

# STEM CAREER PATHWAYS

MAJOR RESEARCH REPORT | AUGUST 2023

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# OVERVIEW

To help address Australia's current and future workforce challenges in science, technology, engineering and mathematics (STEM), the Prime Minister's National Science and Technology Council identified the need for a detailed analysis of STEM Career Pathways.

This report was commissioned by the Office of the Chief Scientist in February 2023 to inform the council's deliberations and its advice to Government.

The central research question asked was:

**"What are the barriers to STEM career pathways that need to be addressed, and solutions to enable opportunities for all Australians and to develop our STEM workforce for the future?"**

The task was to identify issues that currently limit STEM career opportunities – along with an assessment of options to address those issues in line with international best practice.

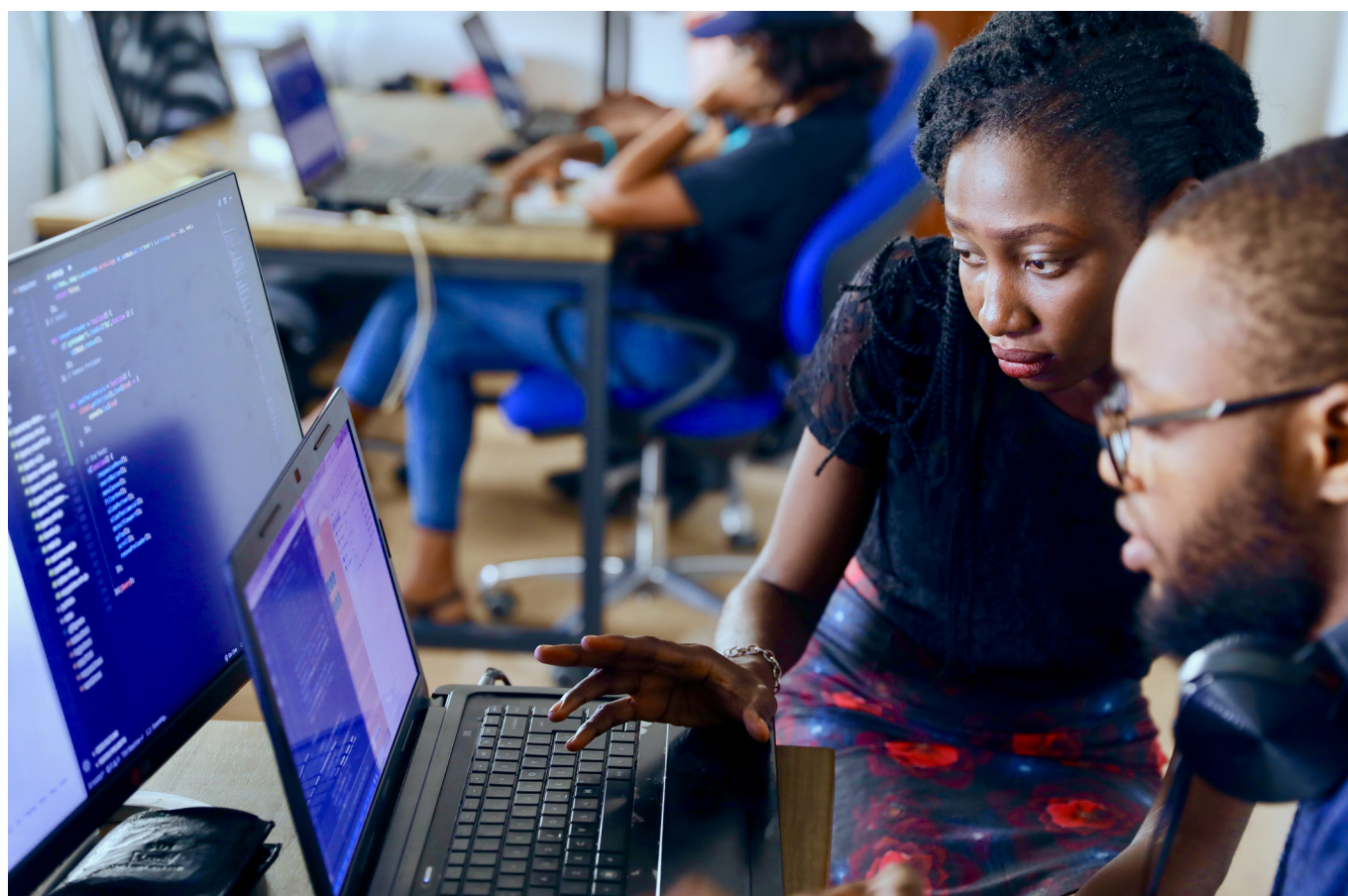
The report's focus is on retention in STEM careers and enabling a wide range of career pathways and career movement across the sector. This includes the visibility of the breadth of STEM careers.

It also illuminates barriers to STEM workers across career stages, including at critical transition points.

This work complements recent and current reviews in the science and education systems including:

- a Senate Inquiry into Job Security in the Higher Education sector
- Review of the Australian Research Council (Department of Education)
- Australian Universities Accord (Department of Education)
- University Research Commercialisation Action Plan (Department of Education)
- National Science and Research Priorities Revitalisation (Department of Industry, Science and Resources)
- Review of Diversity in STEM (Department of Industry, Science and Resources)
- The Modernising Research Assessment project (Australian Council of Learned Academies for Australia's Chief Scientist).

This research report was prepared by Science & Technology Australia, and overseen by an eminent expert group of STEM sector leaders chaired by Professor Mark Hutchinson. By design, these commissioned reports offer a synthesis of the available data and information at the time they are produced, and are peer reviewed by experts in the field. They typically do not provide direct recommendations or policy advice to government.



## Definition of a STEM career

For this report, ‘STEM careers’ was taken to include both ‘STEM careers’ and ‘careers that use STEM skills’. The research sought insights from a wide array of people in Australia’s STEM workforce with post-secondary education qualifications in science, technology, engineering or mathematics – spanning both vocational education and training credentials and university degrees. The scope of STEM careers analysed included people working in health and medical research, for instance, but not people working as doctors or nurses.

## Research methods

This project has gathered comprehensive evidence on barriers to retention and mobility in STEM careers through a thorough academic literature review, a large-scale national survey of nearly 3,500 STEM-qualified people across Australia, and a series of consultations with stakeholders including employers, employees, research peak bodies and education peak bodies.

## Limitations

The major survey had a large sample size of almost 3,500 people, enabling the authors to draw confident conclusions from the data. Statements about survey findings are made only where there are sufficient respondents to enable strong confidence to draw conclusions. While it has a large sample size – larger than most other comparable research studies – and was distributed through wide networks across the STEM sector, the survey was self-selecting. The sample therefore differs from the wider population (that is, the STEM workforce).

The survey sample is a convenience sample – not a random sample – making it vulnerable to selection bias. This also means that a response rate cannot be calculated. Comparing the survey sample with the most recent *Report on the STEM Workforce* published in 2020 by the Office of the Chief Scientist shows some differences in demographic, employment and qualifications variables.

The sample represents a different mix of STEM careers and employment sectors that leans towards universities and other research organisations. While the survey sample is not – and does not purport to be – a representative sample of every single STEM occupation and field, it achieved excellent representation of the range of research careers, and good representation of other STEM professions and careers.

## Abbreviations

<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation
<b>ECRs</b>	Early-Career Researchers
<b>EMCRs</b>	Early and Mid-Career Researchers
<b>HDR</b>	Higher degrees by research
<b>IP</b>	Intellectual property
<b>IT</b>	Information technology
<b>MRI</b>	Medical research institutes
<b>NSC</b>	National Skills Commission
<b>NFP</b>	Not-for-profit organisation
<b>PECS</b>	Physics, engineering, computer science
<b>PFRA</b>	Publicly funded research agency includes CSIRO, Geoscience Australia, the Australian Nuclear Science and Technology Organisation (ANSTO), Australian Antarctic Division and the Australian Institute of Marine Science
<b>PhD</b>	Doctor of Philosophy
<b>R&amp;D</b>	Research and development
<b>STA</b>	Science & Technology Australia
<b>STEM</b>	Science, technology, engineering, maths
<b>VET</b>	Vocational Education and Training
<b>WIL</b>	Work integrated learning

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# EXECUTIVE SUMMARY

Science & Technology Australia undertook this research project on STEM Career Pathways for the Office of the Chief Scientist. This evidence will inform the deliberations of the Prime Minister's National Science and Technology Council.

The STEM Career Pathways project examined barriers to starting and developing STEM careers, and interventions – both actual and potential – to dismantle those barriers. This report draws on a comprehensive evidence base to analyse transitions from post-secondary education and training into the STEM workforce, retention in STEM careers and mobility across the STEM sector between industry, universities, STEM agencies, defence and the public sector. This project synthesised the existing literature on these issues and gathered robust new data through two major exercises:

- A large national survey of nearly 3,500 STEM-qualified people across Australia in mid-2023.
- A series of consultations with stakeholders including employers, employees, research peak bodies and education peak bodies.

**This executive summary is a snapshot of key themes identified in evidence from the literature and new data gathered for this research project. It is underpinned by detailed analysis in the body of the report, which references the supporting evidence in the published literature for each insight.**

## Context: Australia's growing demand for STEM skills

Australia faces a growing demand for workers with STEM qualifications and skills. The National Skills Commission (NSC) reports STEM occupations have been growing faster than non-STEM occupations:

*“Over the 20-year period to February 2020, before the impact of the COVID-19 pandemic on the labour market, employment in STEM occupations grew by 85.0%, or more than twice the rate of non-STEM occupations (which grew by 40.2%).<sup>1</sup>”*

This trend is set to continue over the next five years:

*“Employment in STEM occupations (using science, technology, engineering and maths skills) is projected by the NSC to grow by 12.9%, well above the average of all occupations (of 7.8%) and more than twice as fast as non-STEM occupations (6.2%).<sup>2</sup>”*

To meet our urgent workforce needs, not only must Australia expand the number of people acquiring STEM qualifications and entering our STEM workforce: we must also get better at retaining people in STEM careers. Forging stronger connections and talent movement across the breadth of Australia's STEM sector will help to achieve this goal: diverse and interesting careers are a wellspring of both innovation and talent retention.

## STEM qualifications and skills are valuable – and valued

This new research reveals the strong value of a STEM qualification to both employers and STEM workers. It finds STEM skills are increasingly used in a wide variety of occupations – and that STEM qualifications prepare people well for a broad range of jobs. It highlights that people who work in STEM careers are typically deeply committed to working in STEM. And it confirms that a passion for STEM and a desire to solve complex problems keeps many people in STEM careers – even when they encounter barriers.

But those barriers make it harder for some people to thrive and to stay in STEM careers. This research project identified barriers and potential interventions across three broad areas.

The first major area for action is to strengthen **workplace practices** to help STEM-qualified workers stay in STEM careers. This includes steps to enhance workplace flexibility, job security, workplace cultures and more inclusive workplace practices. Job insecurity is an acute issue in the STEM research sector - and intense competition for scarce competitive research funding grants damages research workplace cultures. Working hours are long in STEM jobs – averaging the equivalent of a 6-day working week.

This research found evidence that working parents, people returning from career breaks and people in the STEM workforce juggling caring responsibilities for both children and the elderly encounter barriers to career progression and success. Insufficient flexibility in workplaces compounds the challenges for these STEM workers.

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*To meet Australia's urgent workforce needs ... we must get better at retaining people in STEM careers.*

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1 National Skills Commission. (2021) 'The State of Australia's Skills 2021: now and into the future', Commonwealth Government of Australia [nationalskillscommission.gov.au/reports/state-of-australia-skills-2021](https://nationalskillscommission.gov.au/reports/state-of-australia-skills-2021)

2 National Skills Commission. (2021) 'The State of Australia's Skills 2021: now and into the future', Commonwealth Government of Australia [nationalskillscommission.gov.au/reports/state-of-australia-skills-2021](https://nationalskillscommission.gov.au/reports/state-of-australia-skills-2021)



The survey also reports on experiences of discrimination or harassment – although at lower self-reported rates in STEM careers than data for the broader Australian workforce.

Employers have a pivotal leadership role to strengthen workplace practices, adopt more inclusive recruitment practices, and improve workplace cultures to help STEM workforce retention. The second major area is expanding access to STEM **skills and experience** sought by STEM employers and needed by STEM workers to advance their careers.

These barriers include a lack of knowledge about the wide array of STEM jobs and career options that people can pursue with a STEM qualification. Others are a lack of wide access to mentoring, career coaching and supervisors who actively nurture the careers of their staff.

The study also identifies challenges in how well people with STEM qualifications can articulate their skills and value clearly to prospective new employers. This not only hampers transitions into a first STEM job, but also career mobility back and forth across segments of the STEM sector. We found experience in other segments of the STEM sector is not recognised consistently, stymieing STEM career mobility.

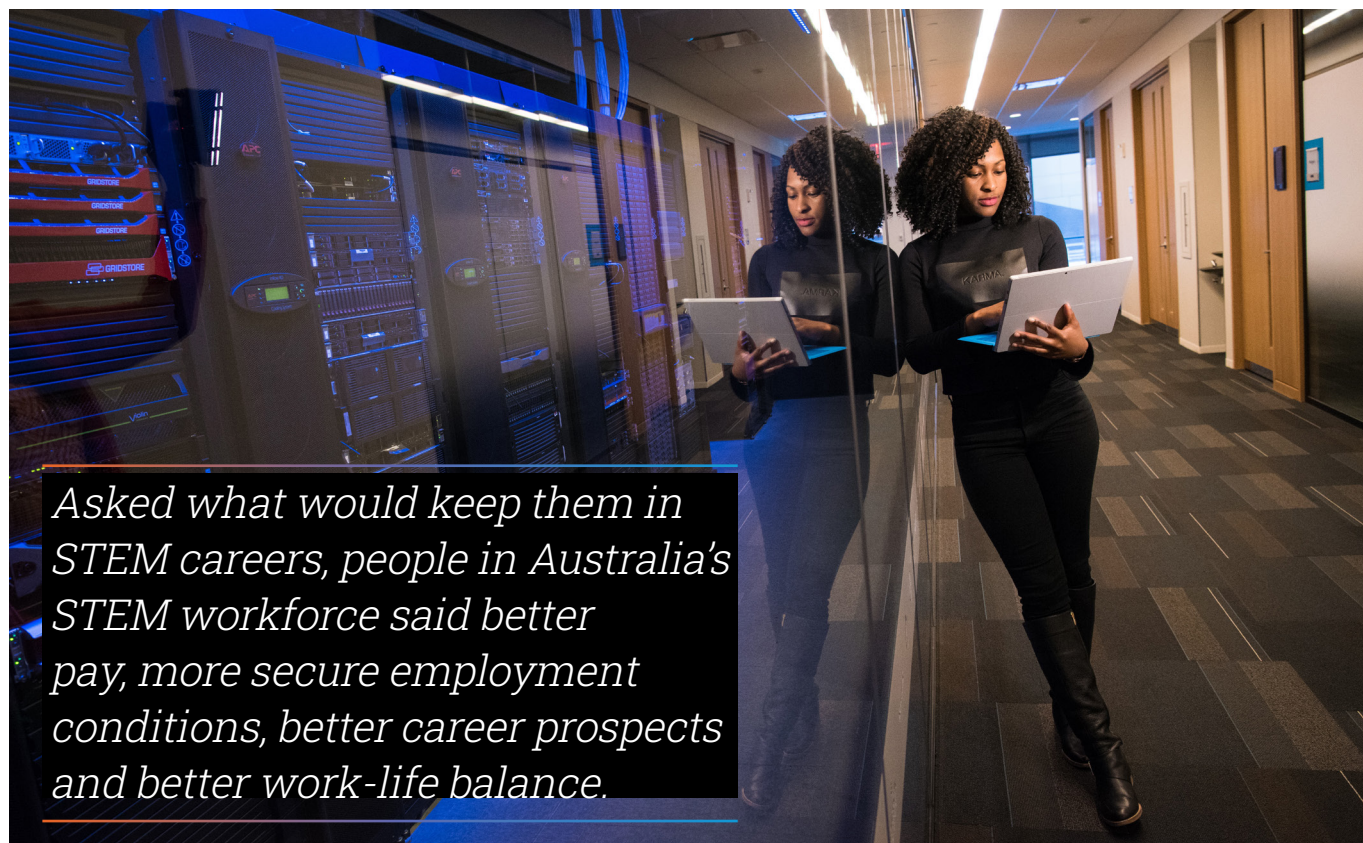
STEM workers are cognisant that additional practical skills and experience can help them progress their careers or move between various sectors of the STEM workforce. Their insights highlight a need for broader access to work experience or work placements during STEM education and broader access to professional development opportunities during their career.

Reforming **system-wide settings** to ensure Australia has the STEM workforce it needs for the future is the third area for action to improve STEM careers in Australia. This research report found evidence that Australia's comparatively low level of business R&D investment is a barrier to STEM career mobility. Policy settings to encourage business to invest more heavily in R&D would diversify and boost the productive capacity of Australia's economy – and also strengthen STEM career pathways and STEM career mobility.

Yet, this research finds stronger overall evidence of career mobility in STEM than is often suggested. It reveals many people in Australia's STEM workforce found it easy to make one shift across the sector in their STEM career – a phenomenon we term 'the diode effect'. But it reveals it is much harder for people to forge careers in which they move back and forth repeatedly between parts of the STEM sector. This barrier can be dismantled by boosting awareness and availability of STEM mobility programs across all career stages.

To fill some of the nation's skills shortages in STEM, Australia currently relies on skilled migrants and on international graduates on post-study work visas. There is an opportunity to better integrate these groups into Australia's STEM workforce by boosting employer understanding of overseas qualifications and international graduates' post-study work rights. Asked what would keep them in STEM careers, people in Australia's STEM workforce said better pay, more secure employment conditions, better career prospects and better work-life balance.

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*Asked what would keep them in STEM careers, people in Australia's STEM workforce said better pay, more secure employment conditions, better career prospects and better work-life balance.*

## STEM career pathways report: key insights from this research

### Workplace practices

#### **Most STEM workers enjoy their jobs.**

More than 70% of STEM-qualified people are satisfied or very satisfied with their jobs and work environment; almost 70% of STEM-qualified people are happy with work/life balance, and more than 60% of STEM-qualified people are satisfied or very satisfied with job security and pay.

#### **STEM-qualified people want better working conditions and more varied career options.**

Asked to identify factors that would make it more likely for STEM workers to stay in STEM, 41% of people said 'better pay', 31% said 'more secure employment conditions', 27% said 'better career prospects' and 24% said 'better work/life balance'.

#### **Job insecurity is a barrier to retention in STEM careers.**

This is particularly acute in Australia's STEM research sector. Researchers, both in Australia and overseas, often identify the research funding system as a driver of job insecurity and short-term employment. Australia's relatively low levels of research funding compared to other advanced economies fuels this situation.

#### **Job insecurity and intense competition for grant funding damage research workplace cultures.**

'Internal competition' resulting from short-term research funding and job insecurity is a STEM career barrier, that damages workplace culture and job satisfaction. STEM researchers described it as a brutal 'hamster wheel' of running constantly to apply for grants, which has a pernicious impact on workload and job satisfaction.

#### **Women are less likely to be on permanent full-time contracts, and more likely to be on fixed-term contracts.**

58% of women, compared to 78% of other genders were on permanent full-time contracts, and 31% of women, compared to 19% of other genders, were on fixed-term contracts.

#### **Juggling a STEM career and caring responsibilities can be challenging.**

People in the STEM workforce with caring responsibilities said their exclusion from work activities held outside of standard working hours, such as evening meetings or networking events, had a detrimental effect on their career.

#### **Women in STEM careers are carrying major workloads both at work and at home.**

Women doing 30 or more hours' unpaid domestic work in a week are also averaging a 40-hour week in their paid jobs in STEM.

#### **The 'sandwich generation' effect is clear for STEM workers with caring responsibilities – particularly women.**

Nearly 4 in 5 STEM-qualified people who have caring responsibilities for someone who is aged, disabled or chronically ill are concurrently caring for children. Two-thirds of those doing both forms of unpaid care were women.

#### **Career breaks present major challenges – particularly in STEM research careers.**

Despite comparatively high parental leave entitlements for some elements of the STEM research workforce, the requirements and pressure to maintain and thrive in a research career can make it hard for parents to stay in and advance in STEM research careers.

#### **Transparent criteria and processes make recruitment and promotions fairer and more effective.**

This can help employers to identify talent and potential wherever it may be found, contributing to greater diversity in the workforce.

#### **Large companies should lead the way in diversity and inclusion.**

'Prestige employers' – large organisations with strong profiles and influence – in both the public and private sectors could use their profile to make important public commitments to diversify recruitment and the STEM workforce.

### Skills and Experience

#### **Employers value their employees' STEM qualifications.**

89% of people working in medical research institutes, 88% of people working in universities, 77% of people in the private sector and 78% of those working in the public service said employers valued their STEM qualifications.

#### **STEM workers value their STEM qualifications.**

88% of people with STEM qualifications said their STEM qualification was important in getting their job and 90% said their STEM qualifications were important to be able to do their job.

#### **STEM skills are not always understood by employers – or communicated effectively by STEM graduates.**

Graduates can struggle to demonstrate – and employers struggle to identify – how core technical and discipline-specific skills, knowledge and experience gained in university study or research can be applied in a wide array of workplaces.

### **STEM workers want to use their STEM skills – and have these skills valued – in their jobs.**

Stakeholders in the consultations for this project highlighted that retention of STEM-qualified people in careers depends on their skills being valued and used.

### **Most STEM workers have access to training and professional development.**

90% of people said they had taken up opportunities to do training or professional development. 85% of people surveyed said their employers supported staff to do formal training and/or professional development – but in some cases these opportunities were not offered to people on short-term contracts or part-time workers.

### **Financial constraints can impede access to work-integrated learning.**

A major barrier identified was the cost – being unable to continue in paid work – to students when undertaking placements.

### **Mentoring is an effective career support – but is only accessible to some STEM workers.**

Nearly 20% of people with STEM qualifications currently had a mentor – and nearly 80% of people found it beneficial. A more systematic approach to mentoring and development throughout careers would support STEM-qualified people to develop and diversify their careers.

## **System-wide settings**

### **STEM skills are increasingly used in a wide variety of occupations and STEM degrees prepare people well for any job.**

This applies particularly in jobs that require critical thinking and complex problem solving – and many jobs now make more direct and intensive use of STEM skills ('STEMification').

### **STEM workers have a positive view of their career prospects.**

64% of people with STEM qualifications considered their career prospects 'very good' or 'excellent'. Only 9% felt their career prospects were poor.

### **Most STEM workers are confident they'll stay in STEM careers.**

63% of people with STEM qualifications were 'quite confident' or 'very confident' they would be working in STEM in five years. 15% were not confident of a medium-term future in STEM.

### **Too often, there is a narrow 'single-track' view of STEM careers.**

Several informants said university cultures encourage narrow views about careers with an over-emphasis on academic research as the notional 'pinnacle of success' in a STEM career can limit career aspirations beyond academia.

### **More than half of STEM-qualified people have worked in another part of the STEM sector.**

54% of people reported they had previously worked in a different segment of the STEM sector from their current employment – indicating movement across different parts of the STEM sector may not be as limited as often suggested.

### **More than half of STEM-qualified people reported it's easy to move between sectors.**

53% of people said it was 'quite easy' or 'very easy' to move between sectors with a STEM qualification. Only 22% of people said it was 'somewhat difficult' or 'very difficult'.

### **Mobility is slightly less easy for people with PhDs.**

47% of people with STEM PhDs said it was 'quite easy' or 'very easy' to move across the sector. 29% of people with a PhD said it was difficult to move between sectors.

### **STEM career mobility is often only one way – 'the diode effect'.**

Employers in different sectors value and assess their STEM workers differently, making it difficult to move back to the first sector after working elsewhere in STEM.

### **Awareness of and access to formal STEM career mobility programs is low.**

Only 21% of people were aware of formal mobility opportunities such as secondments, internships, sabbaticals, graduate programs with rotations, or programs that enabled them to move between sectors and these were not available to all STEM professionals.

### **The effectiveness of current STEM career mobility programs is highly variable.**

46% of people who had participated in a mobility program felt it had low impact, 20% rated their impact as medium and 33% as high impact.



# Barriers and potential solutions to strengthen STEM career retention

	BARRIERS	POTENTIAL SOLUTIONS	SECTION
WORKPLACE PRACTICES	Job insecurity was identified as a major barrier in STEM research careers in Australia – especially in universities and medical research institutes, driven by insecure research funding and the widespread use of short-term contracts even on projects with multi-year funding.	In line with international best practice, move to a more secure system of research funding in Australia and create more longer-term major research fellowships to give STEM researchers crucial security to pursue STEM breakthroughs. Specify minimum terms of employment for researchers on projects funded by competitive grants from Australia's major research granting agencies.	<a href="#">2.10</a>
	1 in 3 STEM-qualified people with childcare responsibilities said personal or family circumstances had been a 'high-impact' career barrier.	Improve workplace policies and cultures to support working parents with childcare responsibilities – including offering job-sharing and part-time roles, flexibility with working hours, avoiding out-of-hours scheduling, and adjusting KPIs to reflect part-time hours.	<a href="#">2.13</a>
	A lack of support after returning from a career break was cited as a 'high-impact' career barrier for 1 in 5 women and almost 1 in 7 of other STEM-qualified people.	Stronger support and workplace flexibility for parents and others returning from a career break to return to the STEM workforce.	<a href="#">2.13</a>
	Discrimination, harassment or bullying (although at lower self-reported rates in STEM than rates for people in the wider Australian workforce and society).	Actively foster workplace cultures free from discrimination, harassment and bullying with strong and consistent messages from leaders, managers and supervisors.	<a href="#">2.14</a>
	A lack of consistently clear and transparent criteria and processes for recruitment and promotion.	Share best practice examples of clear and transparent information on criteria and processes for recruitment and promotion across STEM-employing organisations.	<a href="#">3.4</a>
SKILLS AND EXPERIENCE	A lack of information visible to STEM employers on the curriculum content of STEM degrees and expected graduate skills and capabilities.	Publish clearer information on higher education and VET websites about the granular curriculum content of STEM qualifications and the expected graduate skills and capabilities.	<a href="#">2.1.1</a>
	A 'single-track' education and training model in which people typically study either at university or VET – but seldom do both concurrently – leaves some graduates without some of the practical skills needed from day one in the STEM workplace.	Expand employer-run programs that offer workers 'twin-track' options to do both a degree and a vocational apprenticeship concurrently to develop analytical and practical skills. Closer collaborations between universities, VET providers and Registered Training Organisations to supplement STEM degree knowledge with 'day-one job-ready' practical skills.	<a href="#">2.2</a>
	Not enough students have access to work-based placements during their post-secondary education to prepare them for the workforce – and the cost of doing an unpaid placement can be prohibitive for students who cannot afford to miss paid work.	Expand work-based placements in post-secondary education including wage offset support for students in financial hardship who cannot afford to miss paid work.	<a href="#">2.3</a>
	Limited access to micro-credential training programs to upskill workers in the latest advances in many STEM fields and acquire the specialised technical skills needed in many STEM fields.	Expand access to micro-credential courses to rapidly upskill more of Australia's STEM workforce in the latest advances in technology and the specialised technical skills needed in many STEM fields.	<a href="#">2.14.1</a>
	Limited access to mentoring, active career coaching from supervisors, and informal career support or advice from professional and personal networks to help people develop their STEM careers.	Expand access to mentoring, career coaching and professional development for STEM-qualified people – and equip workplace supervisors with stronger skills in how to actively nurture their staff's careers.	<a href="#">2.14.2</a>
SYSTEM-WIDE SETTINGS	Limited understanding among employers of post-study work rights for international graduates is a barrier to recruitment of international graduates with an Australian VET or university qualification in STEM.	Expand employer outreach to raise awareness of post-study work rights for international students who have an Australian VET or university qualification in STEM.	<a href="#">2.4</a>
	Employer reluctance to hire skilled migrants with STEM qualifications acquired overseas is a barrier to a pool of highly qualified and skilled STEM workers – including in fields with acute workforce shortages such as engineering.	Support programs that enable the workforce placement of skilled migrant STEM professionals who have not been able to secure jobs in Australia's STEM workforce.	<a href="#">2.4</a>



## Barriers and potential solutions to strengthen STEM career mobility

	BARRIERS	POTENTIAL SOLUTIONS	SECTION
WORKPLACE PRACTICES	Consultations with stakeholders – including employer peak bodies and a range of diverse employers – identified recruitment practices as a barrier to the employment of STEM workers, especially people from groups traditionally under-represented in STEM.	Raise awareness among STEM employers of the benefits of widening their talent pool of STEM skills through more inclusive recruitment processes including assessing skills rather than experience.	<a href="#">3.4</a>
	Some STEM employers only classify years in paid employment as relevant experience, which actively discriminates against PhD graduates and their workplace-ready skills acquired in PhD study including project management.	Raise awareness among more STEM employers of the workplace-equivalent skills and capabilities of people with PhDs – and include more explicit policies to HR teams in hiring practices.	<a href="#">3.4</a>
SKILLS AND EXPERIENCE	Many STEM workers find it difficult to articulate to employers how their STEM skills and knowledge could be applied in another sector.	Offer training across the STEM workforce to help more STEM workers articulate the applicability of their skills and knowledge in a new sector.	<a href="#">3.2</a>
	A lack of knowledge and networks with people working in other parts of the STEM sector makes it harder for STEM workers to consider career moves across the sector.	Support initiatives to promote STEM workers having mentors, networks and connections in other parts of the STEM sector.	<a href="#">3.2</a>
	STEM workers looking to enter the private sector felt employers placed too much emphasis on previous experience in the private sector.	Support industry research initiatives that connect PhD students and post-doctoral researchers with private sector businesses to support their R&D and offer researchers experience in the private sector.	<a href="#">3.6</a>
SYSTEM-WIDE SETTINGS	Limited awareness across the STEM workforce of formal mobility opportunities such as secondments, internships, sabbaticals, graduate programs with rotations or programs that enable moves between sectors.	Create more opportunities for employers to promote talent exchange with other sectors.	<a href="#">3.3</a>
	Some mobility schemes in STEM focus on young people, students or people early in their careers, with fewer opportunities for STEM workers further advanced in their careers.	Expand opportunities for career mobility programs across the STEM sector that recruit people at all career stages.	<a href="#">3.3</a>
	Low levels of business R&D in Australia and a lack of appreciation for STEM R&D skills in Australian businesses limit STEM career options in industry compared to other countries.	Expand programs that incentivise businesses to engage with universities and research institutes to create more research-active businesses across the Australian economy	<a href="#">3.5</a>
	STEM-qualified researchers said traditional metrics to measure researcher success were irrelevant to other sectors and this was a barrier to mobility out of research roles.	Metrics for research success should take account of a wider variety of academic activity.	<a href="#">3.7</a>

# 1. INTRODUCTION



The STEM Career Pathways project gathered evidence about the current barriers to starting STEM careers, and to progressing and developing STEM careers. Importantly, the study also examines actual and prospective interventions to address these barriers.

