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The role of the resources sector in harnessing and developing Australian STEM capability

A report by the Bankwest Curtin Economics Centre, commissioned by the Australasian Institute of Mining and Metallurgy.

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About AusIMM

The Australasian Institute of Mining and Metallurgy (AusIMM) is the peak body and trusted voice for professionals working in the resources sector. We advance careers, inspire leadership, uphold standards and connect communities.

AusIMM was named 2024 Association of the Year for demonstrating its impact on the global resources sector through providing world-class professional development and connection for our thriving community of members and resources professionals.

AusIMM was founded in 1893 and operates under a Royal Charter. We have a global community of members, branches and societies, along with influential partnerships with industry, government, education and the community. We offer outstanding professional development opportunities including world class mining conferences, leadership events, online learning and industry news to help build and accelerate careers. We host local and global networking opportunities to connect professionals with common goals and interests and help build their profile.

As a welcoming and inclusive organisation with members in 100 countries, AusIMM is committed to representing those who are building a professional career in the sector and improving environmental, social, and economic outcomes in the sector, now and for generations to come.

About Bankwest Curtin Economics Centre

The Bankwest Curtin Economics Centre (BCEC) is an independent economic and social research organisation located within the Curtin Business School at Curtin University. The Centre was established in 2012 through the generous support of Bankwest, a division of the Commonwealth Bank of Australia. The Centre's core mission is to deliver high-quality, accessible research that enhances our understanding of key economic and social issues that contribute to the sustainability of Western Australia and the wellbeing of families, businesses and communities in the state and across Australia.

The Bankwest Curtin Economics Centre is the first research organisation of its kind in WA and draws great strength and credibility from its partnership with Bankwest and Curtin University. By bringing together experts from the research, policy and business communities at all stages of the process – from framing and conceptualising research questions, through the conduct of research, to the communication and implementation of research findings – we ensure that our research is relevant, fit for purpose, and makes a genuine difference to the lives of Australians, both in Western Australia and nationally.

The Centre is able to capitalise on Curtin University's reputation for excellence in economic modelling, forecasting, public policy research, trade and industrial economics and spatial sciences. Centre researchers have specific expertise in economic forecasting, quantitative modelling, micro-data analysis and economic and social policy evaluation. The Centre also derives great value from its close association with experts from the government, corporate, public and not-for-profit sectors.

Executive summary

Employment in Australia's resources sector has grown strongly over this century and is likely to continue to do so in coming years. The sector faces several challenges recruiting and retaining a skilled workforce. This report provides an analysis of trends in the demand and supply of workers, focusing on key skill and workforce gaps and identifying opportunities to expand supply by diversifying professional pathways and accessing a broader pool of Science, Technology, Engineering, and Mathematics (STEM) graduates.

The report provides a detailed comparative analysis of the working experiences and career paths of workers in the resources sector, to inform policies and programs that will build and maintain a skilled mining and metallurgy workforce. Importantly, the report demonstrates the role the sector can play in developing professional skillsets required for a more diverse research and industrial ecosystem built around, but extending beyond, the immediate resources sector.

The report also identifies gaps in existing datasets and areas for future exploration - particularly regarding mobility across disciplines, within the sector and from mining-aligned industries. It also highlights the need to attract skilled professionals from beyond mining, and to effectively retain talent from underrepresented demographic groups including women, First Nations individuals and people from culturally and linguistically diverse backgrounds.

The resources sector is defined in this report to include mining plus manufacturing activities closely aligned with mining. The latter – termed 'resource-aligned manufacturing' - is largely synonymous with downstream processing of mining output. There are clear contrasts in findings for the mining sector, which has been experiencing robust growth, and those for the recently declining resource-aligned manufacturing sector.

Some of the key findings and major challenges facing the resources sector emerging from the report are as follows.

Key finding: Employment trends and outlook

In the decade between the 2011 and 2021 censuses, employment in the resources sector fell by 4.4 per cent as the number of jobs economy-wide grew by 19.8 per cent. However, this masks a stark contrast in outcomes within the resources sector. Employment grew relatively strongly in mining (by 21.6 per cent, or 38,200 workers) but plummeted by 30.7 per cent (53,600 workers) in resource-aligned manufacturing. Employment fell particularly sharply in petroleum and coal product manufacturing, iron and steel forging, and basic chemical manufacturing.

