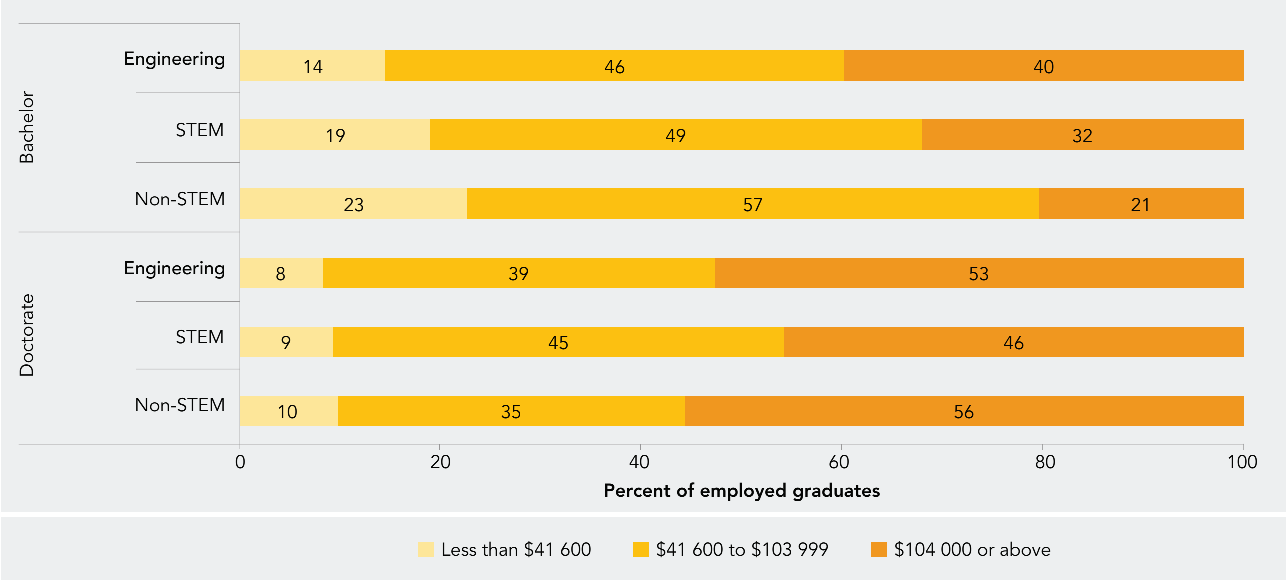
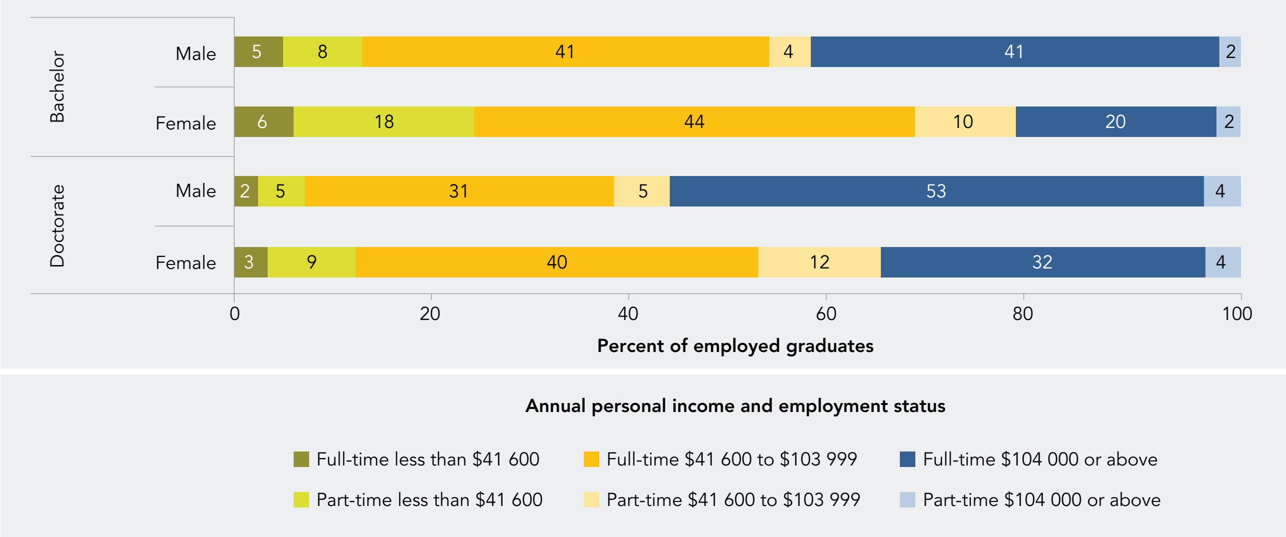


Figure 12.10: Personal annual income of Engineering graduates working full-time and part-time, by gender and level of qualification



The differences in income between genders for those with Engineering doctorates were not as large as for bachelor graduates. The majority (57%) of males with Engineering doctorates had an income in the highest bracket compared to 36% of females. Just 7% of males and 12% of females with Engineering doctorates were in the lowest income bracket.

The percentage of Engineering bachelor graduates with earnings in the highest income bracket peaked between the ages of 40 to 44 for male and female graduates—58% of males and 34% of females in this age bracket earned $104 000 or above (Figure 12.11). From age 40, around double the percentage of males compared to females had an income in the highest bracket.

Among those with doctorates in Engineering, the percentage of graduates in the highest income bracket peaked at age 45 to 49 for males (76%) and age 55 to 59 for females (64%; Figure 12.12). The gender differences in income were smaller for those with doctorates in Engineering compared to those with bachelor qualifications, with similar proportions of both male and female doctoral graduates earning $104 000 or above at age 55 to 59.

Figure 12.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

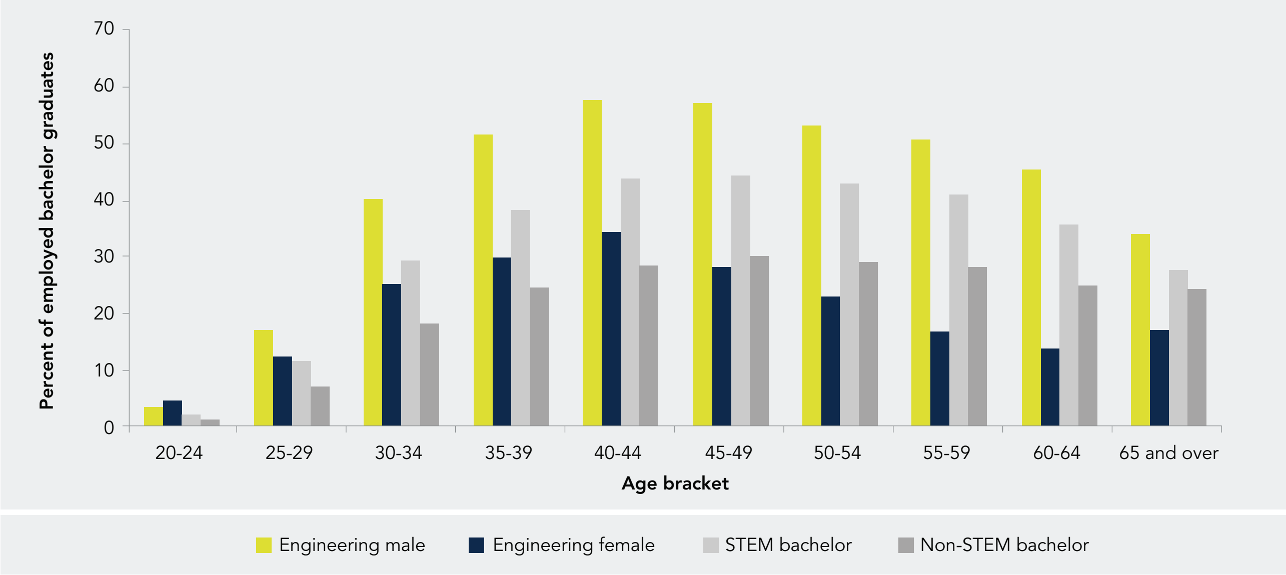
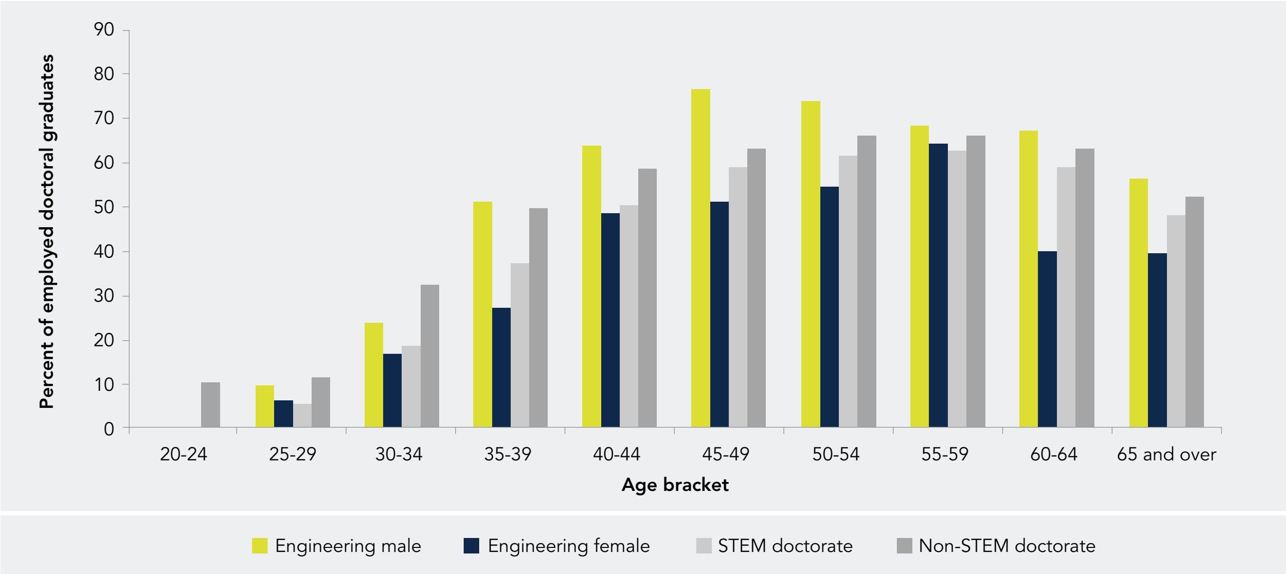


Figure 12.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 13

13

STEM PATHWAYS: MATHEMATICAL SCIENCES

What is Mathematical Sciences?

Mathematical Sciences is the study of abstract deductive systems, numerical facts, data and their applications. The main purpose of this narrow field of education is to develop an understanding of symbolic language and logic, mathematical theories and their deductive systems, techniques and modelling. It also involves developing an understanding of random processes and the ability to apply mathematical methods and modelling techniques to practical problems.

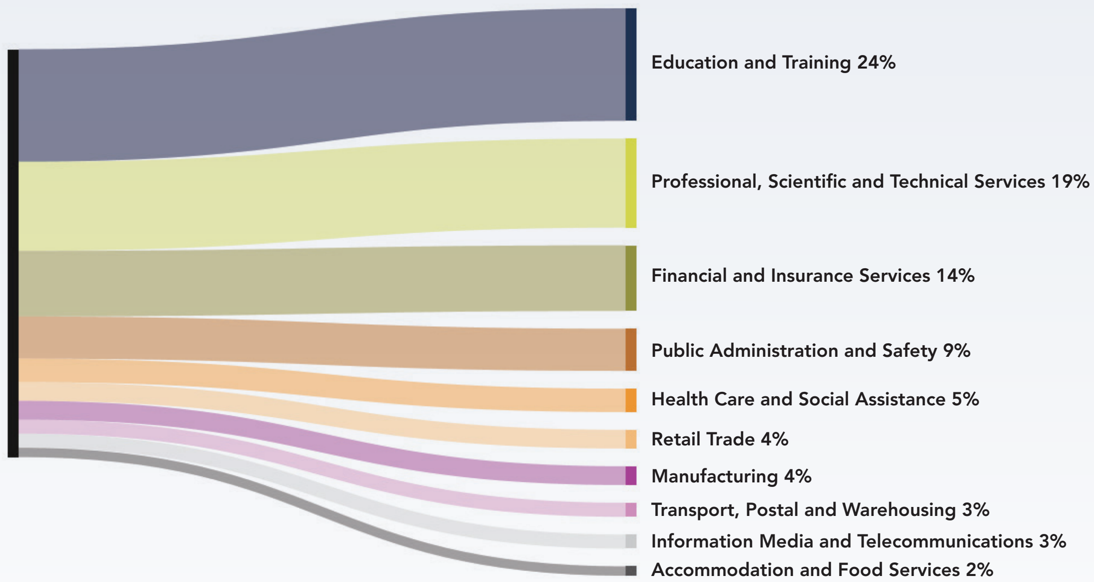
—Australian Bureau of Statistics, 2001

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Mathematical Sciences. Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016, there were 31 333 people with university qualifications in Mathematical Sciences in Australia. Of these, 22 507 people were in the labour force, of whom 21 254 were employed.
- 12% of Mathematical Sciences graduates in the labour force held doctorate degrees, the lowest proportion across all of the narrow fields of Natural and Physical Sciences.
- Mathematical Sciences graduates were older than the overall STEM graduate cohort, with around half of employed Mathematical Sciences graduates aged over 45.
- Education and Training was the most common industry sector of employment for Mathematical Sciences graduates, employing just under a quarter (24%) of the workforce.
- Secondary School Teaching was the top occupation for all Mathematical Sciences graduates, representing 8% of those who were employed. The top occupation for doctoral holders was University Lecturers and Tutors (34%).
- The income distribution for Mathematical Sciences graduates was similar to the income distribution for the whole STEM graduate workforce, with one-third of bachelor graduates earning $104 000 or above. However, a higher proportion of Mathematical Sciences doctoral holders than the overall STEM doctoral cohort had an income in the highest bracket, with over half (57%) earning $104 000 or above.

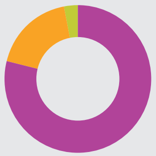
Top ten industries of employment for Mathematical Sciences graduates



31 333 people in Australia had a university qualification in Mathematical Sciences

Type of qualification

- 79% Mathematics
- 18% Statistics
- 3% Mathematical Sciences, nfd



% in the labour force

working or looking for work 72%

not in the labour force 28%

Of those in the labour force

% employed

94.4 % EMPLOYED

5.6% UNEMPLOYED

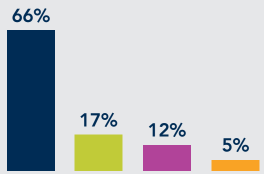
Gender

61% MALES

39% FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



The Mathematical Sciences qualified population

In 2016, there were 31 333 people in Australia with university qualifications in the field of Mathematical Sciences, an increase of 5 600 since 2011. The majority had qualifications in Mathematics (79%), 18% held a Statistics qualification and a further 3% had unspecified Mathematical Sciences qualifications.

The Mathematical Sciences labour force

Of the qualified population, 72% (22 507 people) were in the labour force, either working or looking for work. Females made up 39% of the Mathematical Sciences labour force, an increase of 1 percentage point from 2011. Women made up a smaller proportion of doctoral holders at 24%, up from 20% in 2011.

The unemployment rate in this field was 5.3% for males and 6.0% for females, up from 4.1% and 4.8% in 2011.

12% of graduates held doctorate degrees, the lowest proportion across all of the fields of Natural and Physical Sciences.

Employed Mathematical Sciences graduates

On Census night, 21 254 university qualified Mathematical Sciences graduates were employed. The remainder of this chapter takes a closer look at these employed graduates.

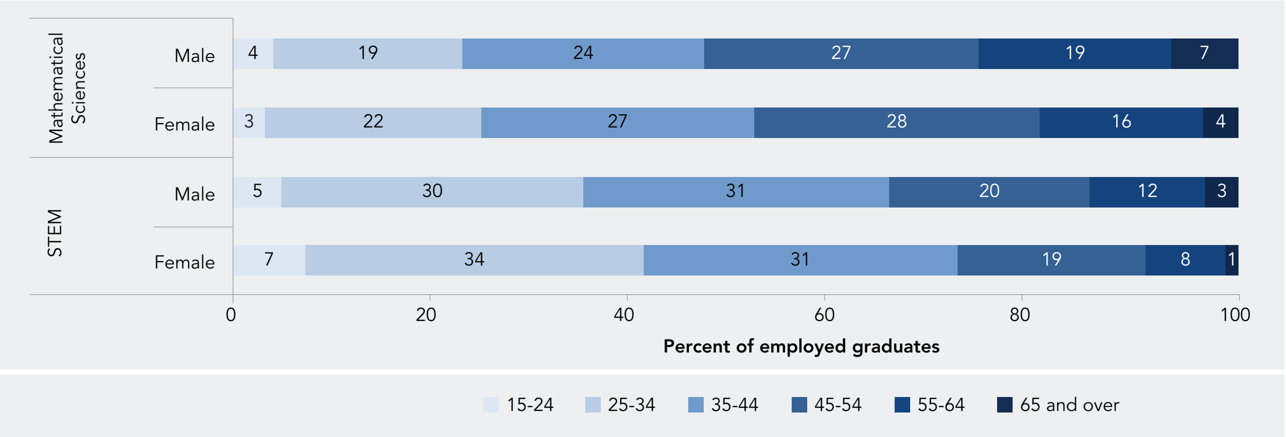
How old is the Mathematical Sciences graduate workforce?

Employed Mathematical Sciences graduates were substantially older than the total STEM qualified population (Figure 13.1). In 2016, around half (53%) of employed male Mathematical Sciences graduates were aged 45 or over — the equal second highest proportion across the STEM fields.

In 2016, around half (49%) of employed female Mathematical Sciences graduates were also aged 45 or over. Female Mathematical Sciences graduates had the highest proportion aged 45 or over across all the STEM fields.

The Mathematical Sciences workforce is aging — between 2011 and 2016 the proportion of males aged 45 and over increased by 3 percentage points and the proportion of females aged 45 and over increased by 5 percentage points.

Figure 13.1: Age distribution of employed graduates with university qualifications, by field and gender



Where do Mathematical Sciences graduates work?

In 2016, the private sector employed 71% of all Mathematical Sciences graduates, varying from 78% of bachelor holders to just 36% of those with doctorates (data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:

- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

In 2016, around one-quarter of all Mathematical Sciences graduates were employed in Education and Training (24%), which was the most common industry division of employment for both genders, employing 23% of males and 27% of females (Figure 13.2).

A further one-fifth of graduates were employed in Professional, Scientific and Technical Services (19%). 14% of graduates were employed in the Financial and Insurance Services industry division, making Mathematical Sciences one of the only two STEM fields where this sector featured in the top three destinations for graduates (the other field was Information Technology).

Among doctoral graduates, the majority worked in the Education and Training industry division (56%; Figure 13.3). The Professional, Scientific and Technical Services industry division employed 17% of doctoral graduates, while the Financial and Insurance Services and the Public Administration Safety industries employed a further 8% each.

Figure 13.2: Top ten industry divisions of employment for Mathematical Sciences graduates with university qualifications, by gender

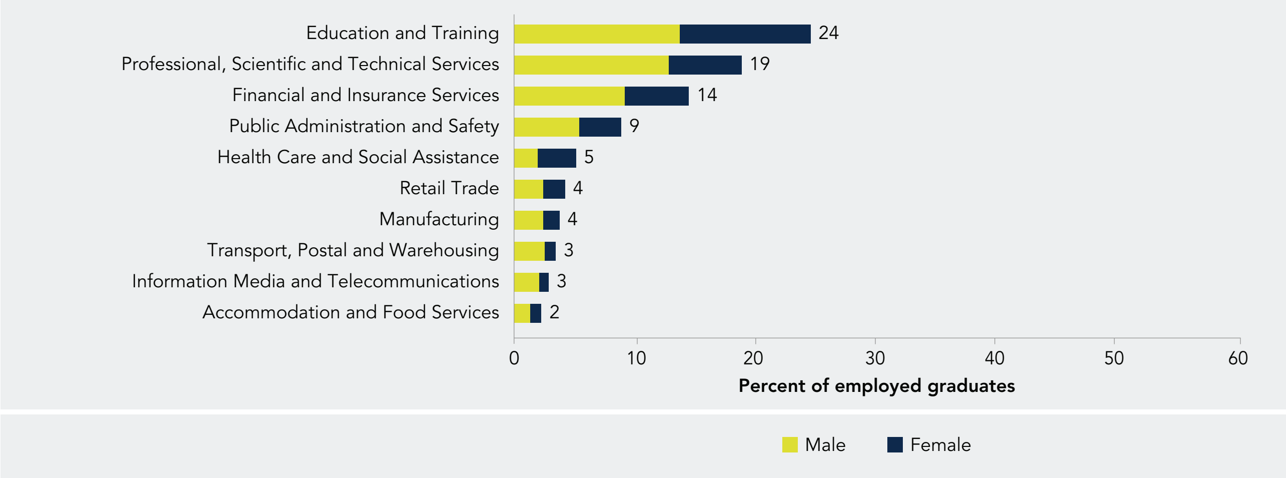
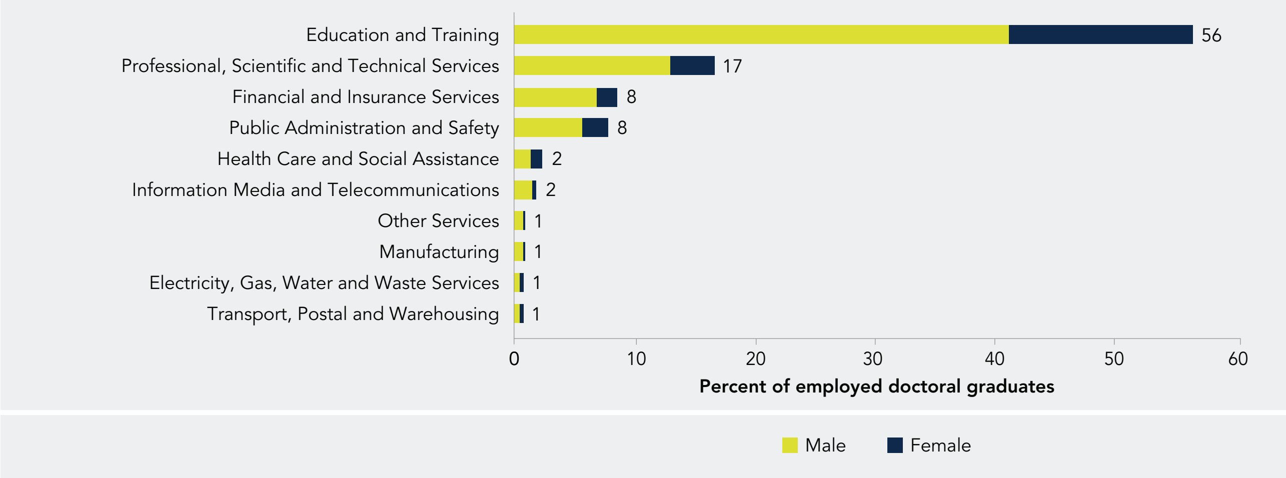


Figure 13.3: Top ten industry divisions of employment for Mathematical Sciences doctoral graduates, by gender



Analysis of industries at the class level allows for a more detailed assessment of graduate employment destinations (Figure 13.4 and Figure 13.5). The most common industry classes of employment for the total Mathematical Sciences graduate cohort were Higher Education (11%), Computer System Design and Related Services (8%), and Secondary Education (7%; Figure 13.4). The top industry class for both males and females was Higher Education, with Secondary Education the second most common industry class of employment for females, and Computer System Design and Related Services the second most common industry class of employment for males.

The most common industry class of employment for Mathematical Sciences doctoral graduates was also Higher Education (50%). The second most common industry class, by a large margin, was Scientific Research Services, which was where 6% of doctoral holders were employed (Figure 13.5).

Figure 13.4: Top ten industry classes of employment for Mathematical Sciences graduates with university qualifications, by gender

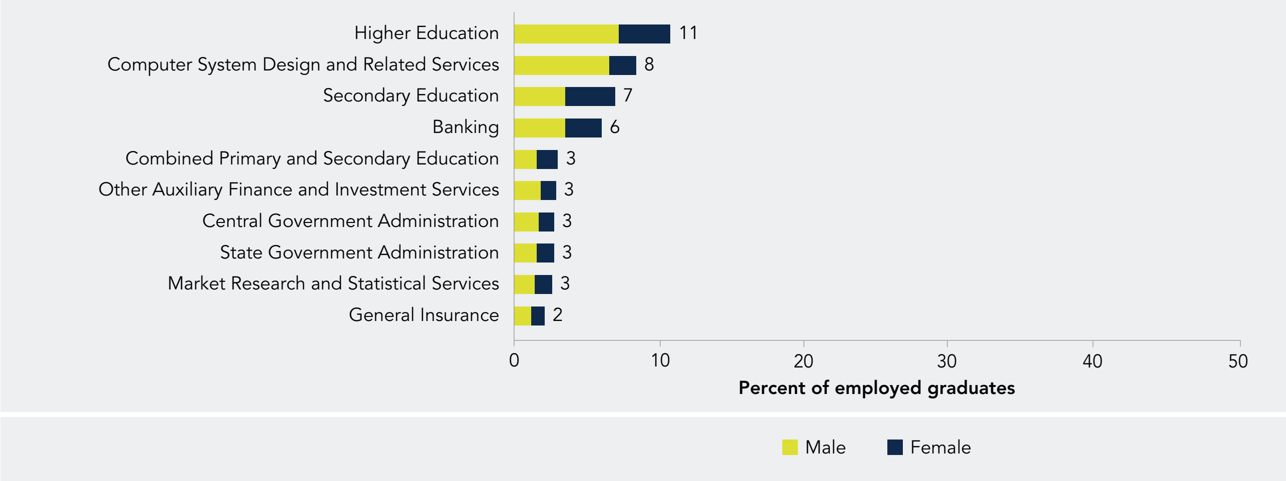
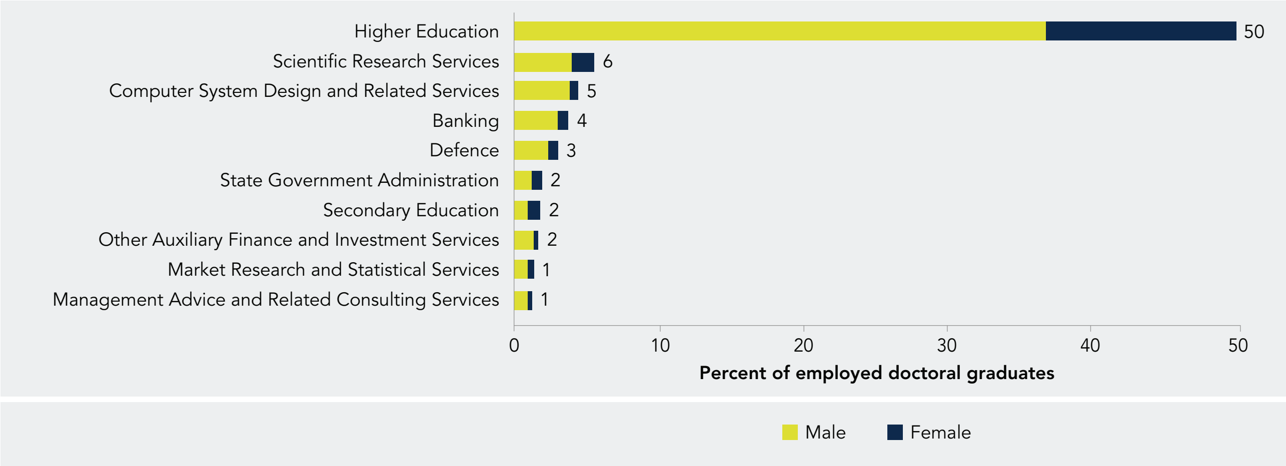


Figure 13.5: Top ten industry classes of employment for Mathematical Sciences doctoral graduates, by gender



What are the occupations of Mathematical Sciences graduates?

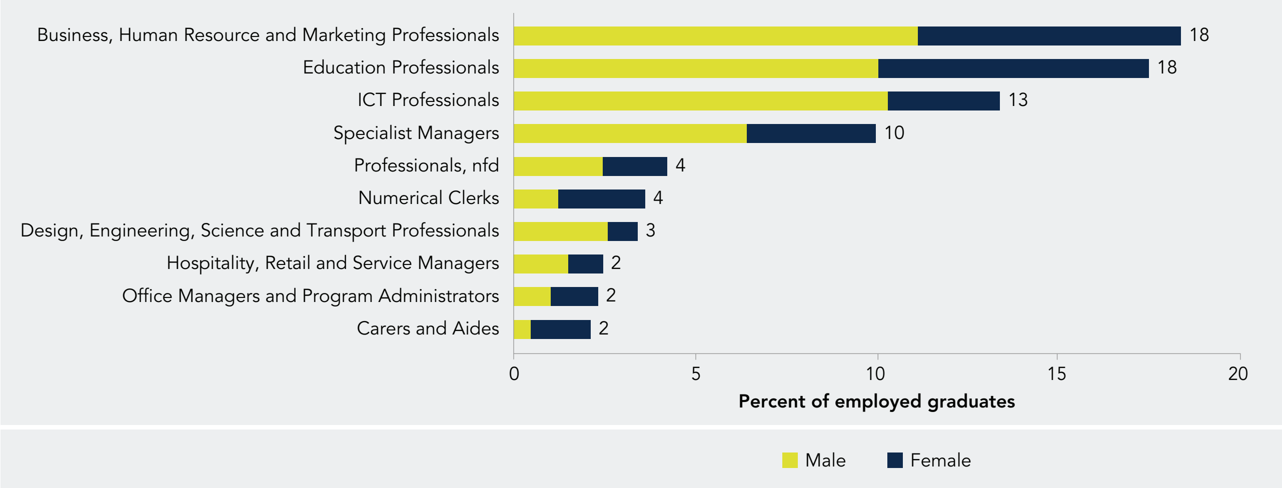
In 2016, at the broadest occupation level, over half of Mathematical Sciences graduates worked as Professionals (57%), and a further 15% worked as Managers. 11% worked as Clerical and Administrative Workers (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

At the sub-major group level of occupation, 18% of all Mathematical Sciences graduates were employed as Business, Human Resource and Marketing Professionals. A further 18% were employed as Education Professionals, with ICT professionals the third most common occupation (13% of the cohort; Figure 13.6).

Figure 13.6: Top ten sub-major group level occupations of Mathematical Sciences graduates with qualifications at the bachelor level and above, by gender



At the more detailed unit group occupation level, Secondary School Teachers and Software and Applications Programming were the most common occupations, each representing 8% of graduates (Figure 13.7). Mathematical Sciences was the only STEM discipline where Secondary School Teachers was the most common occupation at the unit group level. Although 60% of Mathematical Sciences graduates were male, half of all Secondary School Teachers with Mathematical Sciences qualifications were female (data not shown).

At the unit group occupation level, half of all graduates with doctorates in Mathematical Sciences worked as either University Lecturers and Tutors (34%), or Actuaries, Mathematicians and Statisticians (15%; Figure 13.8). These percentages and occupations were the same in 2011 and 2016. The remaining top ten occupations were spread across education, science, research, business and ICT roles.

Figure 13.7: Top ten unit group level occupations of Mathematical Sciences graduates with university qualifications, by gender

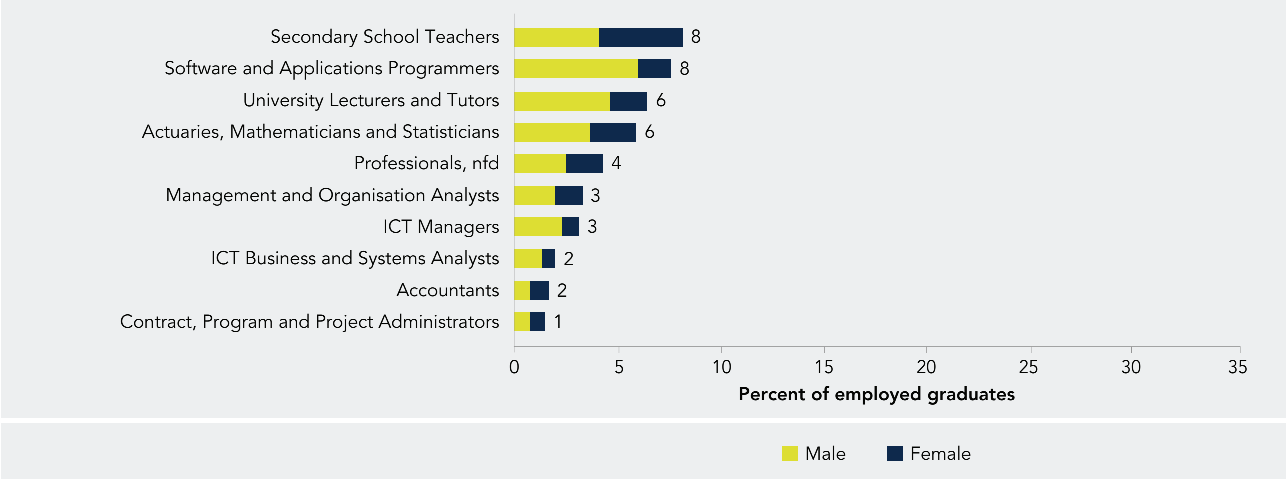
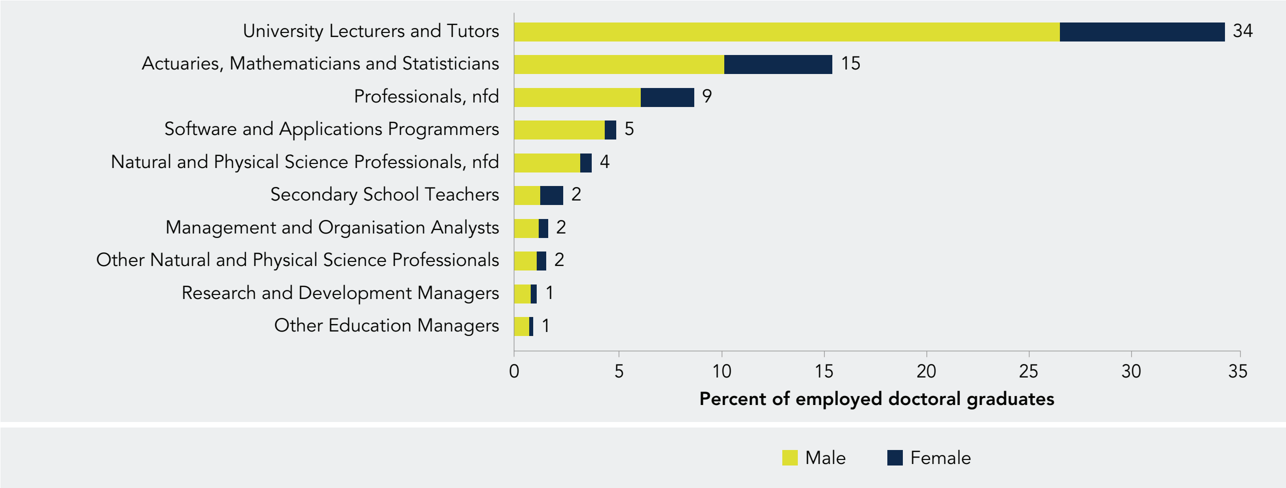


Figure 13.8: Top ten unit group level occupations of Mathematical Sciences doctoral graduates, by gender



Are Mathematical Sciences graduates high earners?

In 2011, 28% of bachelor graduates had an income in the highest bracket of $104 000 or above. In 2016, one-third (33%) of Mathematical Sciences bachelor graduates earned in this bracket, which was a similar proportion to the total STEM bachelor cohort (32%; Figure 13.9). In 2016, one-fifth of Mathematical Sciences bachelor graduates had an income in the lowest bracket (less than $41 600). This proportion was similar to 2011 (21%).

The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

A higher proportion of males and of those who worked full-time had an income in the highest bracket than females and those who worked part-time (Figure 13.10). 40% of males and 22% of females with bachelor degrees had an income in the highest bracket.

Mathematical Sciences doctoral graduates were high earners. Nearly two-thirds (62%) of males and 43% of females with doctorates had an income in the highest bracket, which were the highest proportions across all the STEM fields.