The two key areas of focus are:

- **Retention of a STEM-trained workforce**, including the transition from post-secondary education.
- **Mobility of STEM workers between sectors**, including between academia, industry and government.

The STEM Career Pathways project operated in close collaboration with two other concurrent government-initiated projects:

- The **Diversity in STEM Review** led by an independent expert panel and supported by the Department of Industry, Science and Resources.
- The **Modernising Research Assessment** project being delivered by the Australian Council of Learned Academies for Australia's Chief Scientist.

The STEM Career Pathways project included a comprehensive review of evidence in literature – both Australian and international. This covered academic literature as well as 'grey' literature (such as government reports and policy analysis by professional and peak bodies).

Studies identified in the literature review discussed the barriers and challenges in STEM careers, and potential solutions to address them. In most cases, those solutions were of a general nature, prospective or hypothetical (proposing new interventions or reviewing encouraging preliminary results of an intervention rather than evaluating long-term programs). Many studies discussed interventions to improve retention in STEM, but these interventions were often modest in size and limited to particular fields, occupations or industries. There was little evidence in the literature either in Australia or overseas of systematic coverage of large-scale retention strategies by governments or employers. More generally, the literature commented on the lack of a systematic human resource development approach in discussions about demand for and supply of STEM skills.<sup>3</sup>

This STEM Career Pathways project collected robust new data on current challenges and opportunities in STEM careers, and used this data to identify key pressure points in career development, and actual and potential interventions to dismantle those barriers.

The project undertook a major survey of people with STEM qualifications, including those in the STEM workforce and STEM-qualified people not currently in the STEM workforce. It included people employed in non-STEM jobs and people not in paid work who were studying or looking for work.

The survey collected data on a large-scale cross-section of STEM-qualified people and asked about:

- qualifications
- employment
- experience of training and professional development
- experience of mobility between employment sectors
- views about career prospects
- experience of discrimination, harassment and bullying
- experience of career barriers.

The project also included a series of consultations with key stakeholders, including employers in both the public and the private sector, research and education peaks, government agencies, learned academies, professional bodies and early and mid-career researchers (EMCRs).

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*Many current interventions to improve retention in STEM are modest in size or limited to particular fields, jobs or industries.*

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3 Waite, AM and McDonald, KS. (2018) 'Exploring Challenges and Solutions Facing STEM Careers in the 21st Century: A Human Resource Development Perspective', *Advances in Developing Human Resources*, 21(1) [doi.org/10.1177/1523422318814482](https://doi.org/10.1177/1523422318814482)

Stakeholder consultations addressed four main subject areas:

1. Recruitment of STEM-qualified people into STEM occupations and careers.
2. Retention of STEM-qualified people in STEM careers (and factors which help or hinder this).
3. Mobility around different sectors of employment (e.g. from academic research to industry and vice versa).
4. Equity and diversity.

New evidence collected as part of this project delivers a strong evidence base to identify the major STEM career barriers that cause the most acute challenges for employees and employers. Yet the evidence also suggests that some challenges in the STEM workforce may be less acute – or less widely prevalent – than is sometimes asserted. The evidence from both stakeholder consultations and the large-scale workforce survey gives strong clarity on the kinds of interventions needed to improve retention and mobility and to the likely impact of these interventions if they are well designed, strongly resourced and consistently adopted.

The STEM Career Pathways Report has three sections. Each brings together evidence from the established academic literature with new insights and evidence from this project's survey and stakeholder consultations. Each section includes highlighted insights that draw out new data on Australia's STEM workforce, as well as summaries of barriers and potential solutions based on evidence from the literature as well as original research for this project. Case studies illustrate existing programs that exemplify the types of solutions the research identifies as effective.

The first section of this report focuses on **retention of workers in the STEM workforce**. It covers transitions of STEM-qualified people into the workforce, including how work-based placements or work-integrated learning can support such transitions; the perceived value of STEM qualifications and skills; experiences in the workforce including working conditions and workplace cultures; the satisfaction levels of STEM workers and their anticipated career prospects; and effective enablers of retention in the STEM workforce such as professional development and mentoring.

The second section of the report analyses **mobility between employment sectors**. STEM workers in Australia can be found working in academia, government, the private sector, defence science, medical research institutes, publicly funded research agencies, in the not-for-profit sector, or working for themselves in their own businesses. This section presents fascinating new evidence on the level of career mobility currently occurring across the STEM sector, factors that help or hinder such transitions, and STEM workers' appetite for mobility. It also explores the contribution of formal career mobility programs and Australia's relatively low levels of business investment in R&D. Stronger mobility of STEM workers between segments of the STEM sector can expand and diversify employment options in STEM in Australia, strengthen innovation and deepen the exchange of ideas and knowledge across different parts of Australia's STEM sector.

As the entire report focuses on people's experience and retention in 'STEM careers' rather than their retention in a particular STEM job, there is naturally considerable overlap between the retention section of the report and the mobility section. A career step that moves between two sectors may be one of many job transitions a person makes during their STEM career. Many of the insights identified in the retention section are therefore also relevant to STEM workers as they move from a job in one part of the STEM sector to another part of the sector. Effective strategies to promote or enable mobility between employment sectors in STEM should be informed by the evidence in the first two sections of this report.

The STEM Career Pathways survey, stakeholder consultations and literature review all identified that the experiences of STEM careers can be varied for diverse demographic groups. The final section of the report draws together important insights on the experiences of diverse groups seeking to enter or stay in a STEM career or to move across the STEM sector. Most of existing research literature on this topic relates to women's experiences in Australia's STEM workforce. This project's survey results were able to draw out key insights about the experiences of Aboriginal and Torres Strait Islander people, LGBTQIA+ people, people born overseas or who speak a language other than English at home, and people who have a disability, chronic illness or who are neurodiverse. It gathered valuable new data on experiences in Australia's STEM workforce. This new evidence should be considered when designing retention and mobility strategies and interventions to address barriers and challenges to successful STEM careers.

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*Evidence from stakeholder consultations and the large-scale survey give strong clarity on the interventions needed.*

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## 2. RETENTION IN STEM CAREERS

### 2.1 Value of STEM qualifications in the labour market

The STEM Careers Pathway survey asked nearly 3,500 STEM-qualified people across Australia a range of questions about their qualifications and their experience of employment.

The vast majority of respondents saw their STEM qualifications as valuable in the labour market and in their jobs.

#### INSIGHT:

The STEM Career Pathways Survey found:

- 88% of respondents said their STEM qualification was important in getting their job
- 83% of respondents said their employers valued their qualification
- 90% of respondents said their STEM qualifications were important to be able to do their job.

Among them, 91% of people with a STEM PhD said their STEM qualifications were important for getting a job, compared to 87% of people with a Bachelor degree, 81% of people with a VET Advanced Diploma or Diploma and 64% of people with a VET Certificate.

People with more specialist training are more likely to be working in more highly specialised jobs, specific to their STEM training. Nearly half (48%) of respondents with PhDs work in universities – compared to 10% of other respondents.

Eighty-eight per cent of people with a STEM PhD said their employers valued their STEM qualifications, compared to 81% of people with an undergraduate degree and more than three-quarters of people whose highest qualification was a postgraduate degree, (masters, graduate diploma or graduate certificate in STEM). A lower proportion of VET-qualified respondents (66%) said that employers valued their STEM skills.

#### INSIGHT:

Across employment sectors, 89% of people working in medical research institutes and 88% of people working in universities said employers valued their qualifications, compared to 77% of people in the private sector and 78% of those working in the public service.

Defence science and technology (85%) and the public service (87%) were the only segments of the STEM sector where fewer than 90% of survey respondents agreed their STEM skills were important to doing their jobs.

About 9% of survey respondents were currently studying. Of those who were studying a STEM course additional to their earlier STEM qualifications, 71% said they needed an additional qualification to progress their careers. A further 20% reported they couldn't get the job they wanted with the qualifications they already had.

#### 2.1.1 Is the value of STEM qualifications communicated effectively?

Stakeholder consultations identified difficulties for both employers and prospective employees in documenting the skills and capabilities developed in STEM qualifications.

While the PhD was the biggest focus of these concerns, some stakeholders expressed similar views about Bachelor-level degrees and higher education credentials in general. Employers and employer organisations reported a strong match between VET qualifications and the skills required in VET-qualified STEM jobs.

Some participants suggested current skill categories and classifications in education and the labour market are not effectively aligned.<sup>4</sup> Discussions offered insights that the skills and capabilities STEM employers are looking for or are required to do a specific job are often not clearly described in STEM degree descriptions. The stakeholder consultations heard this should be more clearly reflected in curriculum content, degree names, and a set of listed skills and capabilities that graduates will have. This barrier was identified at the initial recruitment stage in STEM careers and as an impediment to greater mobility across the STEM sector as STEM graduates sought different opportunities later in their careers.

#### BARRIER:

A lack of information visible to STEM employers on the curriculum content of STEM degrees and clear descriptions of graduate skills and capabilities.

#### POTENTIAL SOLUTION:

Publish clearer information on higher education and VET websites about the granular curriculum content of STEM qualifications and the expected graduate skills and capabilities.<sup>5</sup>

4 Australian Academy of Technological Sciences and Engineering. (2022) 'Our STEM-Skilled Future' Australian Academy of Technological Sciences and Engineering, Canberra [atse.org.au/research-and-policy/publications/publication/our-stem-skilled-future-an-education-roadmap-for-an-innovative-workforce/](https://atse.org.au/research-and-policy/publications/publication/our-stem-skilled-future-an-education-roadmap-for-an-innovative-workforce/)

5 Rayner, G and Papakonstantinou, T. (2016) 'The Nexus Between STEM Qualifications and Graduate Employability: Employers' Perspectives', *International Journal of Innovation in Science and Mathematics Education*, 24(3) [openjournals.library.sydney.edu.au/CAL/article/view/11041](https://openjournals.library.sydney.edu.au/CAL/article/view/11041)



These concerns also applied to generic or employability skills which are included implicitly rather than explicitly in the design, assessment and outcomes of higher education qualifications.

#### INSIGHT:

Stakeholders observed graduates can struggle to demonstrate – and employers struggle to identify – how core technical and discipline-specific skills, knowledge and experience gained in university study or research can be applied in a wide array of workplaces.

These insights were also commonly raised in discussions on mobility, demonstrating that they don't only affect new graduates and graduate recruitment practices. STEM workers looking for work in a different sector commonly struggle with articulating how the skills and experience they have in their current sector relate to the required skills for a position in a different sector. This is further discussed in the section on mobility between sectors.

#### INSIGHT:

Participants in the stakeholder consultations said university cultures encourage narrow views about careers. They gave evidence that **an over-emphasis on academic research as the notional 'pinnacle of success' in a STEM career can limit career aspirations beyond academia.**

The stakeholder consultations heard that graduates with an undergraduate degree in science often have a limited understanding of the breadth of possible careers they can pursue in STEM. Some participants stated that universities did not do enough to help students consider their post-study job options. Progressing into academic research remains the default option for many higher degree students – even as it becomes more difficult to achieve.

Stakeholder consultations for this project highlighted that a lack of understanding about graduates' employment-ready skills is particularly acute for STEM PhD qualifications. Several participants – even some employers whose businesses rely heavily on STEM or technical capabilities – were of the view that the advanced problem solving, project design and management, stakeholder engagement, budgeting, analytical and writing skills that are often key components of PhD research are simply not visible or apparent to many employers.

*Progressing into academic research remains the default option for many higher degree students.*

Stakeholder consultations heard evidence that industry-focused PhDs are helping to address these issues, support STEM career transitions into private sector employment at the beginning of careers and also improve mobility options later in careers. Stakeholders observed that where a PhD student has a business problem (not just a research problem) to work on from the outset, they often find it easier to demonstrate to employers what they can do. Other benefits identified in international examples include the establishment of networks in industry and a greater familiarity with private sector workplaces.<sup>6</sup> These were enablers of mobility between sectors which were also identified in the STEM career pathways survey and stakeholder consultations. More insights on industry PhDs are outlined in the career mobility section of this report.

## 2.2 Work-integrated education pathways

STEM employers who participated in the stakeholder consultations talked about graduate employment schemes, scholarships and cadetships as important sources of STEM-skilled people. The stakeholder consultations heard these work-integrated pathways were under-used in jobs that required higher education qualifications but are common in VET as apprenticeships and traineeships.

On the other hand, some employers consulted said they had found existing professional placement activities (e.g. as part of engineering degrees) limited in usefulness and not closely aligned enough to practical workplace demands. These employers expressed strong views about the 'overly theoretical character' of some degrees (in this case, engineering degrees) and what they saw as a lack of emphasis on 'practical skills'. It was clear from consultations with employers that different STEM occupations and careers require different levels of complexity of knowledge and skills.

These employers outlined how they support employees through engineering degrees at the same time as apprenticeships to deliver 'hands on' practical skills. They noted this model produces graduates with several years of work experience who have developed 'practical skills' alongside their professional education.

#### BARRIER:

A 'single track' education and training model in which people typically study either at university or VET – but seldom do both concurrently – leaves some graduates without some of the practical skills needed from day one in the STEM workplace.

#### POTENTIAL SOLUTION:

Expand employer-run programs that offer workers 'twin-track' options to do both a degree and a vocational apprenticeship concurrently to develop analytical and practical skills.

6 Bernhard I and Olsson AK. (2023) 'One foot in academia and one in work-life – the case of Swedish industrial PhD students', *Journal of Workplace Learning*, [emerald.com/insight/content/doi/10.1108/JWL-11-2022-0157/full/html#abstract](https://emerald.com/insight/content/doi/10.1108/JWL-11-2022-0157/full/html#abstract)

**POTENTIAL SOLUTION:**

Closer collaborations between universities, VET providers and Registered Training Organisations to supplement STEM degree knowledge with 'day-one job-ready' practical skills.

Some participants in the stakeholder consultations identified current limitations in securing Recognition of Prior Learning (RPL) as a barrier to training up their staff: they articulated concerns that it was unnecessarily hard to get RPL (for previous VET studies in particular) and that such recognition was not applied by universities in a consistent way.

## 2.3 Work-based placements

The stakeholder consultations affirmed the importance of work-based placements for later-year VET and university students to develop employability skills, apply technical skills and prepare for the workforce. Participants conceded that placements – while very important – can be hard to organise and run for both employers and universities. For university students, placements are often organised by students or universities rather than employers, though once engaged, the majority of employers were keen to continue hosting students. A lack of time to supervise students and a lack of resources were the main barriers to employer's involvement.<sup>7</sup>

The stakeholder consultation findings aligned with previous research that employers identify access to work-ready future employees as by far the strongest benefit of their participation in work-based placements.<sup>8</sup> This evidence confirms work-based placements are an effective solution to give STEM graduates experience to prepare them for the workplace.

*Work placements are important to develop employability skills, technical skills and prepare for the workforce.*

The cost to students of undertaking unpaid work placements has been the subject of extensive recent media coverage<sup>9</sup> as community concern about inflation and the cost of living has mounted. It is among many policy issues being considered by the Australian Universities Accord<sup>10</sup>, which is due to deliver its final report at the end of 2023.

**INSIGHT:**

A major barrier identified in the stakeholder consultations was the cost to students of undertaking a placement, and in many cases being unable to continue with paid work while doing the placement.

Some employers highlighted the value of degree apprenticeships, where students spent the majority of their time working while gaining a university degree part time. The demand for such work/study combinations has grown dramatically in the UK in recent years to help employers meet skills gaps rapidly and effectively. In the first quarter of 2022/23, the UK saw a 14% increase in degree apprenticeship enrolments from the previous year – which made up nearly one-fifth (18%) of all apprenticeship starts.<sup>11</sup>

Very few degree apprenticeship programs have so far been set up in Australia. Employers in the stakeholder consultations reported their experiences that it was difficult and slow to work with universities to set up such courses. These stakeholders contrasted this experience with their dealings with TAFE and other vocational education providers – where processes typically were able to move more swiftly to respond to employer needs.

**BARRIER:**

Not enough students have access to work-based placements during their post-secondary education to prepare them for the workforce – and the cost of doing an unpaid placement is prohibitive for students who cannot afford to miss paid work.

**POTENTIAL SOLUTION:**

Expand work-based placements in post-secondary education including wage offset support for students in financial hardship who cannot afford to miss paid work.

- 7 Commonwealth Department of Industry. (2014), 'Engaging Employers in WIL: Current State and Future Opportunities' [phillipskpa.com.au/dreamcms/app/webroot/files/files/PhillipsKPA\\_WIL%20Research%20Report.pdf](https://phillipskpa.com.au/dreamcms/app/webroot/files/files/PhillipsKPA_WIL%20Research%20Report.pdf)
- 8 Commonwealth Department of Industry. (2014), 'Engaging Employers in WIL: Current State and Future Opportunities' [phillipskpa.com.au/dreamcms/app/webroot/files/files/PhillipsKPA\\_WIL%20Research%20Report.pdf](https://phillipskpa.com.au/dreamcms/app/webroot/files/files/PhillipsKPA_WIL%20Research%20Report.pdf)
- 9 Yoldas, M. (2023) 'Inflation, cost of living pressures increase struggle for students in unpaid health placements' *ABC News Online*, Published 24 May 2023. Accessed: 21 August 2023. [abc.net.au/news/2023-05-24/health-students-completing-unpaid-placements-inflation-struggle/102373242](https://abc.net.au/news/2023-05-24/health-students-completing-unpaid-placements-inflation-struggle/102373242); Morley, C. (2023) 'We can no longer justify unpaid labour': why uni students need to be paid for work placements' *The Conversation*, Published: 23 May 2023. Accessed: 21 August 2023. [theconversation.com/we-can-no-longer-justify-unpaid-labour-why-uni-students-need-to-be-paid-for-work-placements-203421](https://theconversation.com/we-can-no-longer-justify-unpaid-labour-why-uni-students-need-to-be-paid-for-work-placements-203421)
- 10 Commonwealth Department of Education. (2023) 'The Australian Universities Accord Interim Report' [education.gov.au/australian-universities-accord/resources/accord-interim-report](https://education.gov.au/australian-universities-accord/resources/accord-interim-report)
- 11 United Kingdom Government. (2023) 'Apprenticeships and traineeships statistics' Published 10 August 2023. Accessed 21 August 2023. [explore-education-statistics.service.gov.uk/find-statistics/apprenticeships-and-traineeships](https://explore-education-statistics.service.gov.uk/find-statistics/apprenticeships-and-traineeships)

## 2.4 Skilled migration and international graduates

Stakeholder consultations raised concerns about the current efficiency and effectiveness of Australia's skilled migration system: many qualified STEM professionals come to Australia as skilled migrants but can't get jobs in their fields, despite persistent and well-known labour shortages.<sup>12</sup> Stakeholder consultations raised concerns about the current efficiency and effectiveness of Australia's skilled migration system.

The stakeholder consultations suggested this challenge is particularly acute in engineering. These insights align closely with statistical analysis by Engineers Australia.<sup>13</sup>

The stakeholder consultations also identified a career barrier for the currently low proportion of international graduates who stay on in Australia to work in their field. The stakeholder consultations heard evidence that some STEM employers are reluctant to employ international graduates – and identified this as a product of limited understanding among employers of post-study work rights and visa categories, or for other reasons such as perceived 'cultural fit' or English language skills. Previous studies have also shown this is the experience of many international students<sup>14</sup> and that it can be a larger problem in some fields such as engineering, than in others.<sup>15</sup>

*"Being an international student, it becomes further difficult to get a job/move between sectors within STEM because you are either on a student visa following your PhD or post-study visa. Most employers are looking for people with Permanent Residency (PR) - but you don't get that when you complete your PhD. It takes 2 to 5 years to get your PR. Until then you don't get the job/experience you wanted to work and some people decide to move to different countries seeking better opportunities or life and some choose to work in retail."*

– Survey respondent

In the case of both international graduates and skilled migrants struggling to get jobs, racism was an issue identified by several respondents – though this was not a factor unique to the STEM sector.

*"Education, knowledge and experience becomes less to no impact if the employers have a perception of you based on ethnicity and colonial mind set. These [biases] will eventually be seen either in getting job in the first place, job assignments, career progression."*

– Survey respondent

### BARRIER:

Limited understanding among employers of post-study work rights for international graduates is a barrier to recruitment of international graduates with an Australian VET or university qualification in STEM.

### POTENTIAL SOLUTION:

Expand employer outreach to raise awareness of post-study work rights for international students who have an Australian VET or university qualification in STEM.

A gap in employment rates between Australians with a STEM qualification and people born overseas suggests employers are reluctant to employ STEM professionals whose qualifications were gained overseas, as well as international graduates of Australian universities who are on post-study work visas. A 2022 Engineers Australia report found no more than 60% of qualified engineers in Australia work in engineering, and for skilled migrants the figure drops to 40%.<sup>16</sup> Engineers Australia also estimates 100,000 overseas-trained engineers living in Australia are unemployed. This represents a large untapped resource of STEM skills to meet Australia's STEM skill shortages now and in the future. To help access this resource, Engineers Australia has developed a global talent program (see case study). Lessons from this research may be applicable in other STEM fields. In addition, making recruitment practices more inclusive to the diversity of STEM workers, including those born overseas, will help meet Australia's skill shortages. Inclusive recruitment practices are discussed in further detail in the section on mobility between sectors.

### BARRIER:

Employer reluctance to hire skilled migrants with STEM qualifications acquired overseas is a barrier to a pool of highly qualified and skilled STEM workers – including in fields with acute workforce shortages such as engineering.

### POTENTIAL SOLUTION:

Support programs that enable the workforce placement of skilled migrant STEM professionals who have not been able to secure jobs in Australia's STEM workforce.

*Many STEM-skilled migrants can't get jobs in their fields, despite acute labour shortages.*

<sup>12</sup> Stakeholder consultations conducted as part of this project.

<sup>13</sup> Engineers Australia. (2022), 'Strengthening the engineering workforce in Australia', Engineers Australia, Canberra, [engineersaustralia.org.au/publications/strengthening-engineering-workforce-australia](https://engineersaustralia.org.au/publications/strengthening-engineering-workforce-australia)

<sup>14</sup> Tran, LT, Rahimi, M, Tan, G, Dang, XT & Le, N. (2020) 'Post-study work for international graduates in Australia: opportunity to enhance employability, get a return on investment or secure migration?' *Globalisation, Societies and Education*, doi.org/10.1080/14767724.2020.1789449

<sup>15</sup> Tran, LT, Tan, G, Bui, H, & Rahimi, M. (2022) 'International graduates on temporary post-graduation visas in Australia: Employment experiences and outcomes', *Population, Space and Place*, 1-13. doi.org/10.1002/psp.2602

<sup>16</sup> Engineers Australia. (2022), 'Strengthening the engineering workforce in Australia', Engineers Australia, Canberra, [engineersaustralia.org.au/publications/strengthening-engineering-workforce-australia](https://engineersaustralia.org.au/publications/strengthening-engineering-workforce-australia)



**CASE STUDY****ENGINEERS AUSTRALIA GLOBAL ENGINEERING TALENT PROGRAM**

Engineers Australia has developed its Global Engineering Talent program in response to employment difficulties faced by skilled migrants with engineering qualifications in the Australian labour market. Engineers Australia's research found that skilled migrant engineers faced challenges including:

- lack of networks in Australia
- limited pathways to secure employment
- 'industry bias'.

Engineers Australia has recently (July 2023) entered into a partnership with the Northern Territory government under which the Global Engineering Talent program will provide pathways for 20 overseas-trained engineers to enter the Australian workforce. The program addresses the main barriers faced by migrant engineers, informed by research. It includes:

- A 6-week preparatory course covering standards-based training to ensure participants are familiar with local standards. The participants also do a virtual internship to get practice in the Australian context and applying Australian codes and regulations.
- A 12-week internship at an engineering firm to connect them with a potential employer and so they can gain Australian work experience.
- Mentoring from a local engineer to provide contacts and guidance and assist in development of networks.

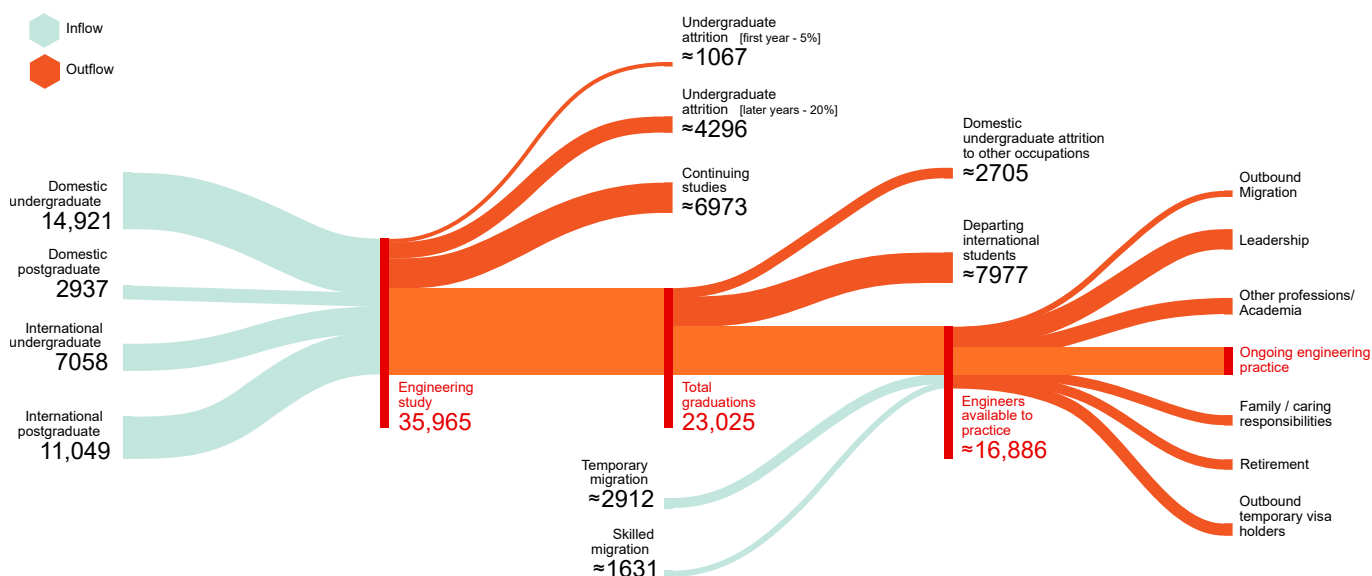
While the program is new its design has been informed by evidence and offers a promising example of how Australia may enable overseas STEM skilled workers to flourish in Australia.<sup>17</sup>



<sup>17</sup> Madew, R. (2023) 'Breaking down the barriers: GET Program Paves the Way for Skilled Migrant Engineers in Australia' LinkedIn.com. Published: 17 July 2023. Accessed: 21 August 2023 [linkedin.com/pulse/breaking-down-barriers-get-program-paves-way-skilled-romilly/](https://www.linkedin.com/pulse/breaking-down-barriers-get-program-paves-way-skilled-romilly/)



**Figure 1**  
The 'leaky pipeline': engineering



Source: Engineers Australia (2022), *Strengthening the engineering workforce in Australia*, Engineers Australia, Canberra

## 2.5 The 'leaky pipeline'

A commonly used metaphor on the loss of talent moving into and staying in STEM careers is the 'leaky pipeline'. This depicts – and sometimes quantifies – the scale of transition from post-secondary education and the points in their careers at which qualified people leave the sector.

Engineers Australia provide a detailed picture of the pipeline from Australian engineering qualification and skilled migration, and the key points at which 'leakage' occurs (Figure 1).

According to Engineers Australia's numbers, more than one third of engineering students don't finish their degrees. Of the total number of qualified engineers (those who complete degrees in Australia, plus temporary and skilled migrants with engineering qualifications), just over 60% are 'available to practice' engineering. These engineers stand at the beginning of a professional pathway.

The diagram depicts (but does not attempt to quantify) the other key points at which engineers leave the profession, and the reasons for their exits.