Forecasts produced for Jobs and Skills Australia (JSA) project a rebound in employment in resource-aligned manufacturing in the coming decade, and more modest growth in mining.

- In the ten years to 2035, JSA project total employment to grow by 13.3 per cent. Employment in the resources sector is projected to grow by 11.0 per cent: but just 8.6 per cent in mining and a much higher 16.9 per cent in resource-aligned manufacturing.
- Employment growth is forecast to be strong in each of the main professional occupations concentrated in the resources sector: chemical and material engineers (23.2 per cent); mining engineers (18.5 per cent); geologists, geophysicists, and hydrogeologists (16.6 per cent) and metallurgists (24.7 per cent).

The declining employment trend for resources-aligned manufacturing over the previous decade appear inconsistent with JSA's projections of a reversal of fortune for the resource-aligned manufacturing sector. Ongoing reports of closures of downstream processing operations and more recent Labour Force Survey data indicate the sector's decline has continued since the 2021 census, although this has been coupled with a more recent renewal in political, policy and industry dialogue regarding the strategic relevance of the sector for Australia's domestic industrial base and global partnerships.

Other evidence in this report suggests that, without an expanded and diversified professional workforce, the resource-aligned manufacturing sector is ill-equipped to realise much vaunted opportunities in downstream processing associated with the growing focus on critical minerals supply chains and the transition to a net zero economy. Workers in resource-aligned manufacturing experience inferior outcomes relative to those in both mining and the wider labour market, including poor skills utilisation and limited access to further training. There has been an alarming fall in apprenticeships and new entrants to resource-aligned manufacturing.

Key finding: Skills shortages

Major skills shortages are likely to develop in the resources sector in coming years. Both mining and resource-aligned manufacturing have seen very large drops in participation in relevant formal training courses and in young entrants.

- Available data on completions of university degrees in mining engineering show annual completion numbers between 2019 and 2024 have more than halved compared to the preceding five years. Census data show a concerning stagnation from 2016 in the number of recent graduates with degrees in the three most mining-specialist fields – mining engineering, geology, and geophysics.
- There has been a fall in apprenticeship commencements in the resources sector over the past decade, and the drop has been particularly pronounced in the resource-aligned manufacturing industries.
- The resource sector's workforce is ageing more rapidly than the wider labour force. In 2011, resource sector workers were over-represented in the age categories from 25 to 54 years. By 2021, that 'middle-aged bubble' had shifted to over-representation in the 35 to 64 year categories. In 2021, workers aged 15-24 years had around half the representation in the resources sector as in overall employment (7 per cent versus 14 per cent).
- There is also a noticeable drift of workers with mining related degrees out of mining and into alternative industries as they age, indicating a loss of valuable experience as well as skills.

In light of declining higher education completion rates, attracting professionals with mining related skills from other industries and through immigration appear to offer the main potential sources for increasing the supply of skilled workers to the mining industry. Mining is losing degree-qualified professionals to professional, scientific and technical services, the education and training sector, and public administration. Few persons with mining related degrees are unemployed or outside of the labour force.

If Australia's mining and energy industry is to continue to prosper, it will likely need to rely heavily on international migration to meet future skills needs.

Key finding: Careers in the resources sector

Within the resources sector, mining generally offers well-paid and high-quality employment.

- For 'like workers' in 'like jobs', working in mining is associated with around 25 per cent higher hourly wages.
- Job satisfaction is relatively high for workers in mining, largely but not solely because of higher pay.
- Workers in mining generally feel their skills are well utilised.
- Despite relatively high overall job satisfaction workers in mining tend to be relatively dissatisfied with their job security and flexibility to balance work and non-work commitments.

The resource-aligned manufacturing sector offers a smaller but positive premium of 7 per cent in hourly wages. Overall job satisfaction for workers in resource-aligned manufacturing is similar to that for workers in the wider labour market. However, they tend to feel their skills and abilities are not well utilised in their jobs.

Key finding: Job retention and turnover

Retention (and turnover) for workers in the resources sector is similar to that for other sectors. During the 2000's and 2010's, resource sector workers typically had longer tenures with their employers (by around 1 year), but tenures have converged to now be similar to other sectors.