Figure 13.9: Personal annual income of graduates, by field and level of qualification

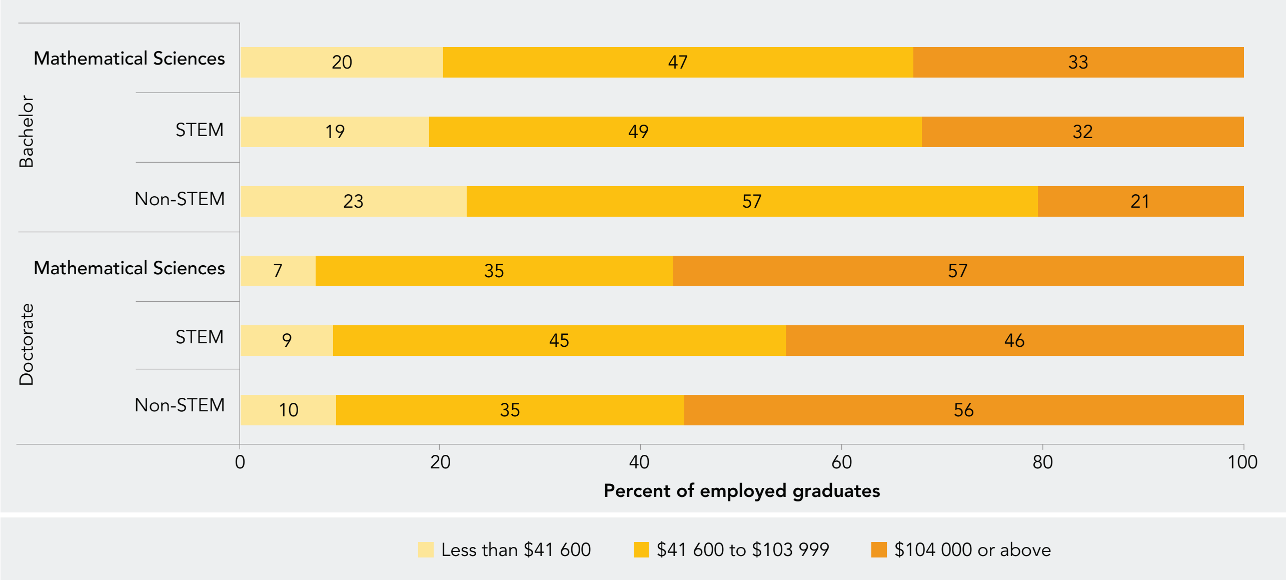
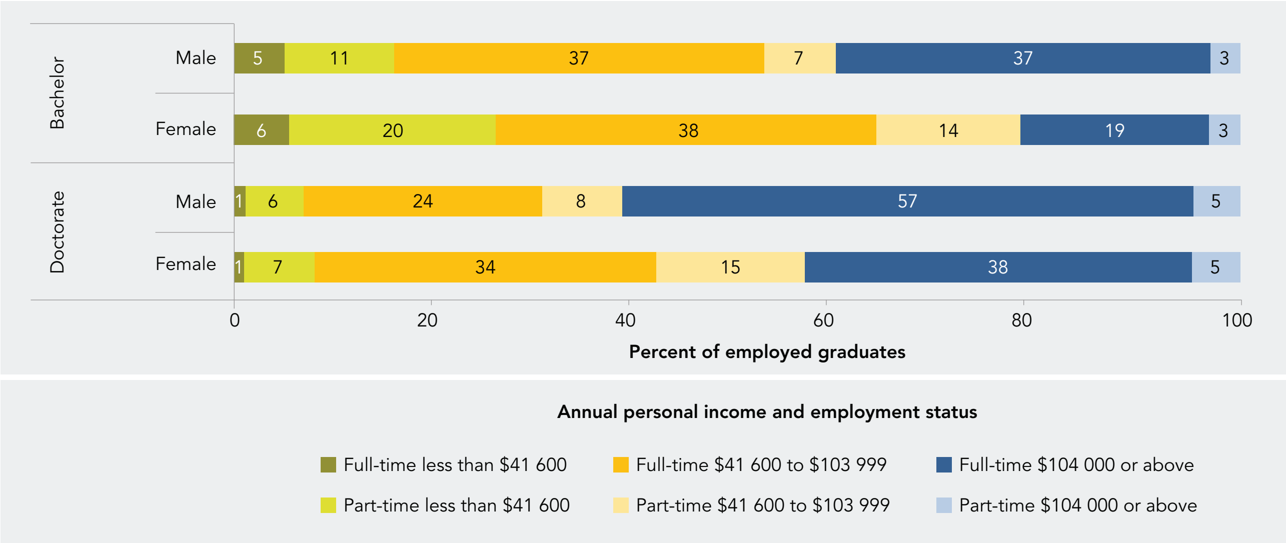


Figure 13.10: Personal annual income of Mathematical Sciences graduates working full-time and part-time, by field, gender and level of qualification



Age is also an important contributing factor to income. For those with bachelor degrees, the percentage of people who had an income in the highest bracket peaked at 53% for males at 40 to 44 years of age, and at 26% for females at 45 to 54 years of age (Figure 13.11). Substantially more males than females with bachelor qualifications had an income in the highest bracket for all age groups up to 65.

For those with doctoral degrees, the proportions of graduates in each income bracket across the age groups must be analysed with care, because only 633 females and 1 906 males are represented in this data. With this in mind, the peak percentage of graduates in the highest income bracket occurred for males at the ages of 50 to 54 at 76%, and for females aged 65 and over at 71% (Figure 13.12). The differences in the percentage of each gender in the highest income bracket were smaller for those with doctoral qualifications compared to bachelor degrees.

Figure 13.11: Percentage of bachelor graduates with an income of $104 000 or above, by field, age group and gender

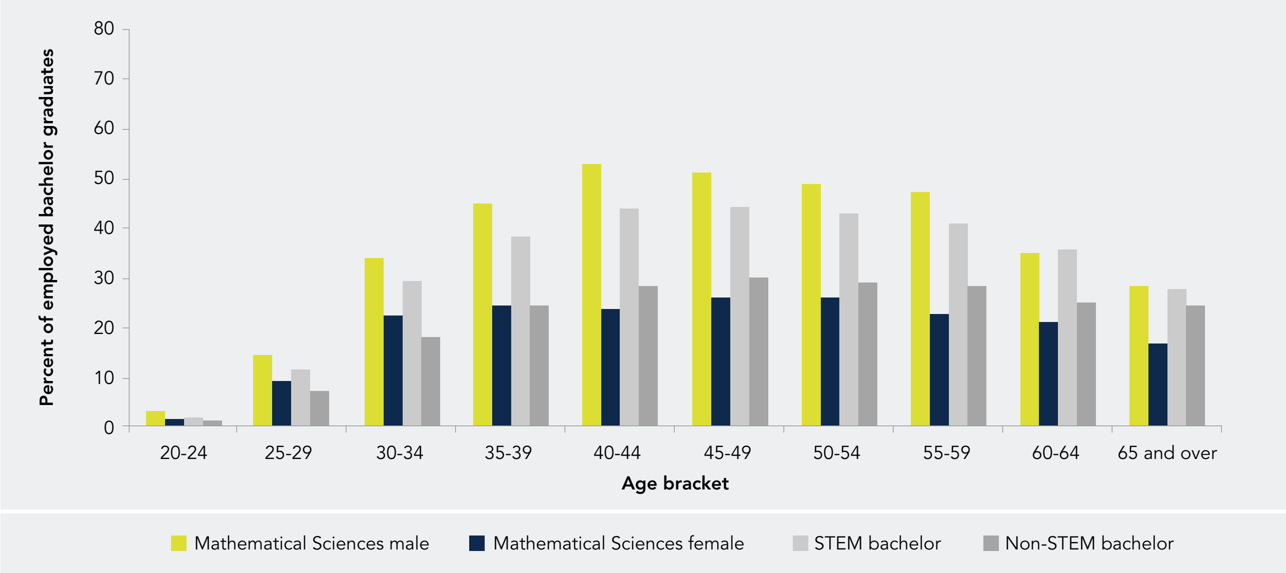
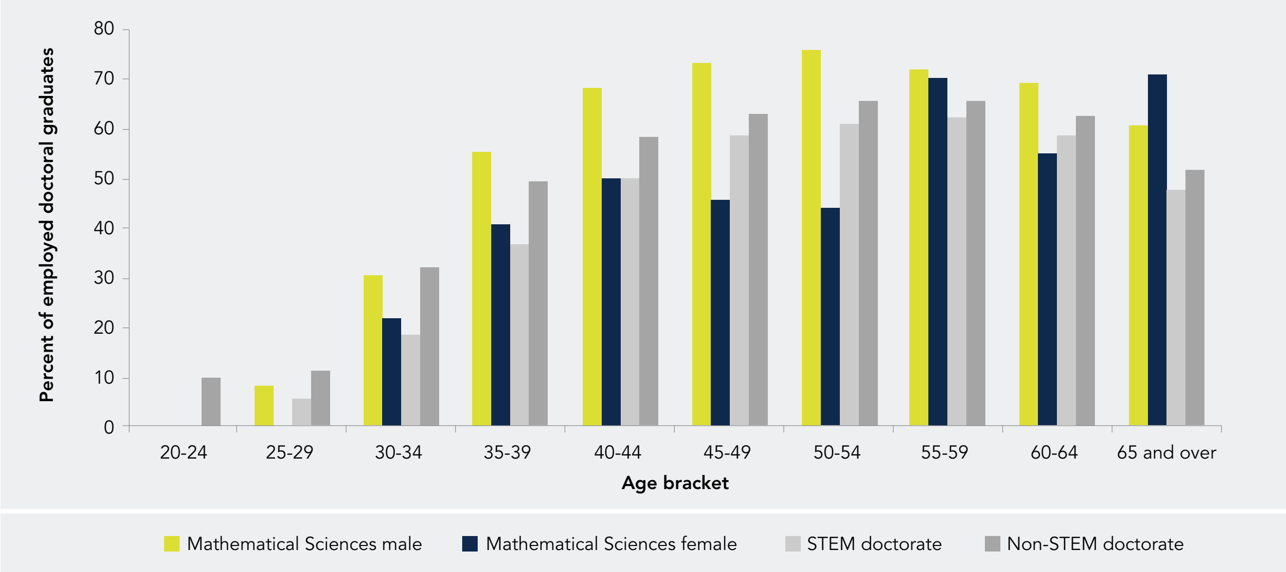


Figure 13.12: Percentage of doctoral graduates with an income of $104 000 or above, by field, age group and gender



CHAPTER 14

14

STEM PATHWAYS: OTHER NATURAL AND PHYSICAL SCIENCES

What is Other Natural and Physical Sciences?

The narrow field of Other Natural and Physical Sciences includes all Natural and Physical Sciences not elsewhere classified, including:

- **Medical Science**—the study of the application of physics, biology and chemistry to medicine.
- **Forensic Science**—the study of the application of scientific techniques to criminal investigations
- **Food Science and Biotechnology**—the study of the physical and chemical properties of food, and the industrial use of living organisms to produce food, pharmaceuticals and other products.
- **Pharmacology**—the study of the development, uses and effects of drugs.
- **Laboratory Technology**—the study of the procedures, techniques and equipment used in biological, chemical, medical and other laboratories.
- **Natural and Physical Sciences not elsewhere classified (n.e.c.)**—includes all Natural and Physical Sciences not elsewhere classified.
- **Other Natural and Physical Sciences not further defined (nfd)**—includes non-defined qualifications in Natural and Physical Sciences.

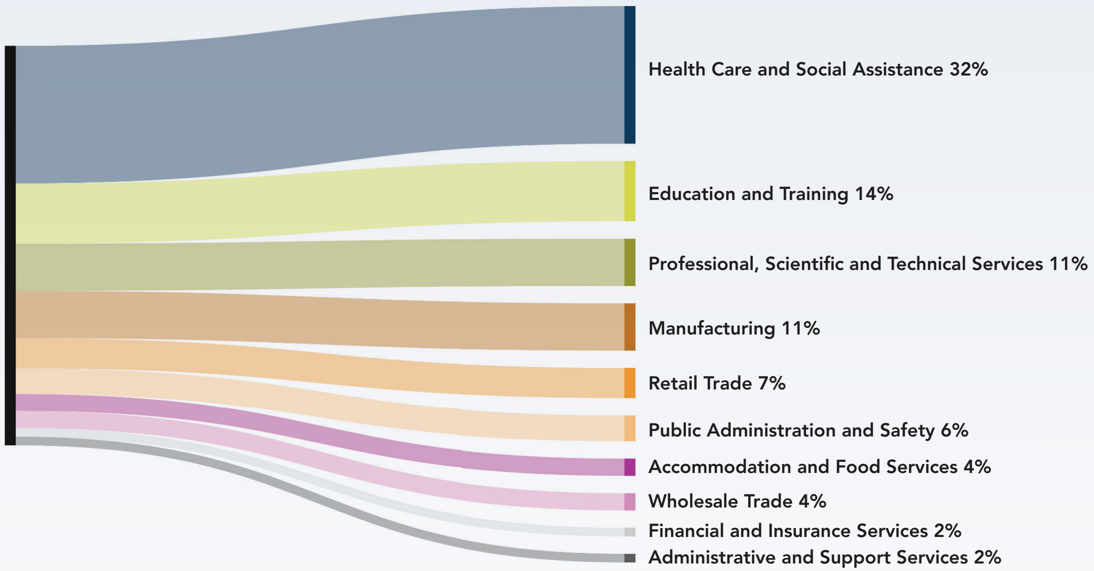
This chapter is new for the 2020 STEM Workforce report and presents analyses that were not included in the 2016 edition of this report.

This chapter examines the employed population in Australia with university qualifications (bachelor degree and above) in Other Natural and Physical Sciences (Other NPS). Comparisons to STEM and to non-STEM populations are also restricted to those with university qualifications.

HIGHLIGHTS

- In 2016 there were 42 311 people with university qualifications in Other NPS in Australia. Of these, 32 839 people were in the labour force, of whom 30 865 were employed.
- Over half of employed Other NPS graduates held qualifications in Medical Science (56%) while a quarter were Food Science and Biotechnology graduates.
- Nearly two-thirds (62%) of Other NPS graduates in the labour force were female, the highest proportion across all the STEM fields.
- The Other NPS graduate workforce was one of the youngest of the STEM qualified cohorts, with 71% of employed males and 77% of employed females aged under 45.
- Other NPS graduates were most commonly employed in the industries of Health Care and Social Assistance (32% of graduates) and Education and Training (14%).
- Medical Laboratory Scientists was the top occupation for Other NPS graduates, representing 19% of the whole cohort and 24% of those with doctorates.
- A lower proportion of Other NPS graduates than the total STEM graduate workforce had an income of $104 000 or above. 13% of bachelor graduates and 40% of employed doctoral graduates had an income in this bracket.

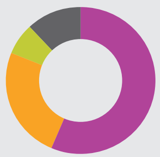
Top ten industries of employment for Other Natural and Physical Sciences graduates



42 311 people in Australia had a university qualification in Other Natural and Physical Sciences

Type of qualification

- 57% Medical Science
- 25% Food Science and Biotechnology
- 7% Pharmacology
- 12% Other fields*



% in the labour force

working or looking for work 78%

not in the labour force 22%

Of those in the labour force

% employed

94.0 % EMPLOYED

6% UNEMPLOYED

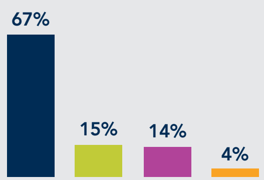
Gender

38% MALES

62% FEMALES

Type of degree

- Bachelor
- Masters
- Doctorate
- Other



* Other fields include Laboratory Technology (6%), Forensic Science (4%), Natural and Physical Sciences, not elsewhere classified (1%), and Other Natural and Physical Sciences.

The Other NPS qualified population

In 2016, there were 42 311 people in Australia with university qualifications in Other NPS fields, an increase of over 12 080 since 2011.

Over half (57%) of Other NPS graduates held a Medical Science qualification, while a quarter (25%) were Food Science and Biotechnology graduates.

The Other NPS labour force

Of the qualified population, 78% (32 839 people) were in the labour force, either working or looking for work. Females made up 62% of the Other NPS labour force, an increase of 1 percentage point since 2011, making Other NPS the STEM field with the highest female representation.

The unemployment rate in this field was 5.8% for males and 6.2% for females, up from 4.8% for both genders in 2011.

Employed Other NPS graduates

In 2016, on Census night, 30 865 university qualified Other NPS graduates were employed. The remainder of this chapter takes a closer look at these employed graduates. The number of employed graduates in each narrow field of Other NPS is shown in Table 14.1.

How old are the Other NPS employed graduates?

In 2016, the Other NPS graduate workforce was younger than the overall STEM qualified graduate workforce (Figure 14.1). Most employed Other NPS graduates were aged under 45, with 71% of males and 77% of females in this age category, making it one of the youngest STEM graduate cohorts. The female cohort was particularly young, with over half (53%) of females aged under 35.

The age distribution of the Other NPS workforce did not change substantially between 2011 and 2016.

Figure 14.1: Age distribution of employed graduates with university qualifications, by field and gender

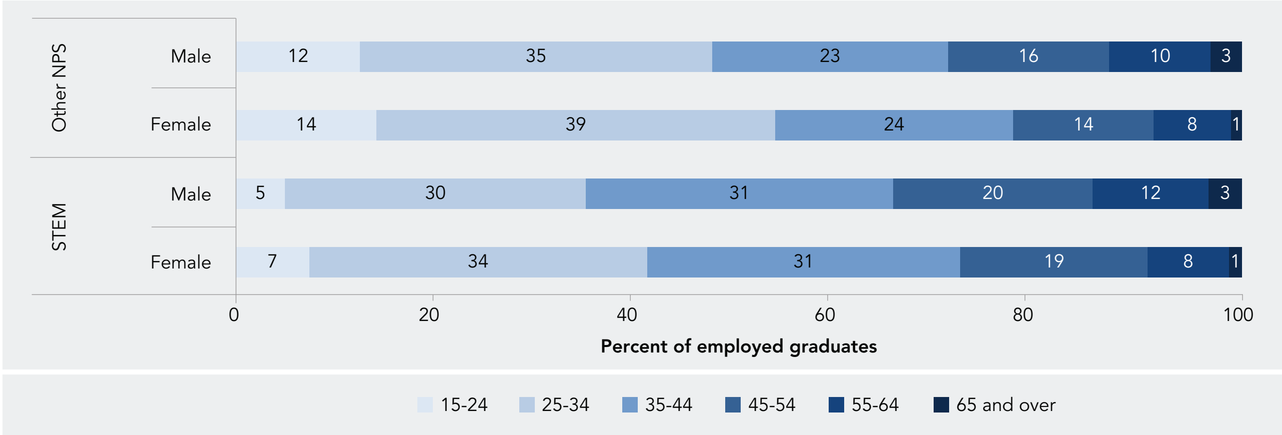


Table 14.1: Number of employed graduates in each narrow field of Other NPS

Detailed Field	Population size 2011	Population size 2016	Percentage increase 2011–2016	Percent of Other NPS graduate cohort (2016)
Medical Science	12 852	17 387	35	56.3
Food Science and Biotechnology	5 910	7 796	32	25.3
Pharmacology	1 505	2 064	37	6.7
Laboratory Technology	1 399	1 598	14	5.2
Forensic Science	933	1 617	73	5.2
Natural and Physical Sciences, nec	248	325	31	1.1
Other Natural and Physical Sciences, nfd	41	76	85	0.3
Total	**22 888**	**30 862**	**35**	**100**

Where do Other NPS graduates work?

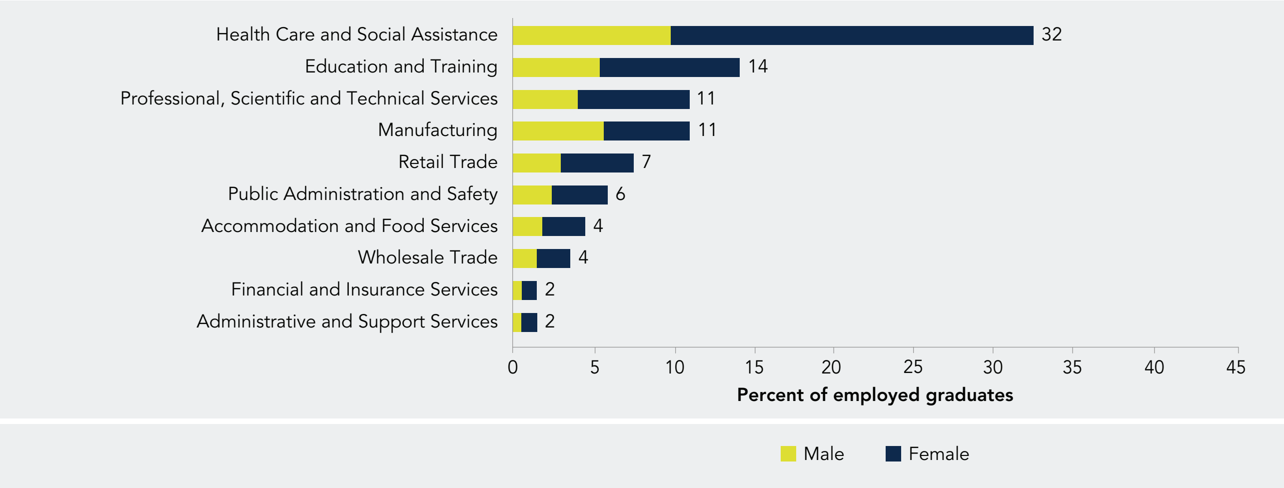
In 2016, 70% of Other NPS graduates worked in the private sector. The proportion of graduates working in the private sector varied across qualifications level, from 76% of bachelor graduates, to 70% of those with a master's degree and 46% of those with doctorates. Food Science and Biotechnology had the highest proportion of graduates working in the private sector (86%), while Forensic Science had the lowest proportion of graduates working in the private sector (52%; data not shown).

INDUSTRIES OF EMPLOYMENT

Industries are classified in four levels:
- Divisions (the broadest level)
- Subdivisions
- Groups
- Classes (the most detailed level)

In 2016, nearly half of employed Other NPS graduates were employed in two industry divisions: Health Care and Social Assistance (32%) and Education and Training (14%). The remainder were spread across the other 17 industry divisions, with the top ten displayed in Figure 14.2. Females outnumbered males in nearly all of the top ten industry divisions of employment, with the exception of Manufacturing where 51% of all Other NPS graduates were male.

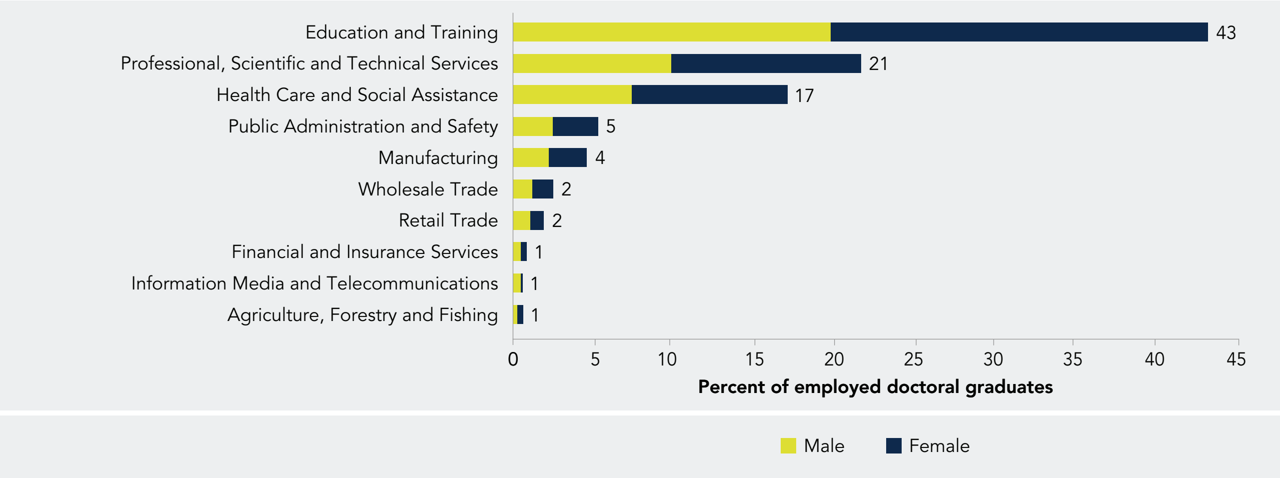
Figure 14.2: Top ten industry divisions of employment for Other NPS graduates with university qualifications, by gender



The leading industries of employment differed across detailed fields within Other NPS (data not shown). For example, nearly half (45%) of Medical Science graduates were employed in Health Care and Social Assistance, while the most common industry division of employment for Food Science and Biotechnology graduates was Manufacturing (32%).

Other NPS doctoral graduates were more concentrated in Education and Training, with 43% of the working population employed in this division (Figure 14.3). Education and Training was also the top division of employment for both Medical Science doctoral graduates (43%) and Food Science and Biotechnology doctoral graduates (41%; data not shown).

Figure 14.3: Top ten industry divisions of employment for Other NPS doctoral graduates, by gender



At the more detailed class level of industry classification, the leading industry class of employment for Other NPS graduates was Pathology and Diagnostic Imaging Services (13%) followed by Hospitals (11%; Figure 14.4). When looking only at those with doctoral qualifications, the leading industry class of employment was Higher Education, which employed 40% of the cohort (Figure 14.5).

The top industry class of employment differed across the detailed fields within Other NPS, as graduates tended to work in industries that were associated with their specific field of qualification. The top industry class of employment for the whole graduate cohort within each detailed field of education is listed below.

- Medical Science ➞ Pathology and Diagnostic Services (18%)
- Food Science and Biotechnology ➞ Wine and Other Alcoholic Beverage Manufacturing (11%)
- Pharmacology ➞ Higher Education (19%)
- Laboratory Technology ➞ Pathology and Diagnostic Imaging Services (36%)
- Forensic Science ➞ Police Services (28%)
- Natural and Physical Sciences, not elsewhere classified ➞ Higher Education (41%)
- Other Natural and Physical Sciences, not further defined ➞ Pathology and Diagnostic Imaging Services (26%)

Figure 14.4: Top ten industry classes of employment of Other NPS graduates with university qualifications, by gender

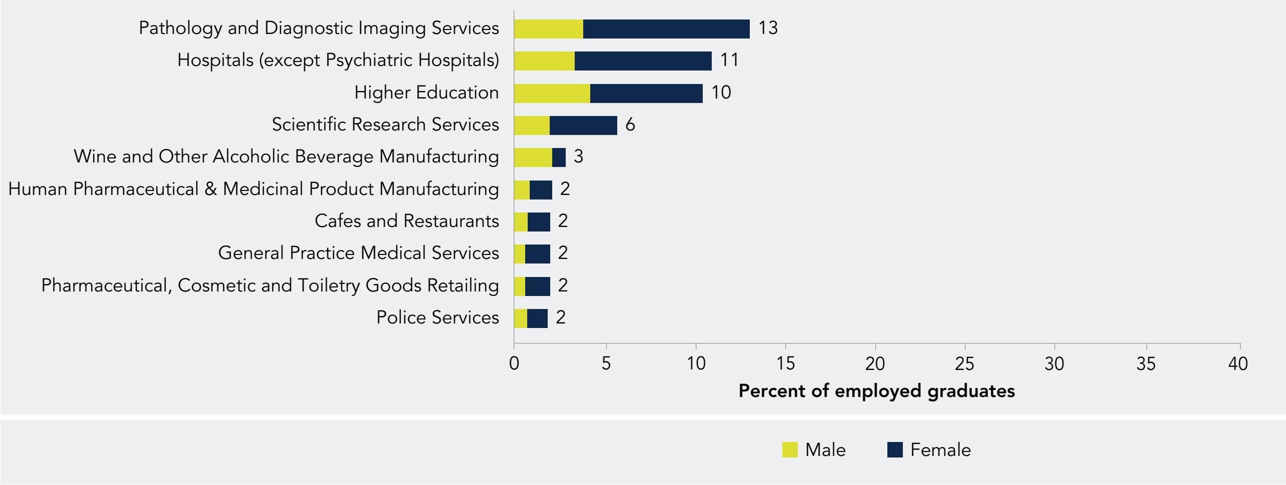
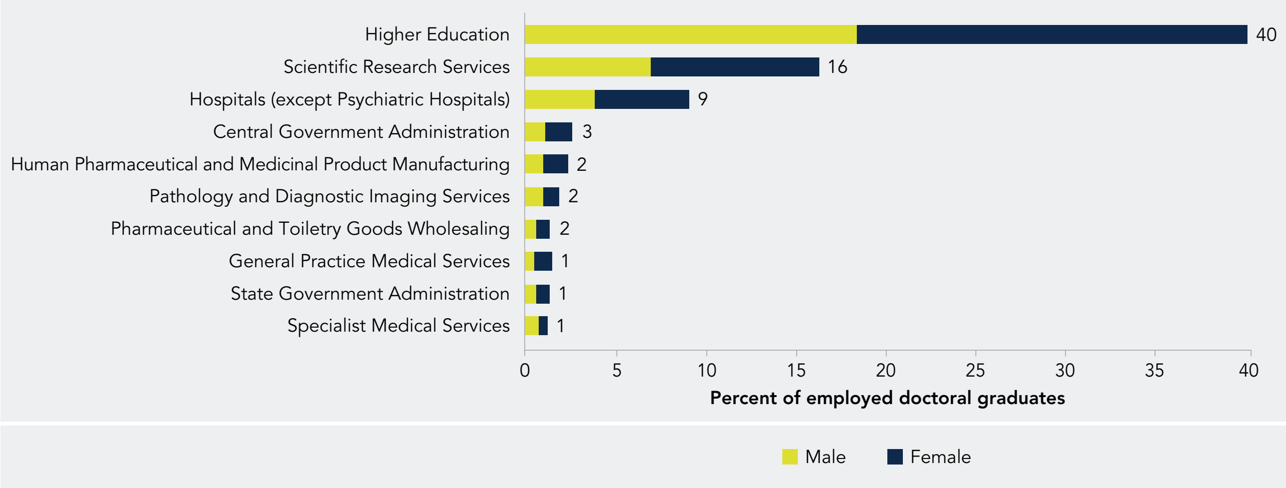


Figure 14.5: Top ten industry classes of employment of Other NPS doctoral graduates, by gender



What are the occupations of Other NPS graduates?

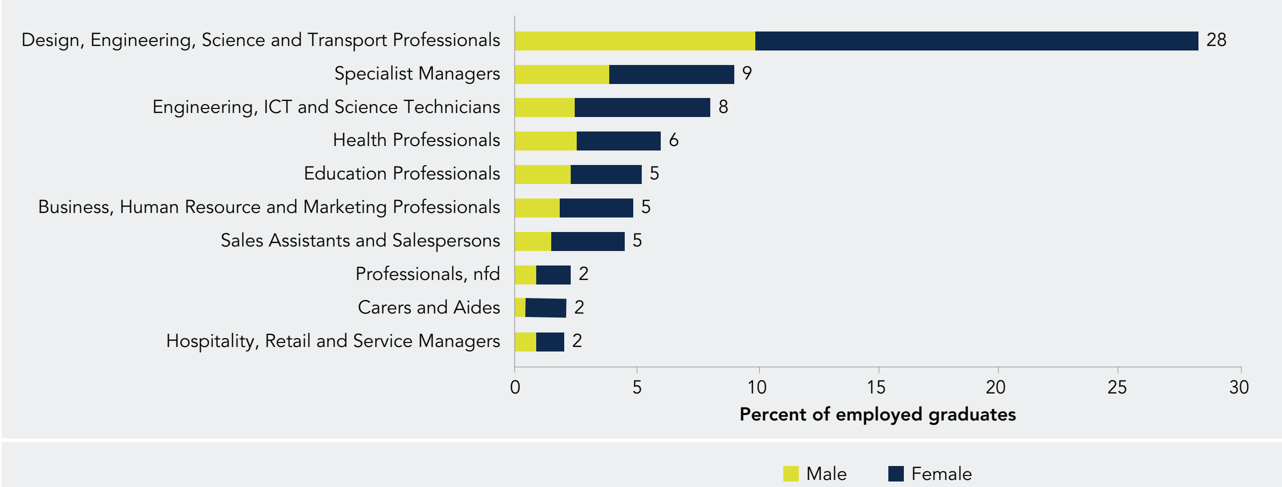
In 2016, nearly half (49%) of employed Other NPS graduates worked in the major occupation group of Professionals, with Managers the second most common occupation group (13%) (data not shown).

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

At the more detailed sub-major group level of classification, the top occupation for Other NPS graduates was Design, Engineering, Science and Transport Professionals, representing 28% of the whole cohort (Figure 14.6).

Figure 14.6: Top ten sub-major group level occupations of Other NPS graduates with university qualifications, by gender



At the unit group level of occupation classification, Medical Laboratory Scientists was the most common occupation for the Other NPS graduate cohort, representing 19% of the working population. While females outnumbered males in most occupations, a higher proportion of males than females were employed as Chemists, and Food and Wine Scientists (58% male), and there were approximately equal numbers of males and females employed as University Lecturers and Tutors.

The most common occupations varied across the sub-fields of education within Other NPS. The top three unit group occupations for the two largest sub-fields within Other NPS are listed below.

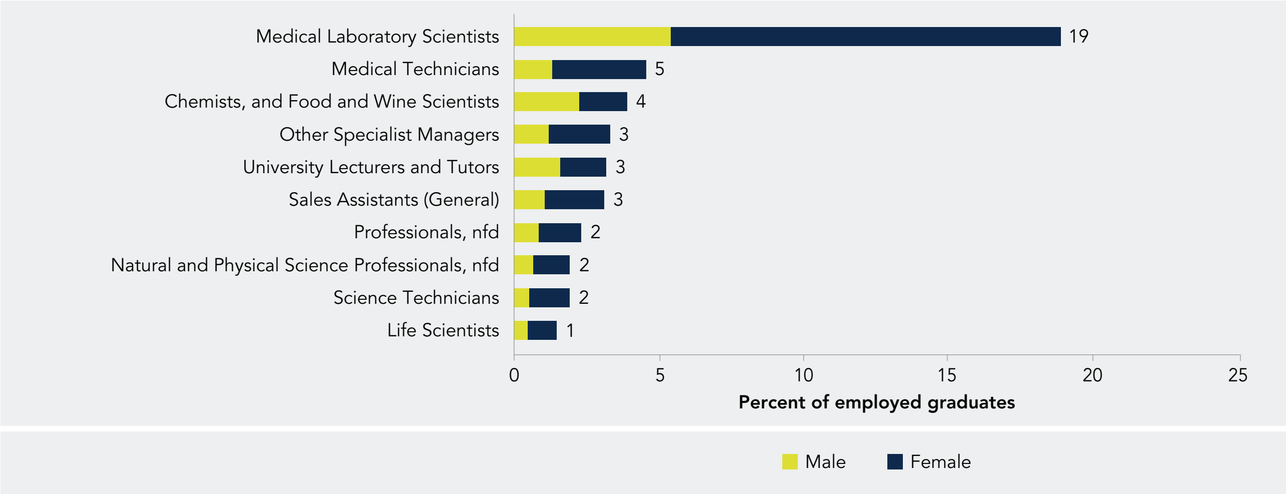
Medical Science

- Medical Laboratory Scientists (28%)
- Medical Technicians (6%)
- University Lecturers and Tutors (4%)

Food Science and Biotechnology

- Chemists, and Food and Wine Scientists (14%)
- Other Specialist Managers (6%)
- Medical Laboratory Scientists (3%)

Figure 14.7: Top ten unit group level occupations of Other NPS graduates with university qualifications, by gender

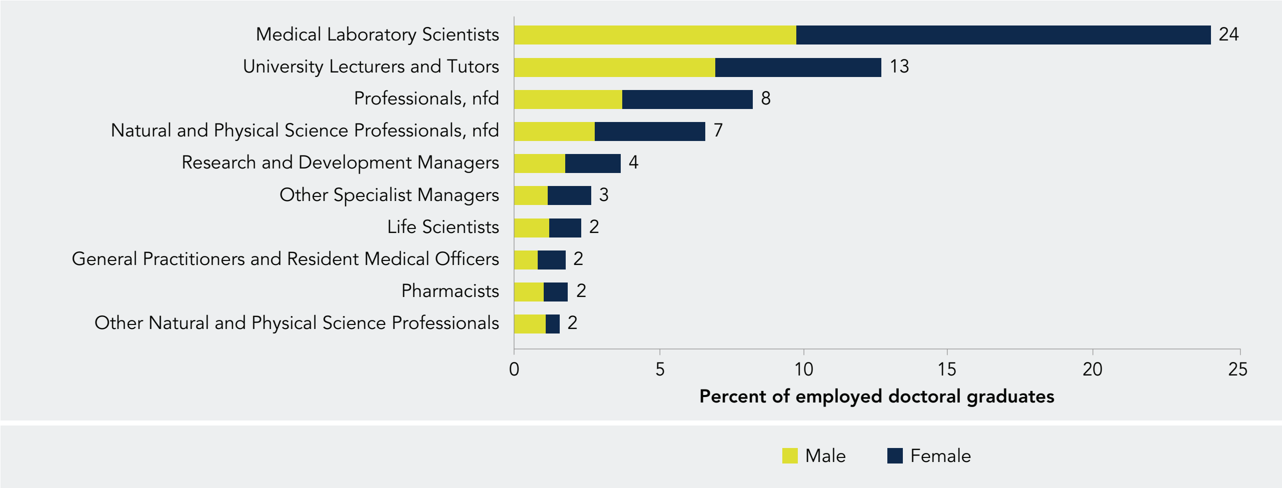


The top occupations for the remaining sub-fields within Other NPS are:

- Pharmacology ➞ Pharmacists (10%)
- Laboratory Technology ➞ Medical Laboratory Scientists (23%)
- Forensic Science ➞ Police (20%)
- Natural and Physical Sciences, not elsewhere classified ➞ University Lecturers and Tutors (10%)
- Other Natural and Physical Sciences, not further defined ➞ Medical Laboratory Scientists (23%)

Figure 14.8 shows the top occupations for employed Other NPS doctoral graduates. Medical Laboratory Scientists was the top unit group occupation for doctoral graduates, employing nearly a quarter (24%) of the cohort. A further 13% were employed as University Lecturers and Tutors, while professional and managerial occupations were also common among the top ten occupations.

Figure 14.8: Top ten unit group level occupations of Other NPS doctoral graduates, by gender



Are Other NPS graduates high earners?

In 2011, 9% of Other NPS bachelor graduates had an income of $104 000 or above, and 34% earned less than $41 600. In 2016, the proportion of Other NPS bachelor graduates with an income in the highest bracket had increased to 13% and the proportion in the lowest income bracket had decreased to 33% (Figure 14.9).

> The highest annual income bracket in the 2011 Census was $104 000 or above. In the 2016 Census, the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report, the $104 000 or above income bracket is maintained in this report.

A lower percentage of Other NPS bachelor graduates than both the total STEM and the non-STEM qualified cohorts had an income in the highest bracket, and a higher percentage of Other NPS graduates had an income in the lowest bracket (Figure 14.9).

For those with doctoral qualifications, 30% of Other NPS graduates had an income in the highest bracket in 2011, increasing substantially to 40% in 2016. Similar to the bachelor qualified cohort, a lower percentage of Other NPS doctoral graduates than the total STEM and the non-STEM qualified cohorts had an income in the highest bracket.

Income was closely related to gender and full-time or part-time employment—a higher proportion of males and of those who worked full-time had an income in the highest bracket (Figure 14.10). For those with bachelor degrees, a far higher proportion of males (19% of males) than females (9% of females) earned $104 000 or above.