The Technology Council of Australia plots a similar story of 'leakage' for technology qualifications and occupations<sup>18</sup> (Figure 2). The Tech Council's figures indicate two-thirds of ICT Bachelors graduates are 'lost' to the tech industry – because they work in other areas after graduation or (if they are international students) because they return home. This leaves a 'net supply' of graduates that is less than half of the number needed.

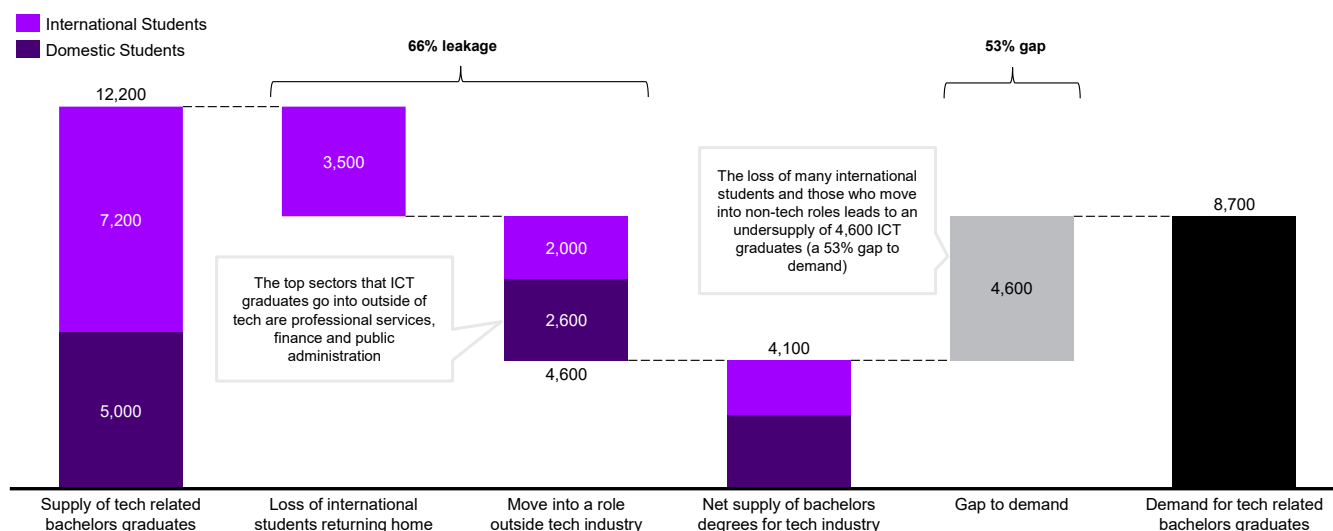
**Not all of the tech graduates who are 'lost' to the tech industry are lost to ICT work: many of them use their skills and qualifications working in other industries.**

Figure 2 shows those who leave the tech sector most often move into professional services, finance and public administration.

Drawing more effectively on the talents and potential of all Australians – including those traditionally excluded from or under-represented in STEM – is imperative to increase the supply of STEM skills. Further details on the different experiences of various demographic groups in the STEM workforce are outlined in [section 4](#).

<sup>18</sup> Tech Council of Australia. (2022) 'Getting to 1.2 Million', Tech Council of Australia, Canberra, [techcouncil.com.au/wp-content/uploads/2022/08/2022-Getting-to-1.2-million-report.pdf](https://techcouncil.com.au/wp-content/uploads/2022/08/2022-Getting-to-1.2-million-report.pdf)

**Figure 2**  
The 'leaky pipeline': the tech industry



Source: Tech Council of Australia (2022), *Getting to 1.2 Million*, Tech Council of Australia, Canberra

## 2.6 The importance of workplaces using and valuing STEM skills

The STEM Career Pathways survey found that, once in the workforce, STEM qualified workers in Australia are generally very positive about their work and career prospects. Most see long-term careers ahead of them in STEM.

This survey found strong evidence that STEM workers are generally motivated by a passion for STEM that keeps them in STEM workplaces and STEM careers – despite the career barriers they identify. More information on people's perceptions of career prospects and the barriers they face is in sub-sections below. The survey found people's passion for STEM is correlated to the high value they place on whether their employer valued their STEM skills.

Preliminary findings from a current Australian Research Council funded study due to report by the end of 2023 aligns with this new evidence in the STEM Career Pathways Project. The research found:

- 'Intrinsic motivation and passion appear to be the fundamental drivers of staying and succeeding in STEM fields.
- Money is not a strong motivator for entering STEM fields or staying in those fields.
- Lack of employment opportunities, job security ... are strong drivers of leaving, or not entering STEM employment...
- Some consider the STEM career pathway to be too uncertain, unpredictable and with strong opportunity costs'.<sup>19</sup>

### INSIGHT:

Stakeholders in the consultations for this project highlighted that retention of STEM-qualified people in careers depends on their skills being valued and used.

The STEM Career Pathways survey shows that the value of STEM skills was less likely to be recognised outside of obvious STEM or STEM research careers – for example, in government or private industry. In these environments, a clear commitment from management and in institutional culture to the value of STEM is important to retention. Making use of STEM-qualified workers' knowledge and skills is a strong factor in retention.

Stakeholder consultations heard evidence from major employers that facilitating access to a breadth of work opportunities and career paths also bolsters staff motivation and retention in STEM. Some employers talked about their practices to ensure new graduate employees had a chance to work in many different areas of the business, including those well outside the technical sphere (such as in administrative and sales roles) to get to know the business and its culture.

*Most STEM-qualified workers in Australia see long-term careers in STEM ahead.*

<sup>19</sup> Kiazad, K. (2019) 'Why do people working in STEM stay in their jobs - and why should we care?' Futurum Careers. Published: 16 October 2019. Accessed: 28 August 2023. [futurumcareers.com/why-do-people-working-in-stem-stay-in-their-jobs-and-why-should-we-care](https://futurumcareers.com/why-do-people-working-in-stem-stay-in-their-jobs-and-why-should-we-care)



## 2.7 Defining a 'STEM career'

Stakeholder consultations for this research project identified the importance of promoting **both** 'STEM careers' and 'careers that use STEM skills'. These two concepts can appeal to STEM-qualified audiences with different career motivations. For example, one way of talking about 'careers using STEM skills' in a cybersecurity context would emphasise 'protecting people', rather than focusing on the technical coding skills. Some stakeholders argued that this type of framing can help to encourage different types of people to consider STEM study and also help STEM qualified people find the right job for them in STEM.

The predicted growth in STEM skilled jobs in the future includes not just more jobs traditionally associated with STEM, but also 'STEMification' or the increasing use of STEM skills in other jobs. The concept of retention in the STEM workforce is therefore set to change as we expect to see more STEM-qualified people using their STEM skills in new fields and areas. These workers should not be viewed as 'lost' from the STEM workforce as they will likely be valued for their STEM skills even if their employer does not consider itself a 'STEM employer'.

*People using their STEM skills in new fields and areas are not 'lost' to the STEM workforce.*

Skrentny and Lewis's analysis of the American National Survey of College Graduates (NSCG) shows that 'even though only 40% of STEM graduates go on to work in 'STEM occupations', 70% of STEM graduates claim to utilize STEM skills on the job'.<sup>20</sup> The authors report that 'about a third of STEM graduates report working in non-STEM occupations but nevertheless utilizing STEM skills'.

Australian research also emphasises the relevance and value of STEM skills across sectors of the economy in an era of technological innovation, and the transferable skills a STEM degree confers.<sup>21</sup> A 2022 report by the Australian Academy for Technological Sciences and Engineering identifies improvement in STEM lifelong learning as a key priority for Australia's economy.<sup>22</sup>

Many STEM jobs require constant updating of skills and genuine lifelong learning (the IT industry has many excellent examples), so a one-directional 'pipeline' model that sharply divides 'education' from 'employment' is not an apt metaphor.

20 Skrentny, JD and Lewis, K. (2022) 'Beyond the "STEM Pipeline": Expertise, Careers, and Lifelong Learning', *Minerva* 60:1–28, [doi.org/10.1007/s11024-021-09445-6](https://doi.org/10.1007/s11024-021-09445-6)

21 West, M. (2012), 'STEM Education and the Workplace', Occasional Paper Series 4 (September 2012), Office of the Chief Scientist, Canberra [chiefscientist.gov.au/sites/default/files/OPS4-STEMEducationAndTheWorkplace-web.pdf](https://chiefscientist.gov.au/sites/default/files/OPS4-STEMEducationAndTheWorkplace-web.pdf)

22 Australian Academy of Technological Sciences and Engineering. (2022) 'Our STEM-Skilled Future' Australian Academy of Technological Sciences and Engineering, Canberra [atse.org.au/research-and-policy/publications/publication/our-stem-skilled-future-an-education-roadmap-for-an-innovative-workforce/](https://atse.org.au/research-and-policy/publications/publication/our-stem-skilled-future-an-education-roadmap-for-an-innovative-workforce/)

2.8 Job satisfaction: evidence from the STEM Career Pathways survey

Results from the STEM Career Pathways survey – which sought insights from across the full breadth of Australia’s STEM workforce – align only partly with frequently articulated concerns about job security and retention in STEM careers. Such concerns were more clearly evident among respondents who worked in universities or medical research institutes.

**INSIGHT:**

On the whole, survey respondents mostly reported strong job satisfaction (Table 1). The survey found:

- More than 70% of respondents are satisfied or very satisfied with their job and work environment.
- Nearly 70% of respondents are happy with work/life balance.
- More than 60% of respondents are satisfied or very satisfied with job security and pay.

Workload was a partial exception to this pattern: barely half of respondents were satisfied or very satisfied with workload. Interestingly, less than a quarter of respondents were actively dissatisfied but a quarter were ‘neutral’.

“In reality I know few people in science who want to work insane hours but the culture requires them to or they will not succeed. Management has no interest in workload managing properly because this serves them too well.”

– Survey respondent

Table 1  
Respondents’ satisfaction with current job

Aspect of working conditions	Percent
Working environment	72%
Job satisfaction	71%
Work/life balance	69%
Job security	63%
Pay	61%
Workload	52%

Respondents to this question: n = 2581

- There were differences in satisfaction with various components of job and workplace across the STEM sector:
- Only 45% of staff at universities said were satisfied with job security.
  - At medical research institutes, only 29% of staff were satisfied with job security – more than half (51%) of respondents were ‘dissatisfied’ or ‘very dissatisfied’.
  - At the other end of the scale, in defence and defence science and technology, 90% of staff were satisfied with job security.
  - Satisfaction with pay was quite low across all sectors. Fewer than half of respondents working in medical research institutes or in the community/not for profit sector were satisfied with their pay.
  - Respondents working in the private sector were most likely (71%) to be satisfied with pay.
  - Only 38% of staff at medical research institutes and 37% of staff at universities were satisfied with their workloads.

Only 45% of staff at universities and 29% of staff at medical research institutes are satisfied with job security.



## 2.9 Working conditions

Two-thirds of employed respondents to the STEM Career Pathways survey were on permanent full-time contracts. A quarter were on fixed-term contracts. Very few respondents (fewer than 60) were employed as casual staff (Table 2).

**Table 2**  
Respondents' type of contract

Contract type	Percent
Permanent full time	66%
Fixed-term contract	25%
Permanent part time	7%
Casual	2%

Respondents to this question: n = 2664

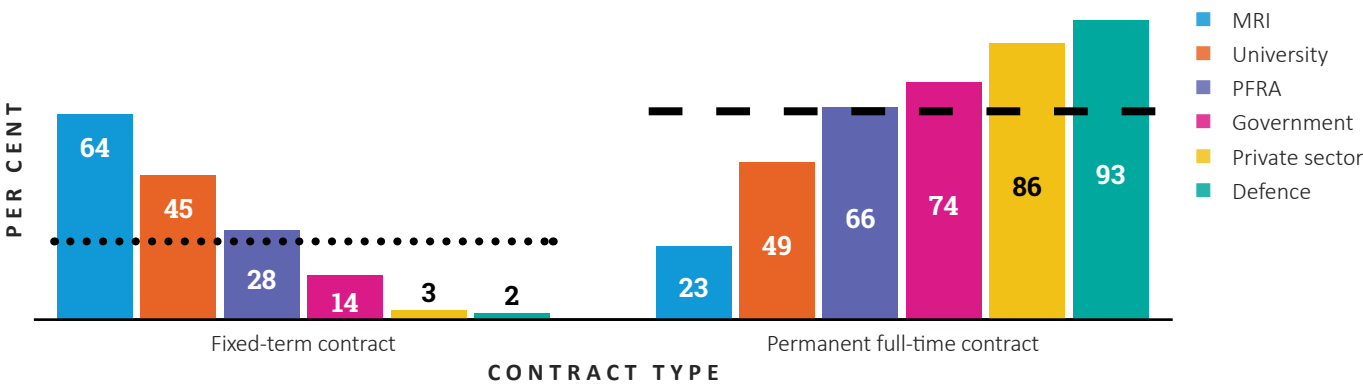
The survey detected differences across the STEM sector in the prevalence of fixed-term contracts instead of ongoing employment (Figure 3). Fixed-term contracts were especially prevalent at medical research

institutes (64% of respondents working at MRIs were on fixed-term contracts). At universities, 45% of staff were on fixed-term contracts. At the other end of the scale, permanent full-time contracts predominated in defence (93%), in the private sector (86%) and the public service (74%).

Figure 4 shows clear differences by highest qualification in the prevalence of permanent full-time and fixed-term contracts. PhD graduates were more than ten percentage points less likely than average to be on permanent full-time contracts. They were 13 percentage points more likely to be on fixed-term contracts.

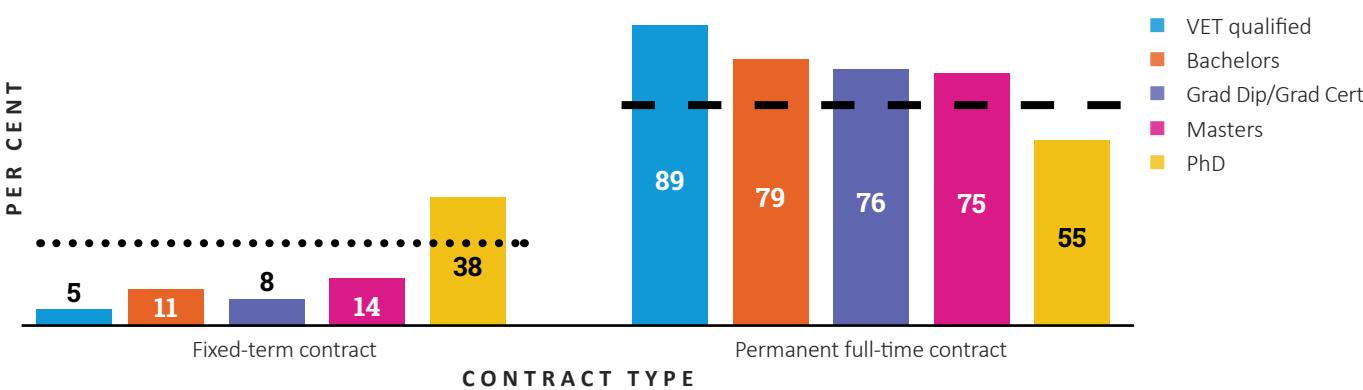
Nearly 70% of PhD graduates in entry-level positions were on fixed-term contracts (25 percentage points higher than the sample average for all levels of qualification). The share of PhD graduates on fixed-term contracts remains higher than the average for all respondents even at higher levels of seniority (13 percentage points higher at mid-level). More than 60% of PhDs employed at mid-level seniority on fixed term contracts were working in the university sector.

**Figure 3**  
Prevalence of fixed-term contracts vs permanent full-time contracts by employment sector



Employment sectors with less than 100 respondents have not been included in Figure 3. The dotted line indicates the survey average of people on fixed-term contracts (25%). The dashed line indicates the survey average of people on permanent full-time contracts (66%).

**Figure 4**  
Prevalence of fixed-term vs permanent full-time contracts, by highest qualification



The dotted line indicates the survey average of people on fixed-term contracts (25%). The dashed line indicates the survey average of people on permanent full-time contracts (66%).

The share of working PhD graduates who are on permanent full-time contracts increases with time in the paid workforce (Figure 5). Nevertheless, even among PhD graduates who have been in the workforce for 15 years or more, 25% were on fixed-term contracts.

While a large percentage of respondents were employed on fixed-term contracts, these contracts were not always short-term: 45% of respondents on fixed-term contracts were employed for 3 years or more, and 60% for 2 years or more. Around 15% (fewer than 100 respondents) were on contracts shorter than 12 months (Table 3).

Respondents with PhDs were less likely to be on short contracts of less than 12 months and more likely to be on three-year contracts.

Despite more women being on fixed-term contracts, there was no notable difference in the duration of contract based on gender (Table 4).

**INSIGHT:**

Women were more likely to be on fixed-term contracts (31%, compared to 19% for other genders), and the share of women on permanent full-time contracts was 16 percentage points below the figure for others.

**Table 3**  
Respondents on fixed term contracts, by length of contract

Contract length	PhD-qualified	Other qualifications	All
36+ months	14%	13%	14%
36 months	34%	24%	31%
24 months	15%	14%	15%
12-23 months	24%	29%	25%
<12 months	13%	20%	15%

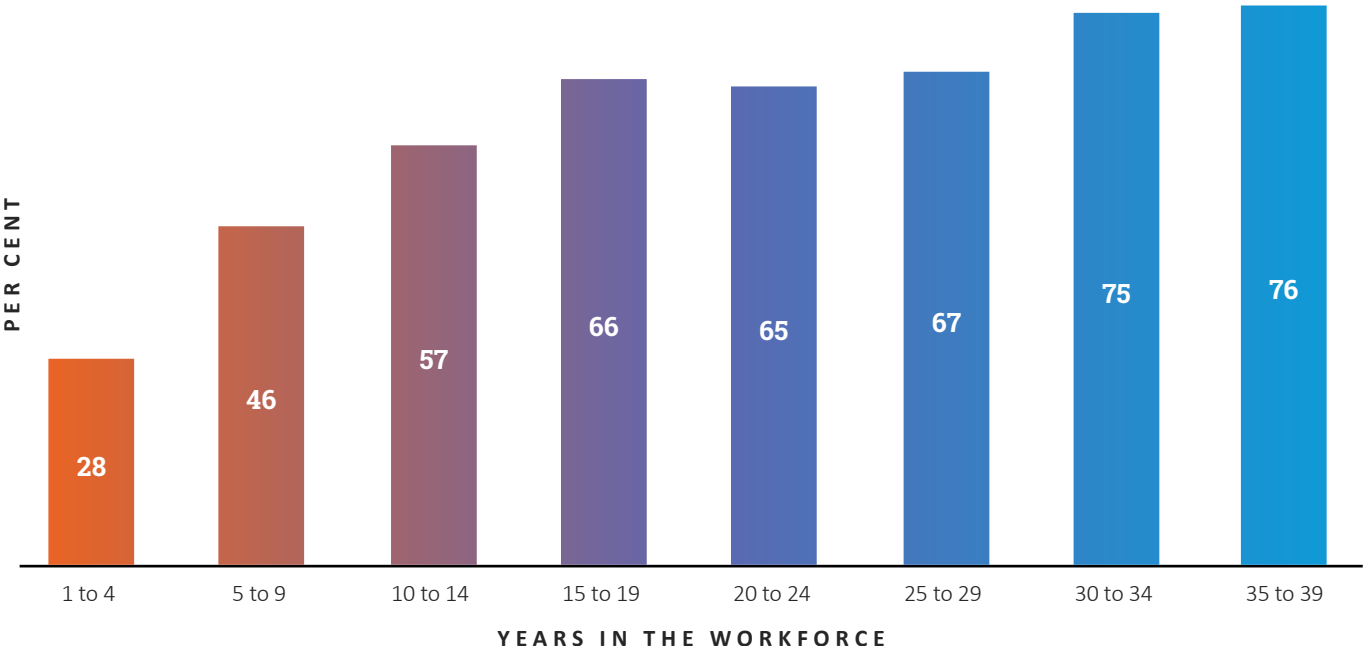
Respondents to this question: PhD qualified n = 506; Other respondents n = 147; All respondents n = 563

**Table 4**  
Respondents' type of contract by gender

Contract type	Women	Other genders	All
Permanent full-time	58%	74%	66%
Fixed-term contract	31%	19%	25%
Permanent part-time	9%	5%	7%
Casual	2%	2%	2%

Respondent numbers: Women n = 1273; Other genders n = 1391; All respondents n = 2664. 'Others genders' includes men, non-binary people and respondents who did not specify a gender.

**Figure 5**  
Percentage of PhD-qualified people on permanent full-time contracts by time in the workforce



## 2.10 Job insecurity

### INSIGHT:

Job insecurity is a barrier to retention in STEM careers, especially in Australia's STEM research sector. Researchers, both in Australia and overseas, often identify the research funding system as a driver of job insecurity and short-term employment. Australia's relatively low levels of research funding compared to other advanced economies fuels this situation.

Even within current funding arrangements, there are options available to work towards more secure employment for researchers, and especially early-career researchers.<sup>23</sup> Participants in the stakeholder consultations said research grants could specify minimum terms of employment for researchers employed on the project. They also observed that in countries like the UK, some major philanthropy research fellowships can run for longer periods up to 8 years<sup>24</sup>—giving researchers security to be able to pour their energies into pursuing STEM breakthroughs.

A 2019 American study funded by the National Institutes of Health found longer periods in research fellowship training was associated with a 21% increase in lifetime research output and a 15% lift in H-index performance.<sup>25</sup>

These issues are also being examined by the Universities Accord and the recent Review of the Australian Research Council Act.

### BARRIER:

Job insecurity was identified as a major barrier in STEM research careers in Australia – especially in universities and medical research institutes, driven by insecure research funding and the widespread use of short-term contracts even on projects with multi-year funding.

### POTENTIAL SOLUTION:

In line with international best practice, move to a more secure system of research funding in Australia and create more longer-term major research fellowships to give STEM researchers crucial security to pursue STEM breakthroughs. Specify minimum terms of employment for researchers on projects funded by competitive grants from Australia's major research granting agencies.

*'My view is that we have a ... crisis in our research career structure in Australia. We have relatively few institutions and roles for our very best scientists that offer ... job security. Still, much of our nation's research sits on the back of fantastic postdoctoral researchers, or people on one and 2-year contracts. I have many friends and colleagues that I went through PhDs with who are still on one and 2-year contracts.'*

– Professor Tanya Monro AC, Australia's Chief Defence Scientist, Universities Australia Conference, February 2023

Many participants in the stakeholder consultations for this study—particularly in the university sector—identified the scale of job insecurity in public research institutions as a negative factor in STEM career retention. Participants observed people are less likely to stay in a career if they don't have a secure job.

Job insecurity and short-term contracts were identified as major contributing factors by people who were not confident that they would still be in the STEM workforce in 5 years.

It was also a major theme identified by survey respondents as the one thing they want improved in STEM careers.

Finally, the stress created by insecure work and the resultant need to move frequently were identified as damaging to survey respondents' wellbeing and job satisfaction.

*"Continual short-term contracts are used to pressure people and silence them. It affects their families' outcomes and security and removes people's power in their work environment."*

– Survey respondent

*Research grant conditions could specify minimum terms for researchers employed on the project.*

23 Science and Technology Australia. (2022), 'Submission in response to the Australian Universities Accord Discussion Paper', Science and Technology Australia, Canberra, [scienceandtechnologyaustralia.org.au/wp-content/uploads/2023/04/STA-Submission-Australian-Universities-Accord.pdf](https://scienceandtechnologyaustralia.org.au/wp-content/uploads/2023/04/STA-Submission-Australian-Universities-Accord.pdf)

24 Examples include: Royal Society Fellowship 8 years: [royalsociety.org/grants-schemes-awards/grants/university-research/](https://royalsociety.org/grants-schemes-awards/grants/university-research/); Wellcome mid-career Fellowships 8 years: [wellcome.org/grant-funding/schemes/career-development-awards](https://wellcome.org/grant-funding/schemes/career-development-awards); Wellcome senior Fellowships 8 years: [wellcome.org/grant-funding/schemes/discovery-awards](https://wellcome.org/grant-funding/schemes/discovery-awards); Wellcome ECR Fellowships 5 years: [wellcome.org/grant-funding/schemes/early-career-awards](https://wellcome.org/grant-funding/schemes/early-career-awards); Wellcome.org/ [grant-funding/schemes/senior-research-fellowships](https://wellcome.org/grant-funding/schemes/senior-research-fellowships); British Ecological Society Long term grants 10 years: [britishecologicalsociety.org/funding/launching-our-new-grants-programme/launching-long-term-research-grants/](https://britishecologicalsociety.org/funding/launching-our-new-grants-programme/launching-long-term-research-grants/); British Heart Foundation 5-10 years: [bhf.org.uk/for-professionals/information-for-researchers/what-we-fund](https://bhf.org.uk/for-professionals/information-for-researchers/what-we-fund); Cancer Research UK Discovery Programme 5-6 years [cancerresearchuk.org/funding-for-researchers/our-funding-schemes/discovery-programme-awards](https://cancerresearchuk.org/funding-for-researchers/our-funding-schemes/discovery-programme-awards); National Institute for Health and Care Research 5 years [nihr.ac.uk/explore-nihr/academy-programmes/research-professorships.htm](https://nihr.ac.uk/explore-nihr/academy-programmes/research-professorships.htm)

25 Holland, TL, et al. (2019) 'Length of Fellowship Training in Population Health Research and Long-term Bibliometric Outcomes', *Epidemiology* 30. [doi.org/10.1097/EDE.0000000000001093](https://doi.org/10.1097/EDE.0000000000001093)

## INSIGHT:

Stakeholder consultations heard evidence that a culture of 'internal competition' as a result of short-term funding and job insecurity is a STEM career barrier, which damages workplace culture and job satisfaction. Several stakeholders described a brutal 'hamster wheel' of running constantly to apply for grants, and the pernicious impact this has on workload and job satisfaction.

*"[I've] worked 23 years for [a university], approaching my 17th contract. Instability of employment has affected outcomes for my entire life."*

– Survey respondent

*"It is frustrating that I have been doing essentially the same job (with increases in duties/responsibilities as the facility has grown) for 34 years but I still have to get my contract renewed annually. Three years is the longest contract I've had and that has only happened twice because my line manager fought for it. This has also impacted my superannuation and retirement benefits."*

– Survey respondent

A respondent to the STEM Career Pathways survey told her research career story, which exemplified experiences reported by others in the survey:

*"I've been on 12-month rolling contracts for most of my 10 years with the uni. They keep making different excuses for why I can't get a longer contract. I'm dissatisfied and disillusioned here but I can't leave because I'm trying to get pregnant and I need as much maternity leave as I can get. Because I'm only on 12-month contracts, policy states that I can only get mat leave to the end of the contract date... so after working there for 10 years I may not even get the proper amount that I deserve. There are admin officers who are on ongoing contracts who have had multiple mat leaves for 12 months each. I feel that the fixed contracts issue affects women disproportionately. Overall, haven't seen any benefits of the push towards women in STEM. They want you in the door but they don't care about you once you're in."*

– Survey respondent



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*Job insecurity and short-term contracts were identified major contributing factors by people who were not confident that they would still be in the STEM workforce in 5 years.*

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2.10.1 Hours worked in STEM careers

The average number of hours that respondents were contracted to work per week was 38.6 (Table 5). Variance was wide, with a standard deviation of 14.6 hours. The median number of contracted hours was 38. Three-quarters of respondents were contracted to work 37 hours or more. A quarter were contracted to work 40 hours or more.

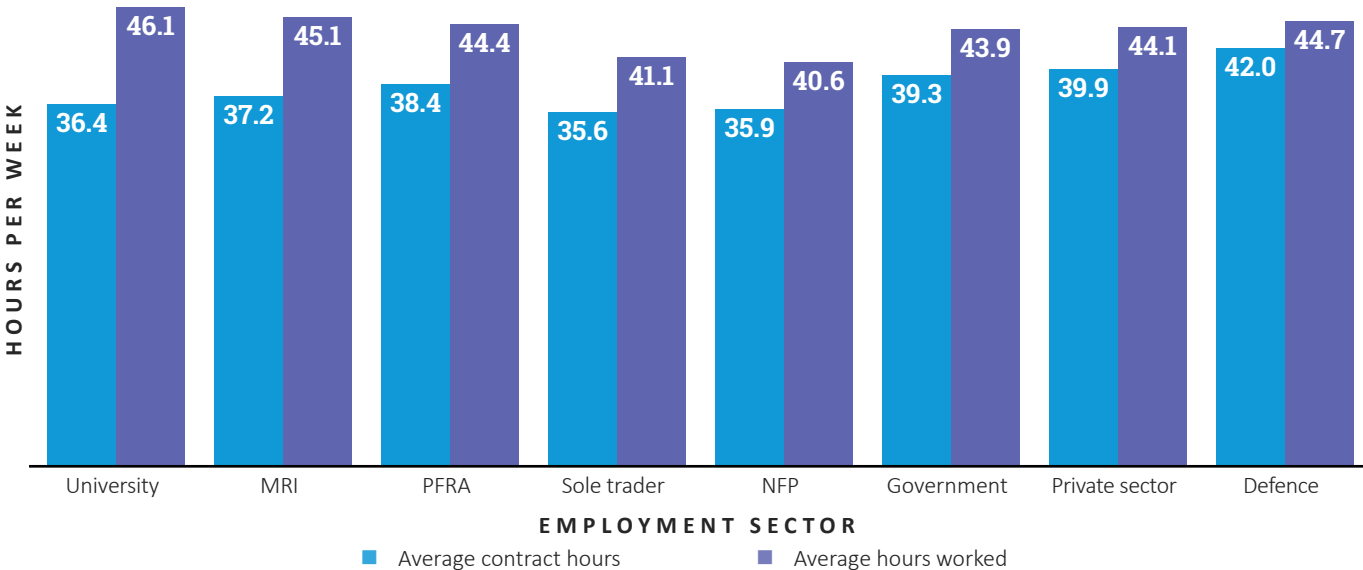
Table 5  
Contracted hours and hours actually worked by employment sector

Employment sector	Average contracted hours	Average hours worked	Extra hours worked
University	36.4	46.1	9.6
MRI	37.2	45.1	7.9
PFRA	38.4	44.4	6.0
Sole trader	35.6	41.1	5.5
NFP	35.9	40.6	4.7
Government	39.3	43.9	4.6
Private sector	39.9	44.1	4.3
Defence	42.0	44.7	2.7
All sectors	38.6	44.8	6.1

Respondents to this question: n = 2616

The survey found people in STEM careers work longer on average than the hours they are contracted to work. The average number of hours respondents worked was 44.8 hours, again with a high variance: the standard deviation was 15.5 hours. The median number of hours worked was 41. Three-quarters of respondents worked 38 hours or more.