- Rates of industry, firm, and occupational turnover are not significantly different for workers in the resources sector after controlling for individual and job-related characteristics.
- In the wider labour market, the likelihood of changing industry steadily falls with level of education. This does not apply in the resources sector, despite the higher return to qualifications in terms of wages. This suggests the resources sector has a particular problem in retaining more qualified workers.

Key finding: Barriers to female employment

Increasing female participation in the resources workforce is one of the clearest opportunities for the sector to meet the looming skills and workforce gaps. The report provides qualitative and quantitative evidence regarding both the current representation of women across professional leadership roles, and the key factors shaping women's experience and advancement in the industry.

Female employment in resources inched up from 16.5 per cent in 2011 to 18.7 per cent in 2021, compared to 48.5 per cent of the full workforce.

Barriers facing women working or seeking to work in the sector are apparent on multiple fronts:

- In the resources sector, equally qualified and experienced women earn around 20 per cent less than men when working in like jobs, double the gender wage gap observed outside of the sector.
- Women who enter the resources sector leave it relatively quickly. In the wider labour market, employed women are significantly more likely than men to access external training courses and workplace training, and more likely to feel their skills and abilities are well utilised in their jobs. None of this is true for the resources sector.
- Female university graduates in key mining related fields of study experience greater occupational mismatch. Fewer progress to managerial positions compared to their male peers, and a higher proportion work in jobs that they are over-qualified for. Occupational mismatch is particularly evident for women with degrees in earth sciences and in engineering and related technologies.
- Expanding part-time work opportunities and flexibility in working hours would be an obvious first step, based on the qualitative evidence surveyed in this report.
    - In 2021, only 11.5 per cent of workers in the resources sector were employed part-time, compared to 35.8 per cent of all workers.
    - Holding a part-time job is associated with lower firm turnover in resources sector, which is not observed in wider labour market. This suggests there is unmet demand among resources workers for jobs with greater flexibility in working hours.

Key finding: Participation in training

- Workers in mining, but not resource-aligned manufacturing, are more likely than other workers to receive workplace training. The higher rate of provision of workplace training in the mining sector has been diminishing over time.
- Workers in the resources sector have lower rates of participation in external formal courses of study (13.1 per cent compared to 19.1 per cent for other workers). Participation is particularly low in resource-aligned manufacturing, with only 9.8 per cent having been enrolled in a course in the previous 12 months.
- Resource workers in lower-skilled occupations are particularly less likely to be actively pursuing further qualifications.
  - This lack of training opportunity may contribute to attrition by limiting career progression and pathways and limit the potential supply of higher-skilled workers through up-skilling workers with trade and technical level qualifications.
  - It suggests a need for the development of formal training courses targeted to meeting the needs of resource sector workers for upskilling and career progression.

Key finding: Future research and data

There is a need for more systematic collection of higher education enrolment and completion data for resources-related courses and qualifications to enable the identification of emerging skill shortages.

The Person Level Integrated Data Asset managed by the Australian Bureau of Statistics and consisting of linked data across multiple administrative and survey datasets offers considerable potential for monitoring labour market conditions and emerging skills shortages in the resources sector. Linking tax and benefit data to the higher education and vocational education collections offers the ability to assess labour market outcomes for workers in specific occupations and with specific qualifications on a timely basis.

Analyses of changes in job content in response to the growing use of Artificial Intelligence, robotics, and other forms of automation and advanced technologies in the resources sector will be an ongoing priority.

Introduction

The resources sector is vital to the Australian economy. Commencing with the gold rush of the mid-1800s, mining and exploration has become an integral part of Australia' post-colonial economic development and national identity, and the wealth it generates substantially underpins our standard of living. With high value of output per worker, the mining industry's modest share of total employment – currently around 2 per cent - belies its economic contribution. Mining accounts for around two-thirds of Australia's merchandise exports and 13 per cent of GDP. The importance of our abundance of natural resources is only likely to grow in coming years, given trends in energy markets, including the energy demands of data centres driven by artificial intelligence, demand for minerals in the transition to renewable energy, and the growing strategic focus on critical mineral supply chains.

Realising this potential and maintaining Australia's competitive position as a leading supplier of minerals, materials, and related expertise relies on the resource sector's skilled workforce. The Australasian Institute of Mining and Metallurgy (AusIMM) is the peak body representing professionals working in the resources sector. It has a strategic focus on promoting professional development opportunities and positive career outcomes for the scientists, technologists, leaders, and other professionals whose expertise will keep Australian industry at the vanguard of global best practice.