Figure 14.9: Personal annual income of Other NPS graduates, by field and level of qualification

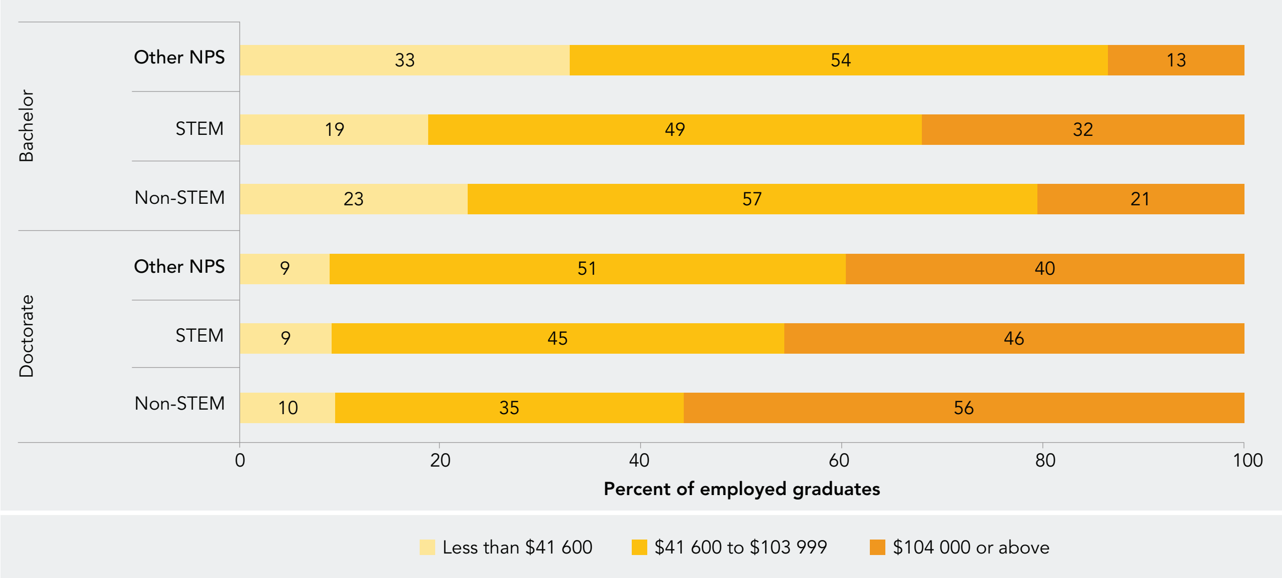
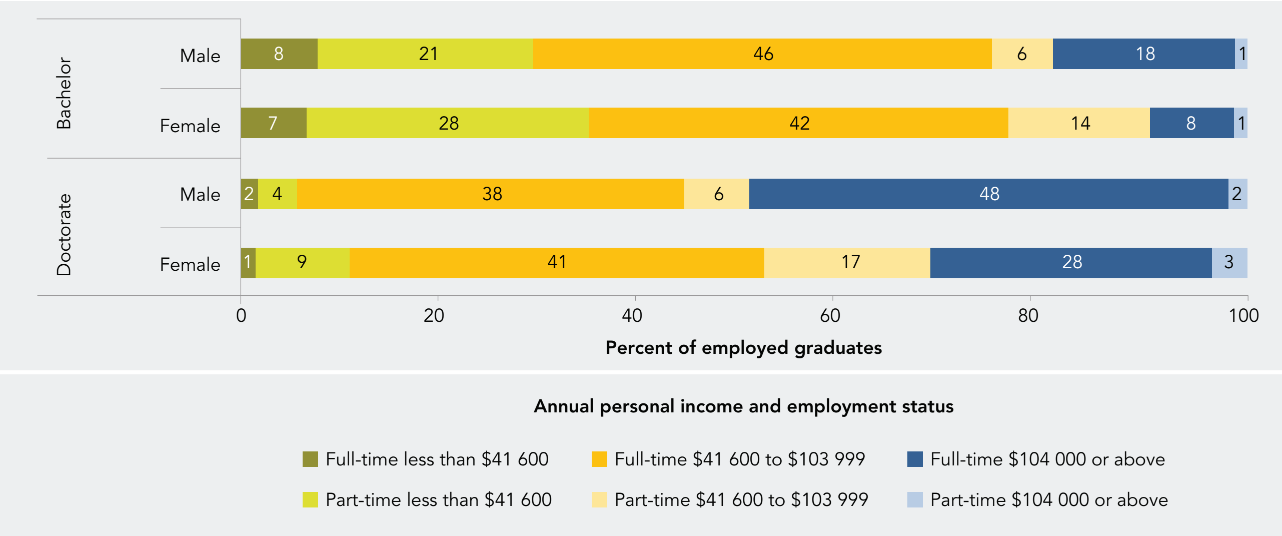


Figure 14.10: Personal annual income of Other NPS graduates working full-time and part-time, by gender and level of qualification



The income distribution for Medical Science graduates was similar to that of the overall cohort, but there were some differences across other detailed fields. A higher percentage of Food Science and Biotechnology bachelor graduates earned above $104 000, or above with 23% of males and 11% of females in this income bracket (data not shown).

In 2016, half of male Other NPS doctoral graduates and nearly a third (31%) of female doctorates had an income of $104 000 or above. Between 2011 and 2016, the proportion of Other NPS doctoral graduates earning in this highest income bracket increased by 10 percentage points for males and 11 percentage points for females.

Along with gender, age is an important factor in the income levels of graduates. Among bachelor graduates (Figure 14.11), those aged 50 to 54 had the highest proportion earning $104 000 or above, with 42% of males and 20% of females in this age group earning in the highest bracket.

For Other NPS doctoral graduates (Figure 14.12), income peaked for males between the ages of 50 to 54, where nearly three-quarters (71%) had an income in the highest bracket. For females, the income peak was at age 55 to 59, where 60% of females had an income in the highest bracket. While a greater proportion of males than females had a high income across all age brackets, this income difference was smaller among those with doctorates compare to those with a bachelor degree.

Figure 14.11: Percentage of bachelor graduates earning greater than $104 000 annually, by field, age group and gender

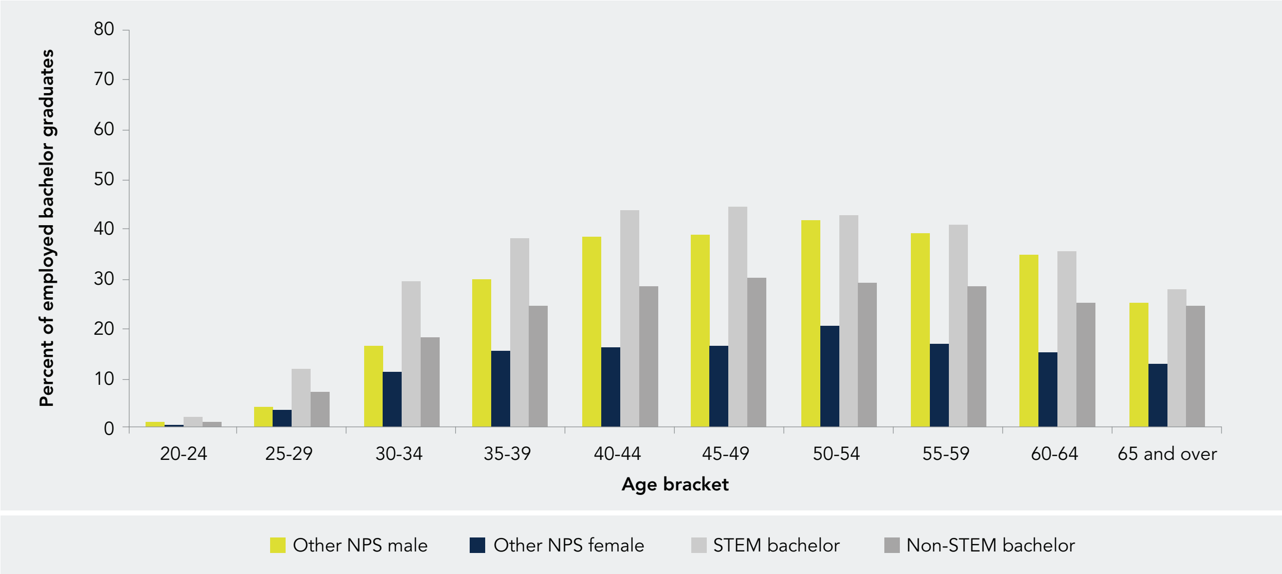
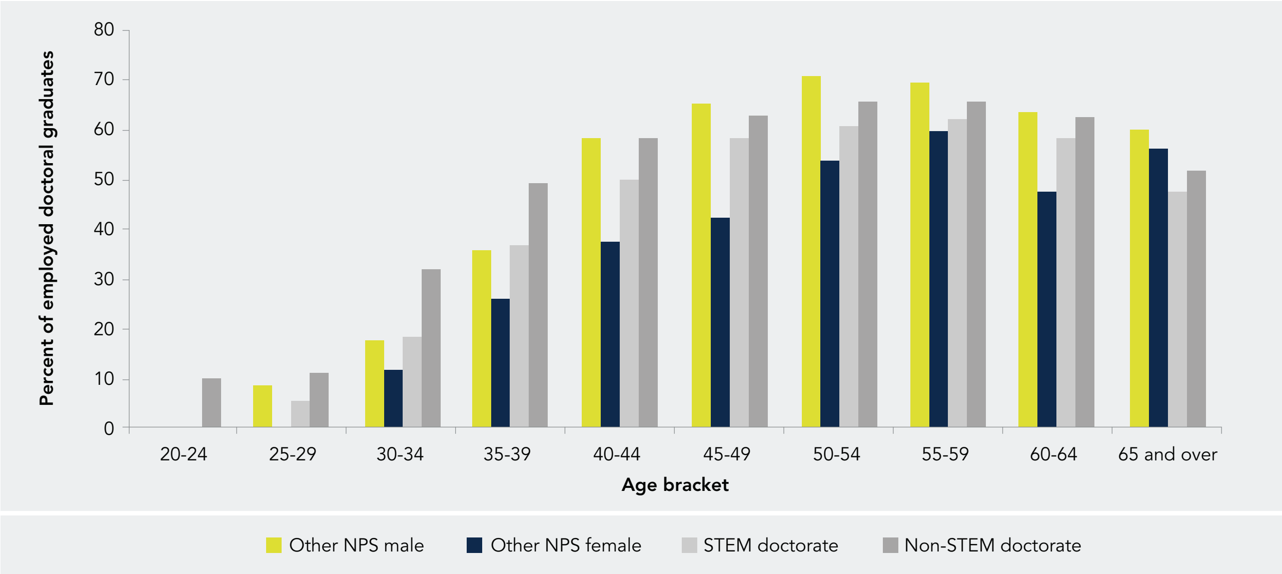


Figure 14.12: Percentage of doctoral graduates earning greater than $104 000 annually, by field, age group and gender



CHAPTER 15

15

WOMEN IN STEM

HIGHLIGHTS

- The female STEM qualified labour force is growing faster than the male STEM qualified labour force. Between 2006 and 2016, the female labour force with VET STEM qualifications increased by 14% (11 698), whereas the male labour force with VET STEM qualifications increased by 13% (119 899). Across the same decade, the female labour force with university STEM qualifications increased by 74% (90 650), whereas the male labour force with university STEM qualifications increased by 57% (190 671).
- The large numerical increase in the female STEM qualified labour force has not translated to a large change in the gender split of the STEM qualified labour force.
  - For those with VET qualifications, females made up 8% of the STEM qualified labour force in both 2006 and 2016.
  - For those with university qualifications, females made up 27% of the STEM qualified labour force in 2006 and 29% in 2016.
- In 2016, STEM qualified females working full-time had lower incomes than males working full-time across the board. There was not a substantial difference between the inequities when comparing STEM and non-STEM fields.
- STEM qualified females who had a child between 2011 and 2016 were significantly less likely to remain employed than females who did not have a child. Nearly one-third (30%) of VET qualified females and nearly one-fifth (19%) of university qualified females who had a STEM qualification and were working full time in 2011 left the labour force after having a child.

For those with VET qualifications:

- Females made up 8% of the STEM qualified labour force.
- 31% of STEM qualified females in the labour force were born outside Australia, compared to 24% of males.
- 9% of STEM qualified females working full-time earned $104 000 or above, compared to 20% of males.
- 7% of STEM qualified managers were female.
- 18% of STEM qualified females in the labour force were aged 55 or over, compared to 23% of males.

For those with university qualifications:

- Females made up 29% of the STEM qualified labour force.
- 56% of STEM qualified females in the labour force were born outside Australia, as were 56% of males.
- 26% of STEM qualified females working full-time earned $104 000 or above, compared to 45% of males.
- 22% of STEM qualified managers were female.
- 9% of STEM qualified females in the labour force were aged 55 or over, compared to 15% of males.

Introduction

As highlighted in earlier chapters of this report, women are in the minority in Australia's STEM workforce and, on average, women with STEM qualifications experience poorer employment outcomes than men. In 2016, just 8% of people in the labour force with a VET STEM qualification were female, while almost one third (29%) of people in the labour force with a university STEM qualification were female (Chapter 3, Figure 3.5). STEM qualified females had higher unemployment rates than males in all STEM fields, regardless of whether they had a VET or university qualification (Chapter 3, Figure 3.12). Amongst university graduates, 39% of STEM qualified males earned above $104 000, while only 19% of STEM qualified females had an income in this top bracket (Chapter 4, Figure 4.15).

The driving forces behind women's underrepresentation in STEM are many and varied, but a lack of interest or aptitude in STEM is not the culprit (Office of the Chief Scientist 2016). Rather, women face a number of systemic challenges in society and the workforce that impact their engagement and experiences at work. Women spend more time than men performing unpaid care and domestic work[24] (Workplace Gender Equality Agency 2016), limiting the amount of time available for paid employment. Even women who work full-time tend to earn less than men, due to factors such as biased hiring practices, lack of workplace flexibility, a concentration of women in industries that have lower than average wages, and the tendency for women to have more time out of the workforce, impacting their opportunities for career progression (Workplace Gender Equality Agency 2018). Older women face particular societal barriers to employment that are not as common for their male counterparts, such as a perceived lack of relevant skills and a perceived limited ability to acquire new skills (Australian Human Rights Commission 2016).

Further barriers exist which can limit women's participation in STEM education and careers, from stereotypes and bias that deter girls from studying STEM subjects at school, to a lack of job security in workplaces, the impact of career disruptions, social and cultural barriers, and gender discrimination and sexual harassment in STEM workplaces.[25] Not all of these barriers are specific to women and girls in STEM, with many experienced by women in all areas of the workforce.

The drive to improve female representation in the STEM qualified workforce is part of a larger push to improve female workforce participation more broadly. In 2018, 73% of Australian women and 83% of Australian men aged 15 to 64 were in the labour force, representing a participation gap of 10 percentage points (OECD 2019a). It has been suggested that reducing the gender participation gap by 25% could add up to $25 billion to the Australian economy[26] (Department of the Prime Minister and Cabinet 2017).

This chapter takes a closer look at STEM qualified women at different stages in their career, from graduation to retirement. The following topics are covered: demographics, income, childcare and flexible work, business ownership and leadership, and mature aged women. These have been selected to shed light on a broad range of topics for which there was sufficient data from the Census to explore. The experiences of women in STEM, and women in the workforce more broadly, are complex, varied, and span across a wide range of themes, not all of which were able to be represented in this report.

24 This includes caring for children, the elderly, or sick family members, along with domestic work such as preparing meals, washing, gardening, home and car maintenance, household shopping, managing financial affairs, and any other domestic work performed by an individual for themselves or for their household.

25 A comprehensive list of barriers to girls' and women's participation in STEM can be found in the *Women in STEM Decadal Plan*, developed by the Australian Academy of Science and the Australian Academy of Engineering.

26 From the 2012 starting point of a 12.1% participation gap.

How many STEM qualified females are in the labour force?

In 2016, there were 95 306 females and 1 071 141 males with VET STEM qualifications in the Australian labour force (Table 15.1).[28] Females made up 8% of this population in both 2006 and 2016. Between 2006 and 2016, the number of females with VET STEM qualifications in the labour force increased by 14% (11 698), while the number of males with VET STEM qualifications in the labour force increased by 13% (119 899; data not shown).

For those with VET STEM qualifications, the most common broad field of education for females in 2016 was Engineering, accounting for nearly two-fifths (38%) of the female VET STEM qualified labour force. The next most common field of education was Agriculture and Environmental Science (28%), followed by Information Technology (18%), and Science (15%).

The Census asks respondents to state whether they are **male** or **female**, and this report uses these terms when reporting Census data.

While the 2016 Census made provisions to allow people to report a sex other than male or female, this information is not available for analysis due to limitations in the data. We recognise that the response options of male and female may not adequately capture those who are intersex or have a non-binary gender identity.

This report also uses the word **gender** rather than sex when reporting Census data. The Census question does not specifically mention sex or gender; as such, we have chosen to use the term gender as it may more closely align with respondents' self-reported identity.[27]

In 2016, there were 212 863 females and 525 209 males with university STEM qualifications in the Australian labour force (Table 15.1).[29] Females made up 29% of this population, an increase from 27% in 2006. Between 2006 and 2016, the number of females with university STEM qualifications in the labour force increased by 74% (90 650), while the number of males with university STEM qualifications in the labour force increased by 57% (190 671; data not shown).

For those with university qualifications, the most common broad field of qualification for females in 2016 was Science, representing 45% of the female STEM qualified labour force. The next most common field of education was Information Technology (21%), followed by Engineering (20%), Agriculture and Environmental Science (10%) and Mathematics (4%).[30]

Table 15.1: Number of females in the labour force with post-secondary qualifications, by field and level

	Science	Ag. & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total non-STEM
Doctoral Degree	13 604	1 122	726	1 917	658	18 026	32 326
Master Degree	11 958	4 175	12 778	7 644	1 760	38 318	267 624
Postgraduate Degree not further defined	212	52	134	77	26	499	8205
Graduate Certificate or Diploma	2 782	1 505	2 679	898	498	8 370	183 042
Bachelor Degree	66 613	15 301	28 452	31 394	5 887	147 650	1 082 199
University total	**95 169**	**22 155**	**44 769**	**41 930**	**8 829**	**212 863**	**1 573 396**
Advanced Diploma and Diploma	7 659	8 814	9 535	8 951	200	35 183	641 968
Certificate not further defined	1 543	2 082	1 320	2 838	41	7 820	128 909
Certificate III & IV	4 583	12 949	4 474	22 467	28	44 505	652 764
Certificate I & II	369	2745	2296	2366	20	7798	80350
VET total	**14 154**	**26 590**	**17 625**	**36 622**	**289**	**95 306**	**1 503 991**
Level not stated	533	615	604	1 583	35	3 369	48 141
Level inadequately described	1 279	334	1 430	1 246	80	4 370	40 012

27 Further information on gender and sex in the 2016 Census is available in 2071.0—Census of Population and Housing: Reflecting Australia—Stories from the Census, 2016.

28 For a list of 'STEM' fields of education, refer to Chapter 1, page 2 of this report.

29 In 2016, a further 7 739 females and 37 725 males in the labour force held a STEM qualification but did not specify their level of education. These cohorts have been excluded from analyses in this chapter.

30 For the total numbers of qualified people in Australia, combining males and females, refer to Chapter 2, Table 2.1.

Are there fewer females than males with post-secondary qualifications in the labour force?

The underrepresentation of females in STEM is not simply due to an overall lower number of females with post-secondary qualifications; rather, females are less likely than males to pursue study in STEM fields. While females were outnumbered by males in STEM fields, they outnumbered males in non-STEM fields, making up 57% of the VET qualified non-STEM labour force and 61% of the university qualified non-STEM labour force (Figure 15.1).

How does female representation vary across the different fields of Science?

Of the STEM fields, Science had the most even gender split. As shown in Chapter 2, in 2016, females made up 56% of all people with VET Science qualifications and 50% of all people with university Science qualifications in Australia (Figure 2.4 and Figure 2.5). However, the distribution of females in the labour force varied with level of education and across the narrow fields of Science.

Of those in the labour force with VET Science qualifications, females outnumbered males in five of the ten largest narrow fields of education (Figure 15.2); Laboratory Technology, Natural and Physical Sciences not further defined, Medical Science, Earth Sciences not elsewhere classified, and Biological Sciences not further defined. Across the largest ten narrow Science fields, females had the highest representation in Laboratory Technology (making up 71% of the population with this qualification) and the lowest representation in Geology (18%).

Figure 15.1: Size of the STEM and non-STEM qualified labour forces, by gender, field and level

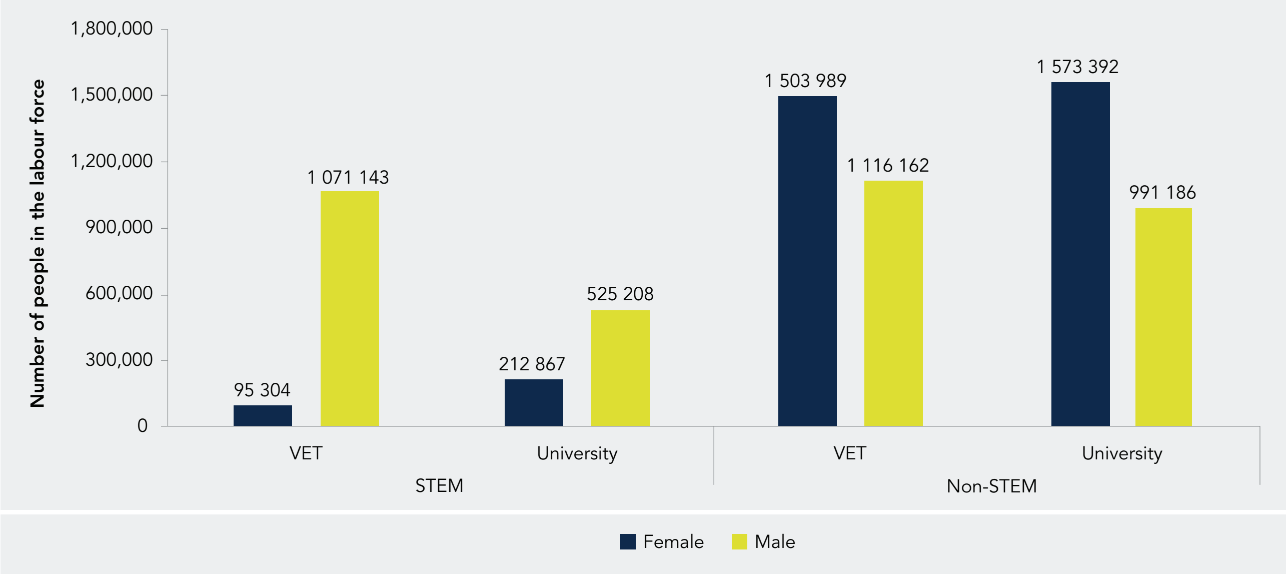
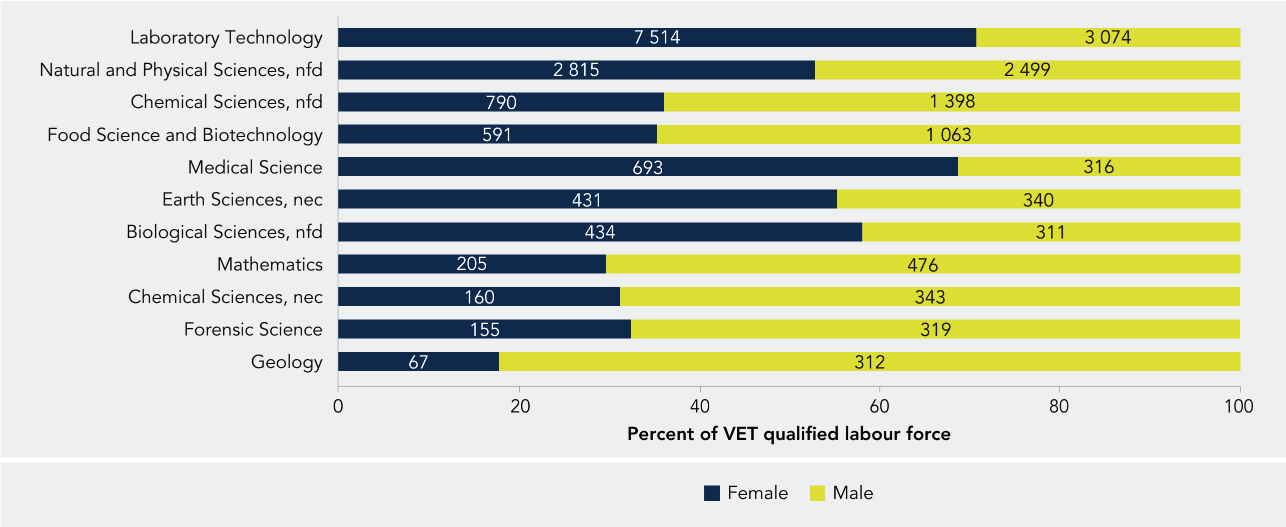


Figure 15.2: Gender distribution of the VET science qualified labour force. Data labels show the number of qualified people in the labour force



Of those in the labour force with university Science qualifications, females outnumbered males in six of the ten largest narrow education fields of Science (Figure 15.3), including Natural and Physical Sciences not further defined, Medical Science, Biological Sciences not further defined, Food Science and Biotechnology, Biochemistry and Cell Biology, and Microbiology. Across the largest ten narrow Science fields, females had the highest representation in Medical Science (making up 65% of the population with this qualification) and the lowest in Physics (19%).

Are females more likely than males to pursue higher qualifications?

The Australian Census Longitudinal Dataset was used to look at the number of people who had a post-secondary qualification in 2011 and a higher level of qualification in 2016. STEM qualified females were more likely than STEM qualified males to gain a higher level of qualification in this time period, across all levels of qualification (Figure 15.4). For example, of people who had a STEM qualification at the certificate level in 2011, 15% of females and 7% of males had a higher level of qualification in 2016.

Figure 15.3: Gender distribution of the university Science qualified labour force. Data labels show the number of qualified people in the labour force

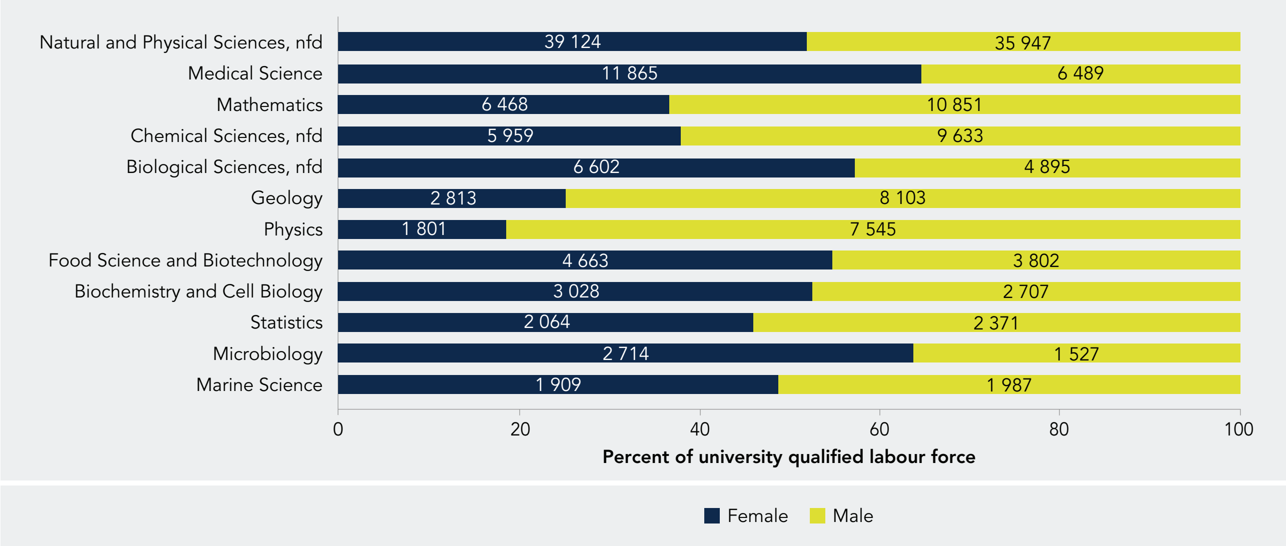
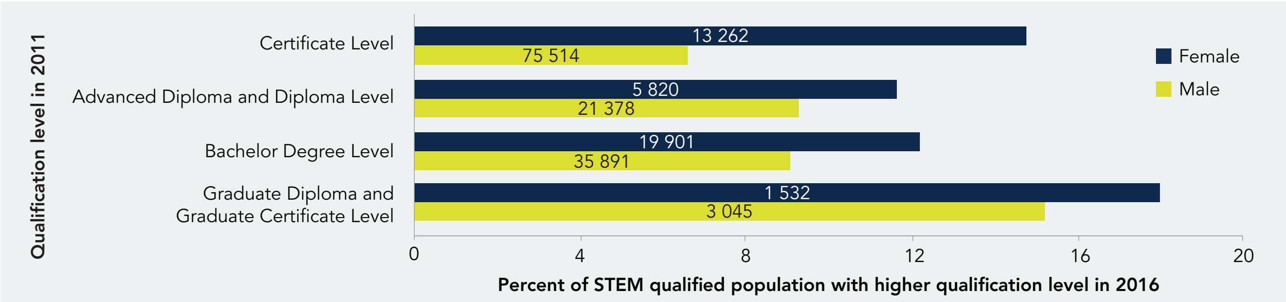


Figure 15.4: Percent of the STEM qualified population who increased their qualification level between 2011 and 2016. Bars are labelled with the number of people who increased their qualification level[31]



31 Those who had master and doctoral level qualifications in 2011 are not analysed here as they had already attained the highest qualification available (when analysing qualification level at the broadest grouping). Data for this figure was sourced from the Australian Census Longitudinal Dataset, 2011-2016.

What is the age distribution of STEM qualified females?

In 2016, the majority (55%) of females with VET STEM qualifications in the labour force were aged under 45 (Figure 15.5). This was slightly greater than the proportion of males with VET STEM qualifications in the labour force aged under 45 (52%). Of females with university STEM qualifications in the labour force, almost three-quarters (73%) were aged under 45 in 2016 (Figure 15.6). This proportion was considerably higher than the proportion of males with university STEM qualifications in the labour force aged under 45 (65%).

Although the majority of the female STEM qualified labour force were aged under 45 in 2016, the proportion of the labour force aged 45 and over has increased over the decade. Between 2006 and 2016, the proportion of females with VET STEM qualifications aged 45 and over increased by 12 percentage points, from 33% to 45% (Figure 15.5). The largest growth was in the 55 to 64 age bracket, where the number of VET STEM qualified females in the labour force increased by 7 216 (or 96%, data not shown). In contrast, the smallest growth occurred in the 25 to 34 age bracket, where the number of VET STEM qualified females in the labour force decreased by 1 709 (-8%). The 35 to 44 age bracket also saw a decrease of 1 749 females (-7%).

Over the same time period, the proportion of females with university STEM qualifications aged 45 and over increased by 4 percentage points, from 23% to 27% (Figure 15.6). The largest growth was in the 35 to 44 age bracket, where the number of STEM qualified females in the labour force increased by 32 633 (or 99%, data not shown). The smallest growth occurred in the 15 to 24 age bracket, where the number of STEM qualified females in the labour force increased by 1 716 (12%).

Figure 15.5: Age distribution of labour force with VET STEM qualifications, by gender and year. Data labels show the percentage of the population in each age group

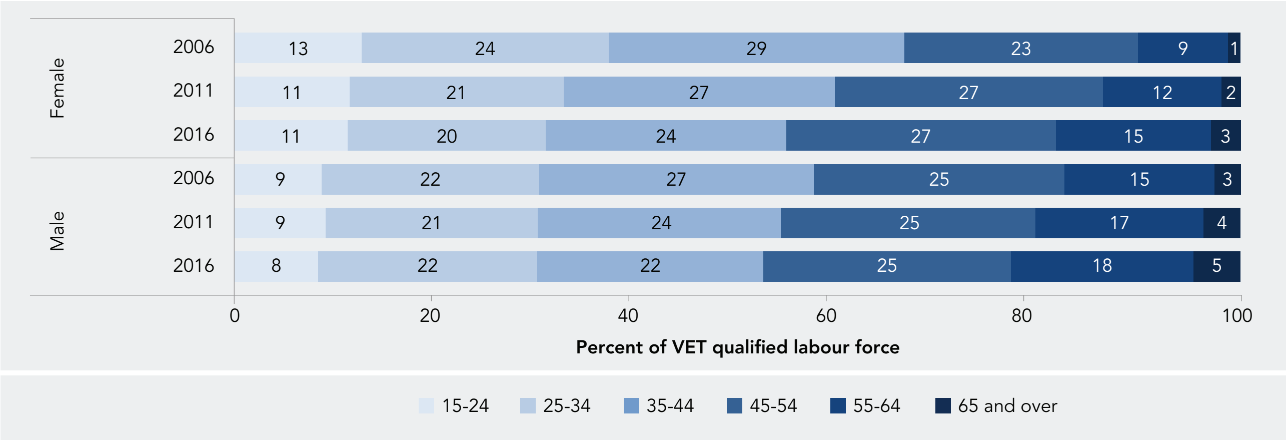
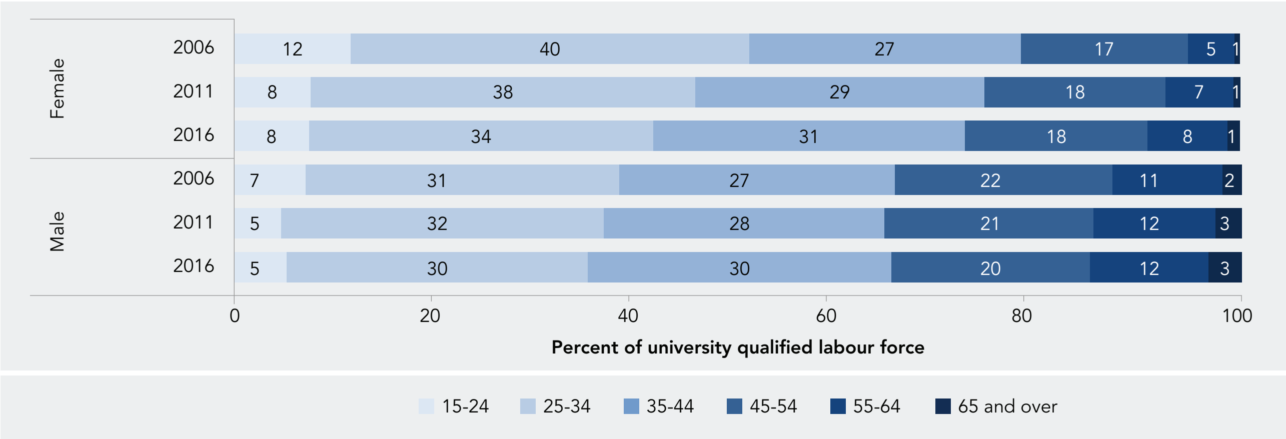


Figure 15.6: Age distribution of labour force with university STEM qualifications, by gender and year. Data labels show the percentage of the population in each age group



How many STEM qualified females speak a language other than English at home?

In 2016, just over one-fifth (21%) of females in the labour force with VET STEM qualifications spoke a language other than English at home (Figure 15.7). Across all STEM fields, a greater proportion of VET qualified females compared to males spoke a language other than English at home, with this difference largest amongst those with Engineering qualifications. For males and females, speaking a language other than English was most common amongst the Information Technology qualified labour force.

In 2016, nearly half (45%) of females in the labour force with university STEM qualifications spoke a language other than English at home (Figure 15.8). Across most STEM fields, a greater proportion of university qualified females compared to males spoke a language other than English at home, with the exception of the Agriculture and Environmental Science qualified labour force, where a greater proportion of males (20%) compared to females (18%) spoke a language other than English at home. Speaking a language other than English was most common amongst the Information Technology qualified labour force, for males and females.

Figure 15.7: Percent of VET qualified labour force who spoke a language other than English at home, by field and gender[32]

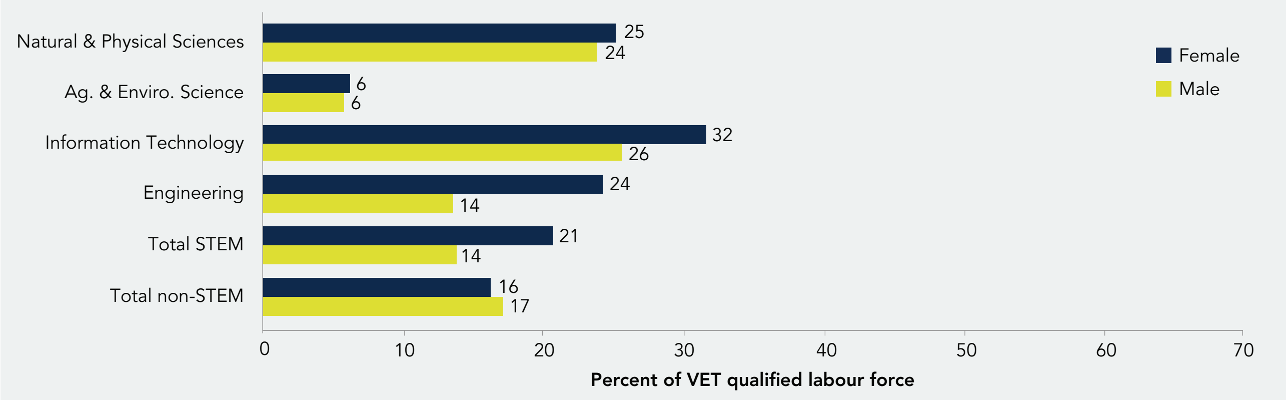
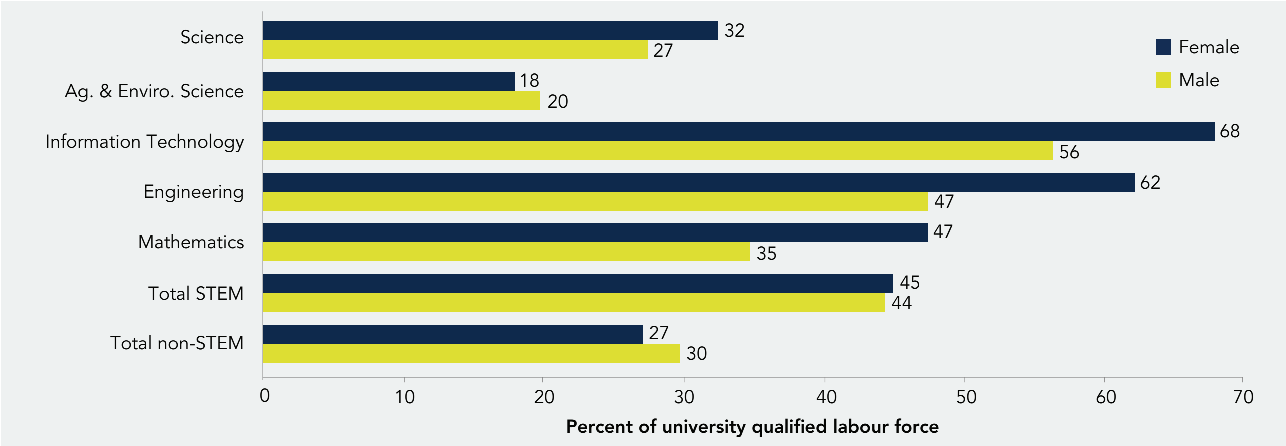


Figure 15.8: Percent of university qualified labour force who spoke a language other than English at home, by field and gender



32 Due to the small number of females with VET qualifications in Mathematics (628), this field has been combined with Science in the field Natural and Physical Sciences.

How many STEM qualified females were born overseas?

In 2016, nearly one-third (31%) of females in the labour force with VET STEM qualifications were born overseas (Figure 15.9). This proportion has remained relatively stable since 2006, increasing by 1 percentage point over the decade. A similar trend was seen in males with VET STEM qualifications, of which the proportion born overseas was 24% in both 2006 and 2016.

In 2016, over half (56%) of females in the labour force with university STEM qualifications were born overseas (Figure 15.10), an increase of 11 percentage points since 2006. The proportion of males in the labour force with university STEM qualifications who were born overseas increased by a similar proportion over the decade, from 46% in 2006 to 56% in 2016.