Figure 6  
Contracted hours and hours actually worked by employment sector



**INSIGHT:**

One in four survey respondents in the survey worked 50 hours or more per week – effectively working a 6.5-day week.

On average, respondents worked 6.1 hours per week longer than the average of 38.6 hours they were contracted to work. The median difference was 3 hours. One quarter of respondents worked no more than one hour in excess of their contracted hours.

To benchmark this against working hours in the wider Australian economy, results were compared with a recent survey by the Australia Institute Centre for Future Work analysing overtime patterns for the whole Australian workforce. This report found respondents averaged 4.3 hours of unpaid overtime per week. For people in full-time employment, the average was 4.9 hours per week.<sup>26</sup>

*On average, people in STEM careers worked a 44.8 hour week.*

Higher average figures in STEM are driven by longer working hours among people working in universities (9.6 hours extra per week) and medical research institutes (7.9 hours extra per week). Figures reported in Table 5 and Figure 6 for the private, government and not-for-profit sectors are closer to the economy-wide average number of extra working hours cited in the Australia Institute’s survey. Staff in defence science and technology were contracted to work longer on average (42 hours a week) than people employed in other segments of the STEM workforce. Consequently, defence had a lower average gap between contracted hours and worked hours (only 2.7 hours).

26 Littleton, E. (2022), ‘Theft by Any Other Name: Unsatisfactory Working Hours and Unpaid Overtime 2022 Update’, Australia Institute Centre for Future Work, [futurework.org.au/wp-content/uploads/sites/2/2022/11/Theft-By-Any-Other-Name-GHOD-2022.pdf](https://futurework.org.au/wp-content/uploads/sites/2/2022/11/Theft-By-Any-Other-Name-GHOD-2022.pdf)

Bachelor graduates averaged 41.7 hours per week (Table 6). Postgraduates worked longer: Masters graduates worked an average of 44.3 hours per week and those with Graduate Diplomas or Graduate Certificates averaged more than 49 hours a week.<sup>27</sup> PhD graduates averaged 45.7 hours' work per week.

VET-qualified people in STEM careers with an Advanced Diploma or Diploma worked the longest average hours – citing a 58-hour working week (though numbers were small – 52 respondents).

**Table 6**

**Respondents' average hours worked by highest qualification**

Qualification	Average hours worked	Standard deviation	Number
Advanced Diploma/Diploma	58.1	30.5	52
Graduate Diploma/Certificate	49.4	23.3	125
Certificate	47.0	22.8	26
PhD	45.7	13.4	1327
Masters	44.3	17.4	344
Bachelors	41.7	13.6	692

Respondents to this question: n = 2615

Respondents on permanent part-time contracts were contracted to work an average of 28.5 hours a week. Average hours actually worked under permanent part-time contracts were 31.9 – nearly 3.5 hours per week more than contracted. The standard deviation was 9.4 hours.

## 2.11 STEM career prospects

Overall, respondents to the STEM Career Pathways survey were very positive about the future of their career in STEM. **A majority of employed respondents (69%) said their experience in their current job would help them to get a better job in the future.** Only 13% disagreed (18% were unsure).

Those working at universities were less likely to think experience in their current jobs would help them get a better job later (61%).

People with PhDs were less likely (64%) to be optimistic about the value of their work experience, compared to those with Bachelor degrees (76%) or Graduate Diplomas/Graduate Certificates (78%). For Masters graduates, the figure was 70%. VET qualified respondents were as likely as Bachelor graduates (76%) to say their current work experience would get them a better job in the future.

Respondents in entry-level jobs were more likely (74%) to believe their work experience would help them get a better job.

Those who felt that their current work experience would not help to get a better job in the future were asked why they felt this way. These are free text responses, so are more difficult to quantify. Some said they were happy with their current job and planned to stay long term. Others noted their next career step was retirement. Some people articulated that their field was so niche that their current experience would not be helpful outside that field. Respondents also identified some specific barriers they felt would override their experience when vying for the next job. These included discrimination – with age and gender discrimination most commonly anticipated; a view that 'who you know' is a bigger factor than experience in securing a job; and economic headwinds leading to a lack of jobs.

Sixty per cent of respondents agreed or strongly agreed that they understood promotion criteria at their current employer. There was little difference between the major employment sectors.

### INSIGHT:

Nearly two-thirds (64%) of people in the STEM workforce considered their career prospects 'very good' or 'excellent' when surveyed. Fewer than one in ten (9%) felt their career prospects were poor.

Fewer respondents with PhDs considered their prospects 'excellent' or 'good' (61%) than did respondents without PhDs (68%).

### INSIGHT:

63% of people working in STEM are 'quite confident' or 'very confident' they would be working in STEM in five years' time. 15% were not confident of a medium-term future in STEM.

Respondents with PhDs were less favourable: 58% were 'confident' or 'very confident' that they would be working in STEM in five years, compared to 66% of other respondents.

Only 11% of respondents said they would rather work outside STEM (nearly 70% disagreed) and two-thirds were confident that they would be able to get a job in STEM. This data highlights that workers want to stay in STEM careers. They say their STEM experience and knowledge of how to advance their careers will serve them well in long-term careers in STEM.

<sup>27</sup> There were 190 respondents in this category.

Nevertheless, just over half (51%) were concerned about job security in STEM. More than a third of respondents said salaries (42%), working conditions (39%) and workplace culture (34%) in STEM were not attractive (Table 7).

Respondents were asked to name up to 3 factors that would make it more likely they would work in STEM in the future (Table 8).

**INSIGHT:**

The factors that would make it more likely for STEM workers to stay in STEM careers were 'better pay' (41%), followed by 'more secure employment conditions' (31%). 'Better career prospects' (27%) came in third, followed by 'better work/life balance' (24%).

**Table 7****Respondents' confidence about working in STEM**

Response	Percent	Number
I am confident I will be able to get a job in STEM	67%	1875
I am concerned about work/life balance in STEM jobs	55%	1548
I am concerned about job security in STEM	51%	1429
I am confident about the career prospects in STEM	50%	1384
I don't believe society values STEM work and STEM workers	46%	1289
Salaries in STEM are not attractive	42%	1165
Working conditions in STEM are not attractive	39%	1099
Workplace culture in STEM is not attractive	34%	941

Respondents could provide multiple answers to this question. Respondents to this question: n = 2791

**Table 8****Factors that would make it more likely for respondents to work in STEM in the future**

Improvement factors	Percent	Number
Better pay	41%	1148
More secure employment conditions	31%	877
Better career prospects	27%	746
Better work/life balance	24%	676
More opportunities for professional development	19%	520
Developing my professional networks	18%	501
More flexible working arrangements	17%	480
A more manageable workload	15%	420
Better work environment	14%	397
Support from a mentor	14%	384
Upskilling with a short course/micro-credential	10%	288
Getting a new qualification	8%	219
More work experience	7%	199
An internship or placement	6%	161
Other	8%	218

Respondents could provide multiple answers to this question. Respondents to this question: n = 2791

## 2.12 STEM career barriers

Survey respondents were asked to identify whether a list of potential barriers had a high, medium, low or no impact on their career. By far the most commonly cited high-impact barrier to respondents' careers was 'Not enough jobs available': more than a third (35%) of respondents said this had had a high impact on their careers. One in five STEM-qualified people – 21% - cited a 'lack of information/career support' as a high-impact barrier in their STEM career. The same proportion cited 'personal/family circumstances' as a high-impact barrier in their STEM career (Table 9).

Respondents with higher qualifications were less likely to cite 'lack of qualifications' as a high impact career barrier (Table 10).

Other interesting insights included:

- **More women (20%) reported lack of support after a career break as a 'high impact' career barrier, compared to only 13% of other respondents.**
- A third of respondents with child care responsibilities said that 'personal/family circumstances' were a high-impact career barrier for them.
  - For women with child care responsibilities, this figure rose to 38%.
- For respondents with other caring responsibilities, 35% experienced personal/family circumstances as a high impact career barrier.
  - For women in this group, the figure was 38%.

**Table 9**

Career barriers that had a high impact on respondents' careers

Career barrier	%	Number
Not enough jobs available	35%	1002
Lack of information/career support	21%	592
Personal/family circumstances	21%	590
Lack of support after a career break	17%	485
Workplace bullying	16%	464
Difficulty in demonstrating how my skills and experience are relevant	16%	455
Lack of qualifications or experience	11%	301

Respondents to this question: n = 2894

**Table 10**

Respondents reporting 'lack of qualifications' as a high-impact career barrier by highest qualification

Qualification	"Lack of qualifications" a high-impact barrier	Number
Advanced Diploma/Diploma	31%	59
Certificate	30%	30
Graduate Diploma/Graduate Certificate	19%	153
Masters	18%	463
Bachelors	12%	756
PhD	4%	1324
All STEM qualifications	11%	2856

Respondents to this question: n = 2856



- Bachelor graduates were a lot less likely to cite ‘no jobs’ (25%), while 2 in 5 PhD graduates said that ‘no jobs’ was a high impact career barrier (42%).
- By sector, respondents who worked at universities were the most likely to say ‘not enough jobs’ had a high impact on their careers (43%).
- Respondents working in private sector business were least likely to cite the barrier ‘not enough jobs’ (19%). Respondents working at MRIs were the least likely (11%) to cite workplace bullying as a major career barrier.
- Bachelor graduates were the least likely (16%) to cite ‘lack of information/career support’ as a high impact barrier.
- Masters graduates were the most likely (24%) to say that difficulty demonstrating their skills was a barrier with a high impact on their careers.<sup>28</sup>
- Women were slightly more likely (23%) to say that ‘personal/family circumstances’ had been a high impact barrier than were other respondents (17%).

A major American longitudinal study published in 2019 analysed the employment effects of parenthood on STEM career retention. The research found nearly half of new mothers and nearly a quarter of new fathers leave full-time STEM employment within 7 years of the birth or adoption of a first child, with gendered expectations of parenting roles and workplace cultures as key factors.<sup>29</sup> This highly-cited study identified ‘a need for more well-regarded part-time options and ramp-up policies that allow part-time STEM workers to transition back into full-time work’.

#### **BARRIER:**

A lack of support after returning from a career break was cited as a ‘high impact’ career barrier for 1 in 5 women and almost 1 in 7 of other STEM-qualified people.

#### **POTENTIAL SOLUTION:**

Strengthen support and workplace flexibility for parents and others returning from a career break to return to the STEM workforce.

#### **BARRIER:**

1 in 3 STEM-qualified people with childcare responsibilities said personal or family circumstances had been a ‘high impact’ career barrier.

#### **POTENTIAL SOLUTION:**

Improve policies and cultures to support working parents with childcare responsibilities – including offering job-sharing and part-time roles, flexibility with working hours, avoiding out-of-hours event scheduling, and adjusting KPIs to reflect part-time hours.

Some survey respondents said both their caring responsibilities and working part-time had impeded their careers, sharing experiences like this one:

*“After returning from maternity leave, I was told by my manager I couldn’t achieve above-average KPIs because I was part-time (even though my whole career my KPIs have been above average). I was also told I couldn’t apply for senior management positions because I was part-time. Male colleagues were sent on leadership training which I was not eligible for - yes you guessed - because I was part-time!”*

– Survey respondent

#### **INSIGHT:**

People in the STEM workforce with caring responsibilities said their exclusion from work activities held outside of standard working hours, such as evening meetings or networking events, had a detrimental effect on their career.

Other barriers were identified by survey participants in open-ended questions about career barriers. These included:

- Needing a PhD to progress, but not being able to afford to get one (noting a PhD stipend can’t cover living expenses).
- A PhD is sometimes viewed as an over-qualification.
- Age limits on early-career grants inhibit those retraining after a previous career.
- A lack of opportunities and jobs combined with highly competitive work cultures.
- Workplace bullying.
- Excessive workloads, insecure work or workplace culture can lead to mental health challenges.
- Fewer opportunities are available in regional areas.
- People who were first in family to get a university qualification or were from a low socio-economic background found it hard to know how to navigate the system and hard to form or find networks for support.
- Some organisations only hire external applicants and do not promote internally.
- In some organisations, jobs and promotion are reliant on networks rather than transparent processes.
- The ‘2-body problem’: couples in academia can find it difficult to find jobs in the same organisation or city.

*2 in 5 PhD graduates said ‘no jobs’ was a ‘high impact’ career barrier.*

<sup>28</sup> Forty-two per cent of respondents with VET qualifications said difficulty demonstrating skills was a high impact barrier, but numbers were small (only 25 respondents with VET qualifications reported that difficulty demonstrating skills had a high impact on their careers).

<sup>29</sup> Cech, EA and Blair-Loy, M. (2019) ‘The changing career trajectories of new parents in STEM’ *Proceedings of the National Academy of Sciences*, 116(10) doi: [org/10.1073/pnas.1810862116](https://doi.org/10.1073/pnas.1810862116)

## 2.13 Discrimination

Despite occurring at lower reported rates than benchmark data for the wider Australian workforce and society, discrimination was identified as a barrier at every stage of STEM careers: in hiring, in access to opportunities and training, and consideration for promotion. Respondents also identified having to deal with inappropriate behaviour from colleagues. Some said they had trouble accessing support they needed, for example to deal with a mental health issue, due to fear of discrimination.

*“I am an Indigenous woman. I graduated as a chemical engineer in 2021. I did not get a job for more than a year. My features, clothes, and skin colour caused me to be rejected for any vacancy. It was no use having a lot of STEM skills; employers only saw my Indigenous features.”*

– Survey respondent

As in many other sectors of Australia’s economy, such experiences can be barriers to workforce retention and to sustainable careers, especially for women and people from other under-represented groups. STEM careers do not have a unique issue – but nor are they immune from this society-wide challenge. The Respect@Work Inquiry into sexual harassment in Australia provides a series of recommendations to guide workplaces in improving their practices.<sup>30</sup> The Diversity Council of Australia has undertaken research on experiences of discrimination and inclusion for a variety of different demographics in Australian workplaces. They provide evidence-informed advice to workplaces to reduce discrimination and create more inclusive workplaces.<sup>31</sup> STEM specific guidance, for example for those running laboratories, has also been developed.<sup>32</sup>



### **BARRIER:**

Experiences of discrimination, harassment or bullying (although at lower self-reported rates in STEM than rates for people in the wider Australian workforce and society).

### **POTENTIAL SOLUTION:**

Actively foster workplace cultures free from discrimination, harassment or bullying with strong and consistent messages from leaders, managers and supervisors.

30 Australian Human Rights Commission. (2020) ‘Respect@Work: National Inquiry into Sexual Harassment in Australian Workplaces’ [humanrights.gov.au/our-work/sex-discrimination/publications/respectwork-sexual-harassment-national-inquiry-report-2020](https://humanrights.gov.au/our-work/sex-discrimination/publications/respectwork-sexual-harassment-national-inquiry-report-2020)

31 The Diversity Council of Australia website. Accessed 21 August 2023. [dca.org.au/research](https://dca.org.au/research)

32 Chaudhary VB and Berhe AA. (2020) ‘Ten simple rules for building an antiracist lab’, *PLoS Computational Biology* 16(10) [doi.org/10.1371/journal.pcbi.1008210](https://doi.org/10.1371/journal.pcbi.1008210); Jeffers, AE. (2022) ‘The Field of Computing Needs to Take Care of Its Mental Health’ *Computing in Science & Engineering*, 24(2) [doi.org/10.22541/au.164786882.20761218/v1](https://doi.org/10.22541/au.164786882.20761218/v1)

**Table 11** summarises respondents' experiences of discrimination in their STEM careers. Less than half of respondents (43%) reported they had not experienced any form of discrimination.

The fifth national survey on sexual harassment in Australian workplaces (2022) found one in three people (41% of women and 26% of men) had been sexually harassed in the workplace in the last five years.<sup>33</sup> Comparatively, 13% of people in the STEM workforce survey said they had experienced sexual harassment: 20% of women and 3% of men. We note these two major surveys had different samples, methods and questions. The STEM Career Pathways survey was a large-scale self-selection instrument rather than a random or representative sample of the STEM workforce.

The **Challenging Racism Project** across the whole of Australian society found 20% of Australians surveyed had experienced racial discrimination in the form of race hate talk, and about 5% had been attacked because of their race.<sup>34</sup> In the STEM Career Pathways survey, 14% of respondents reported experiencing racial discrimination.

The Scanlon Foundation Research Institute's *2021 Mapping Social Cohesion Survey* found that 'more than one in three Australians born overseas of non-English speaking backgrounds experienced discrimination in the last year because of their skin colour, ethnicity, or religion.'

This rises to two in five (40%) for Australians born in an Asian country.<sup>35</sup> The STEM Career Pathways survey figures were broadly consistent, but slightly lower: 26% of Indigenous respondents and 29% of those who spoke a language other than English at home reported racial discrimination.

A 2021 report found 21% of LGBTQIA+ employees had experienced discrimination in the Australian workforce as a whole:<sup>36</sup> around the same proportion as the LGBTQIA+ respondents to the STEM Career Pathways survey (19%).

One in 6 working age people with disability (16%) across Australia have experienced disability discrimination in the past 12 months.<sup>37</sup> Of respondents to this survey who identified as having a disability, 34% had experienced discrimination based on either a physical or mental disability or both at some point over the course of their STEM career.

More than a third (35%) of respondents said they had experienced gender discrimination – this included more than half (51%) of all women surveyed. Age discrimination and discrimination based on family responsibilities were also commonly reported. In the 'other' category, religious discrimination was the most common response. People also reported discrimination on the basis of class or socio-economic status, on the basis of body size or shape, and based on not being part of an 'in group'.

**Table 11**  
**Discrimination in the STEM workforce**

Type of Discrimination	%	Number
Gender discrimination	35%	944
Age discrimination	15%	400
Racial or cultural discrimination	14%	380
Discrimination based on family responsibilities	13%	346
Sexual harassment	13%	355
Other discrimination	9%	241
Discrimination based on sexual orientation	4%	107
Disability discrimination based on a physical disability	4%	103
Disability discrimination based on a mental disability	4%	104

Respondents could provide multiple answers to this question.  
Respondents to this question: n = 2728

33 Australian Human Rights Commission. (2022), 'Time for respect: Fifth national survey on sexual harassment in Australian workplaces', Australian Human Rights Commission, Sydney [humanrights.gov.au/time-for-respect-2022](https://humanrights.gov.au/time-for-respect-2022)

34 Scanlon Foundation Research Institute. (2021), 'Mapping Social Cohesion', Scanlon Institute, Melbourne [scanloninstitute.org.au/mapping-social-cohesion-2021/](https://scanloninstitute.org.au/mapping-social-cohesion-2021/)

35 Scanlon Foundation Research Institute. (2021), 'Mapping Social Cohesion', Scanlon Institute, Melbourne [scanloninstitute.org.au/mapping-social-cohesion-2021/](https://scanloninstitute.org.au/mapping-social-cohesion-2021/)

36 Seek. (2021), P.R.I.D.E. Report, Seek, [cdn.seeklearning.com.au/files/career-guide/article/files/2021\\_026\\_BAM\\_Midsumma\\_PRIDE\\_Report\\_FA2.pdf](https://cdn.seeklearning.com.au/files/career-guide/article/files/2021_026_BAM_Midsumma_PRIDE_Report_FA2.pdf)

37 Australian Institute of Health and Welfare. (2022), People with disability in Australia, Web report, Published: 5 July 2022. Accessed: 28 August 2023. [aihw.gov.au/reports/disability/people-with-disability-in-australia/contents/justice-and-safety/disability-discrimination](https://aihw.gov.au/reports/disability/people-with-disability-in-australia/contents/justice-and-safety/disability-discrimination)

Results for under-represented or at-risk groups were as follows:

- One in two (51%) women in the STEM workforce survey said they had experienced gender discrimination.
- Thirty-eight per cent of respondents with a psychosocial disability or mental illness reported suffering discrimination.
- Nineteen per cent of LGBTQIA+ respondents reported sexual harassment.
- Respondents with disability were twice as likely to report sexual harassment (22%) as those without disability (11%).
- Seventeen per cent of respondents with a physical disability reported discrimination on the basis of their disability.
- Thirty-one per cent of respondents in their 60s reported age discrimination as did 20% of those in their 50s.
- Twenty-four per cent of respondents with child care responsibilities reported discrimination on the basis of family responsibilities, as did 23% of respondents with other caring duties (such as caring for aged or disabled family members).
  - Breaking these figures down by gender, 36% of women who looked after their own children reported discrimination on the basis of family responsibilities, compared to only 11% of other respondents with child care duties.
  - Similarly, 30% of women with other care responsibilities reported discrimination, compared to only 12% of other respondents with these duties.

## 2.14 Enablers of STEM career retention

### 2.14.1 Professional development

#### INSIGHT:

85% of survey respondents said their employers supported staff to do formal training and/or professional development. However, some respondents said their workplaces were biased in who was offered or allowed to undertake training. Those on short-term contracts, and part-time workers, identified that this restricted their access to professional development opportunities. Ninety per cent of respondents had taken up opportunities to do training and/or professional development at some point in their career.

By employment sector, 94% of respondents in defence science and technology said their employers supported training, as did 90% of those working in the public service. University employees were somewhat less likely (80%) to say their employers supported training.

There was little difference by sector in the share of respondents who had taken advantage of training opportunities: the share was 87% or more in all sectors.

Only 8% of those who had done training said that the training wasn't helpful. Nearly three-quarters (74%) said training had helped them in their current job. Eighteen per cent said training would help them to get a better job in future.

Survey respondents identified a variety of benefits from training opportunities. These included that the skills were directly applicable in their current or future role and that they gained skills or confidence to progress their career – such as applying for promotion or starting their own business. Professional development was also identified as an important networking opportunity to further careers. Leadership courses were commonly noted as useful to people's career advancement.

The small number of respondents (258) who had not taken up opportunities to do training and professional development were asked why. By far the most common answer was 'Don't have time/Too much work' (46%). Thirty per cent said their employers didn't support training and almost as many (29%) said available opportunities didn't meet their needs.

*"There is no time allocated for training, so it either leads to overtime to catch up on work if you take it or you don't take the opportunity to do it prioritizing actual work to be done."*

– Survey respondent

Micro-credentials are one method of delivering continuous professional development and expanding and augmenting the fundamental skills that STEM professionals gained through their degrees.<sup>38</sup> The uptake of micro-credentials is a growing global trend.<sup>39</sup> Some stakeholders articulated a need for more widespread use of micro-credentials for upskilling and career development, and of an accessible funding model to support such an expansion. Regulatory and funding settings on micro-credentials are being examined by the Australian Universities Accord, which will report to Government at the end of 2023.

#### BARRIER:

Limited access to micro-credential training programs to upskill workers in the latest advances in many STEM fields and acquire the specialised technical skills needed in many STEM fields.

#### POTENTIAL SOLUTION:

Expand access to micro-credential courses to rapidly upskill more of Australia's STEM workforce in the latest advances in technology and the specialised technical skills needed in many STEM fields.

38 Tamoliune, G. et al. (2023), 'Exploring the potential of micro-credentials: A systematic literature review', *Frontiers in Education* 7 doi.org/10.3389/feduc.2022.1006811

39 Msweli, NT, Twinomurinzi, H, and Ismail, M. (2022), 'The international case for micro-credentials for life-wide and life-long learning: A systematic literature review' *Interdisciplinary Journal of Information, Knowledge, and Management*, 17. doi.org/10.28945/4954 ; National Institutes for Digital Learning 'Micro-credential Observatory' Accessed 21 August 2023 dcu.ie/nidl/micro-credential-observatory



## 2.14.2 Mentoring and career support in STEM

There is strong evidence in academic literature confirming the value of mentoring in STEM careers<sup>40</sup>—especially for women and people from under-represented groups.<sup>41</sup>

### INSIGHT:

Nearly 1 in 5 survey respondents had a mentor and nearly as many (17%) had had a mentor in the past. Around 2 in 5 had access to informal career support and advice from their professional or personal networks. But 1 in 4 survey respondents (23%) had access to none of these forms of career support and advice (Table 12).

At the first meeting of the project's Eminent Expert Group, one of the expert members expressed a view that academic supervision has to change quite radically to provide the kind of mentoring and support needed to empower young scientists to do their best work and launch their careers:

*'If I could change one thing in the academic part [of the STEM sector], I would ban the notion of a supervisor and move to an advisor/mentor model of learning ... so supervisors create a context and environment where people flourish.'*

— Dr Adi Paterson, Principal and Founder, Siyeva Consulting, former CEO, ANSTO

**Table 12**

Respondents' access to different types of career support and advice

Mentee Status	%	Number
I have informal career planning support and advice from my network, but not a mentor	39%	973
I currently have a mentor	18%	564
I have previously had a mentor	17%	457
Other	3%	431
None of the above	23%	66

Respondents to this question: n = 2491

### BARRIER:

Limited access to mentoring, active career coaching from supervisors, and informal career support or advice from professional and personal networks to help people develop their STEM careers.

### POTENTIAL SOLUTION:

Expand access to mentoring, career coaching and professional development for people in STEM careers – and equip workplace supervisors with stronger skills and expectations to actively nurture the careers of their staff.

Across the different sectors, respondents working at publicly funded research agencies (14%) and in the public service (11%) were less likely to have a mentor.

Staff at medical research institutes were more likely to rely on informal advice and support (49%) but were also least likely to have no access to formal career advice and support (13%).

People working in the public service were less likely to have mentors (11%) and the most likely to have no career support (29%).

Nearly 80% of respondents who currently had a mentor found this 'quite useful' or 'very useful'. Of those who had previously had a mentor, 63% found mentoring useful. Only half of those using informal career support and advice found this useful, suggesting that mentoring provided greater value than informal career support.

*"It took me a very long time to realise this fact: if your employer is not talking to you about your career then they are not interested in you at all..."*

— Survey respondent

There was no difference in how useful respondents with different types of higher education qualifications found various forms of career support and advice. However, VET-qualified respondents were more likely to report that career support and advice generally was helpful, though numbers were very small (only 51 VET-qualified respondents answered the question).

There were some differences by employment sector – staff at universities and in the public service (both 74%) were less likely to find mentoring 'quite useful' or 'very useful'.

*Strong evidence confirms the value of mentoring in STEM careers.*

40 Mondisa, J, Packard BW and Montgomery, BL. (2021) 'Understanding what STEM mentoring ecosystems need to thrive: A STEM-ME framework', *Mentoring & Tutoring: Partnership in Learning*, 29(1) [doi.org/10.1080/13611267.2021.1899588](https://doi.org/10.1080/13611267.2021.1899588)

41 Thiry, H, and Laursen, SL. (2011) 'The Role of Student-Advisor Interactions in Apprenticing Undergraduate Researchers into a Scientific Community of Practice', *Journal of Science Education and Technology*, 20(6) [doi.org/10.1007/s10956-011-9142-2](https://doi.org/10.1007/s10956-011-9142-2)

**INSIGHT:**

Mentoring is an effective intervention, but only a minority of respondents had a mentor. A more systematic approach to mentoring and development throughout careers would support STEM-qualified people to develop sustainable and diverse careers.

Research investigating programs that support mentoring relationships or provide training for mentors found mentoring can improve mentees skills and competencies<sup>42</sup> and training for mentors can improve the quality of mentoring.<sup>43</sup>

For respondents who had mentors, this was arranged by their employers for 36% of respondents. Another 27% had mentoring arranged through work networks, and 11% through a structured program outside of work. Nearly a quarter (23%) had arranged a mentor themselves (Table 13).

**Table 13****How respondents arranged mentoring**

Mentor arrangement	%	Number
Arranged by my employer	36%	325
Through work colleagues/networks	27%	239
I arranged it myself	23%	207
Through a structured program outside my workplace	11%	96
Other	3%	26

Respondents to this question: n = 2491

Respondents with different STEM qualifications arranged mentoring in similar ways. Only people with PhDs were decidedly less likely to have had mentoring arranged by their employer – 32%, compared to 41% of people with other STEM qualifications.

There were some clear differences by sector:

- Employees in defence (46%) and the private sector (42%) were more likely to have had mentoring arranged by employers.
- Staff at medical research institutes (24%) and public servants (19%) were more likely to have had access to mentoring through a structured program outside of work.
- Staff at publicly funded research agencies were more likely to have arranged mentoring through work colleagues or networks (35%).

Respondents who had mentoring arranged through a structured program arranged outside their workplace were the most likely to report that mentoring was useful (90%). Between 77% and 79% of respondents whose mentoring was arranged in other ways reported that mentoring was useful.

## 2.15 Main themes: STEM career retention

The evidence from this research study – and particularly from the STEM Career Pathways survey – is clear: STEM workers are deeply committed to working in STEM and to building STEM careers. Most see themselves working in STEM long-term. However, there are barriers that make it harder for people to stay and to thrive in STEM careers.

Some of these barriers have widespread impact, while others have the most acute impact on under-represented groups. To dismantle these barriers and enable greater retention of STEM workers, Australia needs to take concerted action in three areas.

First, **strengthen workplace practices and culture.**

This research finds Australia's STEM workforce wants flexible working conditions, healthier workplace cultures, and clear and consistent messages from employers and managers to prevent bullying and discrimination (these challenges apply across the wider economy). Some workplace career barriers are specific to STEM research careers, such as acute job insecurity and a lack of jobs in research. Imposing new conditions on research grants – requiring employment of researchers for the duration of the grant – would strengthen STEM career success and remove career barriers particularly for early-career STEM researchers, as proposed in the draft recommendations of the 2023 Diversity in STEM Review.<sup>44</sup>

A second major area of work to improve retention of STEM workers in STEM careers is to strengthen access to the **skills and experience people need to thrive in STEM careers.** This research report identifies a growing need for many STEM-qualified people in Australia's to access further practical skills and work experience to forge a STEM career – and stay in a STEM career.

This report finds strong evidence that strengthening access to professional development, professional networks, mentoring programs and ensuring managers actively nurture the careers of their staff are enablers of a successful career in STEM.

42 Jackson C, Milos D, Kerr M. (2019) 'Mentoring for employability: a state-level impact study' *Studies in Graduate and Postdoctoral Education*, 10 (3) [doi: 10.1108/SGPE-04-2019-0047](https://doi.org/10.1108/SGPE-04-2019-0047)

43 Gandhi M, Johnson M. (2016) 'Creating More Effective Mentors: Mentoring the Mentor' *AIDS Behaviour*, 20(S2) [doi: 10.1007/s10461-016-1364-3](https://doi.org/10.1007/s10461-016-1364-3).

44 Commonwealth Department of industry, Science and Resources. 'Diversity in STEM Review: draft recommendations' website. Accessed 21 August 2023 [consult.industry.gov.au/diversityinstem2](https://consult.industry.gov.au/diversityinstem2)

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*Professional development, networks, mentoring and a supervisor who actively nurtures your career enable STEM career success.*

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It also finds forging deeper collaborations between education providers and STEM workplaces to deepen access to career-accelerating opportunities will strengthen Australia's STEM workforce and STEM careers.

Third, the evidence in this major report suggests **changes to system-wide settings can strengthen retention of STEM workers in the Australian workforce.** This includes strengthening systems and practices to enable better recruitment and inclusion of overseas-trained STEM workers and international graduates into Australia's STEM workforce. Our large-scale survey found perceptions in some parts of the STEM workforce about a lack of jobs in STEM – yet that perception is in stark contrast to urgent calls from employers for more STEM-qualified workers to fill acute STEM skills gaps across our economy. Australia can bridge this divide by raising the visibility of the breadth of career options and opportunities in STEM, broadening employer understanding of the value of STEM qualifications, and dismantling barriers for employers to hire overseas-trained STEM workers and international graduates from Australian TAFEs, VET colleges and universities.



### 3. CAREER MOBILITY ACROSS THE STEM SECTOR

STEM skills are increasingly used in a wide variety of occupations.<sup>45</sup> STEM degrees prepare graduates well for any job – particularly in the areas of critical thinking and complex problem solving<sup>46</sup> – and many jobs now make more direct and intensive use of STEM skills ('STEMification').

As STEM workers forge their careers in the modern Australian workforce, they are likely to hold many jobs during their careers. Australian Bureau of Statistics data shows long-term trends on the rates of career moves between jobs and sometimes between sectors: 9.5% of Australia's workforce changed jobs in the year to February 2023.<sup>47</sup> STEM jobs can be found in academia, government, the private sector, defence science, medical research institutes, publicly funded research agencies and in the not-for-profit sector.

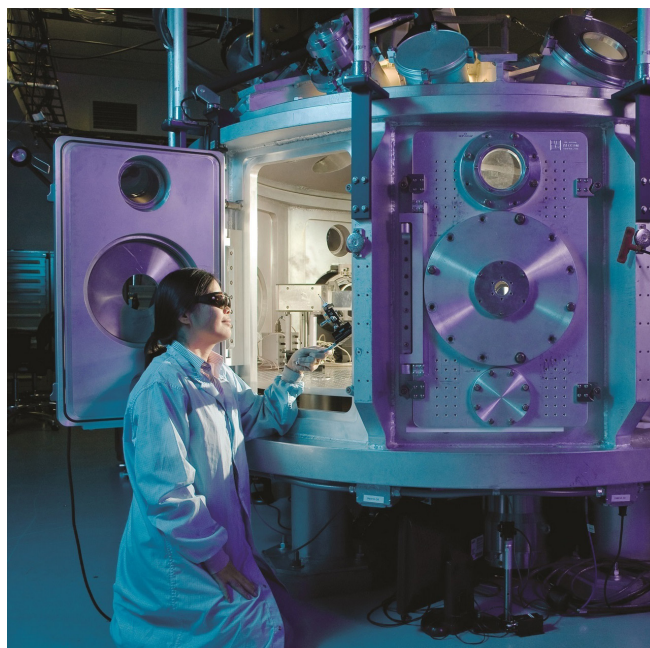
Each of these sectors has different ways of working, different work cultures, and workers' performance is assessed in different ways. These differences can present barriers to workers seeking to change sectors – and those able to make a transition find themselves adapting to a new working environment on arrival. In universities, medical research institutes and publicly funded research agencies, most STEM workers are engaged in research activities that are in a large part publicly funded and discovery-driven. These common features may make transitions between these sectors easier than those into other sectors. However, even for a STEM worker who stays in the role of STEM researcher, there will be large changes to their experience in these three sectors, for example working in a PFRA they will have significantly less autonomy to direct their own research than when working at a university.

*STEM degrees prepare graduates well for any job... particularly in complex problem solving.*

Where STEM workers make transitions between sectors with more fundamental differences – such as from university research into the private sector – they encounter even greater changes in the work environment and the factors employers use to assess their suitability for the role.

One suggestion to strengthen Australia's STEM workforce is to ensure workers can move seamlessly across the STEM sector – so an overabundance of STEM workers in one part of the sector can be remobilised in another to fill skills shortages. This section of the report examines evidence on mobility of this nature across the Australian STEM workforce.

It discusses the level of mobility currently occurring between sectors, factors that help or hinder such transitions, and the level of current appetite among STEM workers for greater career mobility. It also explores the contribution of formal career mobility programs and how Australia's relatively low levels of business investment in R&D affect a thriving STEM workforce.



45 Skrentny, JD and Lewis, K. (2022) 'Beyond the "STEM Pipeline": Expertise, Careers, and Lifelong Learning', *Minerva* 60:1–28, [doi.org/10.1007/s11024-021-09445-6](https://doi.org/10.1007/s11024-021-09445-6)

46 Maxon, ME. (2019) 'Getting a PhD in a STEM field is a great start to a winning career', *Molecular Biology of the Cell* 30 (21), [molbiolcell.org/doi/full/10.1091/mbc.E19-04-0219](https://molbiolcell.org/doi/full/10.1091/mbc.E19-04-0219); Madan, C. (Ed), (2022), *Academia and the World Beyond: Navigating Life after a PhD*, Springer Link [link.springer.com/book/10.1007/978-3-030-82606-2](https://link.springer.com/book/10.1007/978-3-030-82606-2)

47 Australian Bureau of Statistics. (2023), Job Mobility statistics, Published 30 June 2023. Accessed 21 August 2023. [abs.gov.au/statistics/labour/jobs/job-mobility/latest-release#](https://abs.gov.au/statistics/labour/jobs/job-mobility/latest-release#)



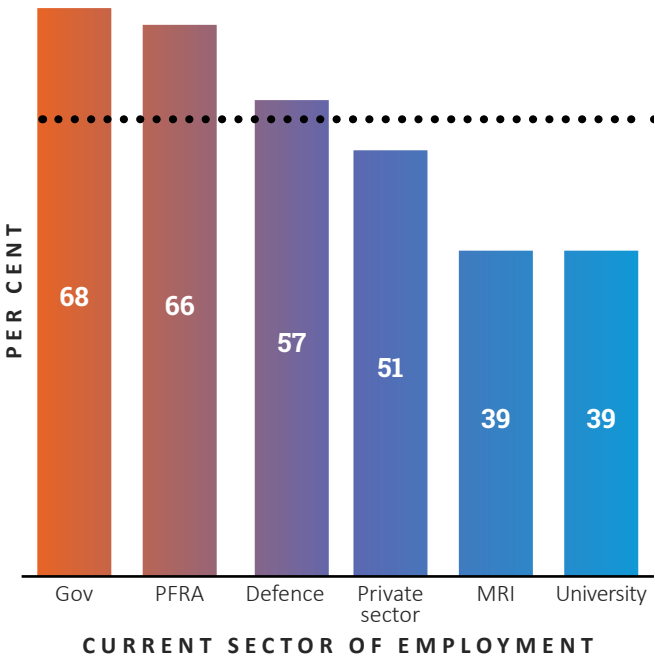
### 3.1 Levels and patterns of STEM career mobility: the diode effect?

**INSIGHT:**

While public discussion in the STEM sector often asserts a strong lack of mobility across sectors in the STEM workforce, this study found evidence that career movement was not as limited as sometimes suggested. More than half of respondents (54%) to the STEM Career Pathways survey had previously worked in a different segment of the STEM sector from their current employment (Figure 7).

Of those who had moved across the breadth of the STEM sector at some point in their career, almost half had only moved once (45%). This suggests that **for many people in STEM careers, a move is often one way. This invokes an analogy of a diode – a semiconductor device that allows current to flow easily in one direction, but severely restricts flow in the opposite direction.**

**Figure 7**  
Proportion of survey respondents from each sector who had previously worked in another sector



Employment sectors with less than 100 respondents have not been included in Figure 7. Dotted line indicates the average of all respondents (54%).

A further 23% of people in STEM careers surveyed said they had moved more than once across the STEM sector in the course of their careers – but these moves were between the university, medical research institute and publicly funded research agency sectors which have more similarities to each other than other segments of the STEM sector.

Having previous experience in a different sector was more common in PRFAs and government, where two-thirds of people had previously worked in other sectors (Figure 7). It was also common for defence employees (57%), but less common for those working at universities (39%) or medical research institutes (39%).

Table 14 shows the patterns of mobility across employment sectors for those respondents who have changed sectors throughout their career. Respondents could name as many sectors as they had previously worked in. Percentages in the table reflect the percentage of people currently working in that sector who have previously worked in the indicated other sector. Cells in the table are colour-coded according to the value reported in each cell: the stronger the mobility between the two sectors, the darker the cell.

**Table 14**  
Patterns of mobility across employment sectors

Current sector (No. of respondents)	Previous sectors (%)					
	University	MRI	PFRA	Defence	Government	Private sector
University (301)		13	18	7	27	45
MRI (39)	59		8	0	15	31
PFRA (247)	53	9		5	19	49
Defence (170)	37	14	14		17	56
Government (243)	53	7	18	4		44
Private sector (247)	43	13	16	7	30	

Table 14 shows where current employees from each employment sector have prior experience. The current sector column indicates the number of respondents from each sector who have previously worked in a different sector. The table shows the percentage of that workforce that has experience in the different sectors. Respondents could select as many previous sectors as they wished. Note: The not for profit (67 respondents in total), sole trader (79 respondents) and 'Other' (40 respondents) sectors have been excluded from Table 14 due to small numbers of respondents.

Of those people who have previously worked in a different sector, the table shows that the most common combinations were:

- staff at universities who had previously worked in the private sector (45%)
- staff at medical research institutes who had previously worked at universities (59%)
- staff at publicly funded research agencies who had previously worked in universities (53%)
- public servants who had worked at universities (53%)
- staff at publicly funded research agencies who had worked in the private sector (49%)
- public servants who had worked in the private sector (44%)
- staff in the private sector who previously worked at universities (43%).

Turning the analysis around (from destinations to points of origin), the university sector contributed significant numbers of staff to publicly funded research agencies, government and the private sector.

A relatively large number of respondents had previously worked in the private sector, and this sector contributed staff to the universities, publicly funded research agencies and government.

## 3.2 How easy is it to move around the STEM sector?

### INSIGHT:

In the STEM Career Pathways survey, more than half of respondents (53%) said it was 'quite easy' or 'very easy' to move between sectors with a STEM qualification. Only 22% said it was 'somewhat difficult' or 'very difficult' (Figure 8).

### INSIGHT:

Fewer than half (47%) of people with STEM PhDs said it was 'quite easy' or 'very easy' to move across the sector, compared to 59% of people with other levels of STEM qualifications. 1 in 3 people with a STEM PhD (29%) said it was difficult to move between sectors compared to only 16% of people with another level of STEM qualification.

*"Without a PhD, it is easy to move between industries. I have worked in four different organisations after receiving my bachelor degree in Chemical Engineering. However, post PhD it is quite difficult to get a suitable position in industry. This is simply because of the specialized knowledge earned during PhD which does not have a wide requirement in the industry."*

– Survey respondent

For those who rated their move between sectors as somewhat or very difficult the reasons given were: a need to retrain or get new qualifications in order to move; jobs were hard to find; employers were looking for previous (Australian) experience in their sector; and employers could not see the value of PhD training. Many said they needed to accept a pay cut, decrease in work conditions or loss of work entitlements. Many people said they also found it a challenge to articulate how their STEM skills and knowledge developed in their current sector could be applied in a new sector, citing this as a barrier to mobility. After moving to a new sector, people identified big differences in culture and/or expectations as challenges they faced in their new sector.

### BARRIER:

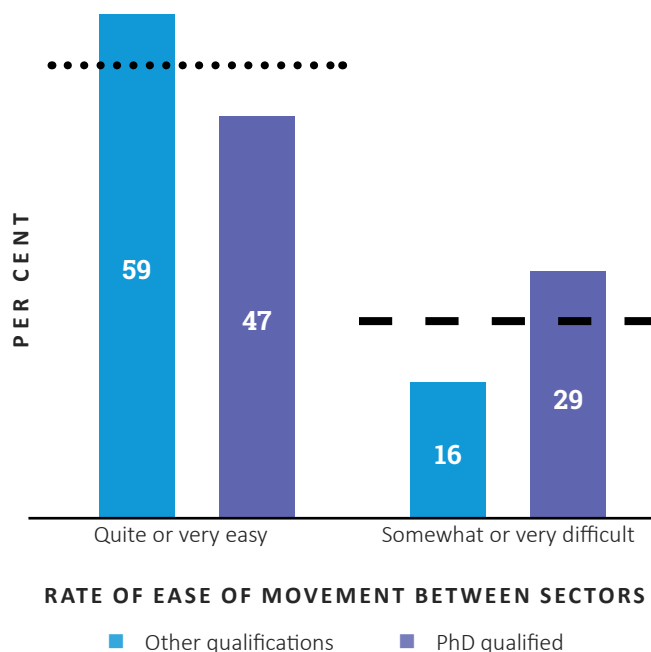
Many STEM workers find it difficult to articulate to employers how their STEM skills and knowledge could be applied in another sector.

### POTENTIAL SOLUTION:

Offer training across the STEM workforce to help more STEM workers articulate the applicability of their skills and knowledge in a new sector.

Figure 8

Ease of movement between sectors



The dotted line indicates the survey average of people who rated moving between sectors very or quite easy (53%). The dashed line indicates the survey average of people who rated moving between sectors somewhat or very difficult (23%).

*"It takes some practise and experience to change your academic CV into a resume and remodel yourself into the shape that non-academic employers want. Even then, they don't necessarily treat people and project management skills obtained in labs as equivalent to those same skills obtained in other environments."*

– Survey respondent

### INSIGHT:

Moving into (or back into) academia after working in another part of the STEM sector was singled out by people in the STEM workforce as being more difficult than other moves. They said their experiences outside academia were not valued – and measures of merit used in academia were widely different from elsewhere with over-reliance on publications.

*“The transition from private industry back to academia was very challenging. The expectations around metrics is insane – which meant my private industry experience accounted for nothing in the traditional academic sector. 13 years after I transitioned back, I am still penalised for the time in industry (based on track record).”*

– Survey respondent

Those who rated moving as ‘very easy’ or ‘quite easy’ said their skills were transferable, demand for workers in their field was high, and job requirements were similar in the two sectors they moved between.

### BARRIER:

A lack of knowledge and networks with people working in other parts of the STEM sector makes it harder for STEM workers to consider career moves across the sector.

### POTENTIAL SOLUTION:

Support initiatives to promote STEM workers having mentors, networks and connections in other parts of the STEM sector.

*“I had a good network of connections that allowed me options, which is valuable, however a STEM qualification is still a really important thing to have in order to demonstrate technical capabilities and adaptability.”*

– Survey respondent

Specific skills or experience, for example industry experience gained during a degree, helped people transition into a private sector role after working in a different part of the STEM sector. Even survey respondents who found the move easy noted there was a learning curve and the need to adapt to a new work culture.

*“It is the knowledge and skill set you take with you that is important in establishing yourself in the next role.”*

– Survey respondent

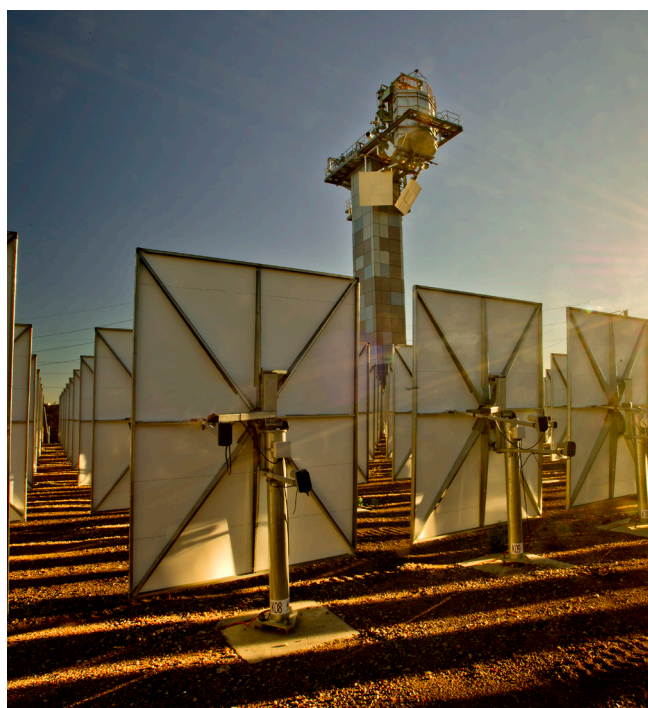
*“The skills I developed in my STEM advanced education have been highly relevant to several different sectors and mastery of those skills have been key in my ability to adapt to a new field as they are fundamental across many disciplines.”*

– Survey respondent

### INSIGHT:

Survey respondents were also asked to rate the importance of their skills and experience in helping them to move across the STEM sector during the course of their careers. The most commonly cited ‘high impact’ factors enabling mobility between sectors were:

- an ability to articulate how my skills could be transferred (66%)
- having STEM qualifications (62%)
- an ability to demonstrate my impact (60%).



Respondents with PhDs and other respondents differed in the factors they cited as having a 'high impact' on mobility (Table 15).

In the survey, people with PhDs were more likely to cite STEM qualifications and networks as factors that aided mobility. They were less likely to cite non-STEM qualifications and the combination of STEM and non-STEM qualifications than respondents without a PhD. This is consistent with PhD graduates tending to work in specialised roles, particularly in research.

Table 16 shows the employer attitudes and practices respondents felt most helped mobility.

Employer attitudes with the highest reported impact were:

- recognition of the value of fundamental skills and knowledge (68%)
- recognition of the value of STEM qualifications (59%)
- a willingness to employ people without direct experience in the destination sector (46%)
- a view that careers are varied and non-linear (46%).

People with a STEM PhD were more likely to cite employers' recognition of the value of a STEM qualification. They were less likely to cite criteria for valuing experience in different sectors or employers' recognition of non-STEM qualifications or a combination of STEM and non-STEM qualifications.

**Table 15**  
'High impact' factors in mobility, PhDs and others

Factor	PhD-qualified	Other qualifications	All
An ability to articulate how my skills could be transferred to the sector I moved to	67%	64%	66%
My STEM qualification	67%	56%	62%
An ability to demonstrate my impact	62%	58%	60%
My connections and network	54%	45%	50%
My experience collaborating with the sector I moved to	45%	45%	45%
The combination of my STEM and non-STEM qualifications	28%	37%	33%
My non-STEM qualification	16%	25%	21%

Respondents to this question: PhD-qualified respondents n = 673; Other qualifications n = 675; All respondents n = 1348

**Table 16**  
Respondents' views on employer attitudes and practices with a high impact on mobility, PhDs and other qualifications

Factor	PhD-qualified	Other qualifications	All
Recognition of the value of fundamental skills	67%	69%	68%
Recognition of the value of a STEM qualification	66%	53%	59%
Willingness to employ people without direct experience in the sector	45%	47%	46%
View that careers are varied and non-linear	44%	47%	46%
Clear criteria for valuing experience in different sectors	31%	39%	35%
Recognition of the combined value of STEM and non-STEM qualification	22%	35%	28%
Recognition of the value of a non-STEM qualification	12%	25%	19%
A specific entry program	14%	17%	16%

Respondents to this question: PhD-qualified respondents n = 673; Other respondents n = 675; All respondents n = 1348



PhD-qualified workers placed greater value on their STEM qualification to help them move around the sector, while those without a PhD were more likely to rely on a non-STEM qualification or the combination of a STEM and non-STEM qualification. Qualitative responses from the survey and stakeholder consultations indicated that some employers lacked an understanding of what value PhD-qualified workers could bring to their workplace. Employers also indicated that they balanced the value of the qualification with the premium price of salaries for PhD-qualified workers.

As PhD-qualified STEM workers rated mobility harder than people without a PhD, better communications training in how to articulate the skills acquired in a PhD could improve mobility options. For example, project management skills acquired in a research environment may be comparable to those gained in a project management short course, or on the job. Micro-credentials may also offer an avenue for PhD-qualified workers to easily gain qualifications which will assist them in their career progression.

*“After completing a PhD and over 10 years of post-PhD employment as an academic, it is disappointing that most employers don’t recognise the additional skills that STEM PhDs bring over a BSc graduate. Leaving academia resulted in a 25% pay cut.”*

– Survey respondent

## CASE STUDY

### CSIRO Industry PhD Program

CSIRO runs an Industry PhD program which brings together CSIRO, universities and businesses to collaborate on a research project. PhD students in the program may still be largely based in a university or CSIRO but engage with a business to work on research which helps solve business problems.

Businesses that have worked with the program have identified the following benefits for their business:

- Access to research at a relatively low cost.
- Growing their own internal research capability, with a positive impact for their business.
- Building relationships and linkages to CSIRO and universities as avenues for continuing collaboration.
- Identifying talent for potential recruitment following the project.

“I think in terms of short-term aim of course this will link him [the student] directly to a job working with us hopefully .... and who knows in the future he might be the future CEO.” - Dr Tam Tran, Chief Technology Officer, EcoMag (business partner in a CSIRO Industry PhD).

A new National Industry PhD Program funded by the Department of Education began in 2022, and the APR.Intern program run by the Australian Mathematical Sciences Institute also supports industry placements for PhD students.

### 3.3 Formal STEM career mobility programs

#### INSIGHT:

Only 1 in 5 survey respondents (21%) were aware of formal career mobility opportunities such as secondments, internships, sabbaticals, graduate programs with rotations, or programs that enabled them to move between sectors. Access to mobility programs was not available to all.

#### BARRIER:

Limited awareness across the STEM workforce of formal mobility opportunities such as secondments, internships, sabbaticals, graduate programs with rotations or programs that enable moves between sectors.

#### POTENTIAL SOLUTION:

Create more opportunities for employers to promote the exchange of talent with other sectors and the influx of new talent into their own enterprise.

More respondents with PhDs (24%) were aware of formal career mobility opportunities than other respondents (17%). Respondents working in MRIs (13%) and in the private sector (14%) were less aware of mobility opportunities. People working in defence (28%) and the public service (26%) were more aware of mobility opportunities.

*"I'm aware of internships etc but can't participate due to needing income"*

– Survey respondent

Mobility programs identified by survey participants are listed in [Table A3](#) at [Appendix: Methods](#). The table illustrates a range of different initiatives and focuses. Some people noted that there were a lot of opportunities while others had access to or familiarity with only a few or none. This was at least partially dependent on field of expertise and on industry/occupation. Some respondents said opportunities were mainly focused on young people, students or those early in their careers and there was a need for programs to support people throughout their careers.

#### BARRIER:

Some mobility schemes in STEM focus on young people, students or people early in their careers, with fewer opportunities for STEM workers further advanced in their careers.

#### POTENTIAL SOLUTION:

Expand opportunities for career mobility programs across the STEM sector that recruit people at all career stages.

#### INSIGHT:

There is wide variability in the effectiveness of current career mobility programs. For survey respondents who had participated in a career mobility program, 46% felt they had low impact, 20% rated their impact as medium and 33% as high impact. Any attempts to upscale programs should be based on evaluations of the effectiveness of specific programs.

#### CASE STUDY NAVIGATE

Navigate is a program run by the Defence Science and Technology Group (DSTG) to improve the Defence Department's mid-career workforce capacity and diversify the Department's workforce. The program aims to:

- Improve Defence's access to high calibre mid-career researchers and technologists by providing a new pathway into Defence.
- Bolster female representation at the mid-to-senior levels of the organisation with a pre-determined gender target of 50% female.
- Provide opportunities for high-performing Defence STEM specialists with a supported opportunity to broaden their leadership exposure and contribution.
- Enable STEM professionals from the broader STEM ecosystem to transition into the complex area of Defence Innovation, Science and Technology.
- Enable career mobility for STEM professionals within Defence.
- Increase diversity to allow greater innovation to solve the future challenges for Defence.
- Create a cohort with a deeper understanding of both Defence and external ecosystem.

The NAVIGATE Program was launched in 2022 with a pre-determined gender target (40% female, 40% male and 20% any gender) and attracted over 800 applicants. With up to 80 ongoing positions on offer, 69 participants commenced on the program in May 2022 (36) and August 2022 (33) comprising 44% female, 56% male. The continuation of the NAVIGATE Program was announced in June 2023 with a new pre-determined gender target of 50% female. NAVIGATE 2023 received a staggering 913 applications comprising 327 women (37%).

During the 12-month program, participants undertake 2 6-month placements in different science and technology areas within the Defence STEM ecosystem and are provided with the opportunity to contribute to high priority areas for Defence. Participants are provided with training and leadership development opportunities and mentoring to support their career development. At the conclusion of the 12-month program, NAVIGATE Participants are offered an ongoing role within DSTG or wider Defence.

### 3.4 More inclusive recruitment practices

Stakeholder consultations revealed perceptions that both universities and private sector employers can be conservative institutions which can (sometimes unconsciously) exclude people who don't fit into a traditional model of what a STEM researcher or professional looks like.

Some groups of STEM workers reported they found mobility harder than the average for the survey. This included people who spoke a language other than English as their first language and those who identified as having a disability, chronic illness or being neurodiverse.

#### BARRIER:

Consultations with stakeholders – including employer peak bodies and a range of diverse employers – identified recruitment practices as a barrier to the employment of STEM workers, especially people from groups traditionally under-represented in STEM.

#### POTENTIAL SOLUTION:

Raise awareness among STEM employers of the benefits of greater access to STEM skills through more inclusive recruitment processes including assessing skills rather than experience.

Interestingly, **Aboriginal and Torres Strait Islander people rated mobility easier than the survey average.** This finding is likely due to the large number of recruitment programs focused on Aboriginal and Torres Strait Islander people. Active commitment from employers through Reconciliation Action Plans and diversity commitments to recruit Indigenous employees may also have an impact. The relatively small population of Aboriginal and Torres Strait Islander people in the STEM qualified workforce in relation to the number of programs likely also contributes to this finding. Insights on how to improve mobility for other under-represented groups and generally for STEM workers may be derived from deeper investigation into this finding.

Stakeholder consultations discussed newer initiatives to streamline recruitment processes to give applicants a clearer opportunity to demonstrate 'whether they **could** do the job', rather than relying heavily on applicants demonstrating that had already done the job in a previous role. More transparent promotion criteria can help employers to identify talent and potential wherever it may be found, strengthening diversity in the workforce.

As with many other initiatives designed to level the playing field for marginalised groups, stakeholders noted such practices improved the effectiveness and transparency of recruitment for the whole STEM workforce.<sup>48</sup>

Another issue identified in this research study was the importance of clear and transparent criteria for promotion in STEM careers. Overall, 40% of survey respondents said they didn't understand the criteria for promotion – or were unsure of what those criteria were. This was slightly higher for some groups traditionally under-represented in STEM, including women and LGBTQIA+ people.