For context, in 2016, 32% of all males and 30% of all females in the Australian labour force were born overseas, including many people who arrived in Australia in the recent five year period of 2011 to 2016 (data not shown). Of the female STEM qualified labour force who were born overseas, 15% (4 325) of the VET qualified labour force and 30% (35 400) of the university qualified STEM labour force arrived in Australia between 2011 and 2016 (data not shown). Of the male STEM qualified labour force who were born overseas, 14% (34 339) of the VET qualified and 28% (80 358) of the university qualified STEM labour force arrived in Australia between 2011 and 2016 (data not shown).

Figure 15.9: Percent of VET qualified labour force born overseas, by gender, year and field of qualification

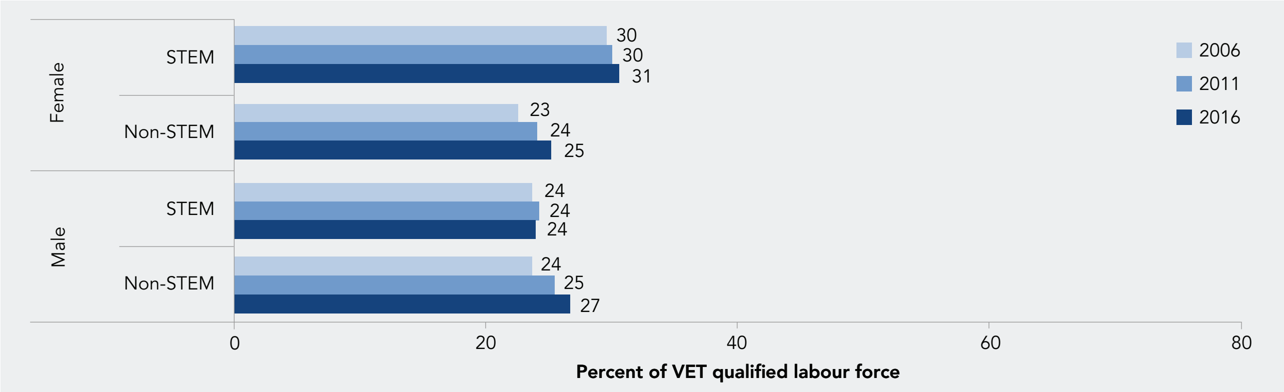
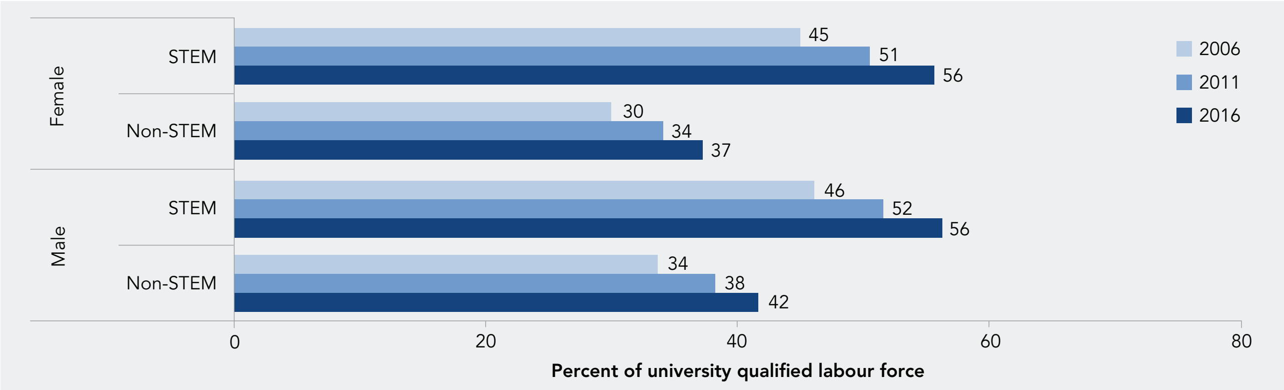


Figure 15.10: Percent of university qualified labour force born overseas, by gender, year and field of qualification



What are the unemployment rates of STEM qualified females born overseas?

In general, people who arrived in Australia between 2006 and 2016 had higher unemployment rates than those who were born in Australia or had lived in the country for over a decade.

Among the female population with VET STEM qualifications, females who were born in Australia had an unemployment rate of 7.1%, females born overseas who arrived prior to 2006 had a slightly lower unemployment rate of 6.5%, and females born overseas who arrived between 2006 and 2016 had the highest unemployment rate of 13.2% (Figure 15.11). This pattern did not hold true for males with VET STEM qualifications, where the highest unemployment rate (6.0%) occurred among those who were born overseas and arrived in Australia between 2006 and 2016, and the lowest (4.6%) among those born in Australia.

Females with VET STEM qualifications had higher unemployment rates than those in non-STEM fields regardless of whether they were born in Australia or not; conversely, STEM qualified males with VET qualifications had lower unemployment rates than males qualified in non-STEM fields.

Among the female population with university STEM qualifications, females who were born in Australia had an unemployment rate of 3.3%, while females born overseas who arrived prior to 2006 had a higher unemployment rate of 5.0%, and females born overseas who arrived between 2006 and 2016 had the highest unemployment rate of 14.1% (Figure 15.12).

Figure 15.11: Unemployment rate of people with VET qualifications, by gender, field, and date of arrival in Australia

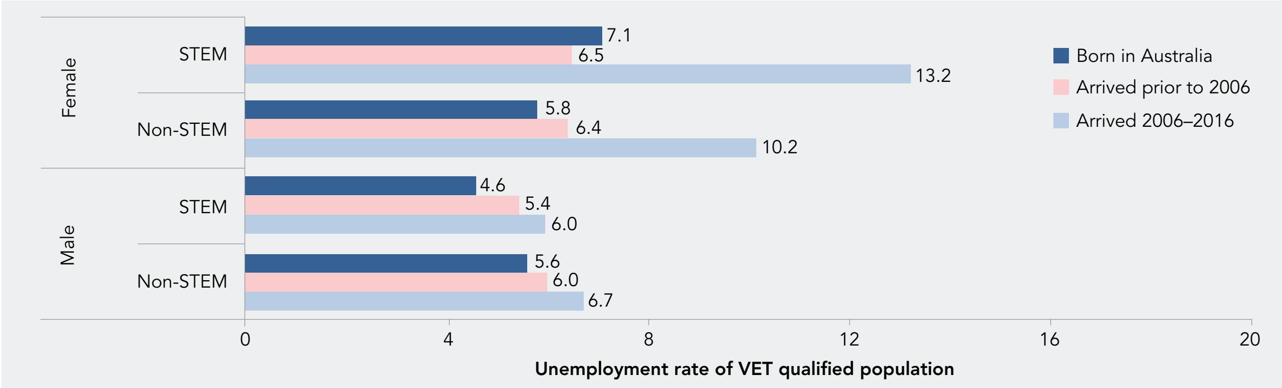
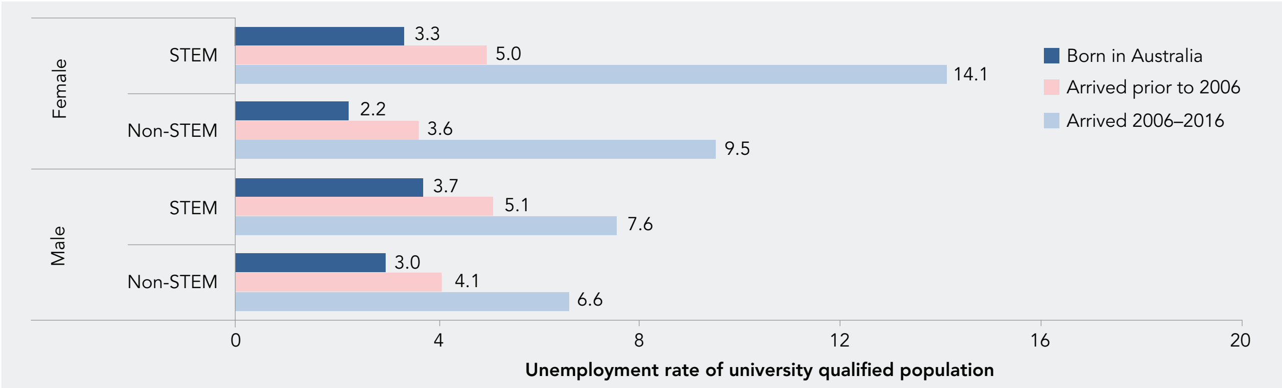


Figure 15.12: Unemployment rate of people with university qualifications, by gender, field, and date of arrival in Australia



This pattern of unemployment also held true for males; among males with university STEM qualifications, the lowest unemployment rate (3.7%) occurred among those born in Australia, while the highest unemployment rate (7.6%) occurred among males born overseas who arrived in Australia between 2006 and 2016.

Both males and females with university STEM qualifications had higher unemployment rates than those with university qualifications in non-STEM fields, regardless of whether they were born in Australia or not.

Income

As shown in Chapter 3 of this report, people with STEM qualifications tended to have higher incomes than the non-STEM qualified population.

This section takes a closer look at how gender affects income levels.[33]

Do females in STEM earn less than males?

The distributions of income for full-time workers with VET qualifications in 2016 are shown in Figure 15.13. A higher percentage of females than males earned an income in all brackets below $65 000, while a lower percentage of females than males earned an income in all brackets of $65 000 or above.

9% of VET STEM qualified females earned $104 000 or above, compared to 20% of VET STEM qualified males, 17% of VET non-STEM qualified males, and just 6% of VET non-STEM qualified females.

The distributions of income for full-time workers with university qualifications in 2016 are shown in Figure 15.14. A higher percentage of females than males earned an income in all brackets below $104 000, while a lower percentage of females than males earned an income in all brackets of $104 000 or above.

33 Income figures in the Census include both earned and non-earned data, comprising income from salaries, government benefits, pensions, allowances, and any other income the worker usually receives, before deductions.

Figure 15.13: Income distribution of full-time workers with VET qualifications, by field and gender

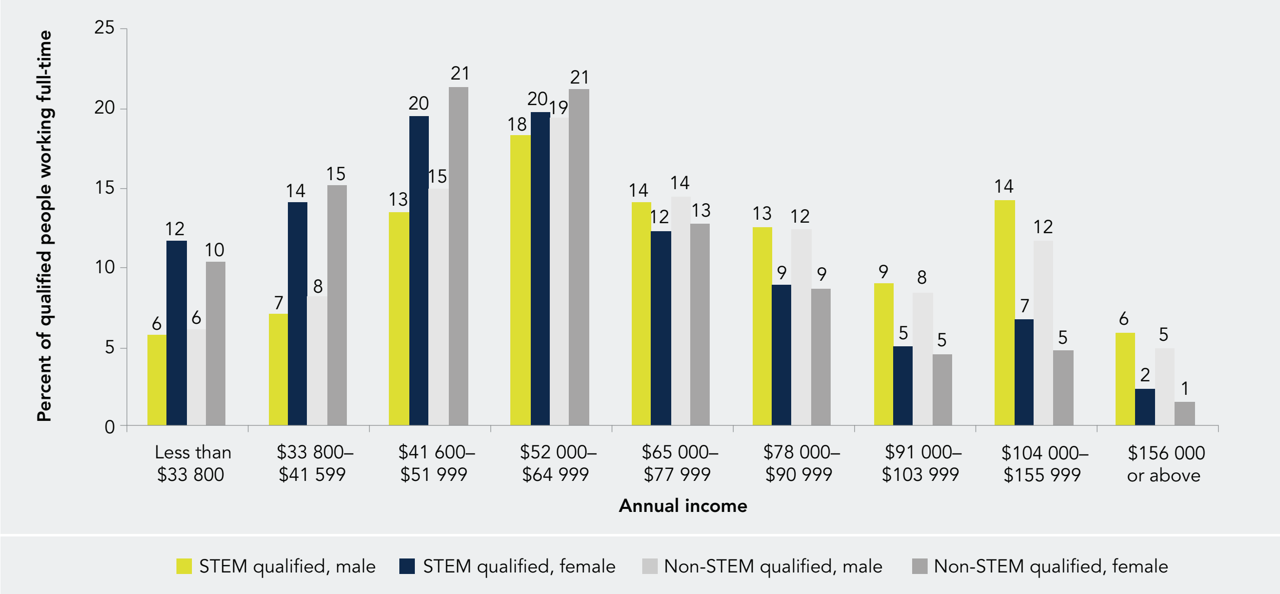
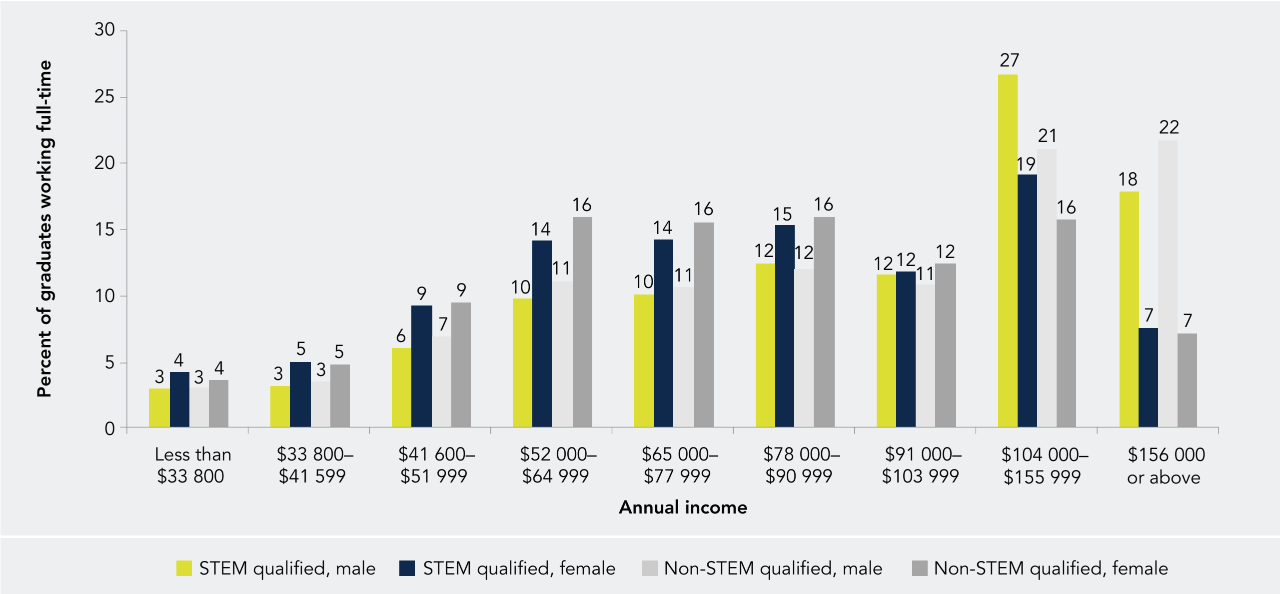


Figure 15.14: Income distribution of full-time workers with university qualifications, by field and gender



26% of university STEM qualified females earned $104 000 or above, compared to 45% of university STEM qualified males, 43% of university non-STEM qualified males and 23% of university non-STEM qualified females.

Although these distributions show that STEM qualified females working full-time had lower incomes than males working full-time across the board, there was not a substantial difference between the inequities when comparing STEM and non-STEM fields.

Childcare and flexible work

Caring for children is a leading barrier to labour force participation for females in Australia (Australian Bureau of Statistics 2017a). This section explores how having a child affects labour force status and income, and what proportion of the STEM workforce engages in flexible work.

Flexible work arrangements are often seen as a way for individuals to manage their paid work alongside family commitments. The term 'flexible workplace arrangements' includes flexibility regarding when people work (such as variable start and finish times and compressed working weeks), where they work (such as working from home or somewhere outside their usual workplace), and how they structure their work (such as working part-time and job sharing).

Does having a child interrupt a woman's career?

Having children is associated with decreased labour force participation and lower average incomes for STEM qualified females. Conversely, the labour force participation of STEM qualified males appears to remain largely unaffected by the birth of a child, and males with children tend to earn more than males without children.

The Census Longitudinal Dataset was used to investigate the impact that having a child can have on employment status.[34] This dataset estimates that, in 2011, there were approximately 11 400 females with VET STEM qualifications working full-time aged 15 to 34 who had not given birth.[35] By 2016, 32% of these females had given birth to one or more children, while 68% had not. Figure 15.15 shows the employment pathways of these cohorts. Of the females that were working full-time in 2011 and had a child between 2011 and 2016, 20% were working full-time in 2016. A further 38% were working part time, 9% were away from work, and nearly one-third (30%) were not in the labour force. Of those who were working full-time in 2011 and did not have a child between 2011 and 2016, the majority (72%) were still working full-time in 2016, 16% worked part time, 4% were away from work, and 3% were not in the labour force.

This dataset estimates that in 2011, there were approximately 42 100 females with university STEM qualifications working full-time aged 15 to 34 who had not given birth. By 2016, 45% of these females had given birth to one or more children, while 55% had not. Figure 15.16 shows the employment pathways of these cohorts. Of the females who were working full-time in 2011 and had a child between 2011 and 2016, 34% were working full-time in 2016. A further 28% were working part-time, 16% were away from work, and nearly one-fifth (19%) were not in the labour force. Of those who were working full-time in 2011 and did not have a child between 2011 and 2016, the majority (80%) were still working full-time in 2016, 9% worked part-time, 3% were away from work, and 4% were not in the labour force.

34 The Census Longitudinal Dataset uses data from the three most recent Censuses to look at how Australian society is changing over time. The 2011-2016 Census Longitudinal Dataset brings together a representative 5% sample from the 2011 Census with corresponding records from the 2016 Census. The data presented in this analysis is based on population estimates, unlike the reporting of normal Census data which provides an actual count of the population on Census day.

35 This age bracket was chosen to capture females of typical childbearing age. The Census collects data on the number of children ever born (live births) for each female, and this data was analysed along with field of qualification, age, and labour force status. This data does not include adopted, step-children or fostered children, and does not indicate if those children are currently living.

The Census does not collect data on the number of children fathered by males. While there are other Census indicators to identify men with children, none are directly equivalent to the one used in Figure 15.15 and Figure 15.16 to examine the pathways of women with children. To present an overall comparison, the employment trajectories for males with STEM qualifications who were working full-time in 2011 and aged 15 to 34 was investigated, with analysis showing that the employment pathways of these males were similar to those of females without children (data not shown). In 2011, there were approximately 280 800 males with VET STEM qualifications in this age bracket who were working full-time, of whom 94% were employed and 84% were still working full-time in 2016. In 2011, there were approximately 152 000 males with university STEM qualifications who were working full-time, of whom 95% were employed and 88% were still working full-time in 2016.

Figure 15.15: Employment pathways for females with VET STEM qualifications aged 15 to 35, by whether or not they had a child between 2011 and 2016[36]

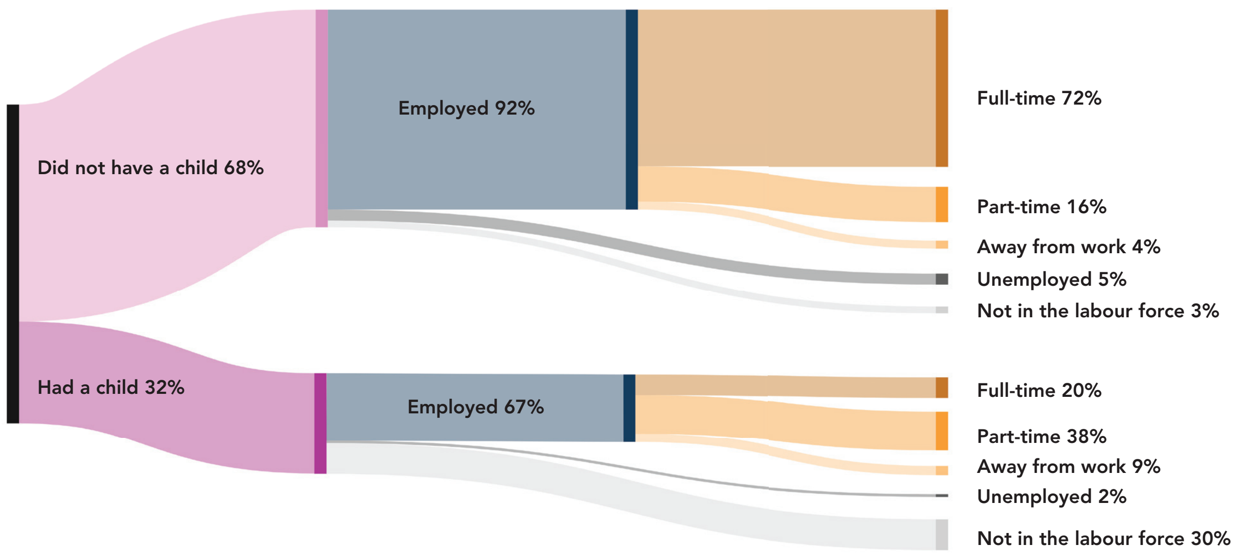
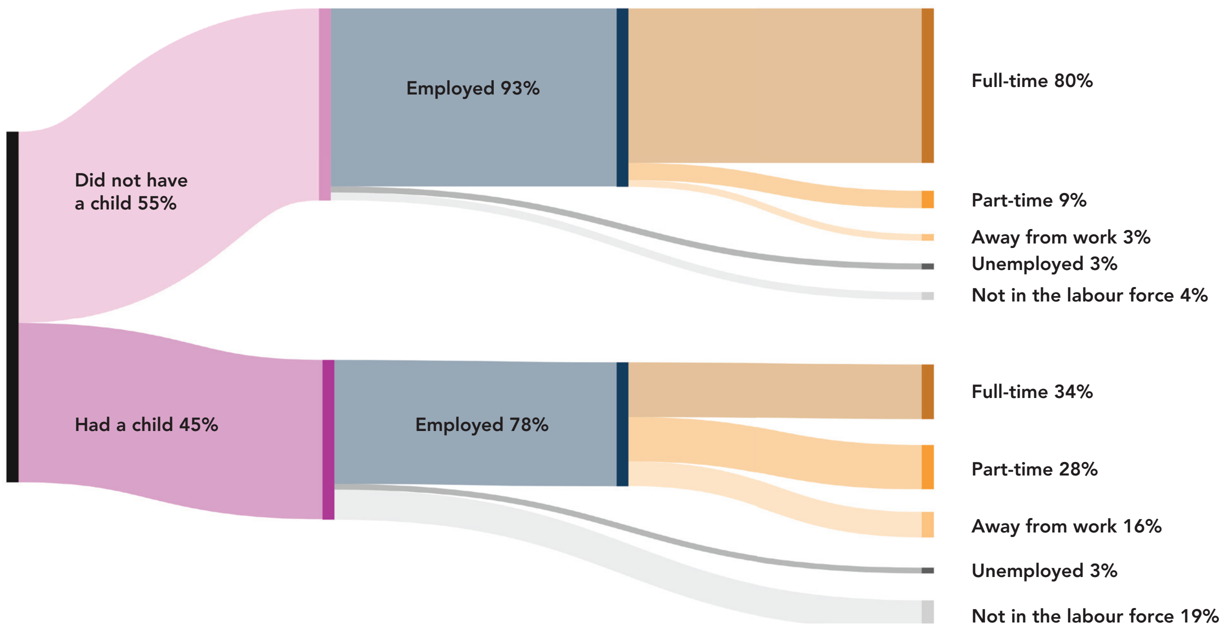


Figure 15.16: Employment pathways for females with university STEM qualifications aged 15 to 35, by whether or not they had a child between 2011 and 2016[37]



36 Data for this figure was sourced from the Australian Census Longitudinal Dataset, 2011–2016.

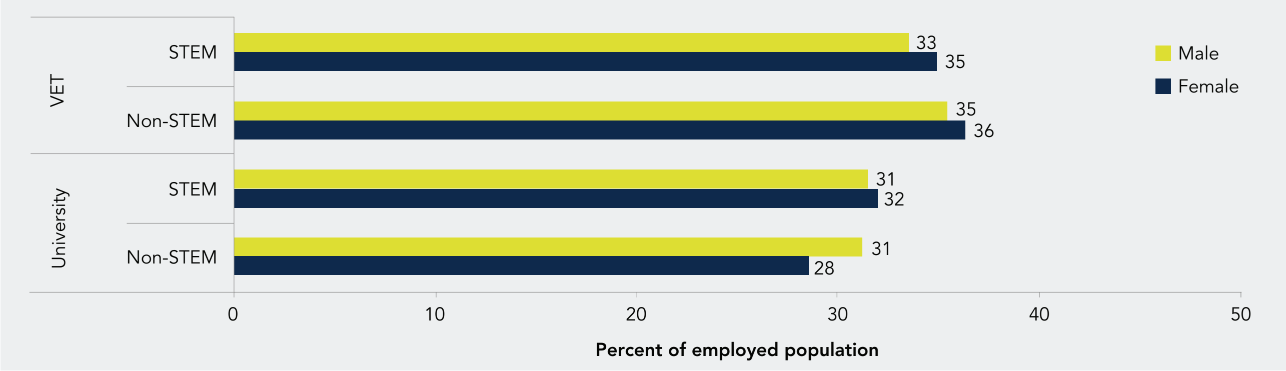
37 Ibid.

How many employed STEM qualified females look after children?

Figure 15.17 shows the percentage of the employed STEM and non-STEM qualified population who provided unpaid childcare to their own child or children in 2016.[38] Of those with VET STEM qualifications, a lower percentage of females (28%) than males (31%) provided unpaid childcare. For those with VET non-STEM qualifications, a similar percentage of females (32%) and males (31%) provided unpaid childcare.

Of the population with university qualifications, similar percentages of STEM qualified females (36%) and males (35%) and non-STEM qualified females (35%) and males (33%) provided unpaid childcare.

Figure 15.17: Percent of employed population that provided unpaid childcare, by gender and field



How does looking after children impact income?

Across almost all age brackets and levels of qualification, a smaller percentage of females who provided unpaid childcare to their children[39] had an income of $104 000 or above, compared to females who did not provide unpaid childcare. The opposite was true for males (Figure 15.18 and Figure 15.19).

For females with VET STEM qualifications, those aged 20 to 49 who provided unpaid childcare to their children were less likely to earn $104 000 or above compared to females who did not have childcare responsibilities. In the 50 to 59 age bracket a similar percentage of females who did and did not provide childcare earned $104 000 or above. For VET STEM qualified males, a greater percentage of those who provided childcare earned $104 000 or above compared to males who did not provide childcare across all age brackets.

38 This includes people who were employed on a full- or part-time basis and who reported spending time caring for their own child, or caring for their own child as well as other children. It is the best indicator in the Census dataset of which adults have children and spend time looking after them.

39 Ibid.

For females with university STEM qualifications, those who provided unpaid childcare to their children were less likely to earn $104 000 or above compared to females who did not have childcare responsibilities. This trend was apparent across most age brackets analysed. For university STEM qualified males, a greater percentage of those who provided childcare earned $104 000 or above compared to males who did not provide childcare across all age brackets.

Figure 15.18 and Figure 15.19 analyse all people who earned an income, including both full-time and part-time workers. The lower income for females with childcare responsibilities can be largely attributed to their higher tendency to take on part-time work (see Chapter 3, Figure 3.8). When analysing only full-time workers, the income discrepancy between genders reduced (data not shown). However, STEM qualified males who worked full-time and provided unpaid childcare were more likely to earn an income of $104 000 or above compared to males who worked full-time and did not have childcare responsibilities, at both the VET and university levels of qualification.

Figure 15.18: Percent of VET STEM qualified population who earned $104 000 or above, by age bracket, gender, and childcare responsibilities

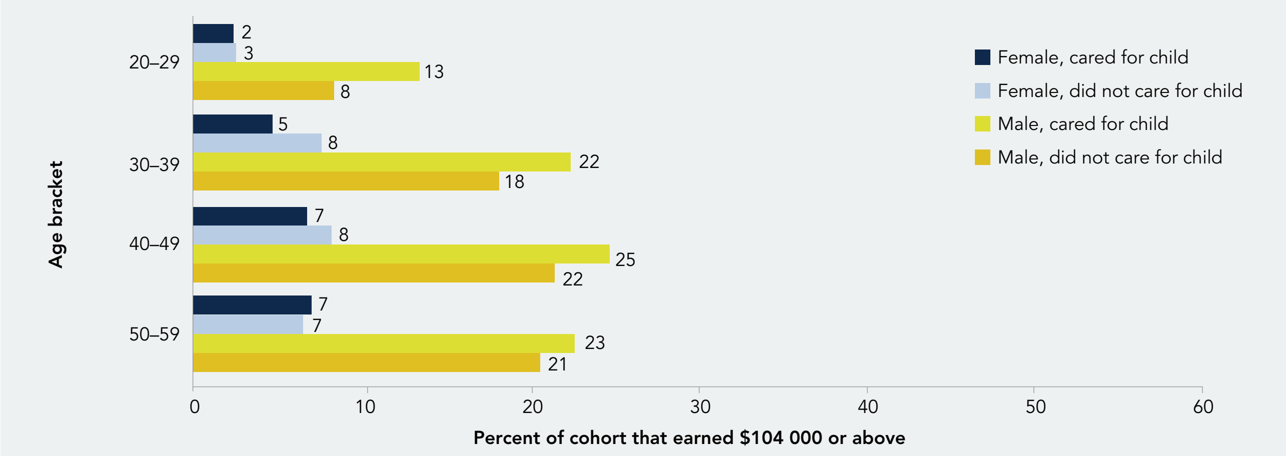
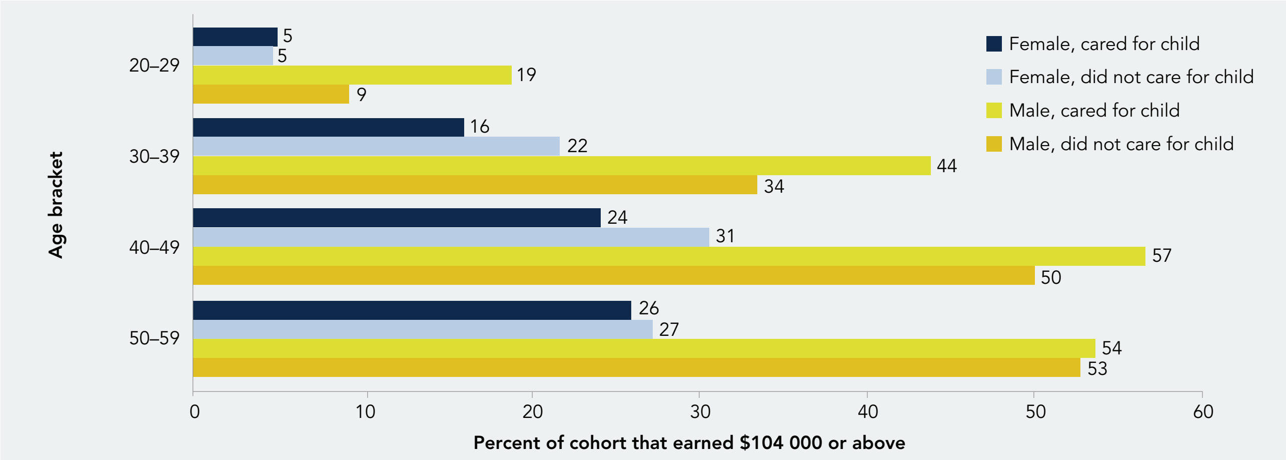


Figure 15.19: Percent of university STEM qualified population who earned $104 000 or above, by age bracket, gender, and childcare responsibilities



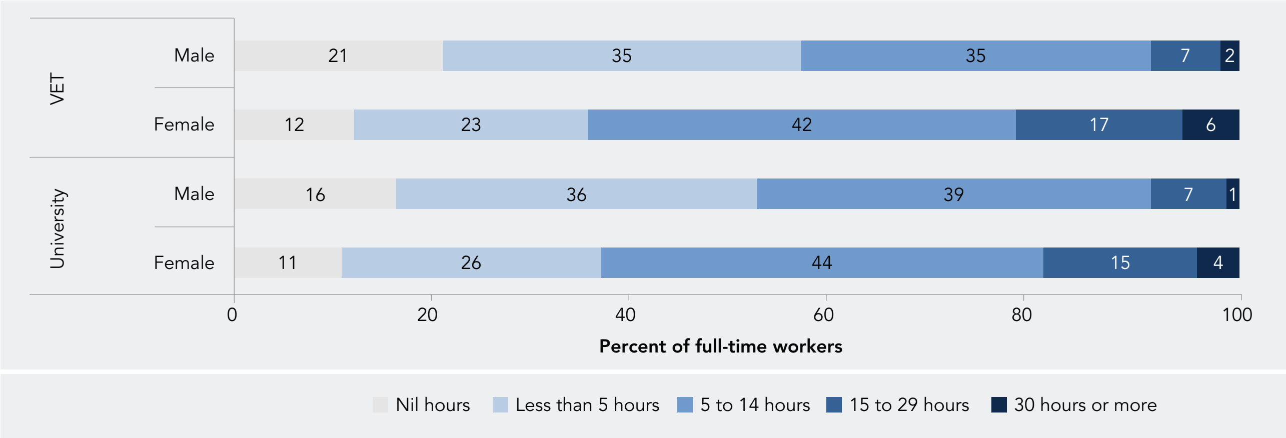
How much unpaid domestic work do STEM qualified females perform each week?

Although similar proportions of STEM qualified males and females had childcare responsibilities (Figure 15.17), females performed more hours of unpaid domestic work[40] each week than males (Figure 15.20).

Among full-time workers with VET STEM qualifications, more than twice the percentage of females (23%) then males (9%) performed 15 hours or more of domestic work per week. Over half (56%) of males performed domestic work for less than five hours per week, compared to just over a third of females (35%).

Among full-time workers with university STEM qualifications, more than twice the percentage of females (19%) than males (8%) performed 15 hours or more of domestic work per week. Over half (52%) of males performed domestic work for less than five hours per week, compared to over a third of females (37%).

Figure 15.20: Number of hours of domestic work performed each week by STEM qualified full-time workers, by gender and level of education



40 Domestic work includes preparing meals, washing, gardening, home and car maintenance, household shopping, managing financial affairs, and any other domestic work performed by an individual for themselves or for their household.

How many STEM qualified people work from home?

Table 15.2 shows the proportion of the employed population who worked from home on the day of the 2016 Census.

Among those with VET STEM qualifications, a higher percentage of females than males worked from home, and more of those working part-time than those working full-time worked from home.

Among those with university STEM qualifications, similar proportions of males and females working full-time worked from home, while slightly more males who worked part-time than females who worked part-time worked from home. A greater proportion of those working part-time than those working full-time worked from home.

Working from home is one flexible practice that may help both males and females balance their paid and unpaid work, however it is not available to all workers, particularly those in roles that require them to work at a specific location. While there are a number of other ways to work flexibly, such as having flexible start and end times, a compressed working week, and job sharing, the Census does not collect data on these.

Table 15.2: Percent of people working full- and part-time who worked from home on Census day, by field and level of education

		Full-time		Part-time	
		Male (%)	Female (%)	Male (%)	Female (%)
VET	STEM	3	6	8	11
	Non-STEM	3	5	7	9
University	STEM	5	5	14	13
	Non-STEM	4	4	13	11

Business ownership and leadership

National and international research has shown that males are more likely to hold senior positions in large organisations compared to females (Chief Executive Women 2018), and that women are underrepresented in legislative, senior official, and managerial roles more generally (World Economic Forum 2017). This section further examines the representation of STEM qualified women in leadership positions in Australia.

HOW MANY STEM QUALIFIED FEMALES ARE IN SENIOR OCCUPATIONS?

Table 15.3 shows the gender distribution of the total employed population, compared to those working as managers and those working as executives, across STEM fields of education.[41] This analysis shows that a lower proportion of females than males worked in these senior occupations.

Among the employed population with VET STEM qualifications, females made up 8% of the total employed population, but only 7% of managers and 3% of executives. The greatest discrepancy across STEM fields occurred in Natural and Physical Sciences, where females made up over half (56%) of the total employed population, but only 37% of managers and 21% of executives. The field of Engineering had the lowest representation of VET qualified females in senior occupations, with females making up 3% of managers and 1% of executives. Among the non-STEM VET qualified population, females made up over half (57%) of the total employed population in 2016, but only 43% of managers and less than a third (31%) of executives.

Among the employed population with university STEM qualifications, females made up 28% of the total employed population, but only 22% of managers and 13% of executives. The greatest discrepancy across STEM fields occurred in Science, where females made up almost half (49%) of the total employed population, but only 39% of managers and 24% of executives. The field of Engineering had the lowest representation of university qualified females in senior occupations, with females making up 11% of managers and 6% of executives. Among the non-STEM university qualified population, females made up nearly two-thirds (61%) of the total employed population, but slightly under half (48%) of managers and slightly less than a third (32%) of executives.

There has been a small increase in the proportion of females in management positions across both levels of education since 2006 (data not shown). In 2006, among the VET qualified population, females made up 8% of the total STEM qualified employed population, 6% of managers and 2% of executives. Among the university qualified population, in 2006, females made up 27% of the total employed population, 18% of managers and 9% of executives.

Table 15.3: Gender distribution of total employed population, managers, and executives, by field, 2016

	VET		
	Total Employed (% female)	Managers (% female)	Executives (% female)
Natural and Physical Sciences*	56	37	21
Ag. and Enviro. Science	21	14	11
Information Technology	19	16	12
Engineering	4	3	1
Total STEM	8	7	3
Total non-STEM	57	43	31
	University		
	Total Employed (% female)	**Managers (% female)**	**Executives (% female)**
Science	49	39	24
Ag. and Enviro. Science	42	30	19
Information Technology	22	19	12
Engineering	15	11	6
Mathematics	39	35	21
Total STEM	28	22	13
Total non-STEM	61	48	32

* Due to the small number of females with VET qualifications in Mathematics (628), this field has been combined with Science in the field Natural and Physical Sciences.

41 Managers refers to those in the occupation major group of 'Managers', and executives refer to those in the occupation minor group of 'Chief Executives, General Managers and Legislators'. The term 'senior occupations' refers to both of these groups.

Do females in senior occupations earn the same as males in senior occupations?

In 2016, a lower proportion of STEM qualified females than STEM qualified males had an income of $104 000 or above, across all levels of occupation.

Figure 15.21 shows that among the VET qualified population who worked full-time, the proportion of STEM qualified people who earned $104 000 or above increased with increasing seniority of occupation (from all workers, to managers, to executives[42]). A smaller proportion of women earned $104 000 or above compared to men in all three occupation groups, and this gap between female and male earnings increased with increasing seniority.