Where such information is opaque, or mostly transmitted informally through mentors or networks, it is harder for traditionally under-represented groups to understand the path to career promotion and leadership progression. International evidence shows the importance of transparent information about the criteria for promotion.<sup>49</sup> The Diversity Council of Australia has undertaken research to inform guidance for employers on how to ensure their recruitment practices are inclusive.<sup>50</sup>

#### INSIGHT:

Transparent criteria and processes make recruitment and promotions fairer and more effective. This can help employers to identify talent and potential wherever it may be found, contributing to greater diversity in the workforce.

#### BARRIER:

A lack of consistently clear and transparent criteria and processes for recruitment and promotion.

#### POTENTIAL SOLUTION:

Share best practice examples of clear and transparent information on criteria and processes for recruitment and promotion across STEM-employing organisations.

Employers in heavily male-dominated industries described their efforts in recent years to readvertise positions for women only. They also cited success in rewriting job advertisements so that women who had not even considered applying for a position based on the original, generic job advertisement realised they could apply for (and land) the job after it was advertised in a different way that was more appealing to women applicants. Academic evidence confirms the effectiveness of gender-targeted recruitment approaches in fields with under-representation challenges.<sup>51</sup>

48 Coffman, J, Rosenblum, E, D'Arcy, A and Thompson Love, L. (2021), 'How clear career paths strengthen retention - and diversity', Bain & Company. Published 11 August 2021. Accessed 21 August 2023. [bain.com/insights/how-clear-career-paths-strengthen-retention-and-diversity/](https://bain.com/insights/how-clear-career-paths-strengthen-retention-and-diversity/)

49 Rice DB, Raffoul H, Ioannidis JPA, and Moher D. (2020) 'Academic criteria for promotion and tenure in biomedical sciences faculties: cross sectional analysis of international sample of universities' *British Medical Journal* 369 [doi.org/10.1136/bmj.m2081](https://doi.org/10.1136/bmj.m2081)

50 The Diversity Council of Australia. 'Inclusive recruitment tools' website. Accessed 21 August 2023. [dca.org.au/research/project/inclusive-recruitment-tools](https://dca.org.au/research/project/inclusive-recruitment-tools)

51 Guillemin, M, Wong, E and Such, G. (2022) 'Affirmative recruitment of women in STEM: a case study', *Journal of Higher Education Policy and Management*, Published online: 16 Dec 2022. [doi.org/10.1080/1360080X.2022.2157928](https://doi.org/10.1080/1360080X.2022.2157928)

## BARRIER:

Some STEM employers only classify years in paid employment as relevant experience, which actively discriminates against PhD graduates and their workplace-ready skills acquired in PhD study including project management.

## POTENTIAL SOLUTION:

Raise awareness among more STEM employers of the workplace-equivalent skills and capabilities of people with PhDs – and include more explicit guidance in hiring practices.

*“[Employers] think postgraduate research is just going to lectures and being a student but [it’s] actually closer to being employed..... [it] brings you way more skills in resilience, independent thinking, autonomy and strategy than any job ever would.”*

– Survey respondent

Stakeholder consultations suggested a way to remove this barrier would be for more STEM employers to explicitly include guidance in their hiring practices on how to recognise and evaluate HDR study in staff recruitment. This is a two-way street – research undertaken in Europe identified a role for education institutions to also promote the value of PhD graduates’ skills more clearly to both industry and society.<sup>52</sup>

Key informants in our stakeholder consultations observed efforts by institutions (both public and private) to ensure people aren’t breaching anti-discrimination laws in workplaces can overlook the historic power dynamics in attitudes and behaviours. Participants in stakeholder roundtables said STEM-employing institutions needed to do more – beyond merely complying with anti-discrimination laws – to forge workplaces cultures that are inclusive, diverse and welcoming.

Stakeholder consultations heard insights from people currently in STEM careers that many STEM employers could do better.

*40% of people didn’t understand the criteria for promotion in their workplace or were unsure of what they were.*

## INSIGHT:

‘Prestige employers’ – large organisations with strong profiles and influence – in both the public and private sectors could use their profile to make important public commitments to diversify recruitment and the STEM workforce. This would set a mark for others to aim for – helping to ‘shift the dial’ for the whole sector.

Many of these issues come back to the familiar problem that ‘it’s hard to be what you can’t see’. Institutions and employers need to make a more positive effort to address under-representation of diverse groups. This can take the form (especially in employment) of a concerted effort to recruit more people from under-represented groups. Such efforts do not compromise competitive, meritocratic processes: rather, they make competition fairer and merit easier to identify.

## CASE STUDY

### iSTEM Co. internship program

iSTEM Co. runs a ‘Tryout to Recruit’ program which provides work experience for women PhD candidates in STEM, with a focus on those historically under-represented in STEM. The program involves a 3- to 6-month internship. There is no obligation for employers to hire participants after their internships, but they have the option to hire participants if they deem that the candidate is a good fit for their business.

There is also a mentoring retention program for all interns. The mentoring helps to improve integration into the company’s business culture and to increase retention beyond the program.

The Tryout to Recruit program also provides a pathway for PhD students to commercialise their research during their work experience or to work on real life impact of their lab/field-based research.

In addition, the program provides check-ins with the candidate and their direct line supervisors at the beginning, mid-way through the program and at the end. The iSTEM Co. Tryout to Recruit Program has already assisted students from 4 Australian universities.

The Tryout to Recruit program has shown a 100% success rate with 75% of participants retained in their parent company and 25% gaining external roles using the experience obtained from the program in other companies.

52 Hnatkova, E, Degtyarova, I, Kersschot, M, and Boman, J. (2022) ‘Labour market perspectives for PhD graduates in Europe’ *European Journal of Education*, 57 [doi.org/10.1111/ejed.12514](https://doi.org/10.1111/ejed.12514)



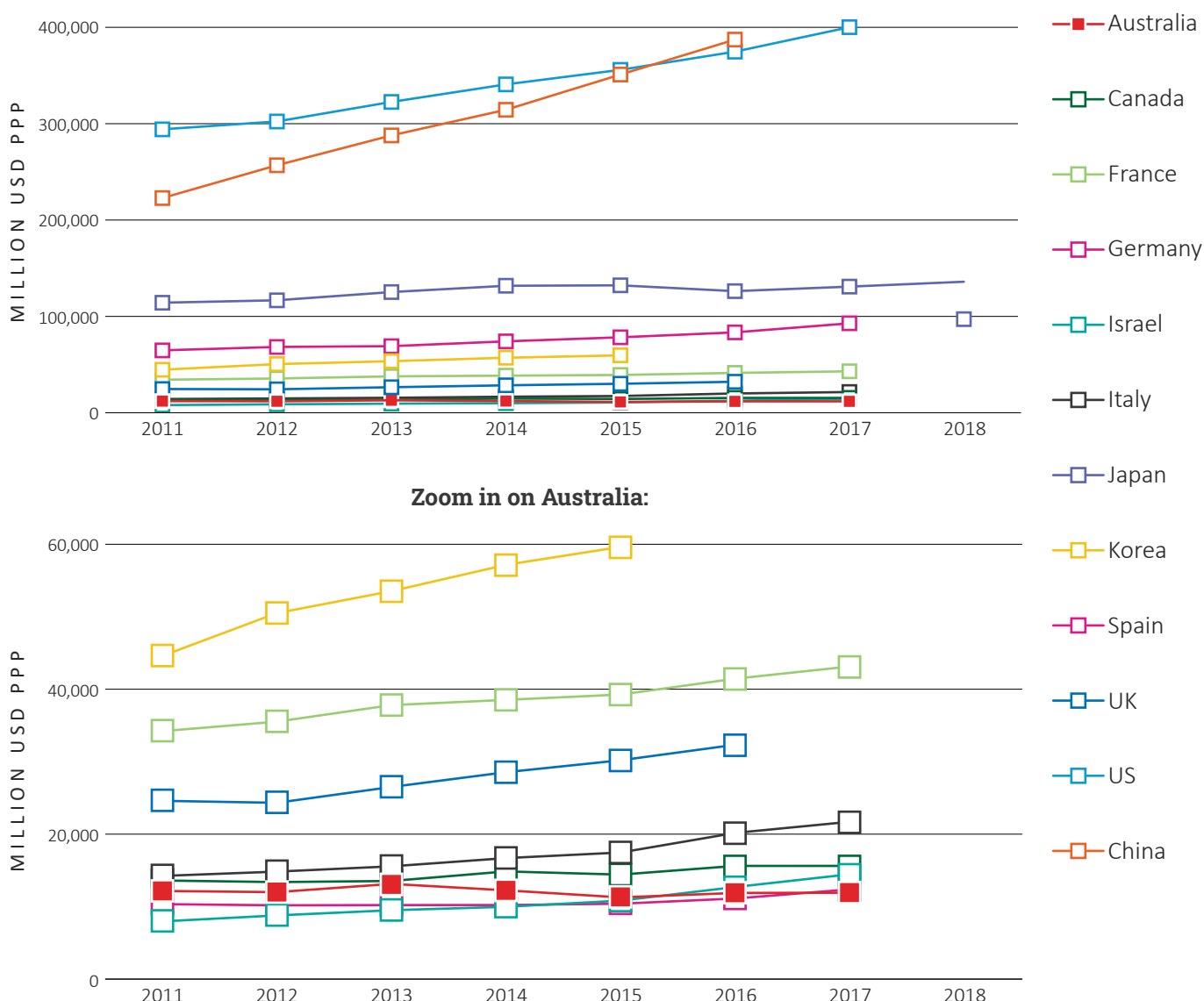
### 3.5 Australia's relatively low levels of business investment in R&D

Both participants in the stakeholder consultations and respondents to the survey pointed to comparatively low levels of industry research and development (R&D) in the Australian economy relative to other advanced economies<sup>53</sup> as an underlying cause of employability challenges, especially for PhDs. They identified a need to build stronger levels of business R&D – and understanding of R&D as a core business activity – to address this barrier to STEM career pathways. Lifting business R&D is essential to strengthen Australia's economic complexity and reduce risky over-dependence on exports of raw materials and primary produce.

A comparison of business expenditure on R&D (reported in millions of USD purchasing power parity) across several OECD countries show two very clear leaders – the United States and China (Figure 9). While Australia shows a similar level of business expenditure on R&D to other countries with similarly sized economies<sup>54</sup> such as Canada and Spain, there is a distinct gap between Australia and many other OECD countries.

**Figure 9**

Business expenditure on research and development, Australia and other selected countries



Source: OECD (2020), *OECD Research and Development Expenditure in Industry 2020: ANBERD*, OECD Publishing, Paris, [doi.org/10.1787/c86631b8-en](https://doi.org/10.1787/c86631b8-en). Expenditure is reported in millions of USD purchasing power parity.

53 Organisation for Economic Co-operation and Development. (2023), 'OECD Main Science and Technology Indicators. R&D Highlights March 2023', OECD Directorate for Science, Technology and Innovation. [oecd.org/science/msti.htm](https://oecd.org/science/msti.htm)

54 The World Bank. 'GDP Indicator' website. Accessed 21 August 2023. [data.worldbank.org/indicator/NY.GDP.MKTP.CD?most\\_recent\\_value\\_desc=false](https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?most_recent_value_desc=false)

## BARRIER:

Low levels of business R&D in Australia and a lack of appreciation for STEM R&D skills in Australian businesses limit STEM career options in industry compared to other countries.

## POTENTIAL SOLUTION:

Expand programs that incentivise businesses to engage with universities and research institutes to create more research-active businesses across the Australian economy.

Business expenditure on R&D (BERD) is 0.9% of GDP in 2019-20. This figure has fallen from a high of 1.4% of GDP 15 years ago.<sup>55</sup> Compared to international benchmarks, BERD in Australia is low: as a percentage of GDP, Australia's spending on BERD is half the OECD average.<sup>56</sup>

The latest edition of the *Atlas of Economic Complexity* produced by Harvard University notes that Australia 'has not yet started the traditional process of structural transformation' to develop higher value industries, and has not diversified its exports.<sup>57</sup> The Atlas notes Australia's economic complexity is much lower than expected for such a rich nation.

'Australia ranks just below Uganda and just above Pakistan in terms of economic complexity despite having a GDP per capita that is 68 times and 40 times larger, respectively.'<sup>58</sup>

And Australia is going backwards, compared to the rest of the world: Australia fell another two places this year and now ranks 93rd of out 133 countries. Australia has fallen 12 places in the past ten years, and 38 places since 1995.<sup>59</sup>

*"[We need] more support for taking ideas from research into use in Australia. We do not have enough home-grown Venture Capital and spin-out culture to support folks with a good (STEM) idea who want to try to take it to market."*

– Survey respondent

*'Australia ranks just below Uganda and just above Pakistan on economic complexity.'*

*"[B]ring more high-tech companies to Australia, so we could have more in-country R&D beyond University circles"*

– Survey respondent

Expansion of business R&D could also improve opportunities and help address barriers to employment in some STEM fields (life sciences, medical research and biotech) in which Australia trains a larger number of researchers than the research sector can absorb. Some STEM workers in the survey noted that while they had appetite to change sectors themselves, there were no opportunities in Australia in their area of expertise outside of university research centres. Some people reported moving overseas was the only option to access such opportunities.

Stakeholder consultations identified an opportunity for state and federal governments to use their procurement power and grants programs to drive collaboration innovation in the business sector.

Participants in stakeholder consultations highlighted discrepancies between student demand and employer demand for particular disciplines and specialisations – in both higher education and VET sectors. They observed 'STEM' could be an unhelpful term because it conflates two different groups of disciplines with opposite patterns of student demand:

- 'PECS' (Physics, Engineering, Computer Science) have very high levels of labour market demand that exceeds current supply of workers and potential future graduates.
- Life sciences and medical science, where the current supply exceeds labour market demand (no shortage of workers and limited business capacity to absorb graduates).

There are also substantial gender differences between these STEM groups: students, graduates and workers in 'PECS' are overwhelmingly male; those in life and medical sciences are mainly female.<sup>60</sup>

Stakeholders in the consultations observed that the size of the current private sector STEM-employing industries is too small to absorb the numbers of people currently being trained in health and medical research. And while Australia has a vibrant tech industry, the number of domestic IT graduates that Australia is producing remains about the same as it was in 2003.<sup>61</sup>

55 Australian Bureau of Statistics. (2021) 'Research and Experimental Development, Businesses, Australia' Published 3 September 2021. Accessed 21 August 2023. [abs.gov.au/statistics/industry/technology-and-innovation/research-and-experimental-development-businesses-australia/latest-release](https://abs.gov.au/statistics/industry/technology-and-innovation/research-and-experimental-development-businesses-australia/latest-release)

56 Organisation for Economic Co-operation and Development. Main Science and Technology Indicators, Accessed 21 August 2023. [stats.oecd.org/Index.aspx?DataSetCode=MSTI\\_PUB](https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB)

57 Cited in InnovationAus.Com (2023), 'Australia's economic complexity ranking now behind Uganda'. Published 31 July 2023. Accessed 21 August 2023 [innovationaus.com/australias-economic-complexity-ranking-worsens-again/](https://innovationaus.com/australias-economic-complexity-ranking-worsens-again/)

58 InnovationAus.Com (2023), 'Australia's economic complexity ranking now behind Uganda'. Published 31 July 2023. Accessed 21 August 2023 [innovationaus.com/australias-economic-complexity-ranking-worsens-again/](https://innovationaus.com/australias-economic-complexity-ranking-worsens-again/)

59 Harvard University Growth Lab. (2023), 'Country & Product Complexity Rankings' website, *Atlas of Economic Complexity*, Accessed 21 August 2023. [atlas.cid.harvard.edu/rankings](https://atlas.cid.harvard.edu/rankings)

60 Commonwealth Department of Education. (2021), *Higher Education Student Statistics*, Published 30 October 2022. Accessed 21 August 2023. [education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2021-student-data](https://education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2021-student-data)

61 Commonwealth Department of Education. (various years), 'Award Course Completion Time Series' *Higher Education Student Statistics*, Accessed 21 August 2023. [app.powerbi.com/](https://app.powerbi.com/)

### 3.6 STEM workers' appetite for mobility

Overwhelmingly, STEM workers want to stay in STEM jobs. Less than 2% of survey respondents said they thought their next career move would be to a non-STEM job (Table 17). Despite this, few STEM workers were looking to change sectors. By far the most common goals for next career moves were options that involved staying in the same sector: people were looking for a promotion (41%) or a sideways move (17%). Only about 12% wanted to move to a STEM job in another sector. Twelve per cent were unsure of their next career move.

People currently working in defence (55%) or the private sector (49%) were more likely than the survey average to be seeking a promotion in the same sector.

The motivations for people's next career move were quite similar no matter where they planned to move (Figure 10). More than half (53%) said 'better pay'. Thirty-seven per cent would seek 'better career prospects'. A quarter of respondents wanted 'better work/life balance' and the same proportion 'more secure employment conditions'.

People looking for a STEM job in a different sector gave different answers on what they were seeking in a new job (Figure 10). These respondents were more likely to want:

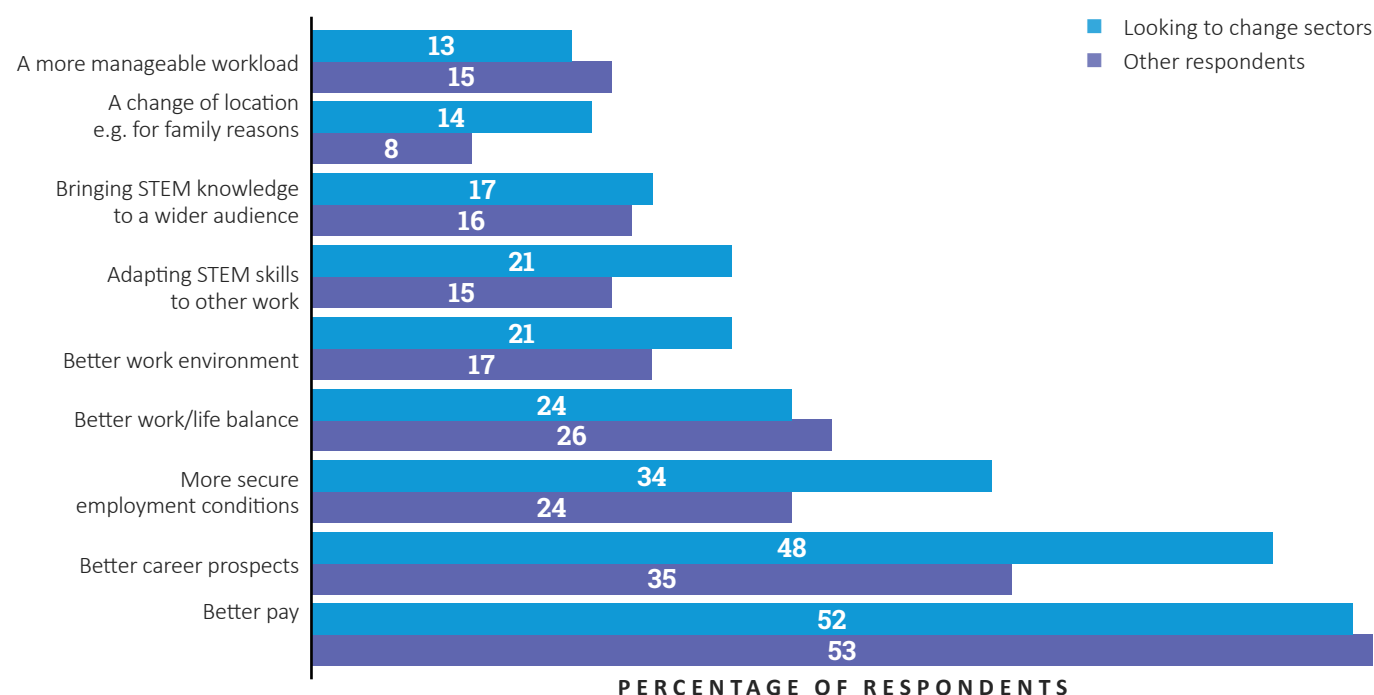
- better career prospects (48% compared to 37% for all respondents)
- more secure employment (35% compared to 25% for all respondents)
- to adapt STEM skills to other work (21% compared to 16% for all respondents)
- a change of location – such as for family reasons (14% compared to 9% for all respondents).

**Table 17**  
Respondents' plans for next career move

Next desired career move	%	Number
A promotion in the same employment sector	41%	995
A sideways move in the same employment sector	17%	424
A move to a STEM job in a different sector	12%	287
A move to a role that draws on my STEM skills but isn't labelled as a STEM job	7%	173
Retirement	6%	149
A move to a non-STEM job	2%	44
Not sure	12%	304
Other	4%	86

Respondents to this question: n = 2464

**Figure 10**  
What respondents are seeking from their next career move



Aspects of their working life that survey respondents identified as appealing in their next career move. Respondents could provide multiple answers to this question.

STEM workers who had not previously worked in a different sector were asked what might make it more likely that they would seek mobility opportunities. Noting respondents could select more than one answer, more than half (53%) named ‘ability to stay at the same pay level’, suggesting that significant numbers of people are deterred from mobility by the need to take a pay cut. This was further supported by qualitative responses to this question, in which people strongly indicated more pay or better working conditions would be necessary for them to consider a move.

Half of respondents said they would be willing to move if employers would employ people without direct experience in their (the employers’) sector. Nearly as many (48%) said they might move if they were able to gain experience in the destination sector before moving there. Nearly 40% said ‘a guaranteed path back to their usual job’ would encourage them to try a move. Some researchers used the ‘Other’ option to identify that they wanted to maintain their ability to do research and to support students in any future considered move.

*“I found that recruiters and employers really prefer specific industry experience. As much as ‘transferrable skills’ get airplay, the reality is that recruiters and employers prefer not to take that effort/risk.”*

– Survey respondent

This survey respondent’s view was aligned with similar sentiments from STEM workers who felt that employers were keen to employ people ready to ‘hit the ground running’ and that employers did not want to invest in training recent recruits. In contrast, some employers spoke about their strong support of training for staff, including supporting staff to complete VET and higher education courses.

#### BARRIER:

STEM workers looking to enter the private sector felt employers placed too much emphasis on previous experience in the private sector.

#### POTENTIAL SOLUTION:

Support industry research initiatives that connect PhD students and post-docs with private sector businesses to support their R&D and offer students some experience in industry.

## 3.7 Impact on academic research careers

Familiar concerns were raised in the stakeholder consultations about the impact of mobility on academic research careers. Like other interruptions to academic research careers, a spell in the private or public sector can mean that people feel that they have fallen behind in the academic publication race during their absence – and this is often the unfortunate reality.

*“Perceptions from academic culture that choosing to do a job outside of traditional academic research/fellowship trajectory means you failed [made moving between sectors hard]. Personal connections I’d made during my career opened my eyes to so many possibilities for my next step to continue making a meaningful difference within the STEM sector. There are many ways to be a STEM professional!”*

– Survey respondent

The impact of these barriers can make mobility a one-way street. A stakeholder from the research sector argued that this wouldn’t change until a different approach to research metrics – and the way researchers are assessed and valued within research recruitment and promotion processes – is adopted.

There was a critical view expressed that universities did not effectively support researchers to access mobility opportunities, or even that they hindered researchers’ efforts to be mobile. Concerns included an allegation that early career researchers are not encouraged to branch out by supervisors, who want to keep them in academia – sometimes on the ‘post-doc treadmill’ and/or working in a junior capacity in their own labs. Academic culture is set up to funnel people on to this narrow path, since it traditionally rewards publications but not other contributions that academic researchers can make, including teaching, community engagement, science communication or various forms of knowledge transfer.

*Academic culture is set up to funnel people on to this narrow path.*



#### BARRIER:

STEM-qualified researchers said traditional metrics to measure researcher success were irrelevant to other sectors and this was a barrier to mobility out of research roles.

#### POTENTIAL SOLUTION:

Metrics for research success should take account of a wider variety of academic activity.

Some research sector stakeholders identified broadening the definition of an excellent researcher – and how to demonstrate this – as a key area for necessary change. There was some discussion of capability frameworks, which allow academics to demonstrate their capability and impact against a range of different indicators, such as teaching, research and engagement. These types of frameworks allow staff at universities to highlight their efforts across different areas which they are expected to contribute to, but which traditionally they have not been rewarded for. This can include industry engagement, obtaining industry funding, undertaking outreach and performing service responsibilities such as being a member of committees.

While many employers likely use a framework to underpin their recruitment and promotion practices these may not be transparent to current or potential employees. There is no common framework in Australia even across the university sector and certainly not more broadly. Evidence on these issues will be canvassed in more detail in the forthcoming Modernising Research Assessment report by the Australian Council of Learned Academies for Australia's Chief Scientist.

## 3.8 Main themes: STEM career mobility

#### INSIGHT:

Mobility was quite common throughout the STEM sector – but for many STEM workers, a move between sectors only occurred once in their career. Despite an emphasis on collaboration between research and business in recent times, STEM career mobility remains a work-in-progress. Research and industry need to come together and understand each other better to make mobility between sectors a normal – and valued – part of STEM careers.

If Australia wants to improve the ability of STEM workers to move seamlessly between employment sectors to address potential future skills gaps and improve our economy, this work has identified a number of barriers to be addressed.

STEM workers in Australia are keen to continue their careers long term in STEM. However, when asked whether they foresaw movement to a different sector in their career future, only a small percentage agreed. The underlying low levels of desire of STEM workers to try work in a different sector is a major barrier to creating a more seamlessly connected STEM workforce. There are three areas where Australia could make interventions to improve mobility around the STEM workforce.

**Workplace practices** particularly relating to recruitment were identified in stakeholder consultations as barriers to mobility. Employers find it hard to assess work experience they are unfamiliar with, for example the work experience and workplace skills acquired as part of completing a PhD. More transparent recruitment processes can also strengthen movement across sector boundaries.

There is a lack of understanding amongst STEM workers of the **skills and experience** needed to help move across the STEM sector. The STEM Career Pathways survey and stakeholder consultations found evidence that STEM workers find it difficult to articulate how their skills meet the needs of employers in a different sector from the one where the skills were gained. Training and support for both employers and workers can help bridge this divide. In some cases, specific mobility programs can also assist by providing STEM workers with the experience that is desired by STEM employers, for example industry PhD programs that engage PhD students to work on current real-world business problems with an industry partner. Networking and mentorship improve mobility, and also help retain people in STEM careers generally.

Finally, changes to **system-wide settings can strengthen mobility**. Both the STEM Career Pathways survey and the stakeholder consultations found strong evidence of a need to raise awareness about formal career mobility programs and ensuring access to mobility programs throughout careers. Taking a system-wide approach to understanding how the metrics used to assess job suitability are applied in different sectors can also strengthen STEM career mobility. The forthcoming Modernising Research Assessment report will include further evidence on effective interventions.

The development of effective strategies to enable mobility between employment sectors in STEM should also be informed by the evidence in the first section of this report. Of the many transitions a STEM worker will make throughout their career, those that go across sector boundaries are only one type. The issues that STEM workers face generally while navigating their careers are often also applicable to transitions between employment sectors.

## 4. STEM CAREER EXPERIENCES FOR DIVERSE DEMOGRAPHIC GROUPS

The evidence gathered in this project showed that STEM career barriers can be varied for diverse demographic groups. This section summarises key differences and similarities in the experiences of diverse demographic groups identified in both the survey and stakeholder consultations. This new evidence should be considered when designing retention and mobility strategies and interventions to dismantle barriers to successful STEM careers.