Figure 15.22 shows that among the university qualified population who worked full-time, the proportion of STEM qualified people who earned $104 000 or above increased with increasing seniority of occupation (from all workers, to managers, to executives). A smaller proportion of women earned $104 000 or above compared to men in all three occupation groups, but this gap between female and male earnings decreased with increasing seniority.

Figure 15.21: Percent of employed VET qualified population who earned $104 000 or above, by occupation, gender and field of qualification

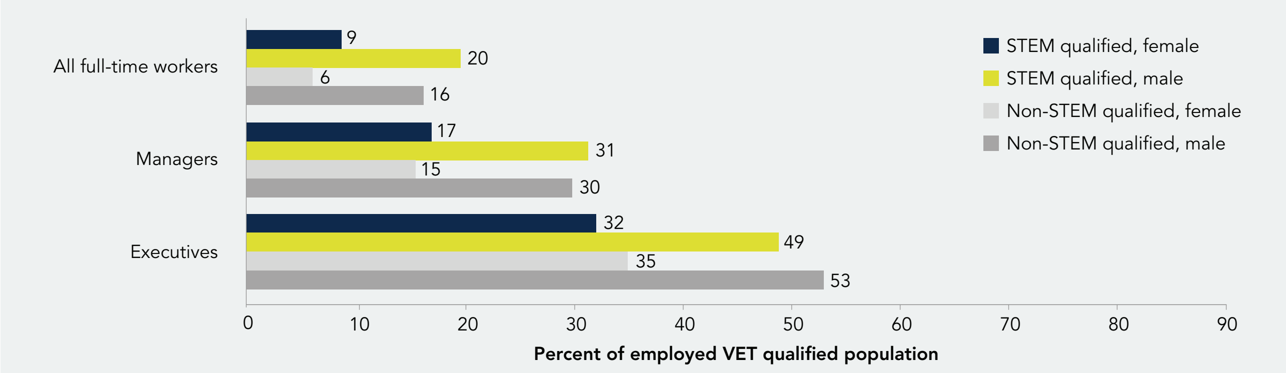
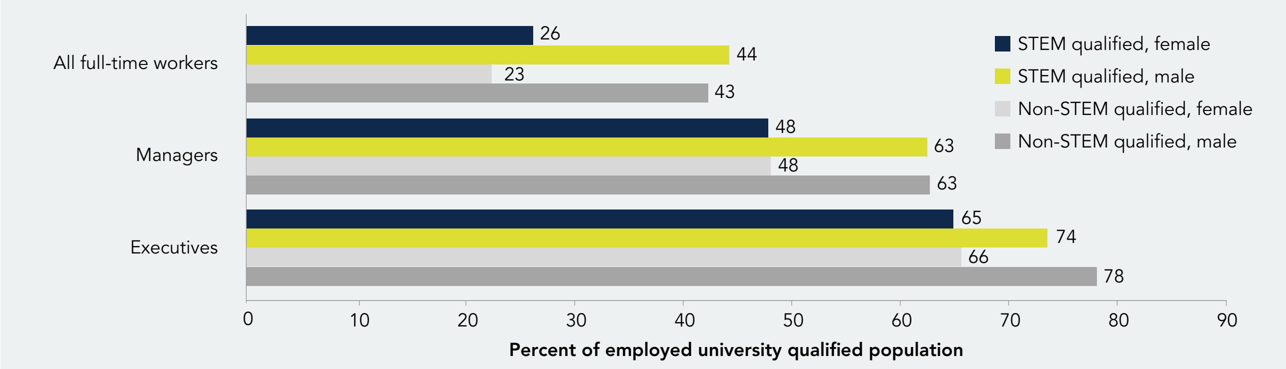


Figure 15.22: Percent of employed university qualified population who earned $104 000 or above, by occupation, gender and field of qualification



42 Managers refers to those in the occupation major group of 'Managers', and executives refer to those in the occupation minor group of 'Chief Executives, General Managers and Legislators'.

Does the rate of business ownership differ across genders?

A lower proportion of STEM qualified females owned a business that employed people compared to STEM qualified males, at all levels of education.

Among those with VET qualifications, 4% of employed STEM qualified females worked as owner-managers (and can be considered as owning a business) and employed at least one person, compared to 8% of employed STEM qualified males (Figure 15.23). Across STEM fields, people with VET qualifications in Agriculture and Environmental Science reported the highest rates of business ownership, at 6% of females and 12% of males.

Among those with university qualifications, 3% of employed STEM qualified females worked as owner-managers (and can be considered as owning a business) and employed at least one person, compared to 6% of employed STEM qualified males (Figure 15.24). For females, those with qualifications in Agriculture and Environmental Science and Mathematics reported the equally highest rates of business ownership, at 4% of each cohort. For males, those with university qualifications in Agriculture and Environmental Science reported the highest rates of business ownership across the STEM fields, at 9%.

Figure 15.23: Percent of employed VET qualified population who owned a business[43], by gender and field of education[44]

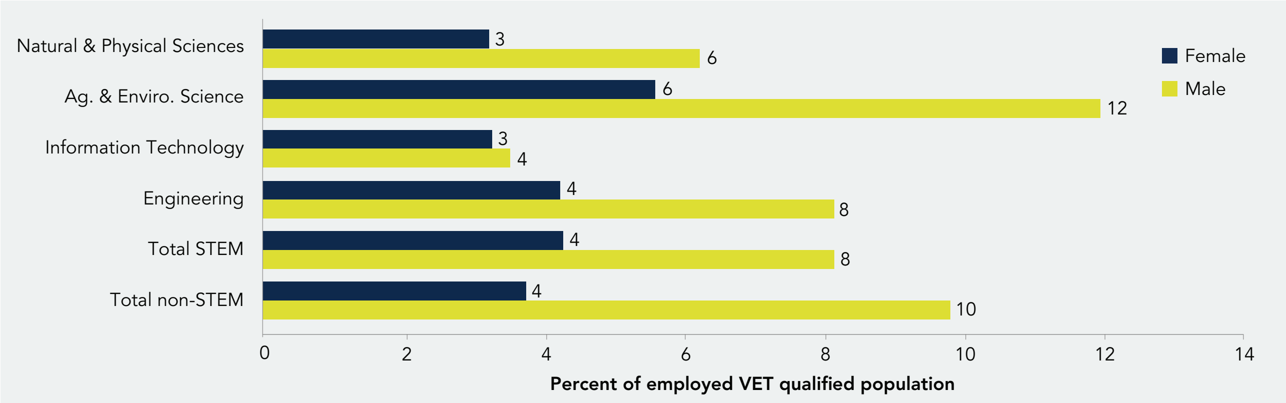
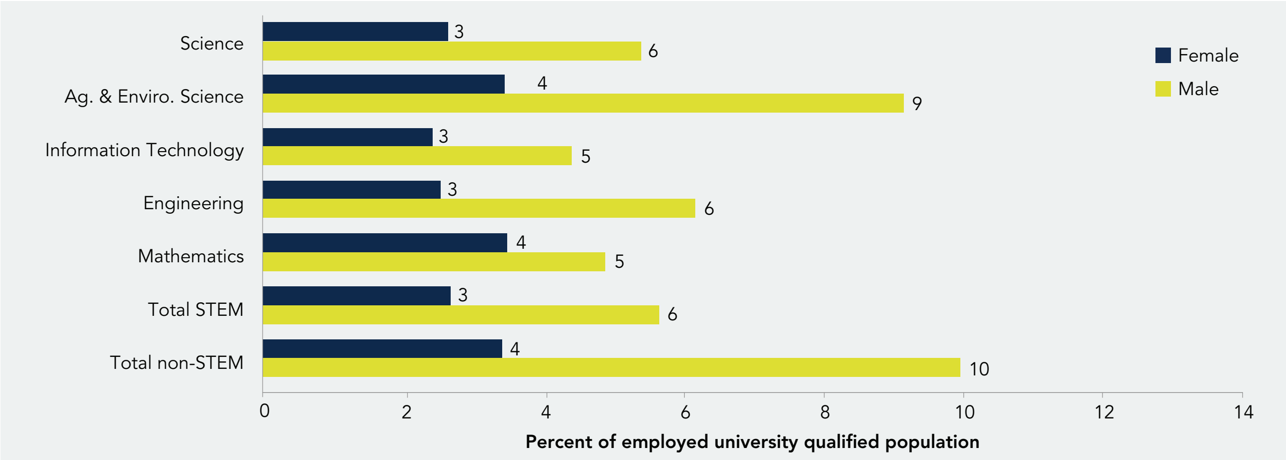


Figure 15.24: Percent of employed university qualified population who owned a business[45], by gender and field of education



43 Only business owners who employed one or more people were included in this analysis.

44 Due to the small number of females (628) with VET qualifications in Mathematics, this field has been combined with Science in the field Natural and Physical Sciences.

45 Only business owners who employed one or more people were included in this analysis.

Mature aged women

Australia's ageing population and growing life expectancy projections are placing increasing demands on labour force participation for older Australians (Australian Human Rights Commission 2016; Commonwealth of Australia 2015). In 2016, the Australian Human Rights Commission found that mature aged women may face particular societal barriers to employment that are not as common for their male counterparts, such as a perceived lack of relevant skills and limited ability to acquire new skills (Australian Human Rights Commission 2016).

The term 'mature aged women' used here refers to females aged 55 and over, consistent with the definition used by the Australian Human Rights Commission (2016).

What proportion of the STEM qualified labour force is aged 55 and over?

In 2016, among those in the labour force with VET STEM qualifications, 18% of females and 23% of males were aged 55 and over (Figure 15.25). These proportions have increased over time. In 2006, 10% of the female VET STEM qualified labour force and 17% of the male VET STEM qualified labour force were aged 55 or over (data not shown).

Among those in the labour force with university STEM qualifications, 9% of females and 15% of males were aged 55 and over (Figure 15.25). These proportions have also increased over time. In 2006, 5% of the female university STEM qualified labour force and 13% of the male university STEM qualified labour force were aged 55 and over (data not shown).

How does labour force participation change with age?

Table 15.4 shows the trend of decreasing labour force participation with increasing age. Among the population with VET STEM qualifications in 2016, 70% of females aged 55 to 59 were in the labour force, which dropped to just over half (52%) of females aged 60 to 64 and around only a tenth (11%) of females aged 65 and over. Among similarly qualified males, 85% of those aged 55 to 59, 67% of those aged 60 to 64 and 17% of those aged 65 and over were in the labour force in 2016.

Among the population with university STEM qualifications in 2016, over three-quarters (77%) of females aged 55 to 59, 57% of females aged 60 to 64 and 20% of females aged 65 and over were in the labour force. Amongst similarly qualified males, 87% of those aged 55 to 59, 68% of those aged 60 to 64 and over a quarter (26%) of those aged 65 and over were in the labour force.

Figure 15.25: Percent of STEM qualified labour force aged 55 and over in 2016, by gender and level of qualification

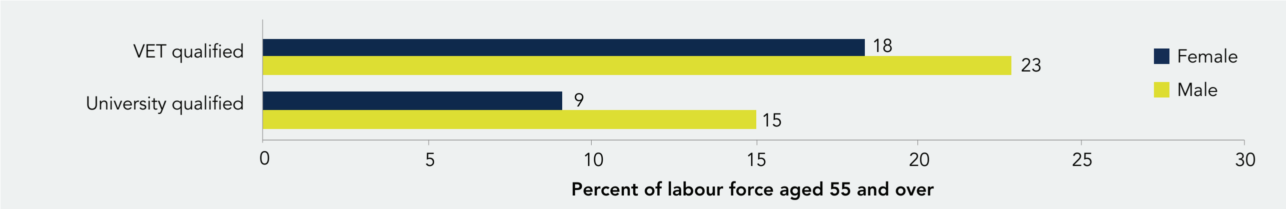


Table 15.4: Labour force participation rates of mature aged people with STEM qualification, by age, gender and level of education

	VET		University	
Age	Male (% in labour force)	Female (% in labour force)	Male (% in labour force)	Female (% in labour force)
55–59	85	70	87	77
60–64	67	52	68	57
65 and over	17	11	26	20

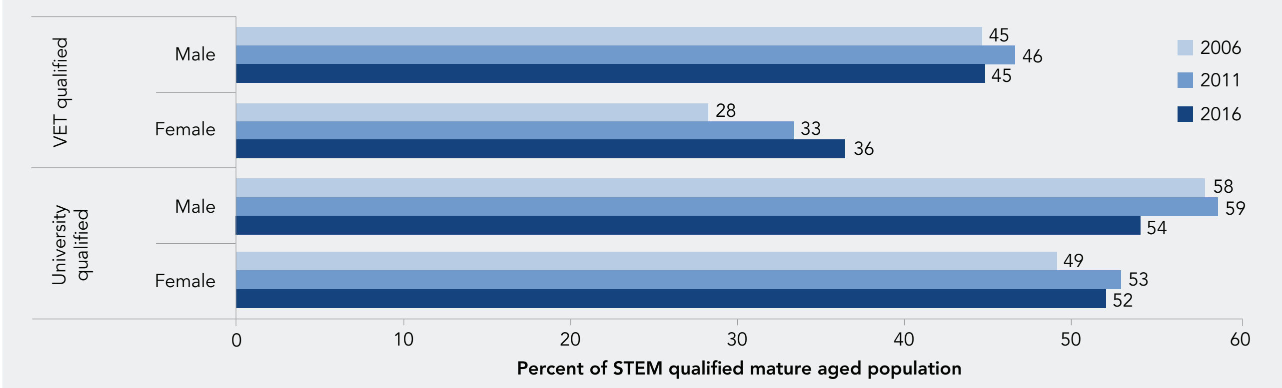
How has the labour force participation rate for mature aged females changed over time?

Mature aged females are increasingly likely to be in the labour force. Figure 15.26 shows the proportion of mature aged females and males with STEM qualifications who were in the labour force in 2006, 2011 and 2016.

Of the mature aged population with VET STEM qualifications, 28% of females were in the labour force in 2006, a proportion that rose considerably to 36% in 2016. The proportion of mature aged males who were in the labour force was 45% in 2006 and in 2016.

Of the mature aged population with university STEM qualifications, 49% of females were in the labour force in 2006, a proportion that rose to 52% in 2016. In contrast, the proportion of mature aged males who were in the labour force reduced from 58% in 2006 to 54% in 2016.

Figure 15.26: Proportion of STEM qualified mature aged people in the labour force, 2006, 2011 and 2016



CHAPTER 16

16

YOUNG PEOPLE IN STEM

HIGHLIGHTS

- In 2016, there were 245 088 young people (aged 15 to 29) with VET STEM qualifications and 177 000 young people with university STEM qualifications in Australia.
- Young people made up 19% of the STEM qualified labour force at both the VET and university levels of qualification.
- Young people with STEM qualifications had a higher unemployment rate than those aged 30 and over across all STEM fields and levels of education.
  - For those with VET qualifications, the unemployment rate was 7.7% for young STEM qualified people and 4.5% for those aged 30 and over.
  - For those with university qualifications, the unemployment rate was 9.2% for young STEM qualified people and 4.9% for those aged 30 and over.
- The proportion of employed STEM qualified young people working full-time has decreased, from 82% in 2006 to 79% in 2016 for those with VET qualifications, and from 76% in 2006 to 67% in 2016 for those with university qualifications. These reductions were especially pronounced for those with Science qualifications, where the proportion of employed young people working full-time decreased across the decade from 64% to 50% for those with VET qualifications, and from 66% to 54% for those with university qualifications.
- Many young people with STEM qualifications were engaged in further study. Almost one-fifth (18%) of young people with VET qualifications and over one-third (36%) of young people with university qualifications were undertaking further study in 2016. Further study was most common among those with qualifications in Science and Mathematics.

For those with VET qualifications:

- Young people made up 15% of the STEM qualified population.
- Females made up 9% of the young STEM qualified population, compared to 9% of the STEM qualified population aged 30 and over.
- The leading industry of employment for young people was Construction, which employed one-fifth (20%) of the STEM qualified workforce.

For those with university qualifications:

- Young people made up 20% of the STEM qualified population.
- Females made up 36% of the young STEM qualified population, compared to 29% of the STEM qualified population aged 30 and over.
- The leading industry of employment for young people was Professional, Scientific and Technical Services, which employed 22% of the STEM qualified workforce.

Introduction

Young people (aged 15 to 29) face specific challenges in the labour force, such as the transition from education to employment and navigating the changing job market. Globally, young people have experienced a downturn in labour force outcomes over the past decade, including an increase in the rates of unemployment and underemployment, with outcomes poorest for those without tertiary qualifications (OECD 2019). It is important that young people have the necessary skills and education to be productive members of the future workforce. STEM skills are among those that will be in high demand for this future workforce, alongside enterprise skills such as problem solving, creativity, and critical thinking (Foundation for Young Australians 2017).

This chapter takes a look at young people in Australia with STEM qualifications and how the outcomes for this group have changed over the decade to 2016. As this report focuses on people with post-secondary qualifications, young people are defined as those aged 15 to 29 in order to capture the period in which most people complete a post-secondary qualification. This age bracket is used by other domestic and international organisations in their analyses of young people, including the Foundation for Young Australians and the OECD.

Unlike the other focus areas in this report, which concentrate on people who were working or looking for work, this chapter begins by looking at the entire young STEM qualified population and then focuses in on those in the labour force. Beginning the chapter by looking at all young people, regardless of their labour force status, allows for a broader view of young STEM qualified people and their experiences. Young people are less likely than those in older age brackets to be out of the labour force due to retirement—for young people, attending an educational institution is the most commonly reported reason for not being in the labour force (ABS 2013b).

Demographics

How many young people with STEM qualifications are there in Australia?

In 2016, there were 245 088 young people (aged 15 to 29) with VET STEM qualifications in Australia, and 177 000 young people with university STEM qualifications.[46] In 2016, there were 4 652 944 young people in total in Australia.

The average age of young people with VET STEM qualifications was 25, while those with university qualifications had an average age of 26. Nearly three-quarters (73%) of young people with VET STEM qualifications were born in Australia, while less than half (43%) of those with university qualifications were born in Australia.

Table 16.1 shows the number of young people with STEM qualifications in Australia, by field and highest level of qualification. Among young people with VET STEM qualifications, the most common STEM field of qualification was Engineering, representing nearly three-quarters (73%) of the cohort. Information Technology, and Agriculture and Environmental Science were the next most common VET fields, each comprising 12% of the young VET qualified STEM population.

For young people with university qualifications, Engineering was the most common STEM field, representing 39% of the young university qualified STEM population. The next most common field of qualification was Science (31%), followed by Information Technology (22%), Agriculture and Environmental Science (6%), and Mathematics (2%).

Table 16.1: Number of young people (aged 15 to 29) with STEM qualifications, by field and level of qualification

	Science	Ag. & Enviro. Science	Information Technology	Engineering	Mathematics	Total STEM	Total Non-STEM
Doctorate	1 588	84	152	588	100	2 512	2 639
Masters Degree	5 838	1 305	9 727	9 601	628	27 099	88 089
Postgraduate Degree, not further defined	54	9	48	51	4	166	1 602
Graduate Diploma or Graduate Certificate	726	312	556	655	109	2 358	35 639
Bachelor Degree	46 587	8 659	29 092	57 526	3 001	144 865	492 098
University total	**54 793**	**10 369**	**39 575**	**68 421**	**3 842**	**177 000**	**620 067**
Advanced Diploma or Diploma	2 800	3 990	12 491	17 129	123	36 533	223 774
Certificate, not further defined	414	1 804	1 013	3 669	124	7 024	42 972
Certificate III & IV	2 690	19 415	11 589	151 497	42	185 233	423 145
Certificate I & II	176	4 098	4 697	7 296	31	16 298	57 471
VET total	**6 080**	**29 307**	**29 790**	**179 591**	**320**	**245 088**	**747 362**
Level not stated	354	512	691	2 373	38	3 968	18 889
Level inadequately described	787	238	1 917	2 232	66	5 240	15 885

46 There were a further 9 208 STEM qualified young people who did not state or adequately describe their level of qualification. This cohort is displayed in Table 16.1 but excluded from analyses in this chapter.

The distribution of STEM qualifications among young people was slightly different to that seen in people aged 30 and over (Figure 16.1). For those with VET qualifications, a higher percentage of young people than those aged 30 and over held qualifications in Agriculture and Environmental Science and in Information Technology, and a lower percentage than those aged 30 and over held qualifications in Engineering. For those with university qualifications, a higher percentage of young people than those aged 30 and over held qualifications in Science and Engineering, but a lower percentage held qualifications in all other STEM fields.

How has the size of the young STEM qualified population changed over time?

The number of young people with VET STEM qualifications increased by 15% over the decade, from 212 908 in 2006 to 245 088 in 2016, while the number of young people with university qualifications increased by 33%, from 132 608 to 177 000 (data not shown).

In contrast, there was a larger increase in the number of young people with non-STEM qualifications over the same time period. The number of young people with VET non-STEM qualifications increased by 42%, from 528 159 people in 2006 to 747 365 people in 2016. The number of young people with university non-STEM qualifications increased by 62%, from 383 866 to 620 066.

Figure 16.1: Distribution of STEM qualifications, by level of education and age

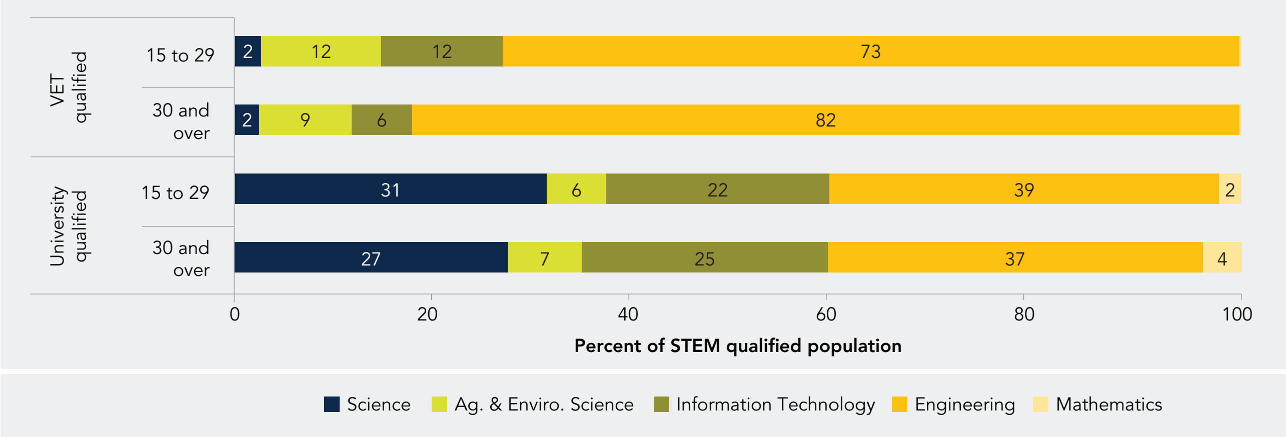


Figure 16.2 and Figure 16.3 examine the growth in the young STEM qualified population in more detail, looking at the field of qualification and corresponding population growths over five year periods. For those with VET qualifications, there was a smaller increase in the young STEM qualified population in the 5 year period 2011 to 2016 than in the previous five year period 2006 to 2011. The field of Engineering had a smaller growth in population size in the most recent five years, while in Agriculture and Environmental Science and Information Technology, the number of qualified young people decreased between 2011 and 2016.

For those with university qualifications, the growth in the young STEM qualified population was stronger in the most recent five year period than in previous years across most fields of education. In the fields of Science, Engineering, and Mathematics, the young population increased by a larger amount in the five years between 2011 and 2016 than in the previous five year period. The number of young people qualified in Information Technology declined in both five year periods. The size of the population of young people with university qualifications in Agriculture and Environmental Science was the same in 2006 and 2016.

Figure 16.2: Percent change in the young VET qualified population, by field and five year period.[47] Data labels indicate the change in the number of qualified people

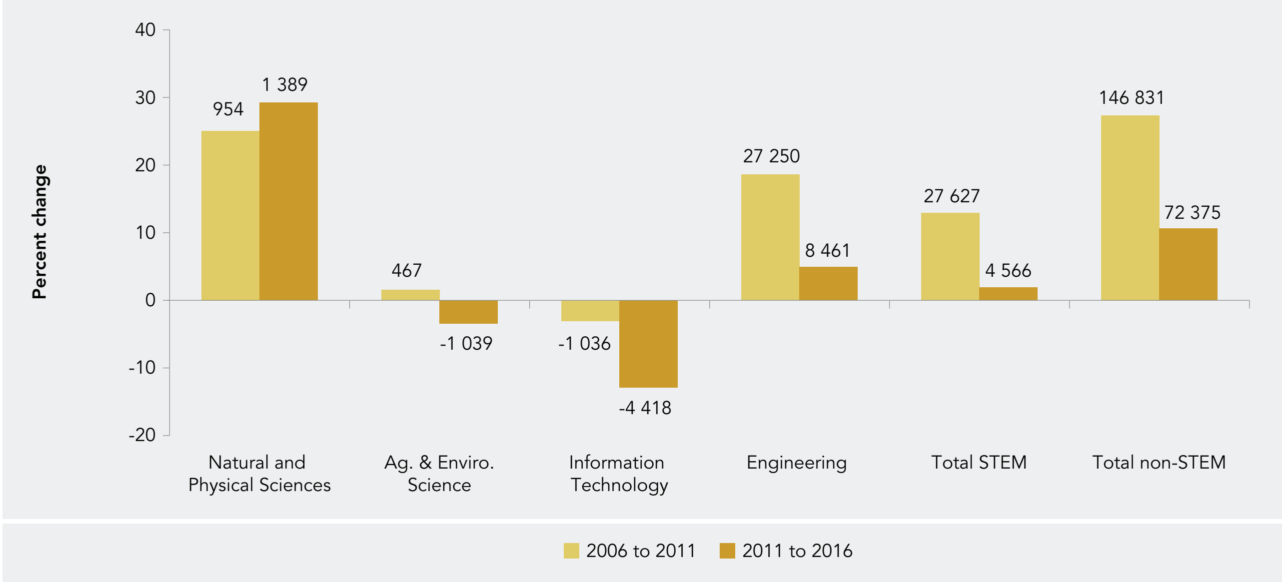
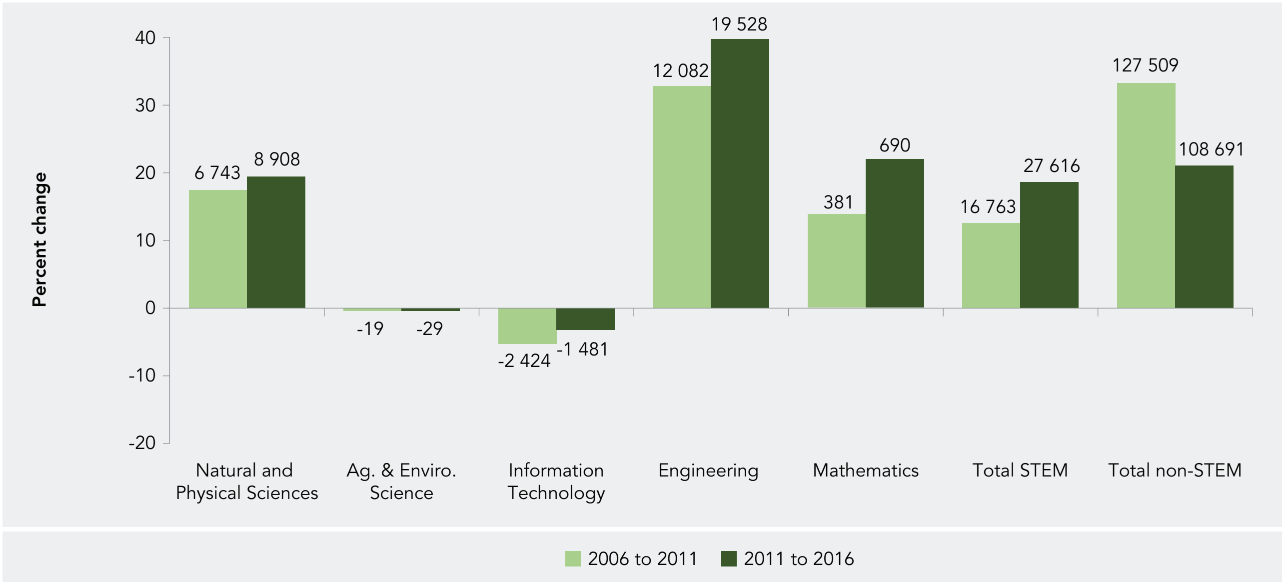


Figure 16.3: Percent change in the young university qualified population, by field and five year period. Data labels indicate the change in the number of qualified people



47 Due to the small number of young people with VET qualifications in Mathematics, this field has been combined with Science to form the field of Natural and Physical Sciences.

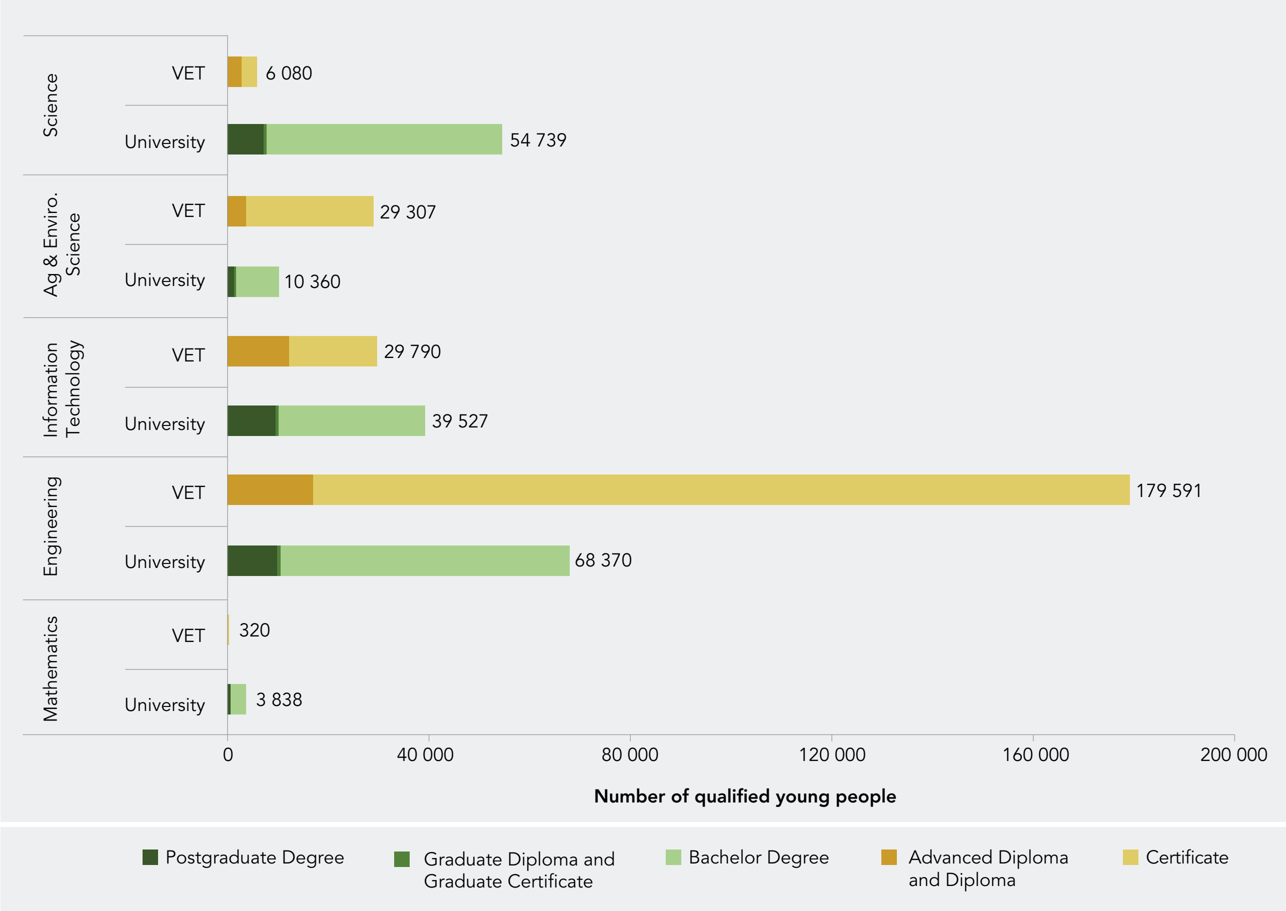
What level are the STEM qualifications held by young people?

Figure 16.4 shows the number of young people with STEM qualifications in 2016. Percentages calculated from these data are discussed in this section.

The majority (85%) of young people with VET STEM qualifications had a certificate I to IV, while the remaining 15% had a diploma or advanced diploma. Certificate qualifications were most common among young people with VET Engineering qualifications, where 90% of the cohort held a certificate, and least common amongst the Science qualified population, where 54% of the cohort held a certificate.

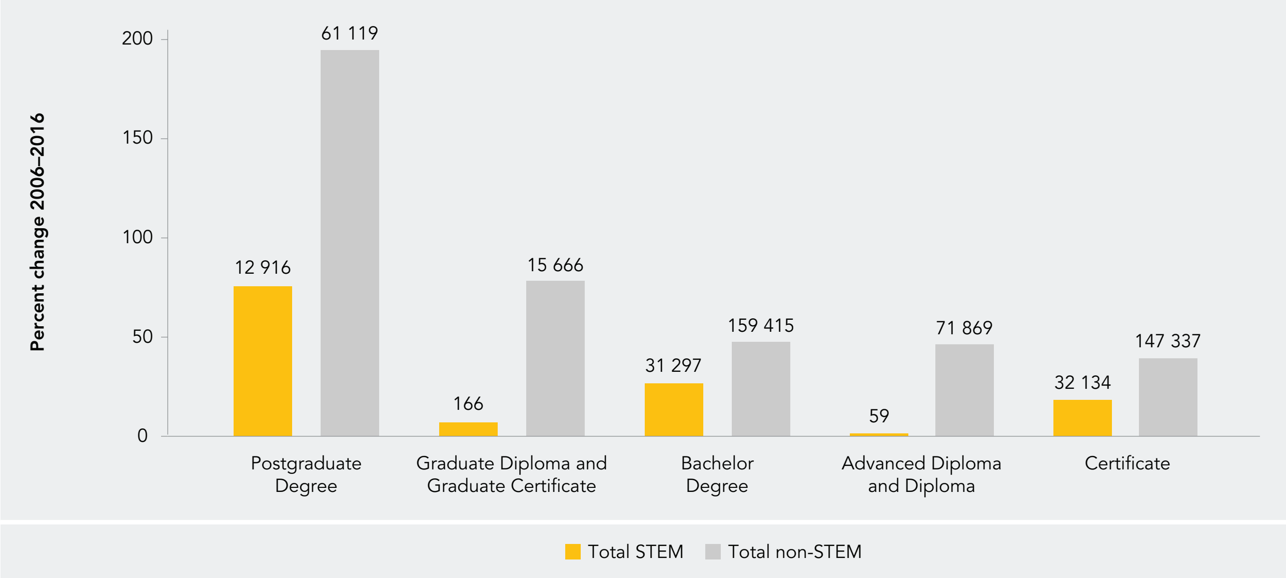
Among young people with university STEM qualifications, the majority (82%) held a bachelor degree, 17% had a postgraduate degree, and just 1% had a graduate diploma or graduate certificate. The distribution of qualifications across individual STEM fields followed a similar pattern, however postgraduate qualifications were more common in the young population with Information Technology qualifications, where a quarter (25%) held a postgraduate degree.

Figure 16.4: Number of young people with STEM qualifications, by level and field. Data labels show the total number of young people in each cohort



In 2016, young people were more likely to have a university qualification and less likely to have a VET qualification than in 2006, across both STEM and non-STEM fields. Figure 16.5 shows the growth in the size of the young STEM and non-STEM qualified populations by level of education. Across all qualification levels, there was a larger percentage increase among the non-STEM qualified population than the STEM qualified population. There was a large growth in the number of people with postgraduate qualifications, with this group increasing by 77% for the STEM qualified population and 196% for those with non-STEM qualifications.

Figure 16.5: Percent change in the number of qualified young people, by field, 2006 to 2016. Data labels show the change in the number of people



Is there a greater proportion of females in the younger STEM cohort than in the cohort aged 30 and over?

Amongst those with VET qualifications, females made up 11% of the young STEM qualified population, compared to 9% of the STEM qualified population aged 30 and over (Figure 16.6). Young females had higher representation across most fields compared to those aged 30 and over, and represented the majority of young people (59%) with qualifications in Science. However, they had considerably lower representation in the field of Information Technology, making up 14% of the young qualified population compared to 27% of those aged 30 and over.

For those with university qualifications, females made up over a third (36%) of the young STEM qualified population, compared to 29% of the STEM qualified population aged 30 and over (Figure 16.7). Young females had higher representation across all STEM fields compared to those aged 30 and over, and represented the majority of young people with qualifications in Science (57%) and Agriculture and Environmental Sciences (57%).

Figure 16.6: Percentage of people with VET STEM qualifications who were female, by field and age[48]

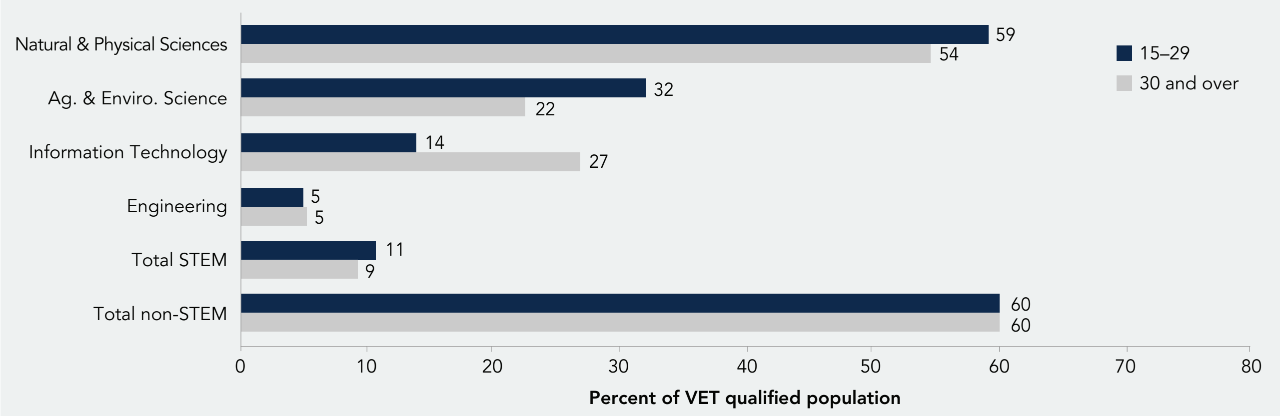
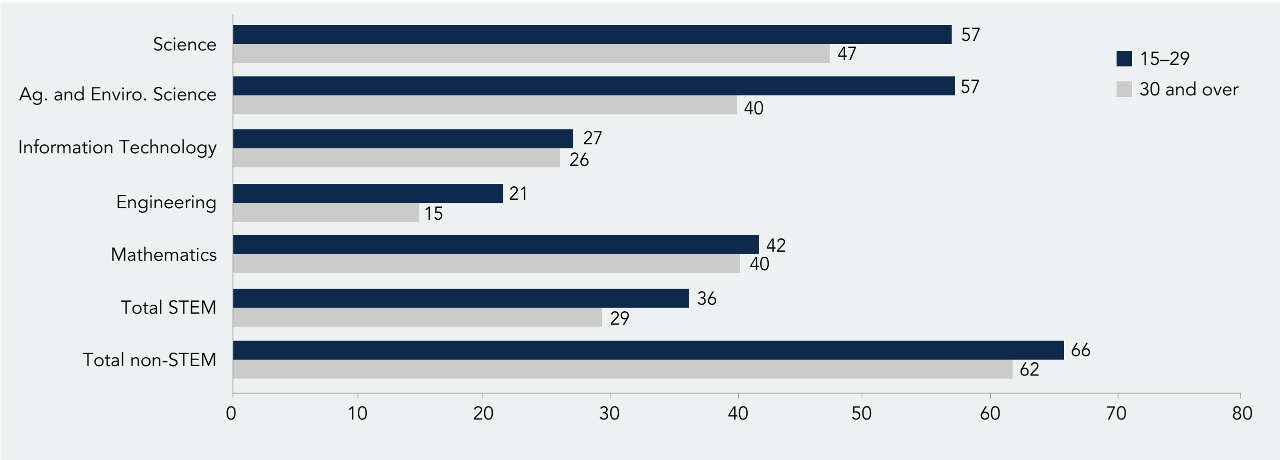


Figure 16.7: Percentage of people with university STEM qualifications who were female, by field and age



48 Due to the small number of young people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

How has the gender distribution of the young STEM qualified population changed over time?

The gender distribution of the young STEM qualified population has not changed substantially since 2006 (Table 16.2). The number of young females with VET STEM qualifications has remained largely unchanged over the decade, with a total net increase of just 207 people.[49] Females made up a slightly larger percentage of the young population with VET qualifications in Agriculture and Environmental Science (from 30% in 2006 to 32% in 2016), but a much lower proportion of the population with qualifications in Information Technology (from 20% in 2006 to 14% in 2016), while the gender split of the population with Science and Mathematics qualifications remained similar over the decade.

For those with university qualifications, females made up just over a third (36%) of the young STEM qualified population in all years analysed, despite the number of young females with STEM qualifications increasing by 16 206 over the decade. By STEM fields, females increased their representation in Information Technology (from 23% of the population in 2006 to 27% in 2016) and also in Agriculture and Environmental Science (from 54% of the population in 2006 to 57% in 2016). The proportion of young people qualified in Science who were female decreased from 61% in 2006 to 57% in 2016, and a similar decrease was seen in the Mathematics population, where females made up 45% of the young population in 2006 and 42% in 2016.

Table 16.2: Number of young females with STEM qualifications, by level of qualification, field and year

	VET Qualified					
	2006 Count	Percent of population	2011 Count	Percent of population	2016 Count	Percent of population
Science	2 242	60	2 772	59	3 659	60
Ag. & Enviro. Science	8 852	30	9 319	31	9 297	32
Information Technology	7 102	20	5 475	16	4 091	14
Engineering	7 338	5	7 869	5	8 632	5
Mathematics	57	37	62	42	119	38
Total STEM	25 591	12	25 497	11	25 798	11
Total non-STEM	334 361	63	411 329	61	447 315	60

	University Qualified					
	2006 Count	Percent of population	2011 Count	Percent of population	2016 Count	Percent of population
Science	23 680	61	26 941	59	31 316	57
Ag. & Enviro. Science	5 567	54	5 624	54	5 940	57
Information Technology	10 170	23	10 159	25	10 673	27
Engineering	7 319	20	10 100	21	14 660	21
Mathematics	1 247	45	1 368	43	1 600	42
Total STEM	47 983	36	54 192	36	64 189	36
Total non-STEM	257 965	67	337 707	66	409 975	66

49 This small increase of 207 people corresponds to a decrease of one percentage point in the proportion of young people with VET qualifications that are female.

How many young people with STEM qualifications were engaged in study?

Among those with VET qualifications, 18% of STEM qualified and 26% of non-STEM qualified young people were engaged in further study[50] in 2016 (Figure 16.8). 8% of STEM qualified young people were studying at a university or other tertiary institution, while 7% were studying at a technical or further education institution. An additional 3% were studying at secondary school or an unspecified institution type. Further study was most common amongst those with Natural and Physical Sciences qualifications, at 49%.

Among those with university qualifications, 36% of STEM qualified and 24% of non-STEM qualified young people were engaged in further study in 2016 (Figure 16.9). 32% of STEM qualified young people were studying at a university or other tertiary institution, while 2% were studying at a technical or further education institution. An additional 2% were studying at an unspecified institution type. Further study was most common amongst those qualified in Science (49%) or Mathematics (43%).[51]

50 The Census records the highest qualification level completed by an individual at the time of taking the Census. Undertaking 'further study' includes study at any qualification level and does not necessarily indicate people who were pursuing a higher level of qualification than this highest qualification.

51 These large proportions may include graduates who had already gained a bachelor degree and were completing an honours year of study at the time of the Census.

Figure 16.8: Percentage of young VET qualified people engaged in further study, by field of qualification and type of institution they were attending[52]

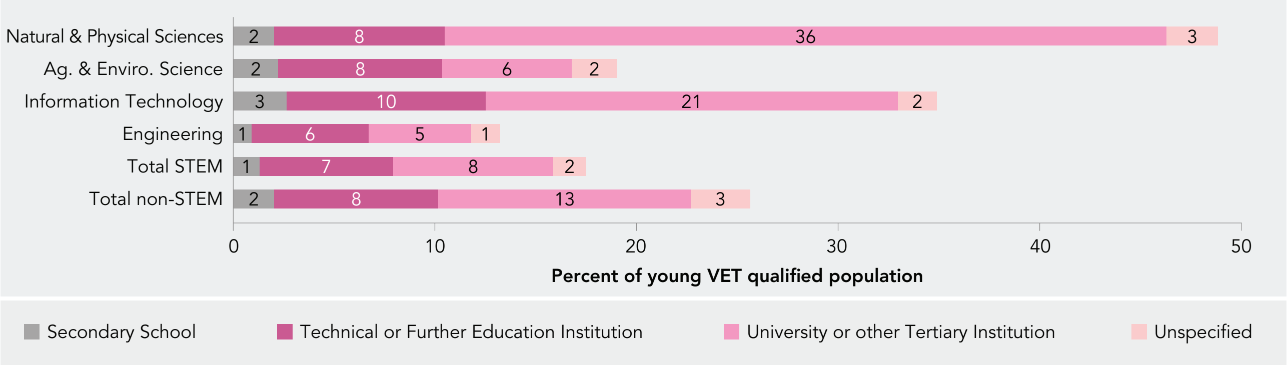
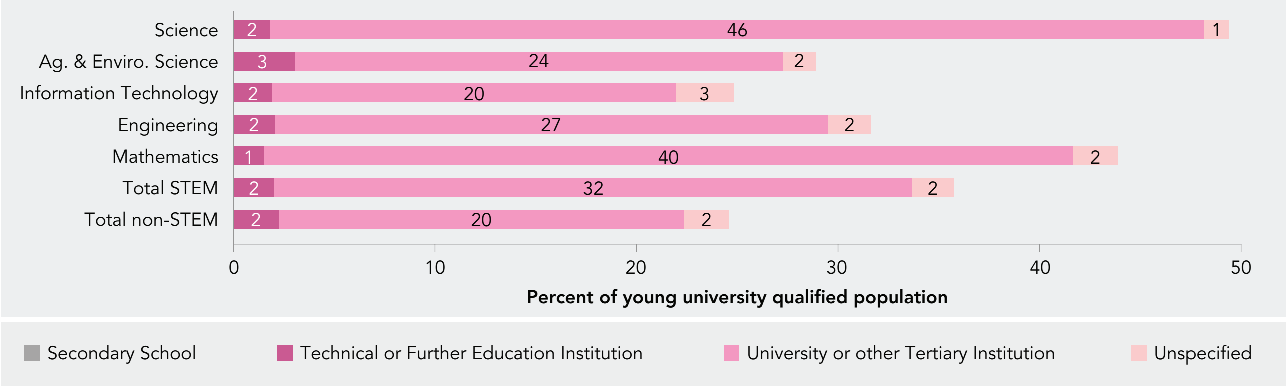


Figure 16.9: Percentage of young university qualified people engaged in further study, by field of qualification and type of institution they were attending



52 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

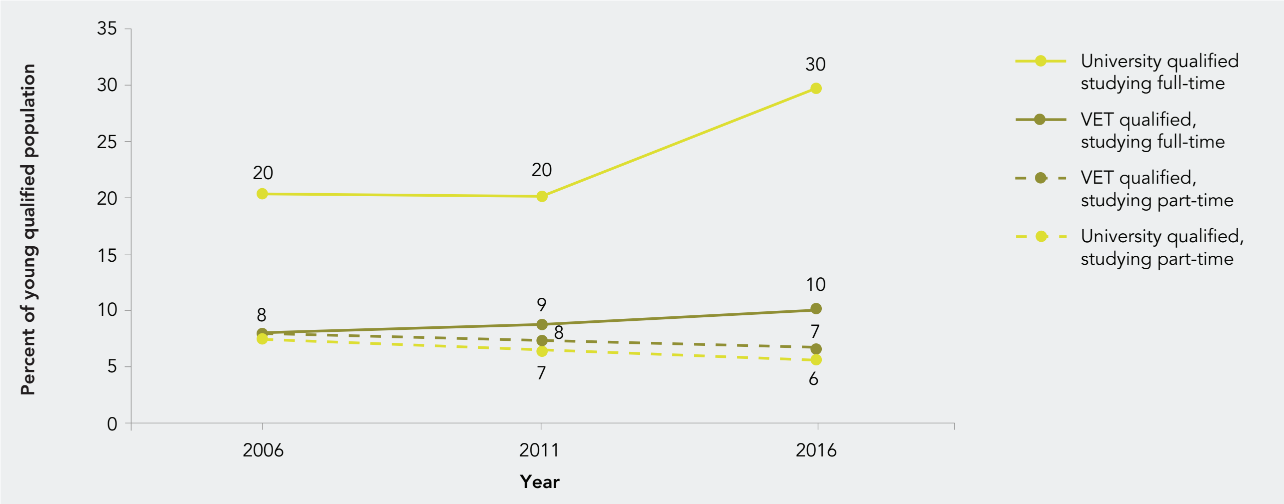
How have the study patterns of STEM qualified young people changed over time?

Figure 16.10 shows the proportion of young people with VET and university STEM qualifications who were studying full-time or part-time, in 2006, 2011, and 2016. The proportion of STEM qualified young people undertaking full-time study increased over the decade, while the proportion enrolled in part-time study decreased.

Among young people with VET STEM qualifications, 8% were studying full-time in 2006, a proportion that increased to 10% in 2016. 8% were also studying part-time in 2006, dropping 7% in 2016.

Among young people with university STEM qualifications, 20% were studying full-time in 2006, a figure that increased to 30% in 2016. In 2006, 8% of young people with university STEM qualifications were studying part-time, which dropped to 6% in 2016.

Figure 16.10: Percentage of STEM qualified young people enrolled in further study, by year and level of qualification



Employment outcomes for STEM qualified young people

What proportion of STEM qualified young people were in the labour force?

The labour force participation rate of young people varied considerably by field of education and level of education (Figure 16.11 and Figure 16.12).

Young people with VET STEM qualifications had a labour force participation rate of 91% and made up 19% of the total VET STEM qualified labour force. Among the STEM fields, young people with VET Engineering qualifications had the highest labour force participation rate, at 94%, while those with VET qualifications in Natural and Physical Sciences had the lowest labour force participation rate, at 72%.

Young people with university STEM qualifications had a labour force participation rate of 80% and made up 19% of the total STEM university qualified labour force. Among the STEM fields, young people with university Agriculture and Environmental Science qualifications had the highest labour force participation rate, at 86%, while those with university Mathematics qualifications had the lowest labour force participation rate, at 72%.

Figure 16.11: Labour force status of young people with VET qualifications, by field of education[53]

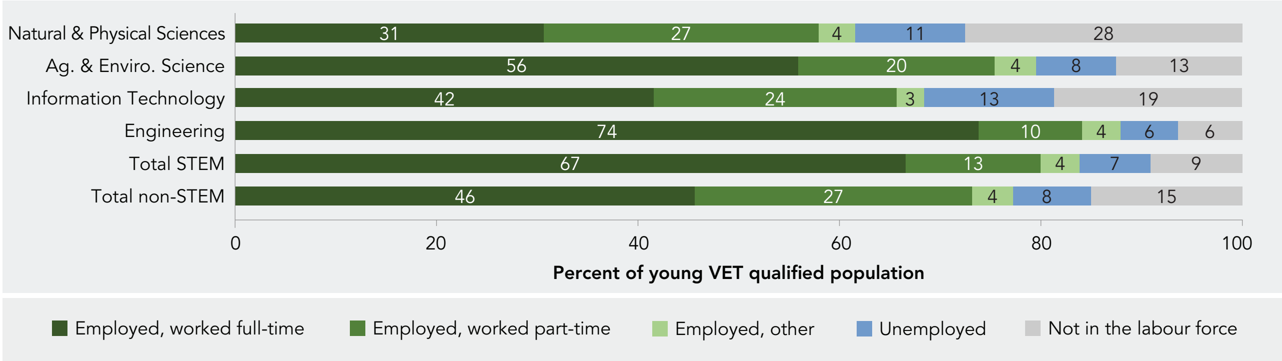
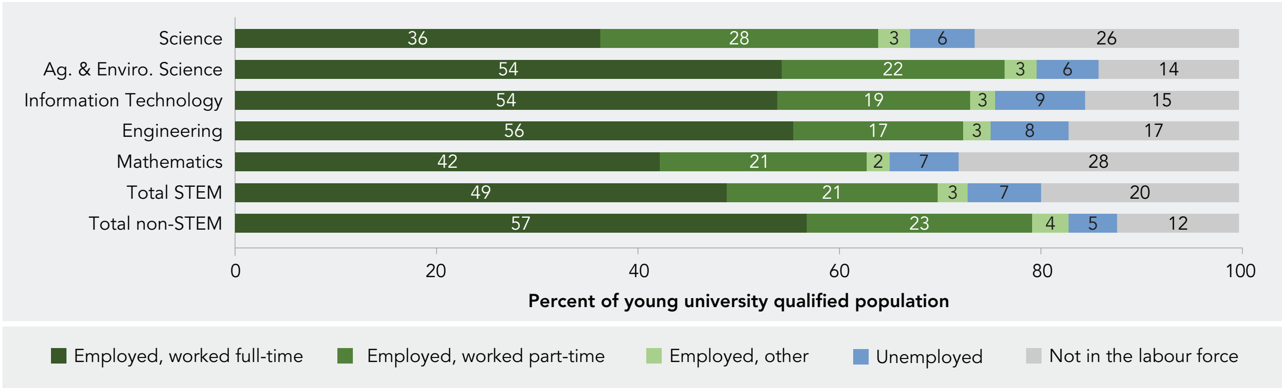


Figure 16.12: Labour force status of young people with university qualifications, by field of education

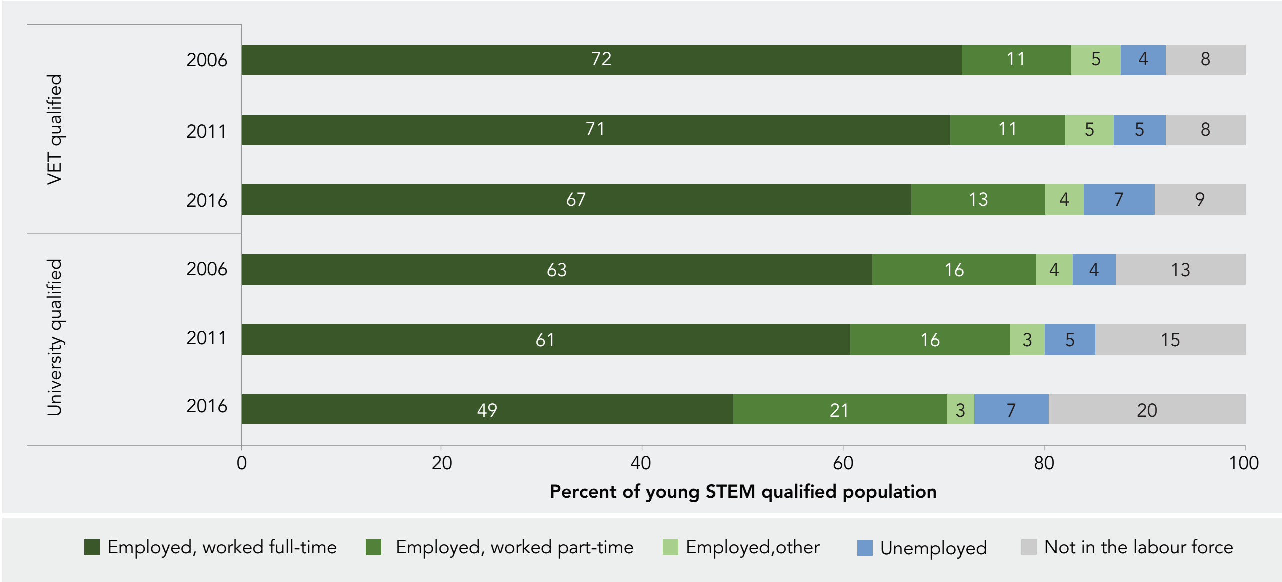


53 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

How has the labour force participation rate of young people changed over time?

The labour force participation rate of STEM qualified young people decreased over the decade 2006 to 2016 (Figure 16.13). For those with VET qualifications, the labour force participation rate decreased slightly from 92% in 2006 to 91% in 2016. For those with university qualifications, the labour force participation rate dropped from 87% in 2006 to 80% in 2016.

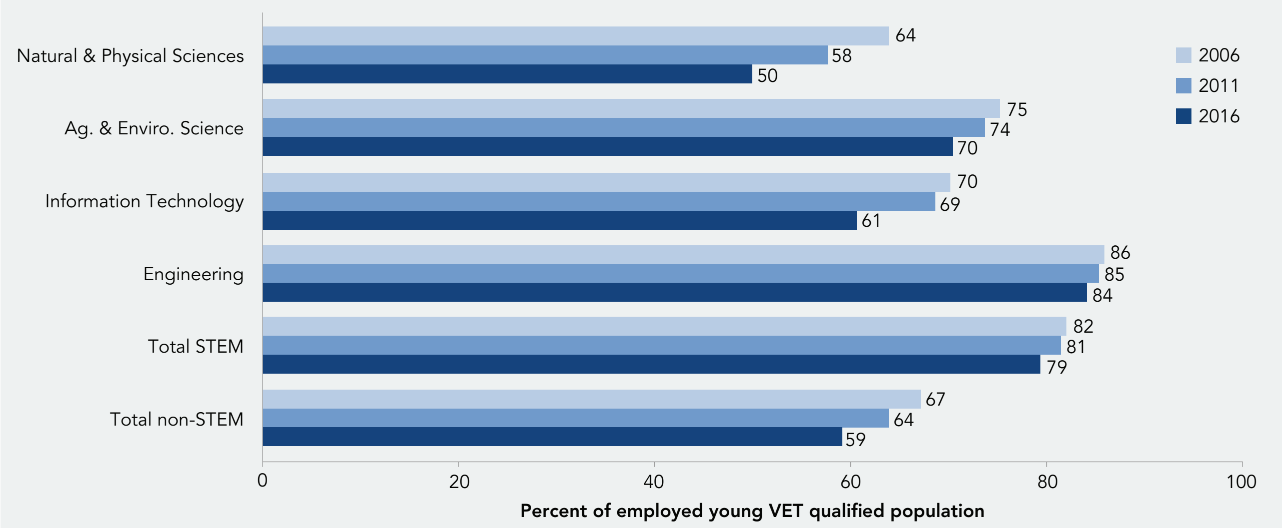
Figure 16.13: Labour force status of the young STEM qualified population, by level of education and year



What proportion of employed young people work full-time?

For those with VET qualifications, 79% of employed STEM qualified young people were working full time in 2016 (Figure 16.14). Across the STEM fields, young people with qualifications in Engineering had the highest proportion working full-time (84%), and those with qualifications in Natural and Physical Sciences had the lowest proportion (50%)—noting that those with Natural and Physical Sciences qualifications were also the most likely cohort to be engaged in further study (Figure 16.8). Since 2006, the proportion of young STEM VET qualified people working full-time decreased by 3 percentage points. Those with qualifications in Natural and Physical Sciences saw the largest drop in the proportion of young people working full-time, from 64% in 2006 to 50% in 2016.

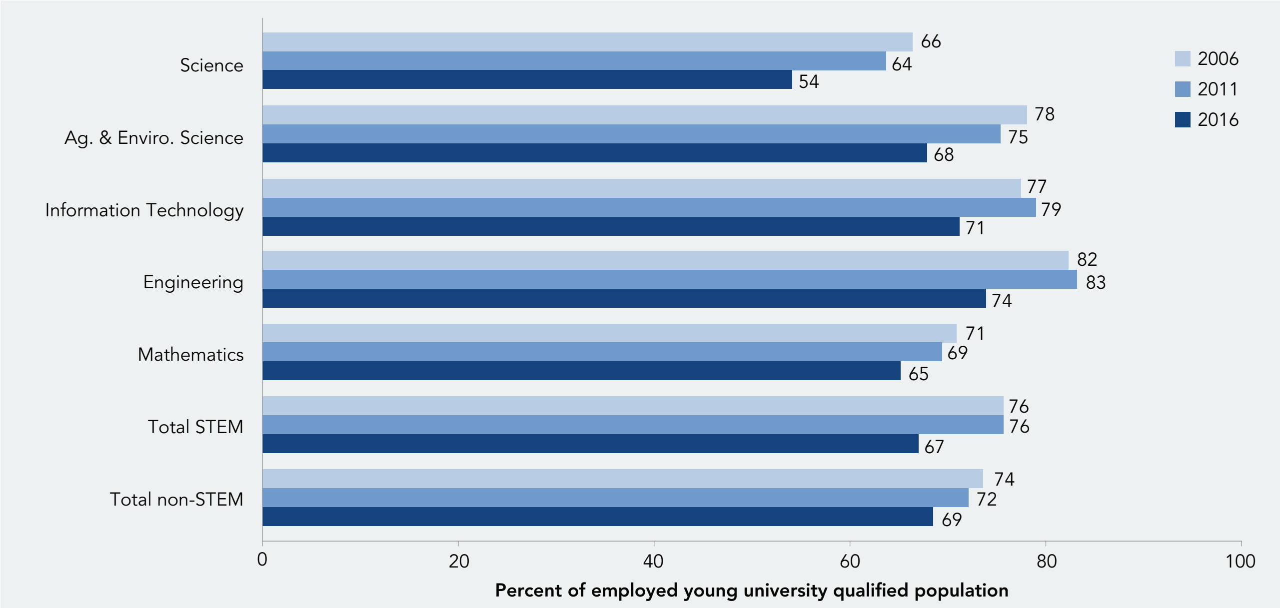
Figure 16.14: Percent of employed VET qualified young people working full-time, by field and year[54]



54 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

For those with university qualifications, 67% of employed STEM qualified young people were working full-time in 2016 (Figure 16.15). Across the STEM fields, young people with qualifications in Engineering had the highest proportion working full-time (74%), and those with qualifications in Science had the lowest proportion (54%)—noting that those with Science qualifications were also the most likely cohort to be engaged in further study (Figure 16.9). Since 2006, the proportion of young STEM university qualified graduates working full-time reduced by 9 percentage points. Those qualified in Science saw the largest reduction in the proportion of young people working full-time, from 66% in 2006 to 54% in 2016.

Figure 16.15: Percent of employed university qualified young people working full-time, by field and year



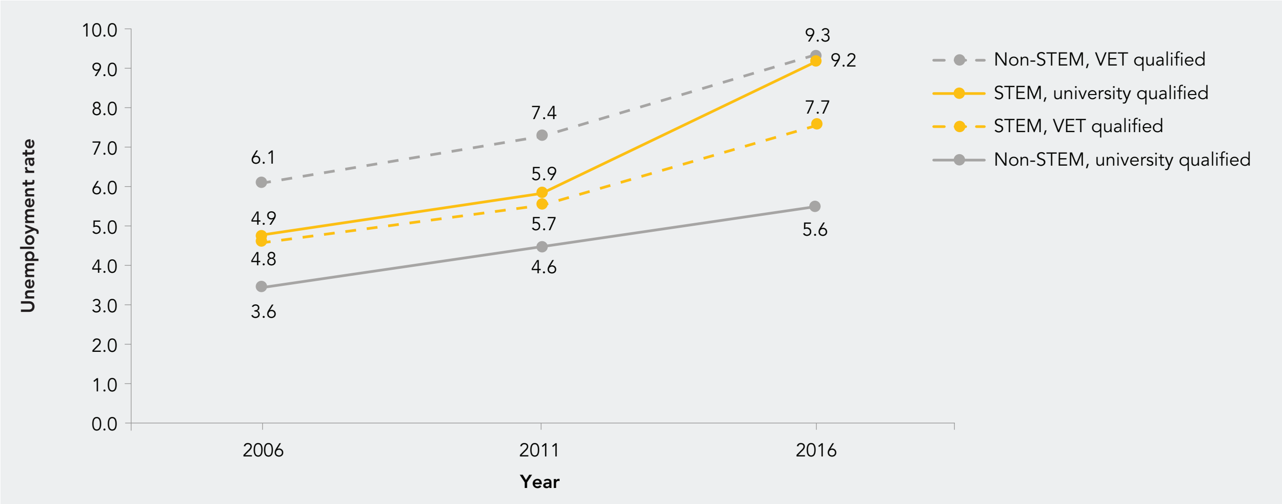
How many unemployed STEM qualified young people are there in Australia?[55]

In 2016, there were 17 012 unemployed young people with VET STEM qualifications, representing 7.7% of the young VET qualified STEM labour force (Figure 16.16). This unemployment rate was lower than the unemployment rate of young people with VET non-STEM qualifications (9.3%), but higher than the unemployment rate for people aged 30 and over with VET STEM qualifications (4.5%; data not shown).

In 2016, there were 13 122 unemployed young people with university STEM qualifications, representing 9.2% of the young university qualified STEM labour force (Figure 16.16). This unemployment rate was higher than the unemployment rate of young people with university non-STEM qualifications (5.6%), and higher than the unemployment rate for people aged 30 and over with university STEM qualifications (4.9%; data not shown).

The unemployment rates for young people have increased since 2006 across the board, for STEM and non-STEM qualified people with VET or university qualifications. There was a large increase between 2011 and 2016, when unemployment rates increased by 2.0 percentage points for young people with VET STEM qualifications, and by 3.3 percentage points for young people with university STEM qualifications. This was a larger increase than seen in the STEM qualified population aged 30 and over in the same period, where unemployment rates rose by 1.4 percentage points for those with VET qualifications and 1.6 percentage points for those with university qualifications.

Figure 16.16: Unemployment rate of young people by field and level of education, 2006 to 2016



55 Unemployment data in this report should be read with reference to prevailing labour market and unemployment conditions in the Census years. Refer to Chapter 1 for further detail.

Do young males and females have the same unemployment rates?

Among young people with VET qualifications, females had higher unemployment rates than males across all STEM fields of education other than Natural and Physical Sciences (Figure 16.17). For both females and males, unemployment was highest among those with Information Technology qualifications (16.9% for females and 15.8% for males) and lowest among those with Engineering qualifications (10.7% for females and 5.8% for males).

Among young people with university qualifications, females had a higher unemployment rate than males in the fields of Information Technology, Engineering, and Mathematics, and a lower unemployment rate than males in the fields of Science, and Agriculture and Environmental Science (Figure 16.18). For both females and males, unemployment was highest among those with Information Technology qualifications (16.1% for females and 8.6% for males) and lowest among those with Agriculture and Environmental Science qualifications (7.1% for females and 7.3% for males).

Figure 16.17: Unemployment rate of VET qualified young people, by field and gender[56]

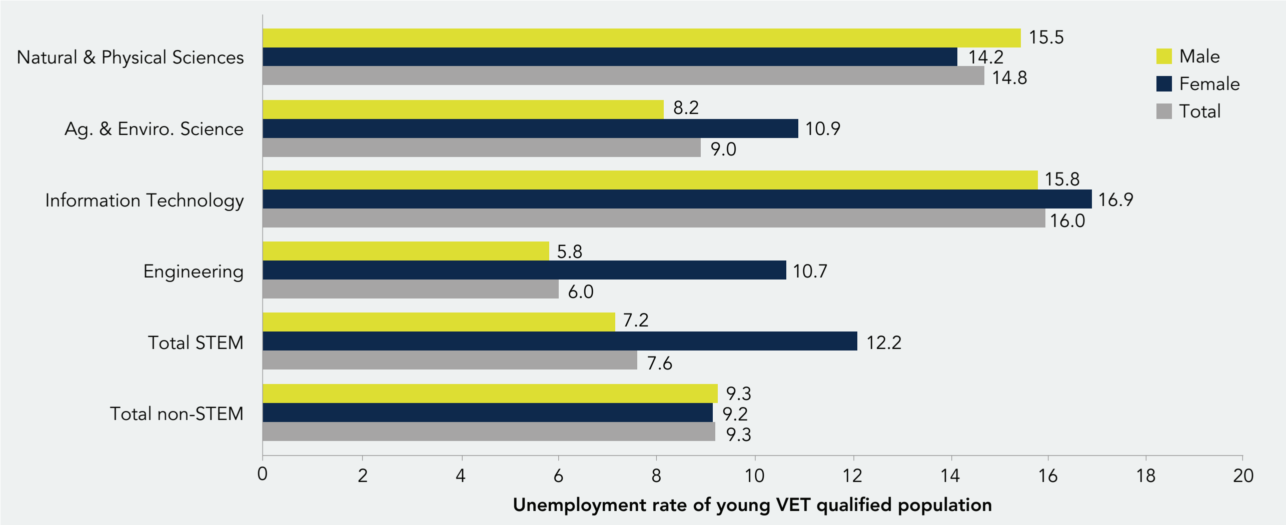
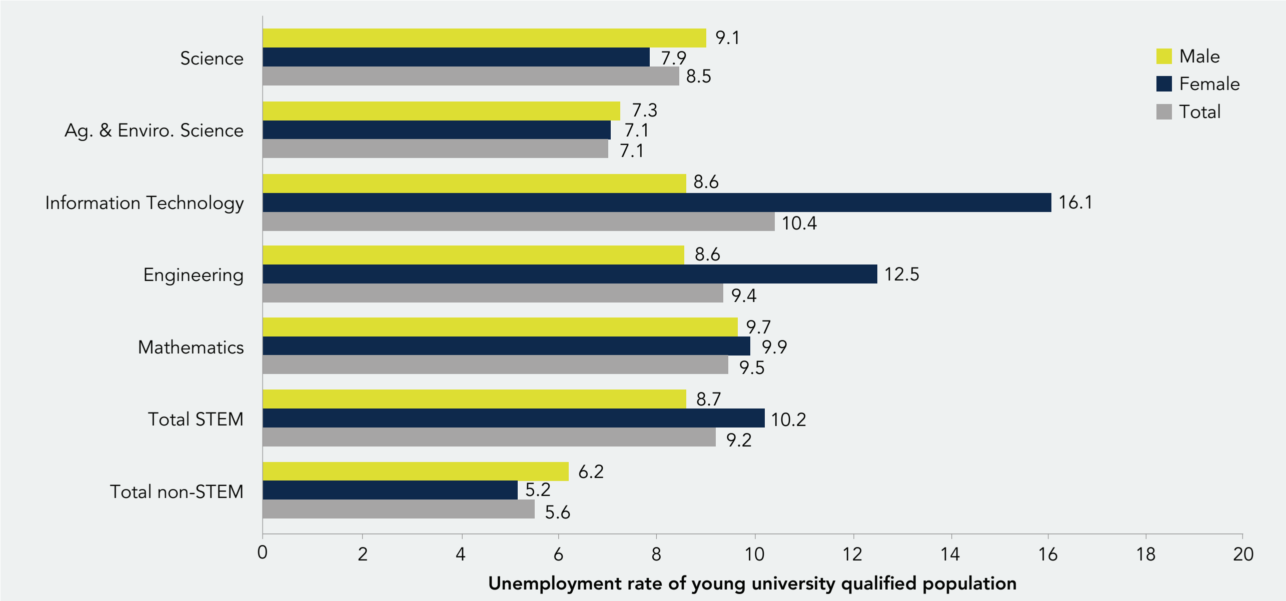


Figure 16.18: Unemployment rate of university qualified young people, by field and gender



56 Due to the small number of young people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

How do unemployment rates differ by age?

Compared to people aged 30 and over, young people had higher unemployment rates across all STEM fields of qualification at both the VET and university levels in 2016 (data not shown).

The unemployment rate for people aged 30 and over with VET STEM qualifications was 4.5% (data not shown), 3.1 percentage points lower than the unemployment rate for young people with VET STEM qualifications (7.6%; Figure 16.17). Among the STEM fields of qualification, the largest difference in unemployment rates was in the field of Information Technology, where the unemployment rate for young people was 16.0%, compared to 6.6% for people aged 30 and over. The smallest difference was in Engineering, where the unemployment rate for young VET qualified people was 6.0%, compared to 4.3% for those aged 30 and over.

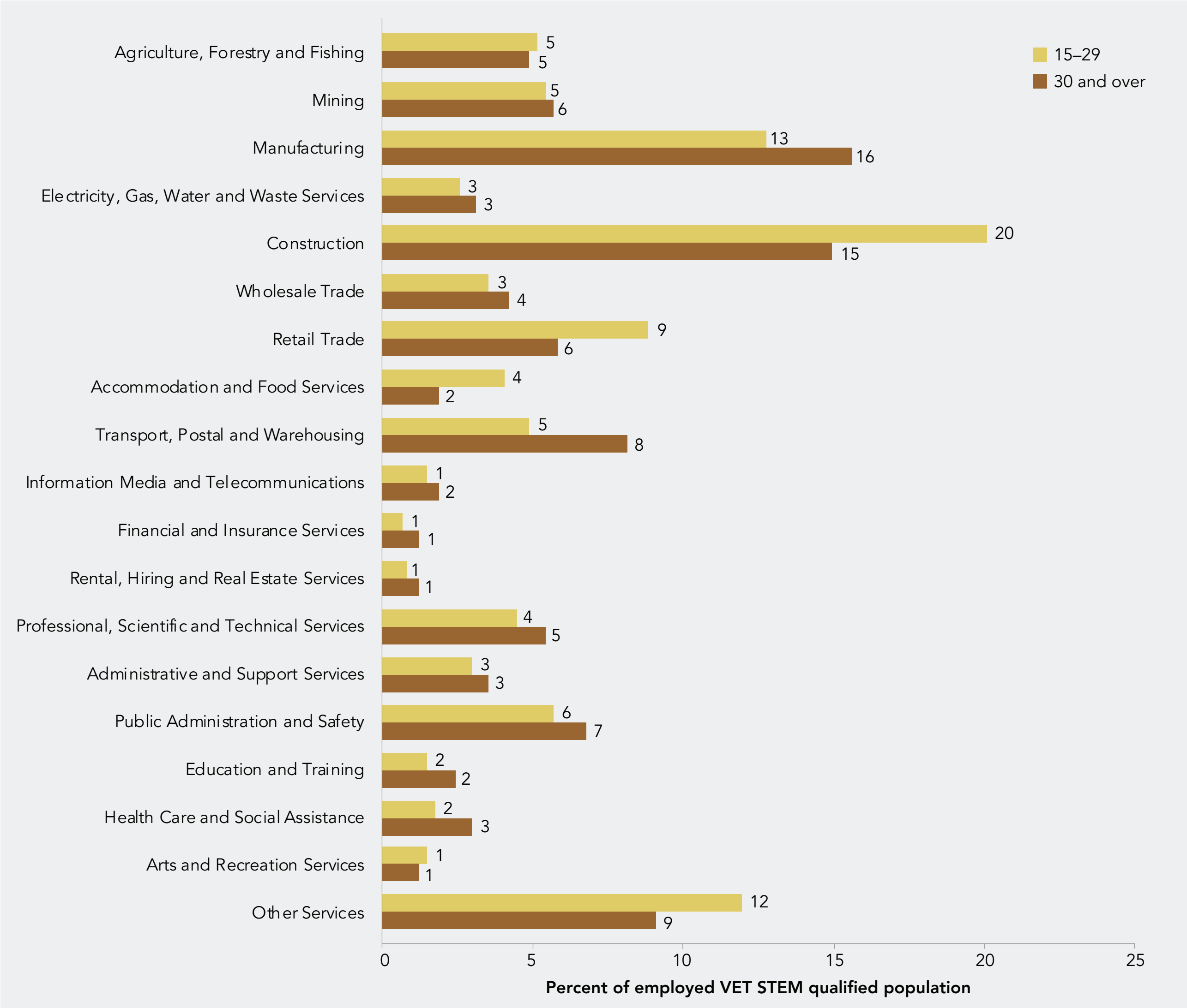
The unemployment rate for people aged 30 and over with university STEM qualifications was 4.9% (data not shown), 4.3 percentage points lower than the unemployment rate for young people with university STEM qualifications (9.2%; Figure 16.18). Among the STEM fields of qualification, the largest difference in unemployment was in the field of Information Technology, where the unemployment rate for young people was 10.4%, compared to 4.9% for people aged 30 and over. The smallest difference was in Agriculture and Environmental Science, where the unemployment rate for young university qualified graduates was 7.1%, compared to 4.1% for those aged 30 and over.

Which industries employ young people with STEM qualifications?

The top industry divisions of employment for young people with STEM qualifications varied by level of qualification.