### 4.1 Women in STEM

Barriers to retention in STEM careers affect many people – especially younger people – but the evidence is clear that they have an especially serious impact upon women’s careers.<sup>62</sup>

Perceptions that STEM professions are unwelcoming to women and put a low value on work-life balance and family life deter some women from even starting STEM careers. Those who do commence careers in research or in a STEM profession often report attitudes and experiences that bear out these negative perceptions.<sup>63</sup>

STEM workplaces can be overwhelmingly male. This starts in the university degree pipeline: only 20% of domestic Bachelor students in IT and only 19% of engineering students are women. Natural and physical sciences are more evenly balanced (women are a majority of domestic Bachelor students at 54%), but there are very pronounced differences by field within this. Maths and physics students are overwhelmingly men.<sup>64</sup>

This imbalance persists in the workplace: women make up only 16% of Australia’s STEM-skilled workforce. At last count, 28% of people in management positions in STEM organisations are women but only 8% of CEOs. In universities, while women are just over half of tutors and lecturers (Levels A and B) in STEM, the share drops by nearly ten percentage points at each of the next three levels (41% of senior lecturers; 32% of associate professors and only 23% of full professors).<sup>65</sup>

#### 4.1.1 Culture and attitudes shape equality

Women’s under-representation is not a given but is a product of culture and attitudes: in China, Malaysia and the former USSR, the female share of the engineering workforce is much closer to 50% and in some countries it’s even higher.<sup>66</sup>

A 2021 survey of women in STEM by Professionals Australia found women leave the STEM workforce for several reasons, including:

- difficulty accessing flexible working arrangements at senior levels
- career penalty for part-time work
- gender pay gaps
- hostile or discriminatory workplace cultures
- lack of recognition
- limited opportunities for career development
- high levels of workplace sexual harassment
- being regarded as less technically competent than male colleagues.<sup>67</sup>

Other surveys of researchers and STEM professionals echo these findings: job insecurity and barriers to career development are a problem for many in research, but especially for women. Employers are unwilling to offer flexible work to people – mostly women – who have caring responsibilities. Sexist attitudes and a ‘boys’ club’ in management are further significant barriers.<sup>68</sup>

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*In China, Malaysia and the former USSR, women are almost 50% of engineers.*

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62 National Academies of Sciences, Engineering, and Medicine. (2022), ‘Long-Term Impacts of COVID-19 on the Future Academic Careers of Women in STEM: Proceedings of a Workshop in Brief’. Washington, DC: The National Academies Press. [doi.org/10.17226/26687](https://doi.org/10.17226/26687)

63 Pitt RN, Taskin Alp Y, and Shell IA. (2021), ‘The Mental Health Consequences of Work-Life and Life-Work Conflicts for STEM’, *Frontiers in Psychology*, 12. [doi.org/10.3389/fpsyg.2021.750490](https://doi.org/10.3389/fpsyg.2021.750490)

64 Commonwealth Department of Education. (2021), *Higher Education Student Statistics*, Published 30 October 2022. Accessed 21 August 2023. [education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2021-student-data](https://education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2021-student-data)

65 Australian Academy of Science. (2019), Women in STEM Decadal Plan, Australian Academy of Science, Canberra [science.org.au/support/analysis/decadal-plans-science/women-in-stem-decadal-plan](https://science.org.au/support/analysis/decadal-plans-science/women-in-stem-decadal-plan)

66 Prinsley, R, Beavis, AS, and Clifford-Hordacre, N (2016) ‘Busting Myths about Women in STEM’, Occasional Paper Series, 13, Office of the Chief Scientist, Canberra. [chiefscientist.gov.au/2016/11/occasional-paper-busting-myths-about-women-in-stem](https://chiefscientist.gov.au/2016/11/occasional-paper-busting-myths-about-women-in-stem)

67 Professionals Australia. (2021), Women Staying in the STEM Workforce: An economic imperative for Australia, Professionals Australia, Melbourne. [members.professionalsaustralia.org.au/documents/Gender/Women\\_in\\_STEM\\_survey\\_report\\_2021.pdf](https://members.professionalsaustralia.org.au/documents/Gender/Women_in_STEM_survey_report_2021.pdf)

68 Professional Scientists Australia. (2022), Professional Scientists Employment and Remuneration Report 2021-22, Professional Scientists Australia, Melbourne [scientists.professionalsaustralia.org.au/Scientists/News/Professional\\_Scientists\\_Employment\\_and\\_Remuneration\\_Survey\\_Report.aspx](https://scientists.professionalsaustralia.org.au/Scientists/News/Professional_Scientists_Employment_and_Remuneration_Survey_Report.aspx)

A 2013 longitudinal study in the United States found that ‘women in STEM occupations are significantly more likely to leave their occupational field than professional women, especially early in their career, while few women in either group leave jobs to exit the labor force’. Differences between jobs, or family factors, did not explain this difference. The authors suggest that ‘investments and job rewards’ (such as training and job satisfaction) ‘fail to build commitment among women in STEM.’<sup>69</sup>

While unconscious bias is a key negative factor for women in STEM and their careers,<sup>70</sup> workplaces can also be actively hostile. A 2022 American survey of women in the IT sector found respondents’ biggest grievances were:

- being treated differently from male colleagues (66%)
- facing comments that devalue them or imply they are less capable than men (62%)
- experiencing incivility, disrespect, contempt, steamrolling, sexist jokes, and sidelining (50%)
- sexual harassment (40%).<sup>71</sup>

### 4.1.2 Women in STEM careers

The *Women in STEM Decadal Plan* developed by the Australian Academy of Science and the Academy of Technological Sciences and Engineering depicted barriers to women’s career progression, as shown in Figure 11.

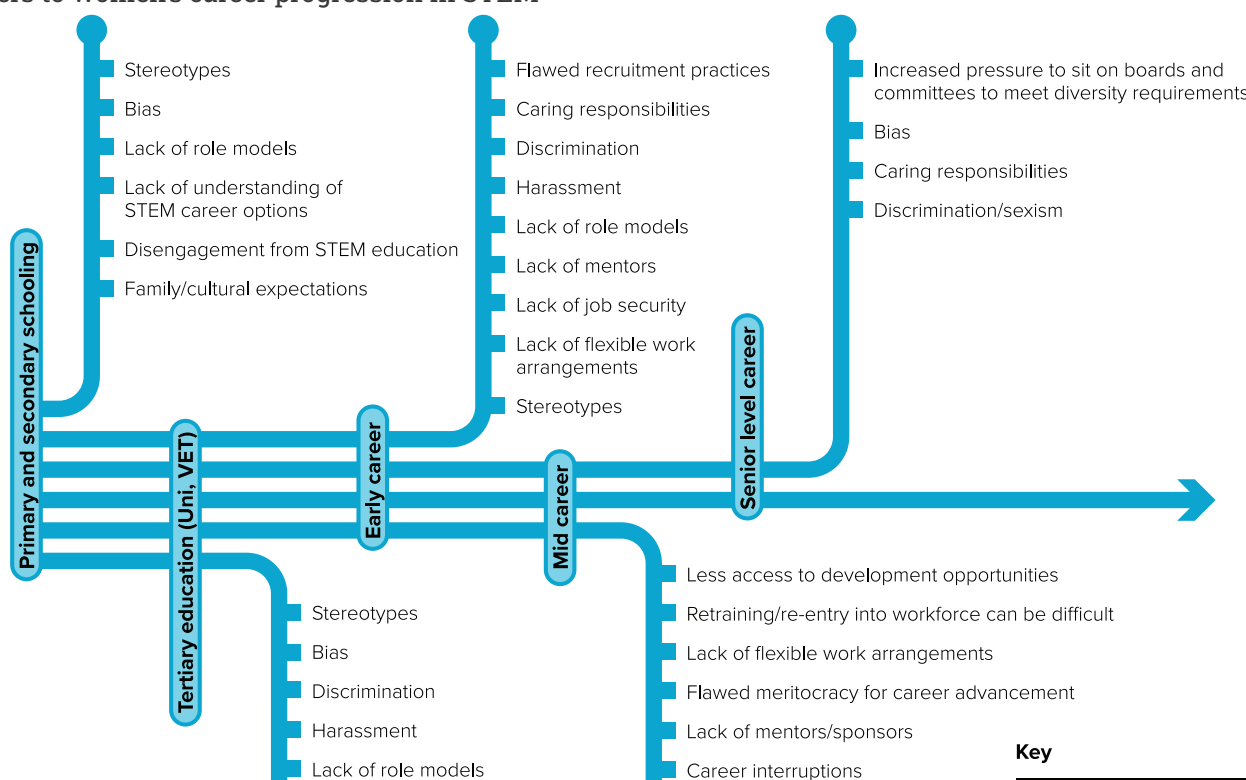
The Government’s *Advancing Women in STEM Strategy* found women in STEM face similar difficulties to women across the workforce, but more so, due to job insecurity and workplace cultures.<sup>72</sup>

The impacts are clear in the data: women in STEM are much less likely to be in the top income bracket and are seriously under-represented at senior levels in academia.<sup>73</sup>

In these respects, Australia is similar to many other countries – particularly other advanced post-industrial economies. Cultural perceptions about women and STEM study combine with expectations about domestic and caring responsibilities as well as ‘unreliable support structures and lack of mobility’ to perpetuate barriers to and within STEM careers.<sup>74</sup>

Figure 11

Barriers to women’s career progression in STEM



Source: Australian Academy of Science. (2019), *Women in STEM Decadal Plan*, Australian Academy of Science, Canberra

69 Glass, JL, Sassler, S, Levitte, Y and Michelmores, KM. (2013), ‘What’s So Special about STEM? A Comparison of Women’s Retention in STEM and Professional Occupations’, *Social Forces*, 92(2) [doi.org/10.1093/sf/sot092](https://doi.org/10.1093/sf/sot092)

70 Prinsley, R, Beavis, AS, and Clifford-Hordacre, N. (2016) ‘Busting Myths about Women in STEM’, Occasional Paper Series, 13, Office of the Chief Scientist, Canberra. [chiefscientist.gov.au/2016/11/occasional-paper-busting-myths-about-women-in-stem](https://chiefscientist.gov.au/2016/11/occasional-paper-busting-myths-about-women-in-stem)

71 Girls Who Code & Logitech. (2022), What (and Who) is Holding Women Back in Tech? Accessed 21 August 2023. [logitech.com/content/dam/logitech/en/mx/women-who-master/logi-wwc-report.pdf](https://logitech.com/content/dam/logitech/en/mx/women-who-master/logi-wwc-report.pdf)

72 Commonwealth of Australia. (2019), *Advancing Women in STEM*, Department of Industry, Science and Resources, Canberra. Published 1 September 2019. Accessed 21 August 2023. [industry.gov.au/publications/advancing-women-stem-strategy](https://industry.gov.au/publications/advancing-women-stem-strategy)

73 Office of the Chief Scientist. (2016b), *Women in STEM: a story of attrition*, Datasheet 2, November 2016, Office of the Chief Scientist, Canberra. Published November 2016. Accessed 21 August 2023. [chiefscientist.gov.au/sites/default/files/OCS\\_Women\\_in\\_STEM\\_datasheet.pdf](https://chiefscientist.gov.au/sites/default/files/OCS_Women_in_STEM_datasheet.pdf)

74 Catalyst. (2022), *Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)*, Catalyst, Published 23 August 2022. Accessed 21 August 2023. [catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/](https://catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/)

While women clearly face barriers in STEM in both education and work, these barriers are not unique to STEM. A lack of female role models is a particular problem for young women interested in STEM, but many of the obstacles faced by women in STEM are also encountered by women in other fields ‘simply because of institutionalized sexism present in academic and career settings’.<sup>75</sup>

A 2021 German study of women’s ‘subjective career success’ in STEM found positive correlations with high career autonomy and with income, and a negative correlation with low career autonomy.<sup>76</sup> Initiatives to support women returning to the workplace from parenting leave can help address the particular and well-known difficulties experienced by women resuming their STEM careers and maintaining professional skills and networks.<sup>77</sup>

To address the other barriers and obstacles women experience, profound changes to workplace culture and practices are necessary. In the university sector, Science in Australia Gender Equity (SAGE) is working through the Athena Swan program to ‘ensure that gender equity, diversity and inclusion work is appropriately resourced, distributed, recognised, and rewarded’<sup>78</sup>. But this is ‘the only transformative gender equity program of its kind in Australia designed to achieve sustained cultural change at a national scale’.<sup>79</sup>

Other successful interventions and programs – such as Superstars of STEM and other Women in STEM and other Entrepreneurship (WISE) grant-funded initiatives – are raising the profile of women in STEM, including through developing diverse role models.<sup>80</sup> At the level of individual employees and employers, systematic mentoring is vital, as is greater transparency in recruitment and promotions processes.<sup>81</sup>

The National Research Internships Program (NRIP) run by the Australian Mathematical Sciences Institute (AMSI) to support industry-based internships for women doing PhDs is another example of a positive intervention.<sup>82</sup>

The Champions of Change Coalition ‘engages leaders to help achieve gender equality and a significant and sustainable increase in the representation of women in leadership’.<sup>83</sup> STEM is one of several of its ‘industry-specific groups’.<sup>84</sup> The Champions of Change Coalition works to advance women in leadership and to build respectful and inclusive workplaces. Changing workplace cultures is a focus of their efforts. One of the Coalition’s key principles is to ‘shift the system, not ‘fix women.’<sup>85</sup>

A 2022 review of 337 gender equity initiatives in STEM run by universities, employers and Government found only seven released any evaluation data, and only one went beyond ‘self-reports of satisfaction and enjoyment’. Accordingly, this paper concluded that ‘we simply do not know’ whether these initiatives work.<sup>86</sup>

American research on under-representation of women in engineering and IT has argued for ‘changes in the workplace and college environments as a necessary preamble to women’s full participation in engineering and computing’. The key themes for change are:

- combating gender stereotypes and biases (which are evident from very young ages)
- emphasising the social relevance and impact of STEM skills and jobs
- ‘cultivating a sense of belonging’ in the field and the profession
- changing the environment (at university and in the workplace) to be more welcoming to women.<sup>87</sup>

75 Christie, MR. (2020), Gender and Persistence in STEM Careers: Predictors and Barriers, PhD thesis, Illinois State University. [doi.org/10.30707/ETD2020.1603713860495](https://doi.org/10.30707/ETD2020.1603713860495)

76 Schmitt, M, Lauer, S and Wilkesmann, U.(2021), ‘Work Motivation and Career Autonomy as Predictors of Women’s Subjective Career Success in STEM’, *Acta Paedagogica Vilnensia*, 46, [doi.org/10.15388/ActPaed.2021.46.5](https://doi.org/10.15388/ActPaed.2021.46.5)

77 Professionals Australia. (2021), Women Staying in the STEM Workforce: An economic imperative for Australia, Professionals Australia, Melbourne. [members.professionalsaustralia.org.au/documents/Gender/Women\\_in\\_STEM\\_survey\\_report\\_2021.pdf](https://members.professionalsaustralia.org.au/documents/Gender/Women_in_STEM_survey_report_2021.pdf); Mavriplis, C et al. (2010), ‘Mind the Gap: Women in STEM Career Breaks’, *Journal of Technology Management and Innovation*, 5(1) [dx.doi.org/10.4067/S0718-27242010000100011](https://dx.doi.org/10.4067/S0718-27242010000100011)

78 Science in Australia Gender Equity. (2022), ‘SAGE Pathway to Athena Swan’ website. Accessed 21 August 2023. [sciencegenderequity.org.au/sage-accreditation-and-awards/sage-pathway-to-athena-swan/](https://sciencegenderequity.org.au/sage-accreditation-and-awards/sage-pathway-to-athena-swan/)

79 Australian Academy of Science. (2019), Women in STEM Decadal Plan, Australian Academy of Science, Canberra [science.org.au/support/analysis/decadal-plans-science/women-in-stem-decadal-plan](https://science.org.au/support/analysis/decadal-plans-science/women-in-stem-decadal-plan)

80 Science & Technology Australia. ‘Superstars of STEM’ website. Accessed 21 August 2023. [scienceandtechnologyaustralia.org.au/what-we-do/superstars-of-stem/](https://scienceandtechnologyaustralia.org.au/what-we-do/superstars-of-stem/); Commonwealth Department of Industry, Innovation and Science (2017) ‘Women in STEM and Entrepreneurship (WISE) factsheet’. Published September 2017. Accessed 21 August 2023. [business.gov.au/-/media/Grants-and-programs/WISE/Women-in-STEM-and-Entrepreneurship-Factsheet-PDF.ashx?hash=B1AA8A7E7A1A838F38247C69B8E66FBD&sc\\_lang=en](https://business.gov.au/-/media/Grants-and-programs/WISE/Women-in-STEM-and-Entrepreneurship-Factsheet-PDF.ashx?hash=B1AA8A7E7A1A838F38247C69B8E66FBD&sc_lang=en)

81 Professionals Australia. (2021), Women Staying in the STEM Workforce: An economic imperative for Australia, Professionals Australia, Melbourne. [members.professionalsaustralia.org.au/documents/Gender/Women\\_in\\_STEM\\_survey\\_report\\_2021.pdf](https://members.professionalsaustralia.org.au/documents/Gender/Women_in_STEM_survey_report_2021.pdf)

82 Australian Mathematical Sciences Institute. (2020), Reflections on the National Research Internships Program, Australian Mathematical Sciences Institute, [amsi.org.au/?publications=reflections-on-the-national-research-internships-program](https://amsi.org.au/?publications=reflections-on-the-national-research-internships-program)

83 Champions of Change Coalition. Accessed 21 August 2023. [championsofchangecoalition.org/about-us/](https://championsofchangecoalition.org/about-us/)

84 Champions of Change Coalition. Accessed 21 August 2023. [championsofchangecoalition.org/groups/champions-of-change-stem/](https://championsofchangecoalition.org/groups/champions-of-change-stem/)

85 Champions of Change Coalition. Accessed 21 August 2023. [championsofchangecoalition.org/about-us/](https://championsofchangecoalition.org/about-us/)

86 McKinnon, M. (2022), ‘The absence of evidence of the effectiveness of Australian gender equity in STEM initiatives’, *Australian Journal of Social Issues*, 57(1), [doi.org/10.1002/ajs4.142](https://doi.org/10.1002/ajs4.142)

87 Corbett, C and Hill, C. (2015), Solving the Equation: the variables for women’s success in Engineering and Computing, AAUW, Washington D.C. [aauw.org/app/uploads/2020/03/Solving-the-Equation-report-nsa.pdf](https://aauw.org/app/uploads/2020/03/Solving-the-Equation-report-nsa.pdf)



An ‘inimical environment’ at university is a factor in women students and those from under-represented culturally diverse groups deciding not to continue with engineering studies, indicating work/study environment and culture is a factor well before graduates enter the workforce.<sup>88</sup>

Since many women disengage from STEM while at school, intervention at this early stage may be the most effective intervention in the long term. Longitudinal research shows that experiential programs at high school can contribute to narrowing the STEM gender gap in university and workforce participation.<sup>89</sup>

Government has an important role to play, both as a significant STEM employer, and as a funder of research and of other programs.<sup>90</sup> This falls in the remit of the Pathways to Diversity in STEM review, which is due to report in late 2023.

### 4.1.3 Work culture and STEM career barriers for women in STEM

A strong body of academic research highlights the role of workplace cultures in persistent career barriers for women in STEM fields.<sup>91</sup> Many stakeholders in the consultations for this report articulated a range of issues that continue to work against the retention of women in STEM careers. In some instances, this was attributed to inhospitable workplace cultures – whether they are actively (though often unconsciously) hostile to women or have not evolved their workplace cultures, practices and flexibility to support and retain women employees.

A particular challenge cited is limitations in how effectively STEM-employing institutions support employees during and after career breaks such as those taken to raise children.

#### INSIGHT:

Despite comparatively good parental leave entitlements for some elements of the STEM research workforce, the requirements and pressure to maintain and thrive in a research career can make it hard for parents to stay in and advance in STEM research careers.

Another practical barrier is lack of support for women (and others) who return to work after a career break. Failure to manage a return from a career break well leads to significant attrition and under-utilises the talents particularly of early and mid-career staff.

These issues of workplace culture – combined with unconscious bias and organisational conservatism – work to limit women’s career prospects in STEM. For example, where middle managers have overwhelmingly been men, and the senior executives appointing middle managers are men, it is hard for women to take this next step in their careers. Stakeholder consultations identified middle management as a diversity pain point in STEM career pathways.

By level of seniority, women participants in the STEM Career Pathways survey were less likely to be at senior level (Table 18).

Table 18

#### Level of seniority by gender

Level of seniority	Women	Other genders	All respondents
Entry level	21%	17%	19%
Mid level	48%	44%	46%
Senior level	25%	33%	29%
Executive	7%	7%	7%

Note that ‘Other genders’ includes respondents who did not specify a gender. Respondents to this question: Women n = 1305; Other genders n = 1331; All respondents n = 2636.

Women were more likely (27%) to work in education and training (the second biggest category) than other respondents (20%). There was little difference between women and others in employment in any other industry.

Women were more likely to be ‘unsure’ (25% compared to 19% for other respondents) whether they would be working in STEM in five years’ time, and less likely to say they were ‘very confident’ they would be in STEM in five years (23% compared to 29%).

There was little difference between women and other respondents in self-assessment of career prospects.

There was little difference between women and others in aspirations for their next career move.

Women were more likely to have a mentor than others (17% compared to 11%). Women were also more likely to have had informal career support but not a mentor (34% compared to 24%).

Women were more likely to have undertaken training (92%, compared to 87% of other respondents).

There was no clear gender difference in satisfaction with work/life balance (67% of women were ‘satisfied’ or ‘very satisfied’, compared with 71% of other respondents).

88 Brown, F, Trampus, K and Odell, M. (2009), ‘The Path to STEM Careers: Student Perceptions of College Pathways and Barriers to Success’, *Proceedings of the 2009 ASEE Gulf-Southwest Annual Conference*, Baylor University

89 Hunt PK, Dong M, Miller CM. (2021), ‘A multi-year science research or engineering experience in high school gives women confidence to continue in the STEM pipeline or seek advancement in other fields: A 20-year longitudinal study’, *PLoS ONE* 16(11) [doi.org/10.1371/journal.pone.0258717](https://doi.org/10.1371/journal.pone.0258717)

90 Commonwealth of Australia. (2019), *Advancing Women in STEM*, Department of Industry, Science and Resources, Canberra. Published 1 September 2019. Accessed 21 August 2023. [industry.gov.au/publications/advancing-women-stem-strategy](https://industry.gov.au/publications/advancing-women-stem-strategy)

91 Hall, W, Schmader, T, Inness, M, and Croft, E. (2022), ‘Climate change: an increase in norms for inclusion predicts greater fit and commitment for women in STEM’, *Group Processes and Intergroup Relations*, 25(7), [doi.org/10.1177/13684302211035438](https://doi.org/10.1177/13684302211035438)

#### 4.1.4 Unpaid domestic and caring duties

The survey included questions based on the Census about respondents' unpaid domestic and caring duties.

Unsurprisingly, women were half as likely as other respondents to report having done no or little unpaid domestic work in the preceding week (Figure 12). Compared to figures from the 2021 Census, respondents to the STEM Career Pathways survey reported hours of unpaid domestic work that differ less by gender and are more concentrated at medium levels, away from either extreme.

Even women who reported doing 30 or more hours' unpaid domestic work in a week in the STEM Career Pathways survey averaged 40 hours a week in their jobs (Table 19).

Thirty-eight per cent of women reported caring for children in the previous week, compared to 30% of other respondents.

Across the survey sample, respondents who reported no unpaid childcare in the previous week averaged 45 hours' paid work per week.

Women who cared for their own children averaged 42 hours' paid work per week while other parents who cared for their own children reported an average of 49 hours' paid work. Two important observations on these figures are:

- The question does not capture the number of hours spent caring for children, so other respondents (almost all men) caring for their children may have

put in fewer hours of care, enabling them to still work more than 10 hours above standard full-time hours on average.

- Women who are caring for their own children still averaged well above standard full-time working hours.

Regarding unpaid care for people with disability, chronic health conditions or old age, 21% of women reported providing such care, compared to 12% of other respondents.

These figures were slightly higher than the numbers in the 2021 Census, which showed 14% of women and 10% of men provide this kind of unpaid care.<sup>92</sup>

#### INSIGHT:

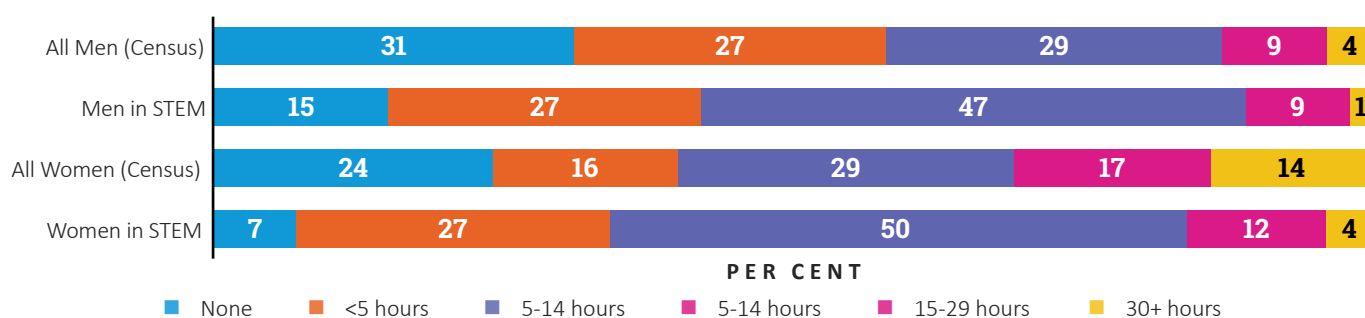
Almost four-fifths (78%) of respondents reporting unpaid care for the aged, disabled or chronically ill were also caring for children. Two-thirds of respondents providing both forms of unpaid care were women.

*"Most female engineers in my company start to fall behind our male peers in promotions and pay and ranking after having children. However, our male peers are able to maintain their career pathway while also having children. I only took 5 months off to have my son and returned to work full time, but that was enough to make me fall behind. 10 years later, I am still behind my peers."*

– Survey respondent

**Figure 12**

Hours of unpaid domestic work per week by gender



Data for men and women in STEM is from the STEM Career Pathways survey results. Comparison is made to Australian Census data (Source: Australian Bureau of Statistics (2022) *Census of Population and Housing 2021*). Numbers of respondents choosing other genders was too small to compare and appropriate comparator data was not available.

**Table 19**

Average hours women worked in employment by hours of unpaid domestic work

Hours of unpaid domestic work in the past week	Average hours worked in employment	Standard deviation
None	47.4	17.7
Less than 5 hours	44.7	12.5
5 to 14 hours	42.9	11.2
15 to 29 hours	42.8	15.3
30 or more hours	40.1	22.0

Respondents to this question: Women n = 1272

<sup>92</sup> Australian Bureau of Statistics. (2022), 'Unpaid work and care: Census' Published 28 June 2022. Accessed 21 August 2023. [abs.gov.au/statistics/people/people-and-communities/unpaid-work-and-care-census/latest-release](https://abs.gov.au/statistics/people/people-and-communities/unpaid-work-and-care-census/latest-release)

## 4.2 STEM career barriers for Aboriginal and Torres Strait Islander people

The sample in the STEM Career Pathways survey was representative of the Indigenous share of the Australian population: 141 respondents (4% of the sample) reported that they were Indigenous.<sup>93</sup>

For their next career move, 25% of Indigenous respondents were looking for a promotion in the same sector while 20% were looking to move to a STEM job in a different sector, compared to a survey average of 12%.

Twenty-six per cent of Indigenous respondents said they had experienced racial or cultural discrimination – twice the figure for non-Indigenous respondents (13%).

*“I’m an Indigenous Elder and I have had numerous issues with lateral violence and disrespect.”*

– Survey respondent

Seventy-two per cent of Indigenous respondents assessed their career prospects as excellent or good, more than the overall average (64%), and only 8% as poor. Twenty per cent were neutral or unsure. Similarly, Indigenous STEM workers were more likely to be confident they would be working in STEM in five years’ time (71% vs 64% of all respondents) and 18% were unsure.

The small number of Indigenous respondents were split fairly evenly between those who had or had previously had a mentor and those who relied on informal career support and advice. Only 9% had accessed no career support or advice, much lower than the survey average of 23%.

Overall, Indigenous STEM workers appeared to be well supported by training, mentoring and career advice compared to the average.

## 4.3 STEM career barriers for people born overseas

More than a third of survey respondents (38%; 1050 respondents) were born outside Australia. While this is a large fraction of the sample, it is a smaller proportion than in the university-qualified STEM workforce as a whole, where more than half (56%) of workers were born overseas.<sup>94</sup>

Of respondents born overseas, the biggest number were born in the UK (16% of those born overseas), with India the second most common country of birth (13%). India was followed by New Zealand (7%) and the United States (6%).

People born overseas were 5 percentage points more likely to be on fixed-term contracts (24%) compared to the Australian born (19%).

Respondents born overseas were 7 percentage points less likely (13%) to report their career prospects were ‘excellent’ compared to people born in Australia (20%). They were 6 percentage points more likely (30%) to have a neutral view of their career prospects, compared to those born in Australia (24%).

There were no clear differences between overseas-born and Australian-born respondents’ level of seniority, or whether respondents expected to be working in STEM in 5 years’ time.

## 4.4 STEM career barriers for people who speak a language other than English at home

The survey asked respondents whether they spoke a language other than English (LOTE) at home. Nearly 30% of respondents spoke a language other than English at home – a lower figure than that for the STEM workforce as a whole (45%).<sup>95</sup>

Just over half (55%) of respondents born overseas spoke a language other than English at home, reflecting the large number of foreign-born respondents who came from English-speaking countries. Of respondents born in Australia, 13% spoke a language other than English at home.

Twenty-nine per cent of respondents who spoke a language other than English reported experiencing racial or cultural discrimination

93 According to the latest ABS estimates, Aboriginal and Torres Strait Islander people make up 3.8% of Australia’s total population (Australian Bureau of Statistics (2021), Estimates of Aboriginal and Torres Strait Islander Australians, Published 21 September 2022. Access 21 August 2023. [abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/jun-2021](https://abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/jun-2021)). New estimates will be released at the end of August 2023.

94 Office of the Chief Scientist. (2020), Australia’s STEM Workforce, Office of the Chief Scientist, Canberra. [chiefscientist.gov.au/news-and-media/2020-australias-stem-workforce-report](https://chiefscientist.gov.au/news-and-media/2020-australias-stem-workforce-report)

95 Office of the Chief Scientist. (2020), Australia’s STEM Workforce, Office of the Chief Scientist, Canberra. [chiefscientist.gov.au/news-and-media/2020-australias-stem-workforce-report](https://chiefscientist.gov.au/news-and-media/2020-australias-stem-workforce-report)

## 4.5 STEM career barriers for people with disability, chronic illness and neurodiversity

Some 12% of respondents reported that they had a disability, a chronic illness or identified as neurodiverse. This is lower than prevalence in the general population (18%).<sup>96</sup>

Of those respondents, nearly a third (32%) were neurodivergent. Almost 20% had a chronic illness or medical condition, and a similar proportion reported a psychosocial disability or mental illness (Table 21). In the general population, 77% of those living with disability had a physical disability (most commonly a musculo-skeletal disorder such as arthritis) and 23% reported a mental or behavioural disorder.<sup>97</sup>

There was little difference in plans for the next career move. However, respondents without disability, chronic illness or neurodivergence were more likely to be planning for a promotion in the same sector (36% compared to 29%).