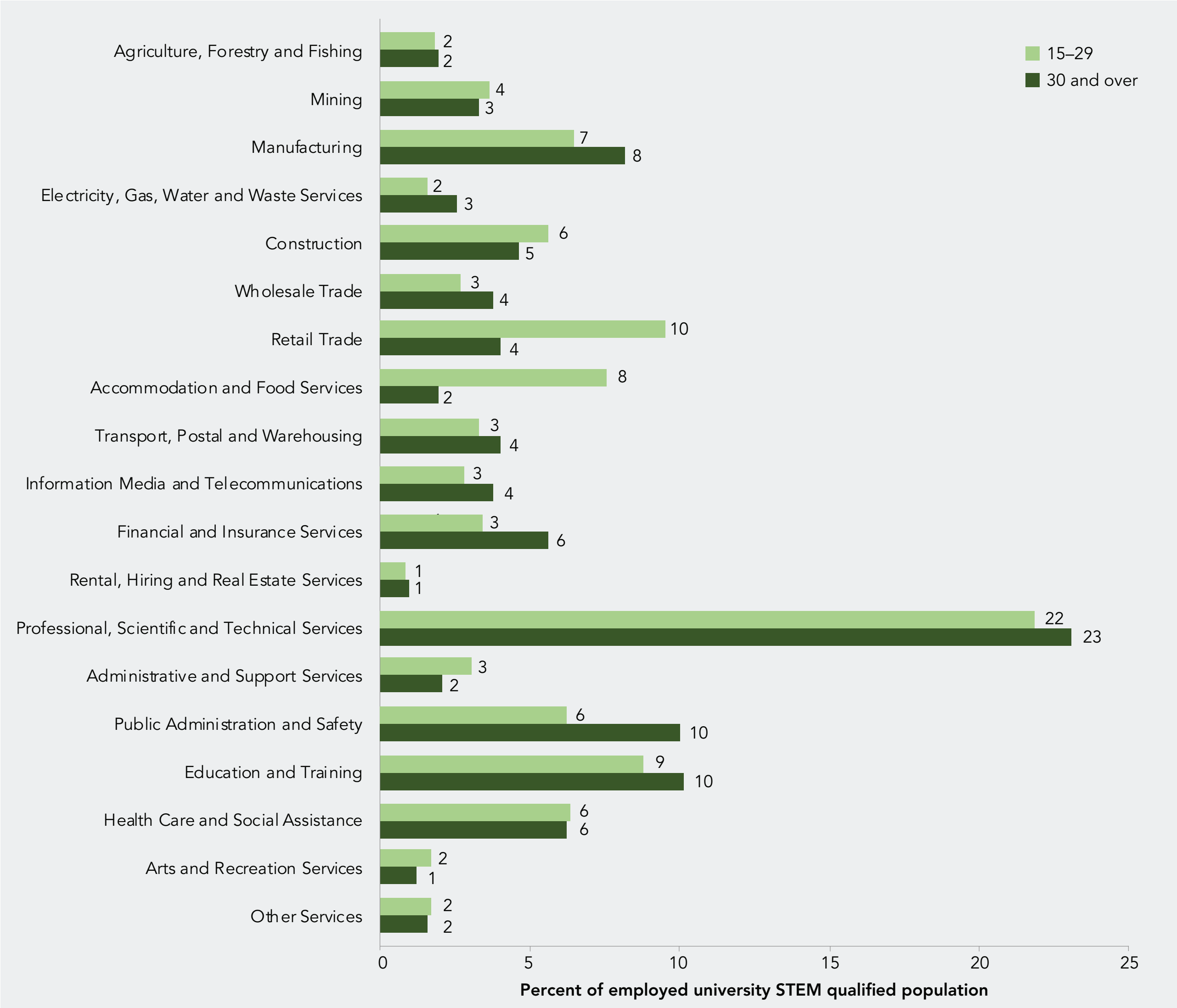
In 2016, the leading industry division of employment for young people with VET STEM qualifications was the Construction industry, which employed 20% of the cohort (Figure 16.19). Other common industries of employment included Manufacturing (13%) and Other Services (12%). Compared to those aged 30 and over with similar qualifications, young people with VET STEM qualifications were more likely to work in the industry divisions of Construction, Retail Trade, Accommodation and Food Services, Arts and Recreation Services, Agriculture, Forestry and Fishing, and Other Services.

Figure 16.19: Industry divisions of employment for people with VET STEM qualifications, by age group



In 2016, the leading industry division of employment for young people with university STEM qualifications was the Professional, Scientific and Technical Services industry, which employed 22% of the cohort (Figure 16.20). Other common industries of employment included Public Administration and Safety (10%) and Education and Training (10%). Compared to those aged 30 and over with similar qualifications, young people with university STEM qualifications were more likely to work in the industry divisions of Mining, Construction, Retail Trade, Accommodation and Food Services, Administrative and Support Services, and Arts and Recreation Services.

Figure 16.20: Industry divisions of employment for people with university STEM qualifications, by age group



Which industries are in growth and decline for young STEM qualified people?

Detailed analyses of the industries that have been in growth and decline for young STEM qualified people are shown in Table 16.3 and Table 16.4. For this analysis, industry subdivisions were ranked by percentage change over the decade 2006 to 2016, and only industries that employed 1 000 or more young people at either time period were included in the analysis.

Industries relating to Construction employed more STEM qualified young people in 2016 than in 2006, while industries relating to Manufacturing saw a reduction in the number of people they employed. The printing industry was a declining employer for those with VET qualifications, while wholesale services became less common for university STEM qualified young people.

Table 16.3: Top five industry subdivisions of growth and decline for young people with VET STEM qualifications

Industry subdivision	2006	2016	Increase	Percent change
Industries in growth				
Metal Ore Mining	1 890	4 713	2 823	149
Construction, nfd	715	1 570	855	120
Coal Mining	1 524	3 096	1 572	103
Heavy and Civil Engineering Construction	2 147	3 757	1 610	75
Food and Beverage Services	4 394	6 972	2 578	59
Industries in decline				
Printing (including the Reproduction of Recorded Media)	1 611	572	-1 039	-64
Polymer Product and Rubber Product Manufacturing	1 024	525	-499	-49
Machinery and Equipment Manufacturing	5 464	2 829	-2 635	-48
Manufacturing, nfd	3 903	2 411	-1 492	-38
Wood Product Manufacturing	2 684	1 700	-984	-37

Table 16.4: Top five industry subdivisions of growth and decline for young people with university STEM qualifications

Industry subdivision	2006	2016	Increase	Percent change
Industries in growth				
Building Cleaning, Pest Control and Other Support Services	726	1 919	1 193	164
Heavy and Civil Engineering Construction	937	2 161	1 224	131
Food and Beverage Services	3 784	8 420	4 636	123
Construction Services	887	1 869	982	111
Building Construction	1 129	2 342	1 213	107
Industries in decline				
Auxiliary Finance and Insurance Services	1 830	1 048	-782	-43
Transport Equipment Manufacturing	1478	865	-613	-41
Other Goods Wholesaling	1 052	617	-435	-41
Machinery and Equipment Wholesaling	2 160	1 465	-695	-32
Machinery and Equipment Manufacturing	1 950	1 383	-567	-29

Do young full-time and part-time employees work in different industries?

The most common industries of employment for STEM qualified young people differed depending on whether they were working full-time or part-time and by their level of qualification.

The top ten industry subdivisions of employment for young people with VET STEM qualifications are displayed in Figure 16.21. The top three subdivisions of employment were largely made up of people working full-time; Construction Services (88% of employed people were working full-time), Repair and Maintenance (91%), and Agriculture (81%). The only subdivision among the top ten where the majority of employees worked part-time was Food and Beverage Services, where 69% of employed young people with VET STEM qualifications worked part-time.

The top ten industry subdivisions of employment for young people with university STEM qualifications are displayed in Figure 16.22. The top two subdivisions of employment were largely made up of people working full-time—86% of young people working in Professional, Scientific and Technical Services and 89% of young people working in Computer System Design and Related Services were working full-time. The next four largest industry subdivisions of employment were made up mostly of part-time employees, including Food and Beverage Services (74% working part time), Tertiary Education (51%), Other Store-Based Retailing (58%), and Food Retailing (70%).

Figure 16.21: Employment status of young people with VET STEM qualifications by industry subdivision.[57] Data labels indicate the number of people employed in each industry

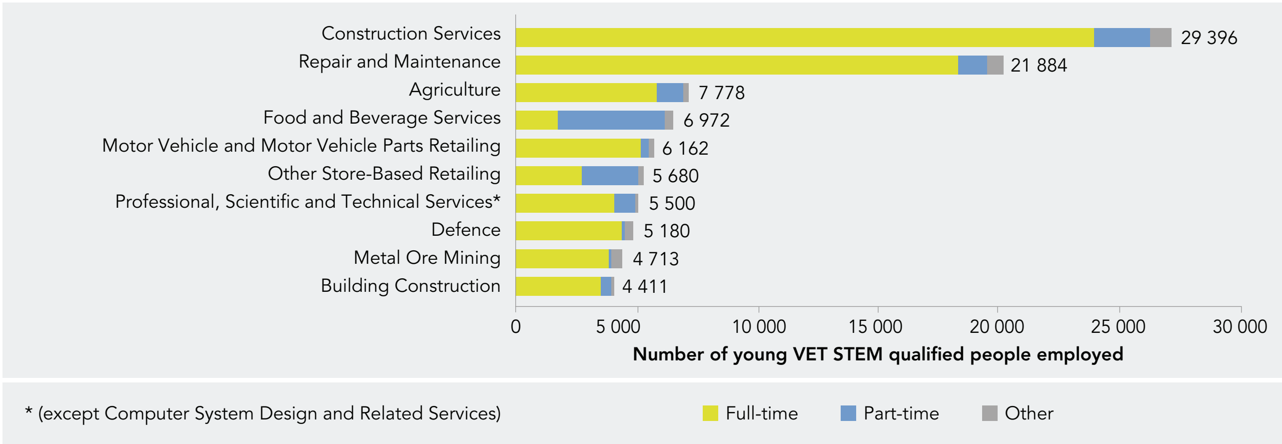
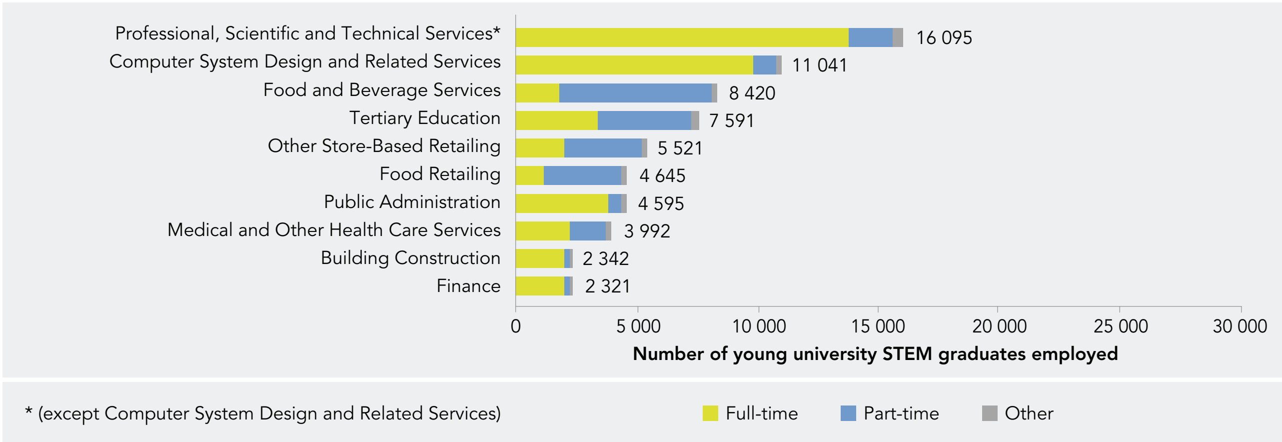


Figure 16.22: Employment status of young people with university STEM qualifications by industry subdivision.[58] Data labels indicate the number of people employed in each industry



57 These are the top ten industry subdivisions of employment for young people with VET STEM qualifications.

58 These are the top ten industry subdivisions of employment for young people with university STEM qualifications.

What are the occupations of STEM qualified young people?

Young people with VET qualifications were most likely to work as Technicians and Trade Workers across all STEM fields, with 59% of the total cohort employed in this major group occupation (Figure 16.23). The proportion of young people working as Technicians and Trade Workers ranged from a quarter (24%) of those with Information Technology qualifications to two thirds (67%) of those with Engineering qualifications.

Young people with university qualifications were most likely to work as Professionals across all STEM fields, with nearly half (49%) of the total cohort employed in this major group occupation (Figure 16.24). The proportion of young people employed as Professionals ranged from just over a third (34%) of those with Agriculture and Environmental Sciences qualifications, to nearly two-thirds of those with qualifications in Mathematics (63%).

Figure 16.23: Major group occupations of young people with VET qualifications[59]

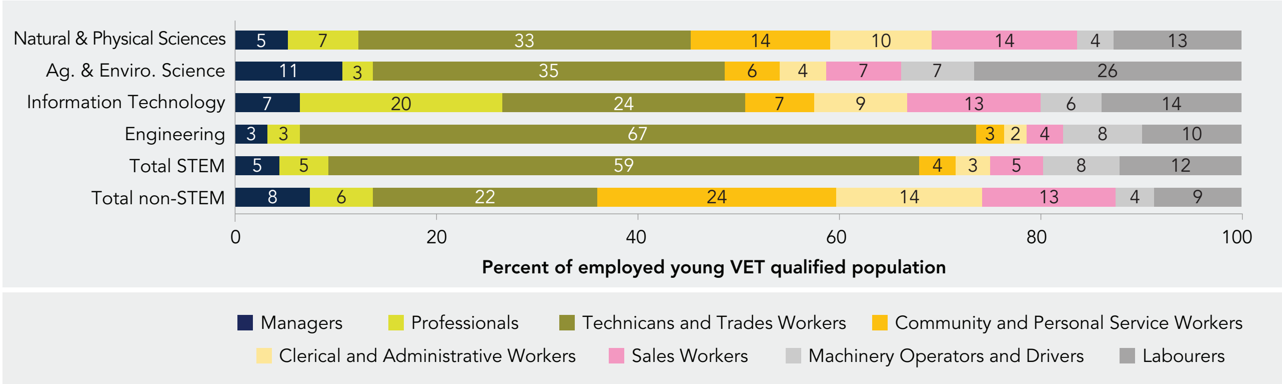
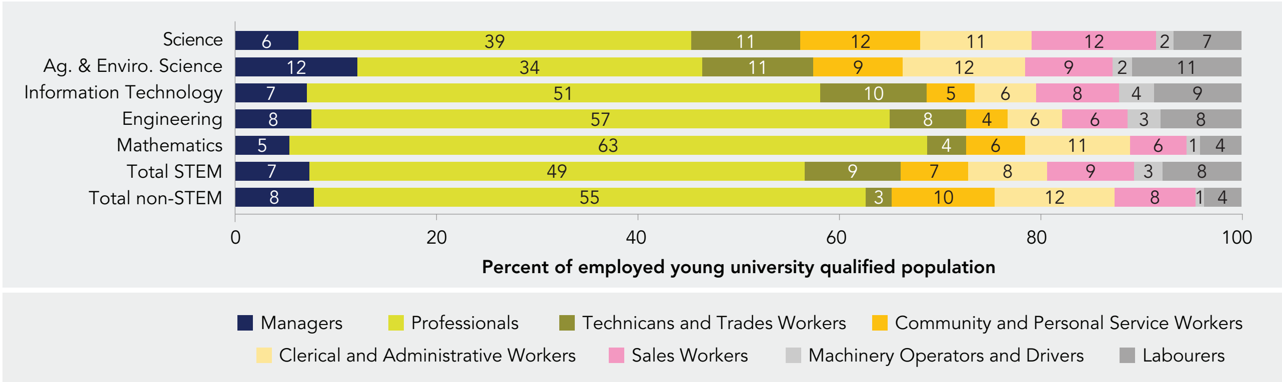


Figure 16.24: Major group occupations of young people with university qualifications



59 Due to the small number of people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural & Physical Sciences.

What do young people with STEM qualifications earn?

Most STEM qualified young people had an income between $41 600 and $103 999 (Figure 16.25 and Figure 16.26).

The highest bracket for recording income in the 2011 Census was $104 000 or above. In the previous report, this bracket was used to compare incomes across various populations. In the 2016 Census the highest income bracket was increased to $156 000 or above. To enable comparisons to the previous report; however, the $104 000 or above income bracket is maintained in this report.

For those with VET qualifications, 60% of young STEM qualified people earned between $41 600 and $103 999, nearly a third (32%) earned less than $41,600, and 8% earned $104 000 or above (Figure 16.25). Across STEM fields of education, young people with Engineering qualifications had the highest proportion earning $104 000 or above (10%), while those with Natural and Physical Science qualifications and Agriculture and Environmental Science qualifications had the lowest (2% of each cohort).

60 Due to the small number of young people with VET qualifications in Mathematics, Mathematics has been analysed alongside Science in the field of Natural and Physical Sciences.

Figure 16.25: Personal income of young people with VET qualifications, by field[60]

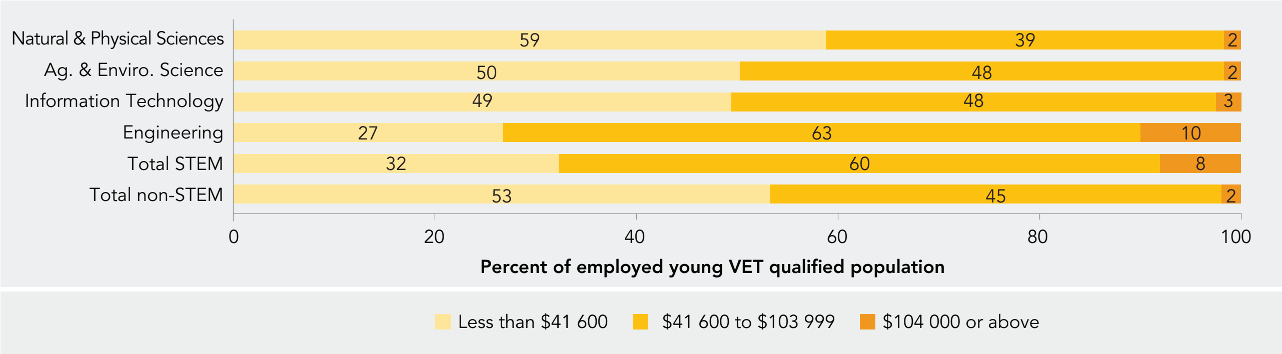
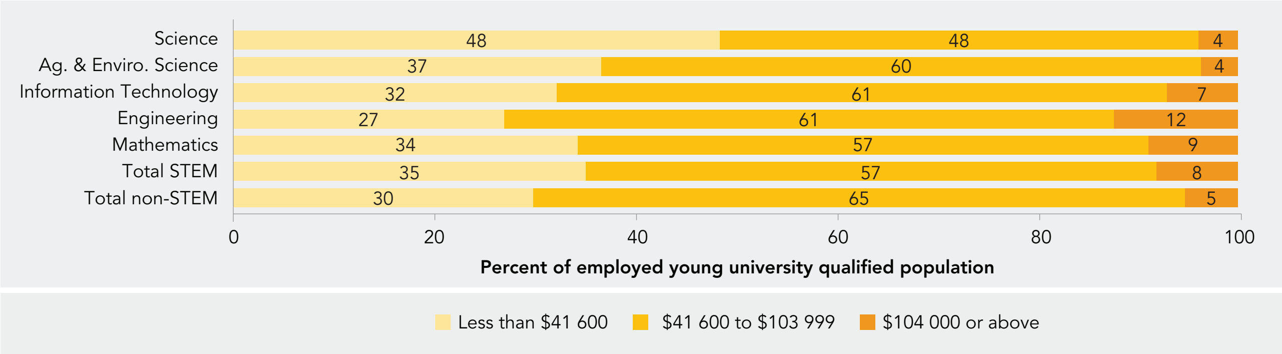


Figure 16.26: Personal income of young people with university qualifications, by field



For those with university qualifications, 57% of young STEM qualified people earned between $41 600 and $103 999, nearly a third (35%) earned less than $41 600, and 8% earned $104 000 or above (Figure 16.26). Across STEM fields of education, young people with Engineering qualifications had the highest proportion earning $104 000 or above (12%), while those with Science qualifications and Agriculture and Environmental Science qualifications had the lowest (4% of each cohort).

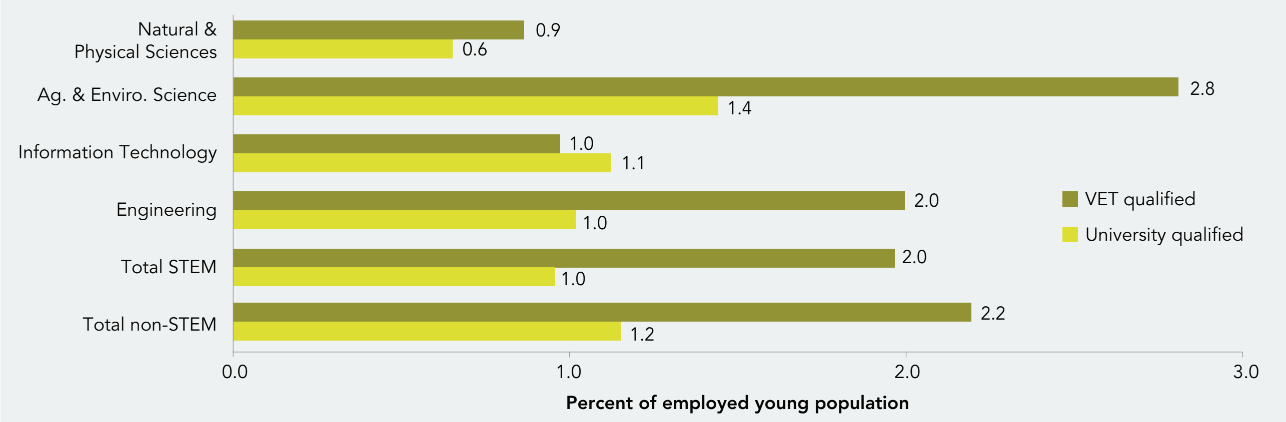
Compared to the overall STEM qualified population, there were fewer young people who had an income in the highest bracket and more with an income in the lowest bracket. The differences in income across fields and education levels were similar to those seen in the total STEM qualified population (Chapter 3, Figures 3.24 and 3.25).

How many STEM qualified young people own their own business?

In 2016, 2% of employed young people with VET STEM qualifications and 1% of employed young people with university STEM qualifications were working as owner managers (considered here as owning their own businesses) and employed at least one person (Figure 16.27). The rate of business ownership amongst young people was similar across STEM and non-STEM fields.

STEM qualified young people were much less likely than STEM qualified people aged 30 and over to own a business (data not shown). In 2016, among STEM qualified people aged 30 and over, 9% of employed people with VET STEM qualifications and 5% of employed people with university STEM qualifications were working as owner managers and employed at least one person (data not shown).

Figure 16.27: Percent of young qualified people who were owner/managers of a business, by field and level of qualification, 2016



CHAPTER 17

17

A CLOSER LOOK AT ENGINEERING

In this report, Engineering refers to the broad educational field of Engineering and Related Technologies. Engineering is the largest STEM field of education, with 928 140 people with VET qualifications and 277 807 people with university qualifications in the labour force in 2016.

This chapter analyses the VET and university qualified Engineering populations including their labour force status, industries of employment and occupations. The chapter investigates differences between the 11 narrow fields of education within the broad field of Engineering and Related Technologies.

Chapter 12 of this report also looks at people with Engineering qualifications, but is restricted to only analysing the employment pathways of those with university qualifications in Engineering.

HIGHLIGHTS

- Engineering is the largest STEM field—in 2016, people with Engineering qualifications made up 80% of the VET STEM qualified labour force and 38% of the university STEM qualified labour force.
- Engineering is male dominated at both levels of qualification but particularly within VET. In 2016, males made up 96% of the Engineering labour force with VET qualifications and 85% of the Engineering labour force with university qualifications.
- The unemployment rates of people with VET and university Engineering qualifications increased substantially between 2011 and 2016.
  - The unemployment rate of the VET qualified Engineering labour force increased from 2.9% in 2011 to 4.6% in 2016.
  - The unemployment rate of the university qualified Engineering labour force increased from 3.5% in 2011 to 6.1% in 2016.
- Unemployment rates were lower for males than for females across the board.
- As was the case across the STEM qualified population, a greater proportion of males than females with Engineering qualifications worked full-time.
- 83% of employed males with VET Engineering qualifications worked full-time in 2016, compared to 55% of the corresponding cohort of females. By gender and narrow field, the group with the smallest percentage working full-time were females qualified in Other Engineering and Related Technologies (45%).
- 83% of employed males with university engineering qualifications worked full time, compared to 67% of the corresponding cohort of females. By gender and narrow field, the group with the smallest percentage working full-time were females qualified in Maritime Engineering and Technology (54%).
- The top occupations and industries of employment differed depending on qualification level.
  - The top industry divisions of employment for people with VET Engineering qualifications were Manufacturing or Construction and the top occupation was Technicians and Trade workers.
  - The top industry division of employment for people with university Engineering qualifications was Professional, Scientific and Technical Services and the top occupation was Professionals.

What does Engineering include?

This chapter analyses people with VET and university qualifications in the field of Engineering, while recognising that many of these people do not work in traditional Engineering occupations or industries.

The Australian Bureau of Statistics uses the Australian Standard Classification of Education (ASCED) to categorise qualifications by field.

Engineering and Related Technologies is the study of the design, manufacture, installation, maintenance and functioning of machines, systems and structures; and the composition and processing of metals, ceramics, foodstuffs and other materials. It includes the measurement and mapping of the earth's surface and its natural and constructed features. The main purpose of this broad field of education is to develop an understanding of the conversion of materials and energy, the measurement and representation of objects, and the operation of plant, machinery and transport systems.

—Australian Bureau of Statistics, 2001

The broad ASCED field of Engineering and Related Technologies (simplified to Engineering in this report) contains 11 narrow fields of education:

- **Manufacturing engineering and technology:** the study of the planning, organisation and operation of manufacturing methods, processes, facilities and systems.
- **Process and resources engineering:** the study of planning, designing and developing systems, processes and plant for locating and extracting minerals, oil and gas from the earth, and for physically and chemically transforming raw materials to produce metals, alloys, petrochemicals, ceramics, polymers and other materials. It includes the industrial manufacture, processing, packaging and handling of foodstuffs, pharmaceuticals and biochemicals.
- **Automotive engineering and technology:** the study of planning, designing, developing, producing and maintaining motor vehicles including earth moving equipment, motor cycles and small engines.
- **Mechanical and industrial engineering and technology:** the study of designing, planning, installing, operating, maintaining and repairing mechanical plant, machinery and tools.
- **Civil engineering:** the study of planning, designing, testing and directing the construction of large scale buildings and structures, and transport, water supply, pollution control and sewerage systems. It includes economic, functional and environmental considerations in the design and construction.
- **Geomatic engineering:** the study of measuring and graphically representing natural and constructed features of the environment.
- **Electrical and electronic engineering and technology:** the study of planning, designing, developing, testing, installing and maintaining electrical, electronic and communications equipment, circuits and systems. It includes designing, installing and maintaining equipment for generating and distributing electrical power.
- **Aerospace engineering and technology:** the study of planning, designing, developing, assembling and maintaining aircraft structures and systems. It includes operating and directing aircraft.
- **Maritime engineering and technology:** the study of designing, maintaining and operating marine craft and shipboard machinery and systems.
- **Other engineering and related technologies:** includes all Engineering and Related Technologies not elsewhere classified:
  - Environmental Engineering
  - Biomedical Engineering
  - Fire Technology
  - Rail Operations
  - Cleaning
  - Engineering and Related Technologies, not elsewhere classified
- **Engineering and Related Technologies, not further defined (nfd):** includes non-defined qualifications in Engineering.

Different levels of Engineering qualifications

The skills, occupations, and industries of employment for people with Engineering qualifications differ substantially depending on their level of qualification.

At the VET level, the field of Engineering is populated largely by people holding certificate III and IV qualifications in Mechanical, Electrical, and Automotive Engineering, who hold occupations such as mechanics, welders, metal fitters and machinists, and electricians. Table 17.1 clarifies the major trades that are categorised by the ABS under the Engineering fields of education and those that are not.

The VET qualified Engineering labour force is largely male. In both 2011 and 2016, females made up just 4% of this population, the lowest representation of any STEM field.

For university qualified Engineering graduates, the most common qualification was a bachelor degree, and close to half (44%) of people with this qualification did not specify a narrow field of education in the 2016 Census. It is likely that the most common qualification at this level is a four-year bachelor degree, as required for entrance to professional engineering practice.[61] However, the length of qualifications is not available from Census data. University qualified Engineers were most likely to work as civil engineers, industrial engineers, software programmers, or in other professional occupations. The university qualified Engineering labour force is also largely male. In 2011, females made up 13% of the university qualified Engineering labour force. In 2016, this proportion had increased, with females accounting for 15% of the cohort.

Table 17.1: The categorisation of selected trades under Engineering, and Architecture and Building detailed fields of education

Engineering trades	Architecture and Building trades
Electrical and Electronics Engineering	Plumbing
Metal Fitting and Machining	Carpentry and Joinery
Vehicle Mechanics	Painting
Boilermaking and Welding	Bricklaying
Printing	Plastering
	Building

How many people in the labour force have Engineering qualifications?

THE VET QUALIFIED ENGINEERING LABOUR FORCE

In 2016, there were 928 140 people in the labour force with VET engineering qualifications, making up 80% of the VET STEM qualified labour force. Between 2011 and 2016, the number of people in the labour force with VET Engineering qualifications grew by 3% (24 040 people). This compares with a growth of 4% in the total VET STEM qualified labour force over the same period.

THE UNIVERSITY QUALIFIED ENGINEERING LABOUR FORCE

In 2016, there were 277 807 people in the labour force with university engineering qualifications, making up 38% of the university STEM qualified labour force. Between 2011 and 2016, the number of people in the labour force with university Engineering qualifications grew by 28% (60 030 people). This compares with a growth of 25% in the total university STEM qualified labour force over the same period.

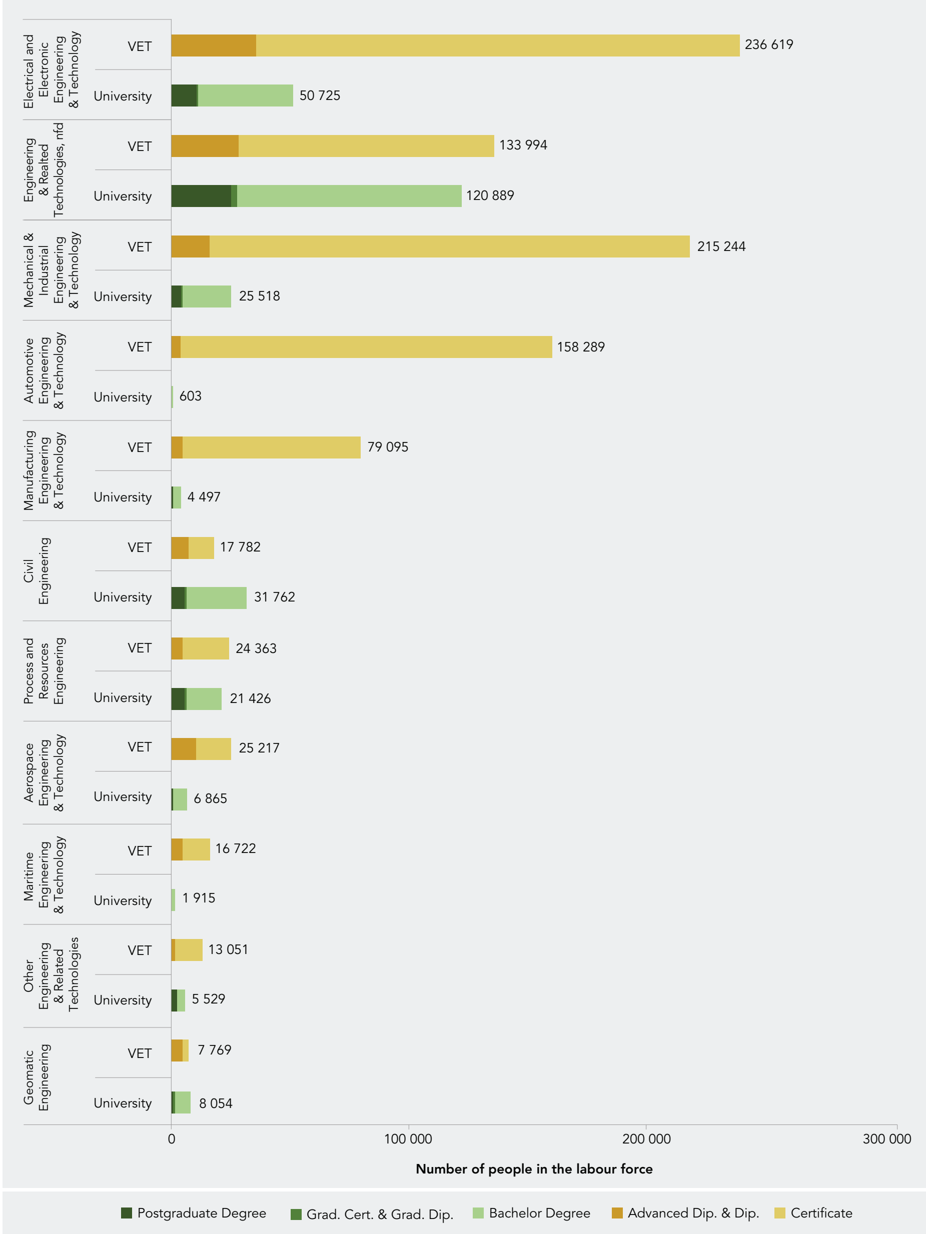
61 https://www.professionalengineers.org.au/rpeng/qualification/

Which are the most common narrow fields of Engineering?

There are 11 narrow ASCED fields of Engineering (pg. 247). Of those with VET qualifications, the largest narrow field was Electrical and Electronic Engineering and Technology (26% of the VET Engineering qualified labour force; Figure 17.1). The next largest narrow field was Mechanical and Industrial Engineering and Technology (23%), while the smallest was Geomatic Engineering (less than 1%).

Within the university qualified Engineering labour force, the largest narrow field was Engineering and Related Technologies not further defined (44%), meaning that the respondents did not specify a more detailed field of education than the broad field of Engineering. The next largest narrow field was Electrical and Electronic Engineering and Technology (18%), while the smallest was Automotive Engineering and Technology at just 603 people (less than 1%).

Figure 17.1: Number of people in the labour force, by narrow field and level of education. The data labels show VET and university totals



What level of education does the Engineering labour force have?

In 2016, the majority (84%) of people in the Engineering labour force with VET qualifications had a certificate qualification, while the remaining 16% had advanced diplomas or diplomas (Figure 17.2). Females represented 3% of those with certificates and 8% of those with advanced diplomas or diplomas.

Within the university qualified Engineering labour force, the majority (77%) of people had a bachelor degree, 21% had a postgraduate degree, and 2% had a graduate diploma or graduate certificate. Females represented 17% of those with bachelor degrees, 15% of the cohort with graduate diplomas and graduate certificates and 20% of those with postgraduate degrees.

What are the unemployment rates of people with Engineering qualifications?[62]

The unemployment rates of people with Engineering qualifications have increased over the last decade. The unemployment rate of people with VET Engineering qualifications was 2.7% in 2006, 2.9% in 2011, and 4.6% in 2016 (Chapter 3, Figure 3.10). Within this cohort in 2016, people with advanced diplomas and diplomas had an unemployment rate of 4.8%, and those with certificates had an unemployment rate of 4.6% (Figure 17.3). Overall, people with VET qualifications in Engineering had a lower unemployment rate than those with VET qualifications in any other STEM field (Chapter 3, Figure 3.10).

Figure 17.2: Engineering qualified population by level of qualification and gender. Data labels show the total number of people in the labour force qualified at each level

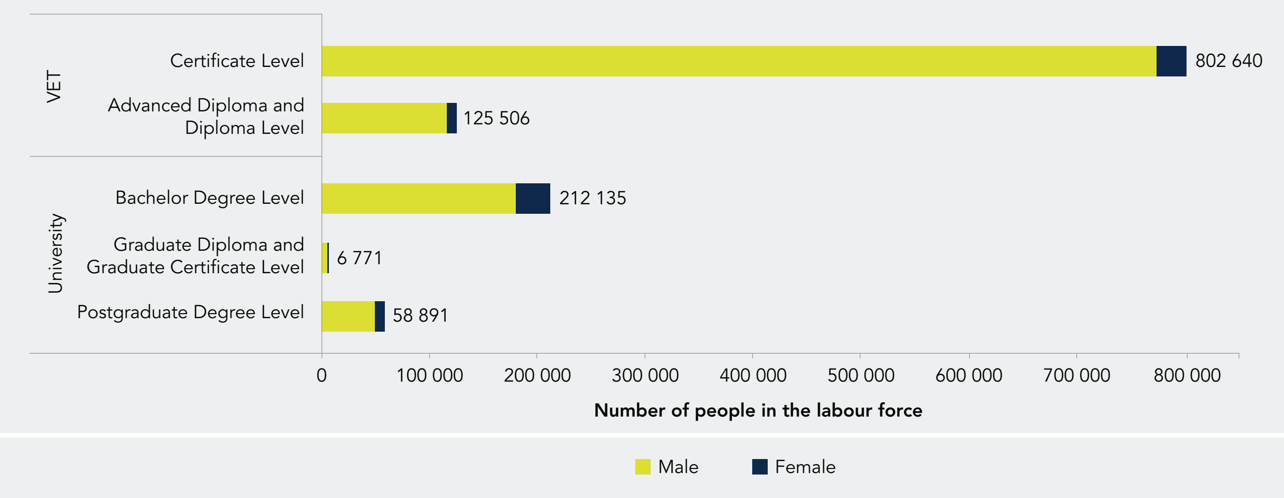
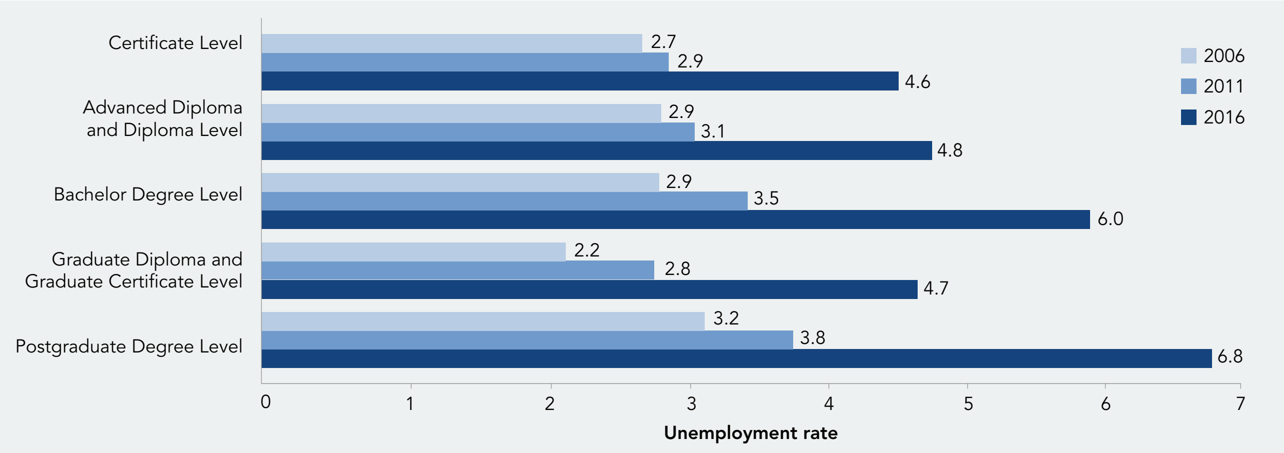


Figure 17.3: Unemployment rates of Engineering labour force by qualification level, 2006 to 2016



62 Unemployment data in this report should be read with reference to prevailing labour market and unemployment conditions in the Census years. Refer to Chapter 1 for further detail.

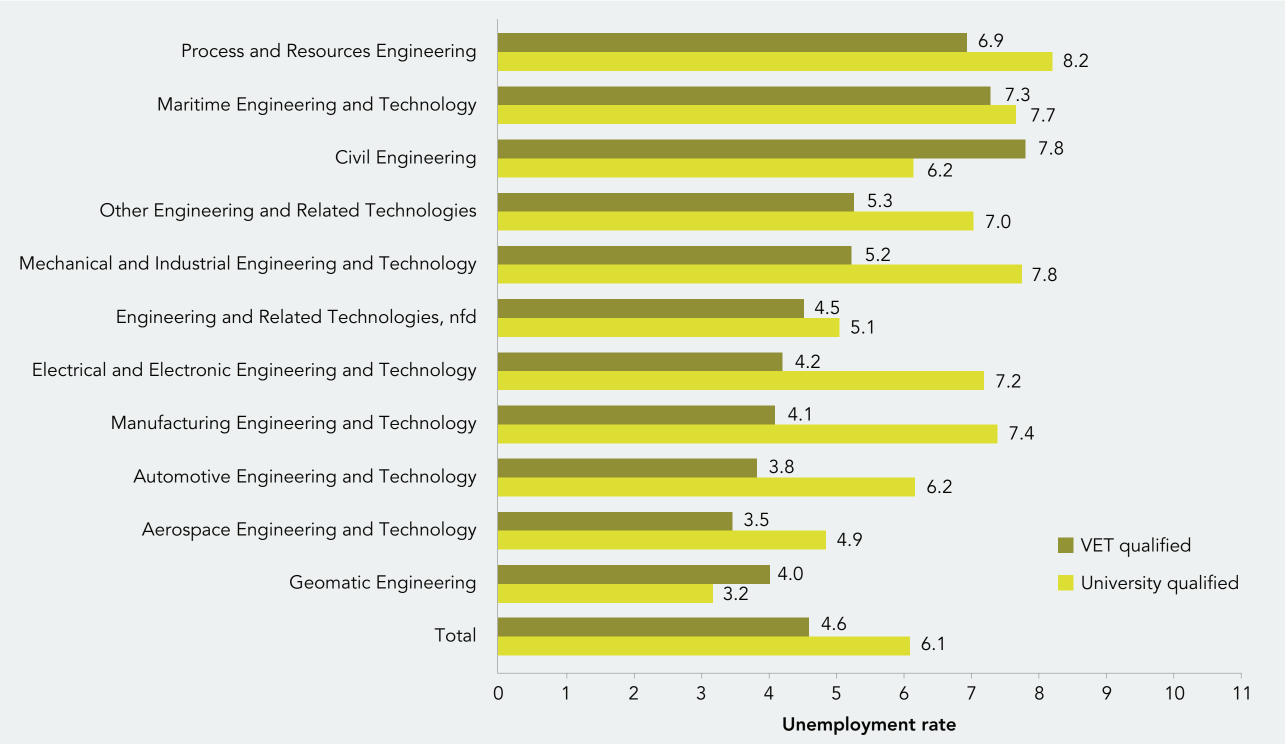
For those with university Engineering qualifications, the unemployment rate was 2.9% in 2006, 3.5% in 2011, and 6.1% in 2016 (Chapter 3, Figure 3.11). Within this cohort in 2016 people with postgraduate degrees had an unemployment rate of 6.8% and those with bachelor degrees had an unemployment rate of 6.0% (Figure 17.3). Those with graduate diplomas and graduate certificates had the lowest unemployment rate at 4.7%. People with university qualifications in Engineering had a higher unemployment rate than those with university qualifications in any other STEM field (Chapter 3, Figure 3.11).

Females with Engineering qualifications had higher unemployment rates than males at both levels of education. This gender difference was particularly evident among those with university qualifications, where the female unemployment rate was 3.6 percentage points higher than the male unemployment rate (Chapter 3, Figure 3.12).

For the VET Engineering qualified population, the narrow field of Civil Engineering had the highest unemployment rate (7.8%), while Aerospace Engineering and Technology had the lowest, at 3.5% (Figure 17.4).

For the university Engineering qualified population, the narrow field of Process and Resources Engineering had the highest unemployment rate (8.2%). Geomatic Engineering had the lowest unemployment rate (3.2%), as well as the smallest overall cohort size.

Figure 17.4: Unemployment rate by narrow field and qualification level



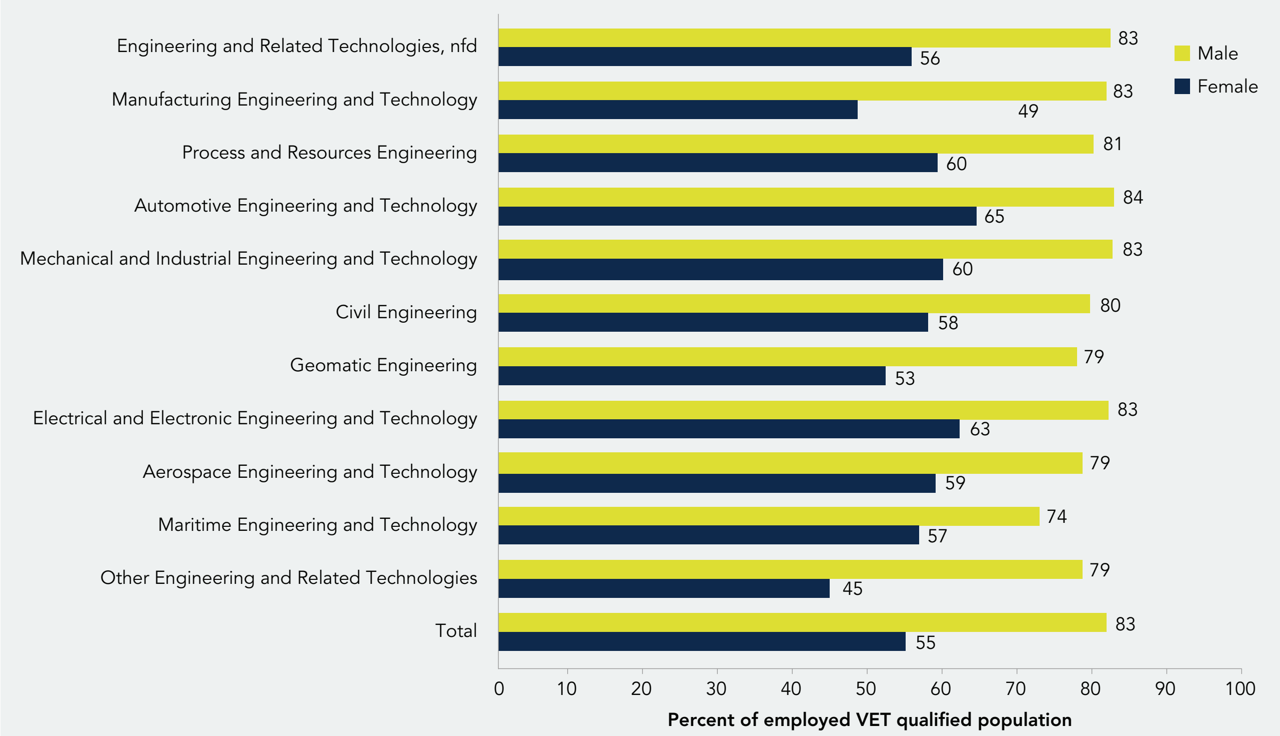
What proportion of employed people with Engineering qualifications work full-time?

The proportion of employed people with VET Engineering qualifications who worked full-time in 2016 is shown in Figure 17.5. 83% of employed males and 55% of females with VET Engineering qualifications worked full-time. These figures were the same in 2011.

In comparison, in 2016 82% of males and 52% of females with VET STEM qualifications worked full-time (data not shown).

For VET Engineering qualified workers, the narrow STEM field of education with the highest full-time employment rate for both males (84%) and females (65%) was Automotive Engineering and Technology. The narrow fields with the lowest full-time employment rates were Maritime Engineering and Technology for males (74%) and Other Engineering and Related Technologies for females (45%).

Figure 17.5: Proportion of VET qualified people working full-time by gender and narrow field

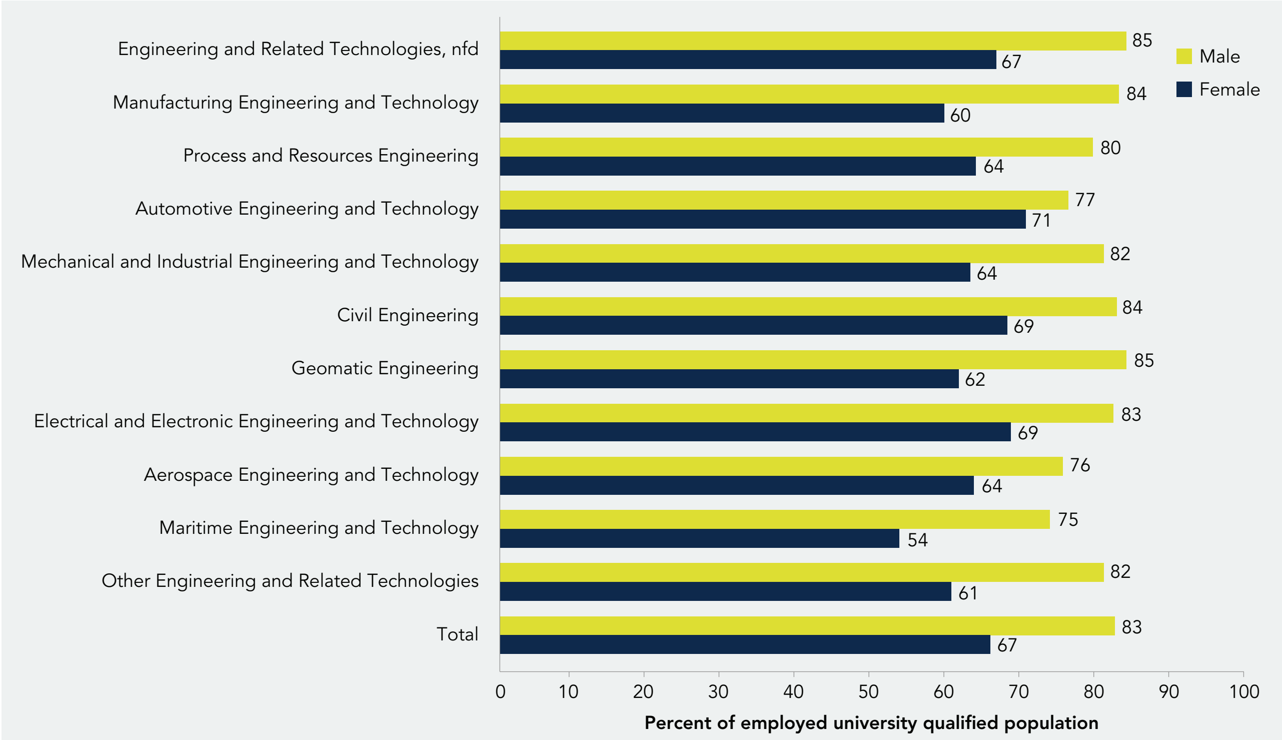


The proportion of employed people with university Engineering qualifications who worked full-time in 2016 is shown in Figure 17.6. 83% of males and 67% of females with university Engineering qualifications worked full-time. These figures show a drop from 2011, when 86% of males and 70% of females worked full-time.

In comparison, in 2016 82% of males and 60% of females with university STEM qualifications worked full-time (data not shown).

For university Engineering qualified workers, Geomatic Engineering (85%) and Engineering and Related Technologies, not further defined (85%) were the narrow STEM fields of education with the highest full-time employment rates for males, and Automotive Engineering and Technology had the highest full time employment rate for females (71%). The narrow field with the lowest full-time employment rates was Maritime Engineering and Technology for both males (75%) and females (54%).

Figure 17.6: Proportion of university qualified people working full-time by gender and narrow field



Industries and occupations of the VET qualified Engineering labour force

This section analyses the employment outcomes for people with VET Engineering qualifications. The size of the labour force in each narrow field of education is shown in Figure 17.1.

WHICH INDUSTRIES EMPLOY PEOPLE WITH VET ENGINEERING QUALIFICATIONS?

Table 17.2 shows the distribution of industry divisions of employment for people with VET Engineering qualifications across each narrow field of Engineering in 2016. In most fields of education there was a single dominant industry of employment. Across the fields of education, Manufacturing, Construction, and Transport, Postal and Warehousing were common top industries of employment. The top industries of employment for the total VET Engineering population (far right column) were Manufacturing, and Construction, each employing 18% of the working population.

Table 17.2: Industry divisions of employment of VET qualified workers by narrow field of Engineering qualification. Numbers are percentage of population. The darker the shade of blue, the higher the percentage

Industry division of employment	Narrow field of education: Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies	Total
Agriculture, Forestry and Fishing	3	2	3	3	4	2	2	1	2	9	1	3
Mining	7	2	26	5	11	2	7	5	2	4	4	7
Manufacturing	15	40	28	8	29	5	3	9	15	15	5	18
Electricity, Gas, Water and Waste Services	2	1	1	1	3	3	3	8	1	1	2	4
Construction	11	14	7	8	15	32	13	36	3	8	6	18
Wholesale Trade	5	4	4	6	4	2	2	4	2	2	2	4
Retail Trade	8	7	6	12	3	3	3	4	3	5	3	6
Accommodation and Food Services	2	2	3	1	1	2	2	2	2	3	2	2
Transport, Postal and Warehousing	9	6	4	10	7	6	5	5	35	28	17	8
Information Media and Telecommunications	1	2	0	0	0	1	1	5	1	0	0	2
Financial and Insurance Services	1	1	0	1	0	1	1	1	1	1	1	1
Rental, Hiring and Real Estate Services	2	1	1	2	1	1	1	1	1	1	1	1
Professional, Scientific and Technical Services	6	3	4	1	3	15	30	5	4	3	1	4
Administrative and Support Services	2	3	3	2	3	3	2	2	2	3	13	3
Public Administration and Safety	6	4	3	4	4	19	19	5	19	8	27	6
Education and Training	1	2	1	1	1	1	2	1	3	2	4	1
Health Care and Social Assistance	1	3	2	1	2	1	2	2	2	2	5	2
Arts and Recreation Services	1	1	0	1	1	1	1	1	1	1	1	1
Other Services	16	3	2	32	6	1	1	6	2	3	5	11
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

What are the occupations of people with VET Engineering qualifications?

For most narrow fields of education in Engineering, Technicians and Trade workers was the top major group occupation. In 2016, 51% of the working VET Engineering qualified population worked as Technicians and Trade Workers (Table 17.3). Three fields had other leading occupation classes—Machinery Operators and Drivers was the top occupation class for people with qualifications in Process and Resources Engineering (26% of workers qualified in this narrow field), and Professionals was the top occupation class for those with qualifications in Geomatic Engineering (46%) and Maritime Engineering and Technology (29%). The top occupation class for people with qualifications in Other Engineering and Related Technologies was Labourers (28%).

At a more detailed level of occupation, the unit group level, there was more diversity among occupations (Table 17.4). The top occupation was closely linked to each narrow field of Engineering—for example, the leading unit group occupation for those with qualifications in Electrical and Electronic Engineering and Technology was Electricians, and for those with qualifications in Automotive Engineering and Technology was Motor Mechanics.

Occupations are classified in five levels:

- Major group (the broadest level)
- Sub-major group
- Minor group
- Unit group
- Occupation (the most detailed level)

Table 17.3: Major group occupation of VET qualified employees, by narrow field of Engineering qualification. Numbers are percentage of cohort. The darker the shade of blue, the higher the percentage

Major group occupation (1-digit level)	Narrow field of education (4-digit level)											
	Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies	Total VET Engineering population
Managers	14	13	15	10	11	14	12	11	11	13	9	12
Professionals	7	4	6	2	4	11	46	6	26	29	3	6
Technicians and Trades Workers	48	41	21	53	52	26	15	65	41	22	12	51
Community and Personal Service Workers	3	4	3	2	2	3	4	2	4	4	24	3
Clerical and Administrative Workers	4	7	4	4	3	6	8	4	4	4	3	4
Sales Workers	4	6	4	5	3	3	3	3	3	3	3	4
Machinery Operators and Drivers	11	13	26	14	15	19	4	4	6	8	17	11
Labourers	8	12	22	9	10	19	7	5	4	17	28	9
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 17.4: Top unit group level occupations for VET qualified Engineering employees, by narrow field of Engineering qualification

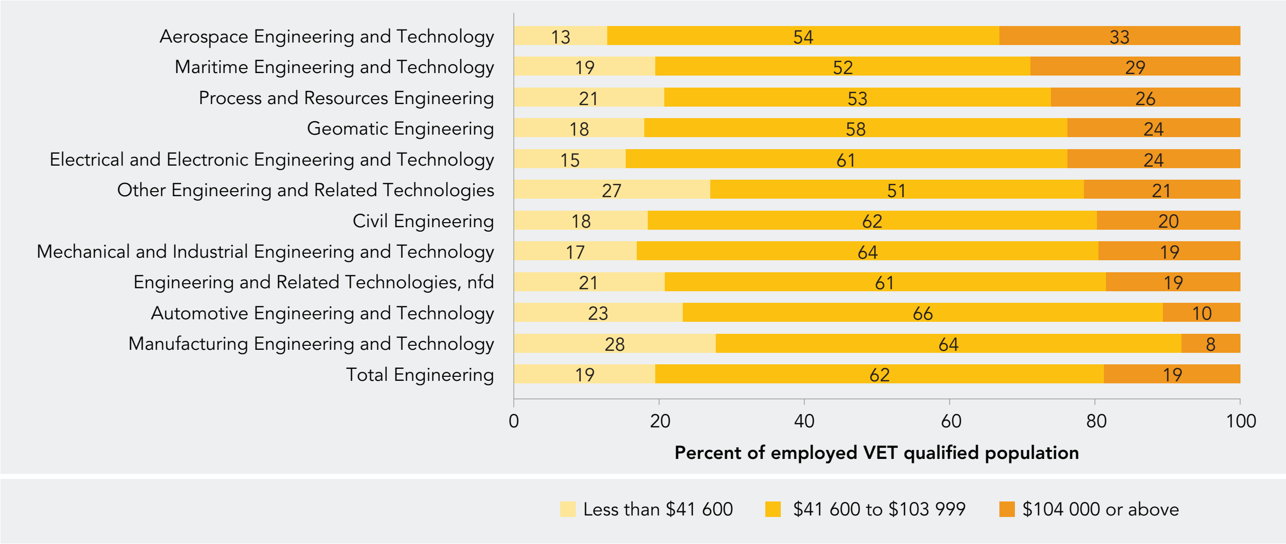
	Narrow field of education (4-digit level)										
	Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies
Top Unit group occupation (% of employed population)	Motor Mechanics (19)	Cabinetmakers (15)	Drillers, Miners and Shot Firers (10)	Motor Mechanics (23)	Metal Fitters and Machinists (18)	Civil Engineering Draftspersons and Technicians (10)	Surveyors and Spatial Scientists (37)	Electricians (38)	Aircraft Maintenance Engineers (32)	Marine Transport Professionals (24)	Fire and Emergency Workers (21)

What do people with VET Engineering qualifications earn?

In 2016, around two-thirds (62%) of the employed VET qualified Engineering population had an income between $41 600 and $103 999 (Figure 17.7). While close to one-fifth (19%) of the VET qualified Engineering population had an income of $104 000 or above, this varied substantially across the narrow fields of Engineering. People with qualifications in Aerospace Engineering and Technology had the highest proportion of workers earning $104 000 or above (33%), while people qualified in Manufacturing Engineering and Technology had the lowest (8%).

A higher percentage of males than females had a high income—19% of VET qualified males with Engineering qualifications earned $104 000 or above, compared to 6% of VET qualified females (data not shown). These percentages are similar to those for the STEM qualified VET population, where 18% of males and 6% of females earned $104 000 or above.

Figure 17.7: Income of employed VET qualified population, by narrow field of education. Data labels show percentage of each cohort



Industries and occupations of the university qualified Engineering labour force

This section analyses the employment outcomes for people with university Engineering qualifications. The size of the population in each narrow field of education is shown in Figure 17.1.

WHICH INDUSTRIES EMPLOY PEOPLE WITH UNIVERSITY ENGINEERING QUALIFICATIONS?

Table 17.5 shows the distribution of industry divisions of employment for people with university qualifications across each narrow field of Engineering. Nearly a quarter (24%) were employed in the Professional, Scientific and Technical Services industry division—the top division of employment for five of the 11 narrow fields of Engineering. Manufacturing, Construction, and Public Administration and Safety were also common industries of employment, employing 12%, 10%, and 8% of the university qualified cohort, respectively. While Retail Trade was the top industry of employment for people with Automotive Engineering and Technology qualifications, there were only 608 people with a university qualification in this field.

Table 17.5: Industry of employment for university qualified workers by narrow field of Engineering qualification. Numbers are percentage of each cohort. The darker the shade of blue, the higher the percentage

Industry division of employment	Narrow field of education											
	Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies	Total
Agriculture, Forestry and Fishing	1	1	1	1	1	1	1	1	1	2	1	1
Mining	6	2	22	2	6	2	7	2	1	4	2	6
Manufacturing	13	23	20	16	23	4	1	10	10	12	7	12
Electricity, Gas, Water and Waste Services	5	2	3	0	3	3	2	5	1	1	5	4
Construction	10	5	3	3	8	26	9	5	2	5	4	10
Wholesale Trade	4	7	4	5	6	1	1	7	2	3	4	4
Retail Trade	4	10	4	21	5	3	2	5	4	5	4	4
Accommodation and Food Services	3	4	3	5	4	2	1	3	3	5	4	3
Transport, Postal and Warehousing	5	5	3	12	5	5	3	4	36	23	3	5
Information Media and Telecommunications	4	3	1	0	1	1	1	10	1	1	2	4
Financial and Insurance Services	3	3	2	1	2	1	1	5	2	1	2	3
Rental, Hiring and Real Estate Services	1	1	1	2	1	2	2	1	1	1	1	1
Professional, Scientific and Technical Services	26	17	16	4	18	29	45	25	9	13	24	24
Administrative and Support Services	2	3	2	4	3	2	1	2	2	3	3	2
Public Administration and Safety	8	3	4	1	4	12	17	5	16	9	14	8
Education and Training	5	5	8	2	4	3	4	5	6	3	10	5
Health Care and Social Assistance	2	4	3	2	2	1	1	3	2	5	6	2
Arts and Recreation Services	1	1	1	0	1	0	1	1	1	1	0	1
Other Services	2	3	1	19	3	1	1	2	1	2	2	2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

What are the occupations of people with university Engineering qualifications?

For most narrow fields of Engineering, Professionals was the top major group occupation in 2016, representing 52% of the total university qualified population (Table 17.6). The only narrow field of education where this was not the case was in Automotive Engineering and Technology, where the leading major group occupation was Technicians and Trades Workers.

Table 17.6: Occupation of university qualified Engineers, by narrow field of education. The darker the shade of blue, the higher the percentage

	Narrow field of education (4-digit level)											
Major group occupation (1-digit level)	Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies	Total
Managers	22	20	24	11	20	21	13	15	16	15	17	20
Professionals	54	40	47	17	41	54	70	52	53	38	52	52
Technicians and Trades Workers	7	11	7	38	13	8	5	13	9	12	9	9
Community and Personal Service Workers	2	5	3	4	3	2	2	2	4	5	5	2
Clerical and Administrative Workers	6	8	6	7	7	7	5	6	7	5	6	6
Sales Workers	3	6	3	5	4	3	2	4	4	3	3	3
Machinery Operators and Drivers	2	4	4	13	5	2	1	3	3	10	2	3
Labourers	3	6	5	7	7	4	2	5	3	13	6	4
Total	**100**	**100**	**100**	**102**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

At the more detailed unit group level of occupation, there was more diversity across occupations (Table 17.7). For each narrow field of education, the top unit group occupations fell under the Professional major group occupation. The only exception was for Automotive Engineering and Technology graduates, where the most common unit group occupation was Motor Mechanics—a detailed occupation under the major group Technicians and Trade Workers.

Table 17.7: Top unit group level occupations for university qualified Engineering labour force, across the narrow fields of Engineering

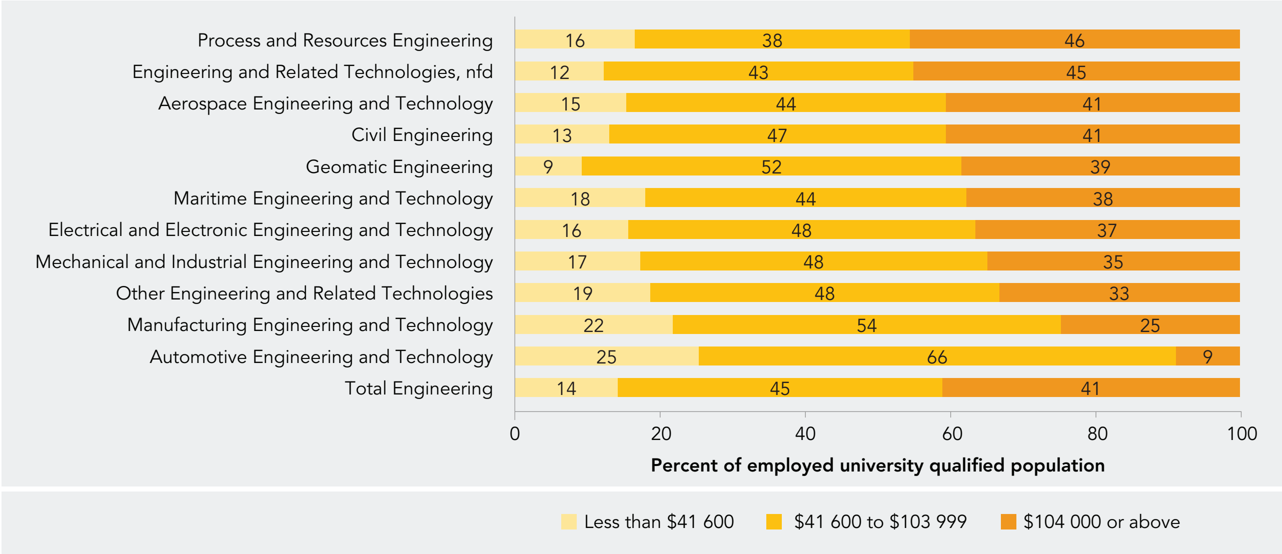
	Narrow field of education (4-digit level)										
	Engineering and Related Technologies, nfd	Manufacturing Engineering and Technology	Process and Resources Engineering	Automotive Engineering and Technology	Mechanical and Industrial Engineering and Technology	Civil Engineering	Geomatic Engineering	Electrical and Electronic Engineering and Technology	Aerospace Engineering and Technology	Maritime Engineering and Technology	Other Engineering and Related Technologies
Top Occupation (% of employed population)	Civil Engineering Professionals (11)	Industrial, Mechanical and Production Engineers (8)	Mining Engineers (11)	Motor Mechanics (28)	Industrial, Mechanical and Production Engineers (19)	Civil Engineering Professionals (41)	Surveyors and Spatial Scientists (54)	Software and Applications Programmers (12)	Air Transport Professionals (29)	Marine Transport Professionals (19)	Other Engineering Professionals (11)

What do people with university Engineering qualifications earn?

Around two-fifths (41%) of university qualified Engineers had an income of $104 000 or above, with a similar proportion (45%) earning between $41 600 and $103 999 (Figure 17.8). Of the narrow fields of education, those with qualifications in Process and Resources Engineering had the highest percentage earning an annual income of $104 000 or above, with close to half (46%) of the cohort in this group. Automotive Engineering and Technology had the smallest proportion of people earning $104 000 or above (9%)[63], followed by Manufacturing Engineering and Technology (25%).

A greater proportion of males than females had a high income—44% of males and 24% of females with university Engineering qualifications had an income of $104 000 or above (data not shown).

Figure 17.8: Income of employed university qualified population, by narrow field



63 Note that only 608 people were qualified in Automotive Engineering and Technology at this level.

Do people with Engineering qualifications work in "Engineering occupations"?

Although the Office of the Chief Scientist does not distinguish between STEM and non-STEM occupations, other organisations have developed classification systems that allow for more in-depth analysis of the workforce destinations of people with Engineering qualifications.

There are 358 4-digit (detailed) unit group occupations in the ANZSCO list. According to Engineers Australia, 51 of these occupations can be considered as Engineering occupations (Appendix A). These occupations require formal Engineering qualifications, the applications of Engineering skills, and attachment to the Engineering profession.

While the following analysis uses the Engineers Australia's list of occupations (Appendix A), the population analysed in this report is not comparable with Engineers Australia research. Table 17.8 shows the population analysed in this section and the population used by Engineers Australia. The university population is used in this section to align the analysis with the rest of this report.

In this section, 'Engineering occupations' refers to people with university Engineering qualifications working in Engineers Australia defined Engineering occupations, and 'Non-Engineering occupations' refers to people with university Engineering qualifications working in any other occupation.

In 2016, the majority (63%) of people with university qualifications in Engineering worked in Engineering occupations. The cohort working as Professionals had the highest percentage of workers holding Engineering occupations (84%, Figure 17.9), followed by Managers (71%), Technician and Trades workers (41%), and Clerical and Administrative Workers (39%).

Table 17.8: A comparison between the population analysed in this section and the population usually analysed by Engineers Australia

Engineering population analysed in this section	Engineering population used by Engineers Australia
People with university qualifications in Engineering (bachelor degrees and above)	Professional Engineers (4-year degrees or higher)
	Engineering Technologists (3-year degrees)
	Engineering Associates (Associate degrees and Advanced Diplomas)

Are Engineering occupations more common for graduates of some narrow fields of Engineering?

The narrow field of Engineering qualification with the highest proportions of graduates working in Engineering occupations was Civil Engineering (74%), followed by Electrical and Electronic Engineering and Technology (62%, Figure 17.10). The fields where the lowest percentage of graduates held Engineering occupations were also those with the smallest number of university graduates —Automotive Engineering and Technology (101 graduates in Engineering occupations, 18% of the population with university Automotive Engineering qualifications) and Geomatic Engineering (61 graduates, 23% of the population).

Figure 17.9: Number of employed people with university Engineering qualifications working in Engineering and non-Engineering occupations as defined by Engineers Australia, by major group occupation

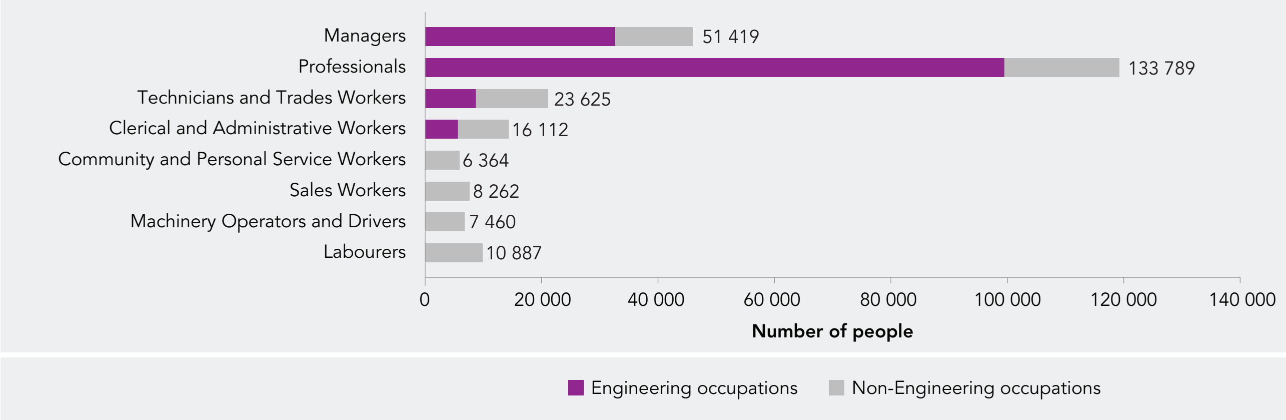
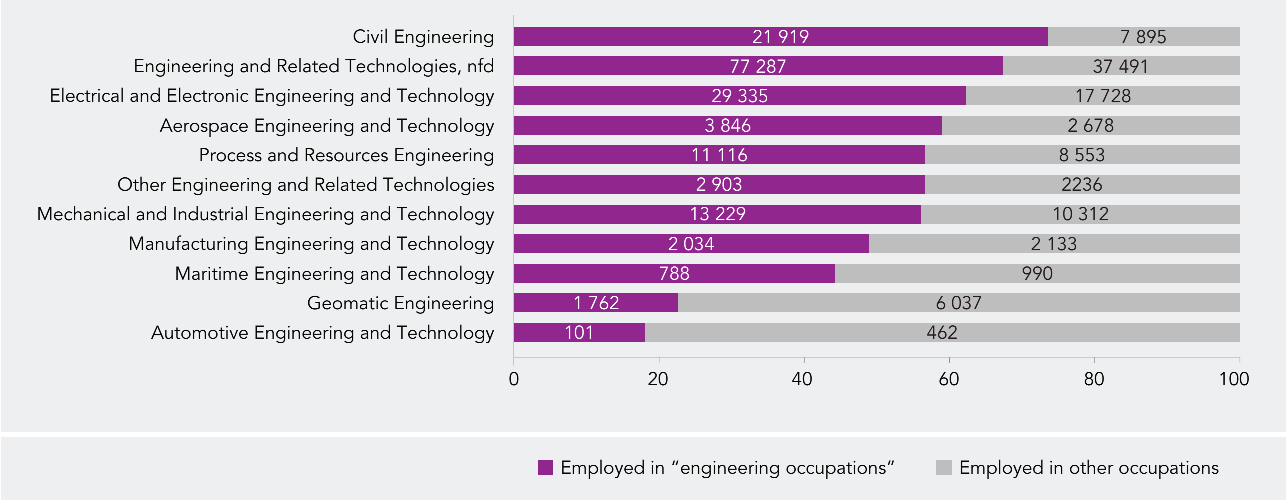


Figure 17.10: Proportion of workers with university Engineering qualifications employed in Engineers Australia defined Engineering occupations, by narrow field. Data labels show the number of workers



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APPENDIX A

A

ENGINEERS AUSTRALIA ENGINEERING OCCUPATIONS, BY ANZSCO MAJOR, SUB-MAJOR, MINOR AND UNIT GROUPS

This list contains the 4-digit ANZSCO occupations identified by Engineers Australia as engineering occupations (Kaspura, 2010).

1 MANAGERS	
11	**CHIEF EXECUTIVES, GENERAL MANAGERS AND LEGISLATORS**
111	**Chief Executives, General Managers and Legislators**
1111	Chief Executives and Managing Directors
1112	General Managers
13	**SPECIALIST MANAGERS**
132	**Business Administration Managers**
1324	Policy and Planning Manager
1325	Research and Development Manager
133	**Construction, Distribution and Production Managers**
1331	Construction Manager
1332	Engineering Manager
1334	Manufacturers
1335	Production Manager
1336	Supply and Distribution Manager
134	**Education, Health and Welfare Services Managers**
1344	Other Education Managers
135	**ICT Managers**
1351	ICT Managers

139	**Miscellaneous Specialist Managers**
1391	Commissioned Officers
1392	Senior Non-commissioned Defense Officer
1399	Other Specialist Managers

2	**PROFESSIONALS**
22	**BUSINESS, HUMAN RESOURCE AND MARKETING PROFESSIONALS**
224	**Information and Organisation Professionals**
2241	Actuaries, Mathematicians and Statisticians
2242	Intelligence and Policy Analysts
2247	Management and Organisational Analysts
225	**Sales, Marketing and Public Relations Professionals**
2252	ICT Sales Professionals
2254	Technical Sales Professionals
23	**DESIGN, ENGINEERING, SCIENCE AND TRANSPORT PROFESSIONALS**
231	**Air and Marine Transport Professionals**
2311	Air Transport Professionals
2312	Marine Transport Professionals
232	**Architects, Designers, Planners and Surveyors**
2326	Urban and Regional Planners
233	**Engineering Professionals**
2331	Chemical and Materials Engineers
2332	Civil Engineers
2333	Electrical Engineers
2334	Electronic Engineer
2335	Industrial, Mechanical and Production Engineers
2336	Mining Engineers
2339	Other Engineers
234	**Natural and Physical Science Professionals**
2343	Environmental Scientist
2349	Other Physical Sciences

24	**EDUCATION PROFESSIONALS**
242	**Tertiary Education Teachers**
2421	University Lecturers and Tutors
2422	Vocational Education Teachers
26	**ICT PROFESSIONALS**
261	**Business and Systems Analysts, and Programmers**
2611	ICT Business and Systems Analysts
2613	Software Developers
262	**Database and Systems Administrators, and ICT Security Specialists**
2621	Database and Systems Administrators
263	**ICT Network and Support Professionals**
2631	Computer Network Professionals
2632	ICT Support and Test Engineers
2633	Telecommunications Engineering Professionals

3	**TECHNICIANS AND TRADES WORKERS**
31	**ENGINEERING, ICT AND SCIENCE TECHNICIANS**
312	**Building and Engineering Technicians**
3121	Architectural, Building and Surveying Technicians
3122	Civil Engineering Draftspersons and Technicians
3123	Electrical Engineering Draftspersons and Technicians
3124	Electronic Engineering Draftspersons and Technicians
3125	Mechanical Engineering Draftspersons and Technicians
3126	Safety Inspectors
3129	Other Engineering Technicians
313	**ICT and Telecommunications Technicians**
3131	ICT Support Technicians
3132	Telecommunications Technical Specialists

5	**CLERICAL AND ADMINISTRATIVE WORKERS**
51	**OFFICE MANAGERS AND PROGRAM ADMINISTRATORS**
511	**Contract, Program and Project Administrators**
5111	Contract, Program and Project Administrators

LIST OF TABLES AND FIGURES

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