Respondents to this question were more likely to say their prospects were poor (16% compared to 8%) (Table 21).

Respondents to this question were more likely to be in entry level positions (26% compared to 18% of the entire survey sample) and less likely to be in senior level positions (22% compared to 30% of the entire survey sample) (Figure 13).

Of respondents who reported disability, chronic illness or neurodivergence, 57% said they were 'quite confident' or 'very confident' they would still be in STEM in five years' time. However, this statistic was lower than the figure for respondents who did not have disability, chronic illness or neurodivergence (64%).

*"[I'm] Autistic and can't tell people to get support."*  
– Survey respondent

There was no difference in this group in the rating of the usefulness of a current mentor. However, they were much less likely to find previous mentors useful (47% compared to 66%).

Respondents with disability, chronic illness or neurodivergence were less likely to report that professional development and/or training was helpful to them either in their current jobs (67%, compared to 75% of other respondents) but were about equally likely to say training would help in getting future jobs.

**Table 20**

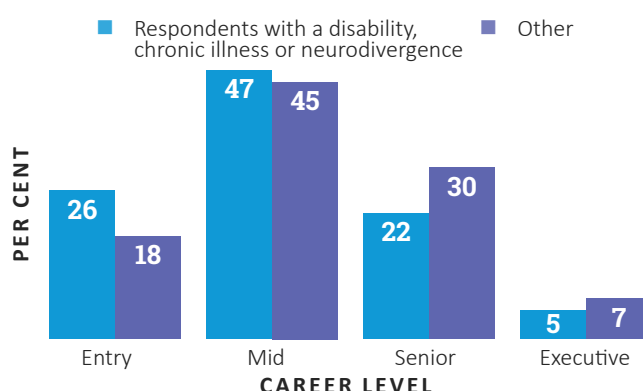
Disability, chronic illness and neurodivergence reported by respondents

Type of disability, chronic illness or neurodivergence	%	Number
Neurodivergent	32%	178
Psychosocial disability / mental illness	21%	118
Chronic illness or medical condition	19%	105
Deaf or hard of hearing	7%	39
Physical disability	6%	35
Blind or vision impaired	5%	28
Cognitive/intellectual disability	3%	14
Prefer not to say	1%	8
Other	4%	24

Respondents could provide multiple answers to this question.  
Respondents to this question: n = 549

**Figure 13**

Employment by seniority level of those with a disability, chronic illness or neurodivergence vs other respondents



**Table 21**

Respondents' with a disability, chronic illness or neurodiversity self-rated career prospects

Rating of career prospects	Respondents with a disability, chronic illness or neurodivergence	Other
Excellent	14%	18%
Good	46%	47%
Neutral/unsure	24%	27%
Quite poor	13%	6%
Very poor	3%	2%

Respondent numbers to this question: People with a disability, chronic illness or neurodivergence n = 365; Other respondents n = 2418

<sup>96</sup> Australian Bureau of Statistics. (2019), *Disability, Ageing and Carers, Australia: Summary of Findings*, Published 24 October Accessed 21 August 2023. [abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/2018](https://abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/2018)

<sup>97</sup> Australian Bureau of Statistics. (2019), *Disability, Ageing and Carers, Australia: Summary of Findings*, Published 24 October Accessed 21 August 2023. [abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/2018](https://abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/2018)





## 4.6 STEM career barriers for LGBTQIA+ people

Of all respondents that answered the question, 13% identified as LGBTQIA+. A further 4% of respondents preferred not to say whether they were LGBTQIA+ or not.

LGBTQIA+ respondents were less likely to be on permanent full-time contracts (45% compared to 60%). They were 13 percentage points more likely to be in entry-level jobs (30% compared to 17% of non-LGBTQIA+ respondents) and less likely to be in senior-level jobs (18% compared to 31%). LGBTQIA+ respondents were less likely to be executives (2% compared to 7%) (Figure 14).

Two-thirds of LGBTQIA+ respondents said their career prospects were 'excellent' or 'good' – about the same figure as for non-LGBTQIA+ respondents.

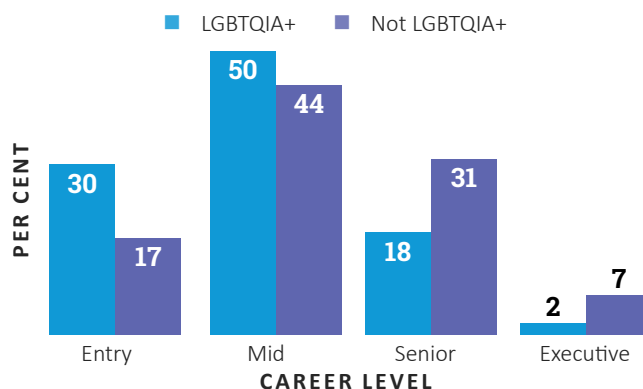
There was no difference in the proportion of respondents who expressed confidence (63%) that they would be working in STEM in five years' time.

LGBTQIA+ respondents were more likely to have some form of career support or advice (12% said they had no access to career support or advice compared to 20% of all STEM workers).

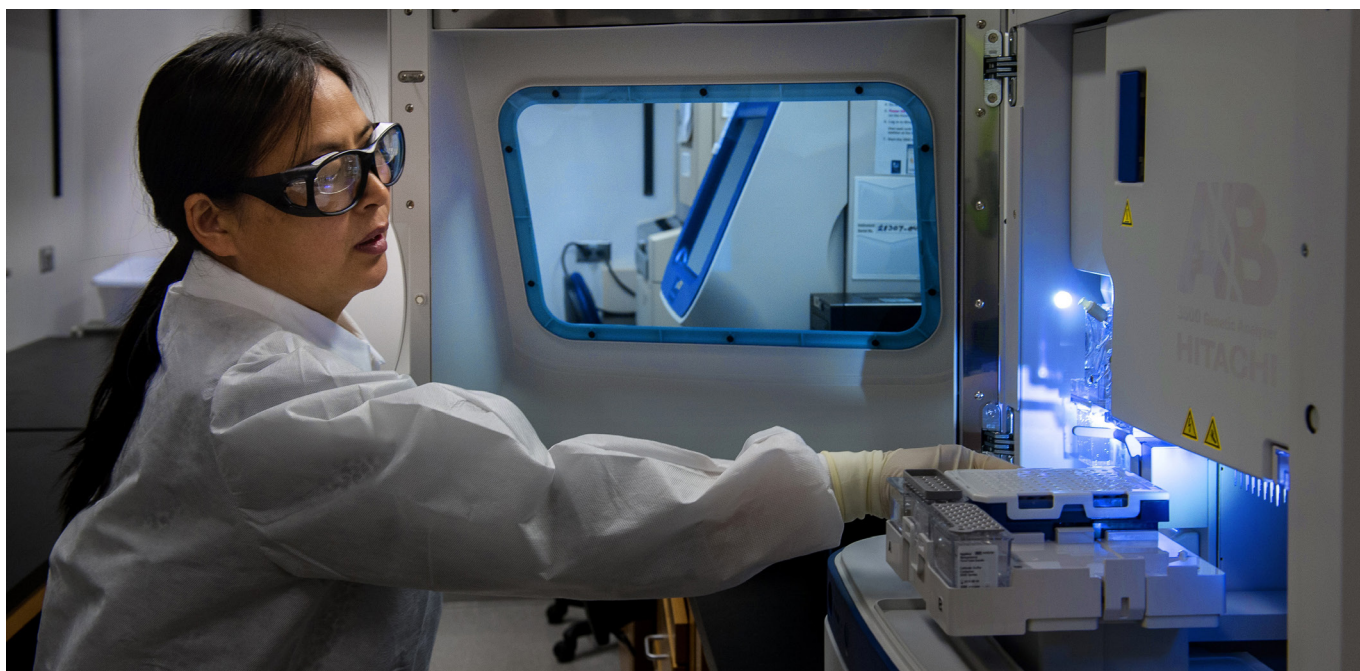
LGBTQIA+ respondents were less likely to report training was helpful to their current job (63% compared 76% of respondents who were not LGBTQIA+), but more likely to believe that training would help them get a better job (27% compared to 17%).

**Figure 14**

Employment by level of seniority for people who identify as LGBTQIA+



## 5. CONCLUSION



This STEM Career Pathways project has gathered important new data and evidence from a wide array of sources on current barriers and solutions to retention and mobility in STEM careers.

Our large-scale survey found people working in STEM careers in Australia are passionate about working in STEM and strongly committed to STEM careers. There is a large fund of enthusiasm, goodwill and commitment that powers STEM careers and STEM work across the breadth of the sector. To honour this goodwill – and to leverage it – there is a clear evidence-backed case to strengthen career supports for Australia's current STEM workforce and drive improvements to expand Australia's future STEM workforce.

Drawing on a large body of literature, a new wide-reaching survey of the STEM workforce, and consultations with stakeholders across the STEM sector, this report identifies three main areas for action to strengthen STEM careers: in workplace practices, skills and experience, and system-wide settings.

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*There is a clear evidence-backed case to strengthen career supports for Australia's current and future STEM workforce.*

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Many of the solutions identified in this report are not the sole responsibility of a single organisation or sector. Actions by governments, employers, education and training providers, and workers can strengthen retention and mobility across Australia's STEM workforce.

Employers have a clear leadership and governance role in improving – indeed, fixing – workplace practices identified as current STEM career barriers. By extending flexible work conditions and fostering supportive workplace cultures – particularly after career breaks – employers can strengthen STEM workforce retention. An economy-wide adoption of more inclusive recruitment practices would drive stronger STEM workforce participation and fill urgent skills gaps in Australia's STEM workforce. Preventing harassment, bullying and discrimination in workplaces requires clear, consistent and strong leadership from employers with support from government.

Both higher education and vocational education training institutions have a responsibility to give employers better visibility of the skills that come with STEM qualifications. The evidence highlights a need for education institutions to equip STEM students to articulate their skills more clearly to employers – which would also strengthen mobility in STEM careers. This research also strongly points to a role for employers to work with education providers to better align both vocational and higher education content with the skills and knowledge that STEM employers need now and in the future. It also highlights a need for employers and education and training institutions to work closely together to expand opportunities for STEM students to gain workplace experience in work-integrated learning and work placements to strengthen STEM-workforce readiness.



The evidence in this report also highlights a clear need to improve Australia's integration of overseas-trained or overseas-born STEM workforce. Employers need a stronger understanding of international graduates' post-study visa conditions – and support to interpret overseas-acquired STEM qualifications.

The evidence suggests expanded access to and support for career mobility programs with proven impact would also strengthen career mobility across the STEM sector, helping employers to fill acute and urgent STEM skill gaps in Australia's economy. Government leadership in R&D and deeper private sector investment in innovation can drive a culture of business research to diversify and strengthen the productive capacity of Australia's economy, broaden opportunities for STEM workers and strengthen STEM career pathways.

This research presents a crucial evidence base that makes the case to build a stronger culture of collaboration. Despite important recent developments to strengthen research commercialisation and engagement between the research sector and business in Australia, evidence gathered in this study suggests there are still very much two cultures that struggle to understand and communicate with each other – or to fully respect each other. This inhibits both retention of talent in STEM careers as well as workforce mobility across the STEM sector.

The report includes examples of how targeted measures can help to deepen collaboration between the research sector and Australian businesses. This will also depend on all parts of Australia's STEM sector taking a broader view of their skills needs – and truly appreciating the value of STEM training and experience from other parts of the STEM sector. Closer collaboration and stronger movement of talent across the sector would expand opportunities for STEM workers to have engaging and varied careers. It is also crucial to national aspirations to make Australia's economy more diverse and complex.

In the STEM research sector, the evidence shows the scale of job insecurity – particularly for early and mid-career researchers – is a damaging barrier to STEM career success. The draft recommendations of the Diversity in STEM review propose imposing new conditions in government research grants to require employers to offer longer-term employment contracts for researchers. The evidence also suggests deeper public investment in research would alleviate the scarcity of research funding that shapes brutally competitive workplace cultures in STEM research careers.

Finally, the evidence shows mentoring and fostering strong professional networks are highly effective enablers of STEM career success, retention and mobility. Expanding access to these powerful career accelerators should be on the priority list of every STEM employer, government, and education and training institution.

## 5.1 Scope for future research and data collection

The STEM Career Pathways report analysed the large body of existing literature and research on STEM career retention and mobility. As noted at the start of this report, much of that literature analyses barriers and challenges in STEM careers, with relatively limited research analysing the success of interventions to dismantle those barriers – in part because many initiatives have not been in place for long-term timeframes. Further research evaluating the various types of solutions and interventions' effectiveness is a clear area for future work.

This research project also identified a stark contrast between the volume of government data collected on the employment trajectories and careers of university graduates in Australia, compared to relatively scant comparable data collected by governments for people with vocational education and training qualifications from TAFE or Registered Training Organisations. Both Jobs and Skills Australia and the State Training Authorities could play a valuable expanded role to collect, monitor and publish comparable data for VET-qualified workers to give Australia a more holistic picture of STEM career pathways.

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The STEM Career Pathways project gathered new, up-to-date data on the current challenges and opportunities in STEM careers, pressure points in career development, and actual and potential interventions that could address the issues and barriers.

## The STEM Career Pathways Survey

The first element of data collection for the project was a major survey of people with STEM qualifications, including those in the STEM workforce and STEM-qualified people who are not currently in the STEM workforce. The latter category includes people who were employed in non-STEM jobs as well as those not in employment who were studying or looking for work.

The survey collected data on a large-scale cross-section of STEM-qualified people and included 75 questions, covering:

- qualifications
- employment
  - sector and industry of employment
  - level of seniority
  - years in the workforce
  - type of contract
  - job satisfaction
- experience of training, career development and mobility
- views about career prospects
- experience of discrimination, harassment and bullying
- experience of career barriers.

The survey also collects detailed demographic data on respondents.

The survey was assessed using the *National Statement on Ethical Conduct in Human Research 2007*. It was designated as negligible risk research and as such exempt from review by human research ethics committee.

Data are stored in accordance with data management plan DMP2023-00384 approved by The University of Adelaide.

The questionnaire was designed by Science & Technology Australia (STA) with specialist advice from members of the project Eminent Expert Group, comprising respected senior leaders and researchers in the STEM sector (listed at the beginning of this report). The survey was administered online through Survey Monkey. A link to the survey was distributed by STA to its uniquely wide membership network and also more broadly to other key stakeholders such as business, industry, professional, education and research peak bodies. STA sent out targeted communications to members and to these other stakeholders and encouraged recipients to share the survey link as widely as possible. Recipients duly circulated the link through various communication channels including their regular member newsletters and social media.

STA also promoted the survey on its website and through LinkedIn. STA developed communications collateral to promote the survey, including material for other organisations' newsletters as well as social media tiles and email footers.

The survey used a convenience/snowball sample method. STA distributed a link to the survey quite widely and other organisations (and individuals) who received the link shared it with their networks. Respondents self-selected to participate in the survey.

## Analysis of survey data

Analysis of survey results in this report is largely limited to straightforward descriptive statistics – frequencies, cross-tabulations by variables of interest (qualifications, sector of employment, demographic variables) and reporting of averages and medians as well as distribution of continuous variables such as hours worked.

Further analysis of the survey dataset in the future could examine the results in more detail for various groups of respondents and test hypotheses. Data will be freely available to other researchers through open access.

In this report, differences between groups of respondents are reported where the difference is at least five percentage points. Where variation in the results (for example, by gender or highest qualification) falls beneath this threshold, no difference is reported.

In all tables and graphs in this report, totals represent the total number of respondents that answered the relevant question(s). Like all surveys, the STEM Career Pathways survey had some missing data (often because respondents did most of the questions but failed to complete the questionnaire, e.g. the demographic questions at the end). Further, skip patterns in the design of the questionnaire meant that not all respondents were required (or able) to answer all questions: for example, questions about current study were only answered by respondents who had indicated that they were currently studying.

## The survey sample, compared to the total university-educated STEM workforce

As shown in [Table A1](#), the sample represents people with qualifications in Natural and Physical Science particularly strongly. People with Engineering qualifications, on the other hand, are under-represented compared to the population, but still make up a fifth of the sample or well over 600 respondents. People with IT qualifications make up over a quarter of the university-educated STEM workforce but are only 7 per cent of the sample (236 individuals). Agricultural and Environmental Studies claim the same share of the sample and the population. In the sample, 6 per cent of respondents had a highest qualification in an 'Other' field. These 'Other' fields were a range of STEM and STEM-adjacent fields and some non-STEM fields.

The sample over-represents postgraduate qualifications compared to the population ([Table A2](#)).

In the survey sample, more than three-fifths of respondents have doctoral or Masters degrees – and just under half of the sample (45%) is PhD-qualified. The share of the full university-qualified STEM workforce with PhDs is just over a quarter. Conversely, people whose highest qualification is a Bachelor degree make up 70% of the university-qualified STEM workforce, but less than 30% of the sample. Graduate Diplomas and Graduate Certificates are slightly over-represented in the sample.

**Table A1**

Field of qualification, survey sample compared to population data (Australia's STEM Workforce)

Field of qualification	% of survey sample	Survey sample N	Australia's STEM workforce
Natural & Physical Science	59%	1952	29%
Engineering	20%	622	38%
IT	7%	236	26%
Agricultural & Environmental Studies	7%	219	7%
Other	6%	211	
Total	100%	1952	100%

Source for Australia's STEM Workforce: Office of the Chief Scientist (2020), *Australia's STEM Workforce*, Office of the Chief Scientist, Canberra.

**Table A2**

Level of education, survey sample compared to population data (Australia's STEM Workforce)

Level of qualification	% of survey sample	Survey sample N	Australia's university-qualified STEM workforce
Doctoral/Masters degree	61%	2047	26%
Graduate Diploma/Graduate Certificate	6%	190	4%
Bachelors	28%	927	70%

Note: For comparability with OCS data on the total university-qualified STEM workforce, data on the survey sample in [Table A2](#) exclude respondents whose highest qualification was an Advanced Diploma/Diploma (2%) or Certificate (1%) or who reported their highest qualification as 'Other' (3%). For this reason, survey data do not sum to 100%. Source for Australia's STEM Workforce: Office of the Chief Scientist (2020), *Australia's STEM Workforce*, Office of the Chief Scientist, Canberra

By industry of employment, Professional, Scientific and Technical Services was the biggest industry in both the sample and the university-education STEM workforce as a whole. Consistent with the strong representation of the university workforce in the sample, Education and Training is over-represented in the survey sample. The three next biggest industries were under-represented in the sample compared to the workforce population (Figure A1).

The survey asks respondents which ‘employment sector’ they work in (Figure A2). This concept doesn’t correspond closely with concepts reported in *Australia’s STEM Workforce*. Nevertheless, the distribution of survey responses by employment sector helps explain the figures reported above, and the differences between sample and population figures.

Thirty per cent of survey respondents work in universities. A further 30% work in other public sector research (MRIs, PFRAs, defence science and technology). Nearly 20% work in private sector business and 14% in the public service.

The survey collects quite detailed demographic data. There is a stark difference between the gender breakdown of the sample survey – over half (55%) of respondents were women – and the overall workforce (more than 70% men).

The survey sample and the total STEM workforce also differ on country of birth: where a majority of the

university-qualified STEM workforce (56%) was born overseas, most of the survey respondents (62%) were born in Australia.

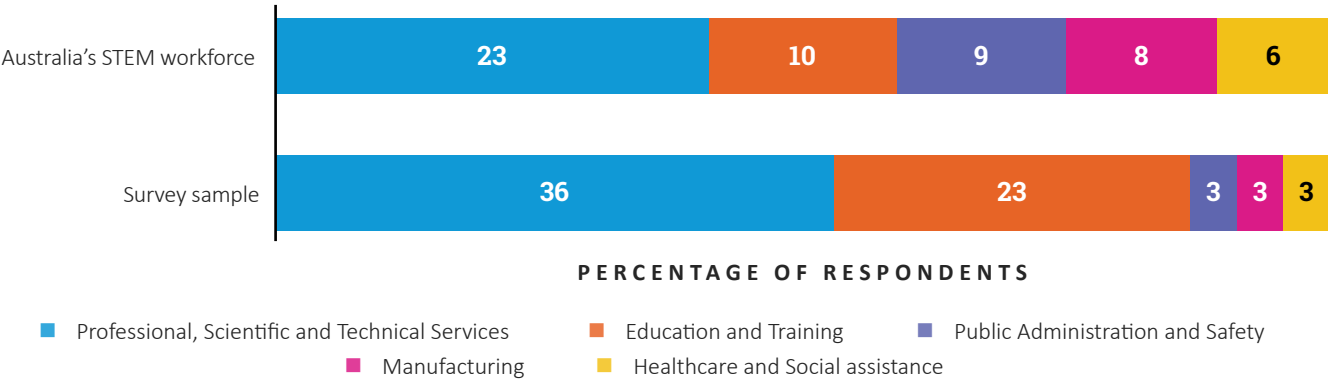
Similarly, 45% of the university-qualified STEM workforce reported that they spoke a language other than English at home. In this survey, the figure was 29%.

Age distribution in the survey sample is very similar to population figures. The share of people aged less than 30 was 21% in both the sample and the population. In the STEM workforce, 37% were aged 45 or over. The sample uses ten-year age groups so this figure can’t be directly compared. In the survey results, 49% were aged 40 or above and 20% were aged 50 or above. These sample figures appear broadly comparable with the population data.

Regionality variables are also different for the sample and the population. More than three-quarters of survey respondents (78%) lived in a capital city. In the total university-educated STEM workforce 86 per cent lived in a ‘major city’. ‘Major city’ is however a much broader category than capital city.

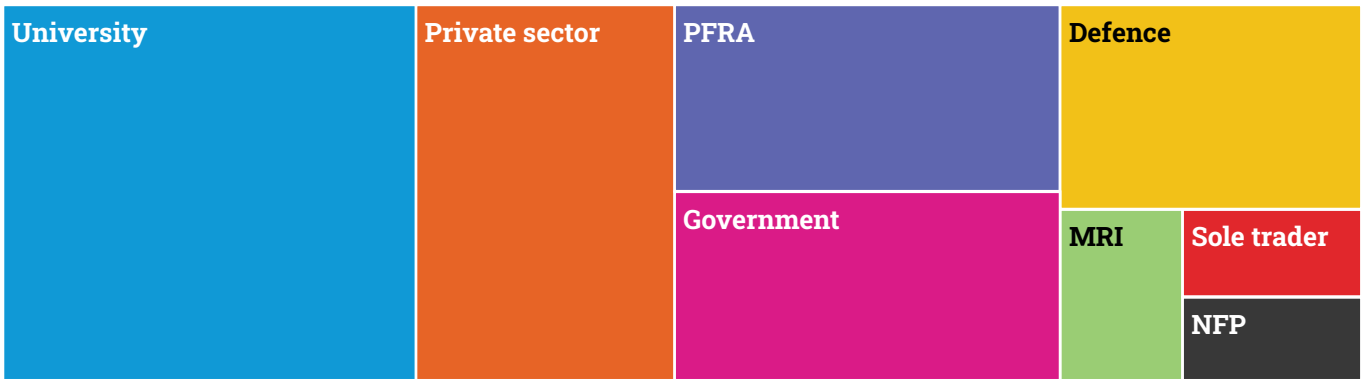
*Australia’s STEM Workforce* also reports figures on the share of the university-educated STEM workforce with childcare responsibilities (37%) as well as those who cared for disabled or elderly relatives (11%). Sample figures (36% and 20%, respectively) were consistent with the STEM workforce data.

**Figure A1**  
Employment by industry, survey sample compared to population data



Source for Australia’s STEM Workforce: Office of the Chief Scientist (2020), *Australia’s STEM Workforce*, Office of the Chief Scientist, Canberra

**Figure A2**  
Respondents by employment sector





**Table A3**

Mobility programs identified by survey respondents

**Undergraduate and postgraduate students****QUT GRED**

Professional development for students, includes internships in industry:  
[qut.edu.au/research/study-with-us/research-education-and-training](http://qut.edu.au/research/study-with-us/research-education-and-training)

**APR internship**

Short term placements in the workplace for PhD students and masters students:  
[aprintern.org.au/](http://aprintern.org.au/)

**AAS Policy internships**

3 month policy project for PhD students:  
[science.org.au/about-us/careers/science-policy-intern](http://science.org.au/about-us/careers/science-policy-intern)

**IMNIS Industry mentoring scheme**

For PhDs and ECRs mentoring and professional development. Also has an internship part:  
[atse.org.au/career-pathways/imnis/#](http://atse.org.au/career-pathways/imnis/#)

**People in the workforce****ASC's Graduate Program**

Introduction into a career in the defence industry:  
[asc.com.au/careers/graduate-program/](http://asc.com.au/careers/graduate-program/)

**Australian Science Policy Fellowship**

1 year fellowship for PhD qualified people in the Australian Public Service:  
[chiefscientist.gov.au/australian-science-policy-fellowship-program](http://chiefscientist.gov.au/australian-science-policy-fellowship-program)

**Astronomy Data and Computing Services (ADACS) internships**

An opportunity to for researcher to intern at ADACS:  
[adacs.org.au/category/internship/](http://adacs.org.au/category/internship/)

**DSTG Navigate**

Targets mid-career STEM professionals into DSTG with rotational placement, and support systems:  
[dst.defence.gov.au/careers/navigate](http://dst.defence.gov.au/careers/navigate)

**Jawun Secondment**

Places professionals into Indigenous organisations for short term placements:  
[jawun.org.au/jawun-community/secondment-partners/](http://jawun.org.au/jawun-community/secondment-partners/)

**Switch secondment**

CSIRO staff placed into Industry partner organisations:  
[alumni.csiro.au/get-involved/switch/](http://alumni.csiro.au/get-involved/switch/)

**MTP Connect Researcher Exchange and Development in Industry (REDI)**

Training program in med tech industry and Bridge Industry Fellowship - fellowships in industry for academics:  
[mtpconnect.org.au/programs/REDI](http://mtpconnect.org.au/programs/REDI)

**ARC Industry placed fellows**

Puts academics into industry positions:  
[arc.gov.au/funding-research/funding-schemes/linkage-program/mid-career-career-industry-fellowships](http://arc.gov.au/funding-research/funding-schemes/linkage-program/mid-career-career-industry-fellowships)

**Australian Federal Police Directions Program**

Entry program into AFP:  
[jobs.afp.gov.au/job-opportunities/directions-program](http://jobs.afp.gov.au/job-opportunities/directions-program)

## Qualitative stakeholder consultations

The second part of the data collection for the STEM Career Pathways project was a series of stakeholder consultations. These consisted of three different kinds of interactions with stakeholders:

- meetings with key stakeholders
- a series of key informant interviews undertaken in June and early July 2023
- stakeholder roundtables undertaken as part of the key informant exercise.

All of these meetings with stakeholders were conceived as qualitative data collection exercises. Results were written up as such after the meetings.

Stakeholder consultations were semi-structured discussions. Consultations at 2 and 3 above used lists of questions drafted by STA staff and adapted for different categories of stakeholder (e.g. employers, research peaks). By and large (though to varying degrees), discussions were led by stakeholders' experiences, concerns and ideas. Roundtables were held where a stakeholder peak body convened several of its members to discuss the issues.

STA talked to a range of different stakeholders including:

- employers (including STA members like the Australian National Fabrication Facility (ANFF))
- employer peaks (Australian Industry Group; the Master Builders Association)
- education and training providers (TAFE Directors Australia)
- PFRAs (ANSTO)
- professional bodies (the Australian Council of Professions, the Australian Institute of Medical and Clinical Scientists)
- early and mid-career researchers (EMCR Forum)
- research peaks (Cooperative Research Australia)
- government agencies (the Department of Climate Change, Environment, Energy and Water (DCCEEW); Jobs and Skills Australia; IP Australia)
- Learned Academies (the Australian Council of Learned Academies (ACOLA), the Australian Academy of Technological Sciences and Engineering (ATSE)).

Stakeholder consultations addressed four main subject areas:


- recruitment of STEM-qualified people into STEM occupations and careers
- retention of STEM-qualified people in STEM careers (and the factors which help or hinder this)
- mobility around different sectors of employment (e.g. from academic research to industry and vice versa)
- equity and diversity.

A full list of stakeholders is at [Table A4](#).

**Table A4**

### List of stakeholder consultations

ACOLA
AiGroup
ANSTO
ATSE
Australian Council of Professions
Australian Institute of Medical and Clinical Scientists
Australian National Fabrication Facility
Cooperative Research Australia
Deadly Science
Department of Education
DMTC
Professor Elanor Huntington
EMCR Forum
Forum of Australian Chief Scientists
Government Scientists' Group
International Ocean Discovery Program
IP Australia
iSTEM Co.
Jobs and Skills Australia
Master Builders Association
Office of the Science Convenor, Department of Climate Change, the Environment, Energy and Water (DCCEEW)
Associate Professor Peter Cabot (UQ Master of Pharmaceutical Industry Practice)
Queers in Science
STEM Champions of Change
Professor Steve Blackburn (ANU IT and Google Research)
TAFE Directors Australia

The background is a dark blue gradient with numerous diagonal light trails of varying thickness and brightness, creating a sense of motion and depth. Scattered throughout are several glowing points of light, some appearing as larger, more intense spheres and others as smaller, sharper dots. The overall effect is reminiscent of a starry night sky or a high-tech digital environment.

[scienceandtechnologyaustralia.org.au](http://scienceandtechnologyaustralia.org.au)