A recent White Paper (AusIMM 2025) highlighted major challenges in the recruitment, retention, and skills development of workers in the Australian resources sector, including a declining supply of graduates from university courses targeted for key mining and metallurgy professions.

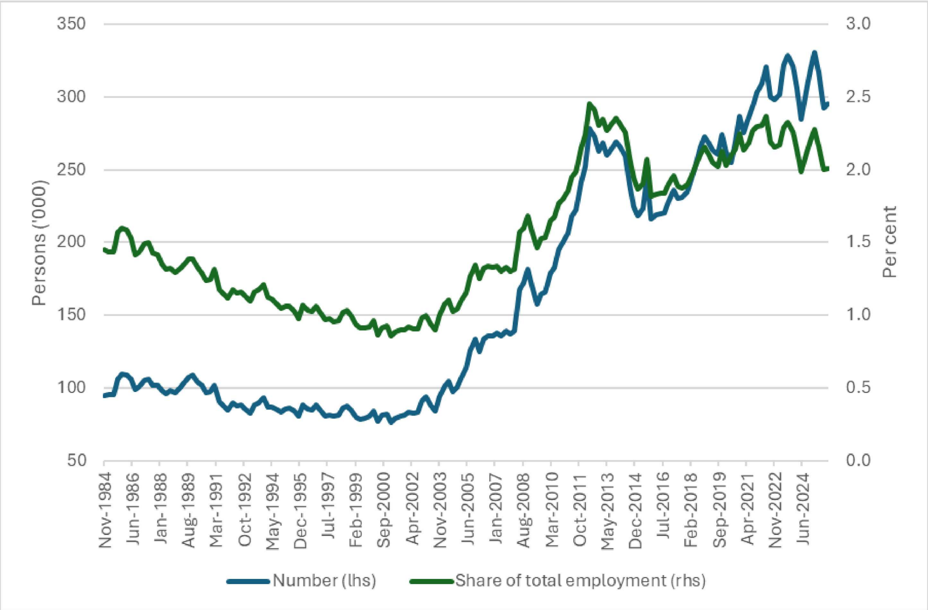
Recognising the need to efficiently match the supply and demand of skilled personnel in the resources sector, and the role the sector can play supporting Australia's broader research and industrial base, AusIMM commissioned the Bankwest Curtin Economics Centre to provide a comprehensive overview of the resources sector workforce, benchmarked against wider Australian workforce and labour market trends. This report draws on existing secondary data sources to provide a detailed evidence-base to inform employer, industry, and government programs focussed on a common goal of career and professional development to support the resources sector and ensure it is equipped to contribute meaningfully to advancing Australia's national interests.

Workforce issues and trends

Employment in the mining industry has grown strongly since 2000, peaking at an estimated 330,000 persons in the first quarter of 2025, and representing 2 per cent of total employment based on data for the December quarter, 2025 (see Figure 1). Cyclical fluctuations in labour demand in the resources sector present a constant challenge for the development of career pathways and for professionals' sense of vocational attachment to the sector.

While the immediate outlook for the sector is positive (Australian Resources & Energy Employer Association [AREEA], 2025), some emerging trends have the potential to significantly impact the number and type of workers required. This includes Australia and the United States entering into a critical mineral compact in October 2025, alongside similar arrangements with other partner nations which are set to bolster investment in Australian rare earth projects. The strategic focus on the control of supply chains in critical minerals, rather than just the output of raw materials, may also see greater investment in downstream processing, with associated demand for metallurgical and other advanced materials specialists.

Figure 1: Employment in mining: persons and share of total employment, Q4, 1984 - Q4, 2025



Source: ABS Labour Force Survey Detailed, November 2025, seasonally adjusted series.

Increasing investment in, and uptake of, advanced technologies and automation within the mining sector will likely be required for Australia to achieve the productivity and efficiency improvements required for continued export growth, particularly in the face of competition from other countries. However, this added technological capacity can only be realised with changes to the workforce structure and training.

Advancements in artificial intelligence, machine learning, 3D visualisation, and modelling allow for improved automation and remote operations and help improve the productivity of mining through more seamless operations and effective work from employees. These advancements have the potential to relocate work away from the mine site, and improve the health and safety of workers, making those jobs highly sought after and necessary for the mining industry's sustained growth (EY, 2019a).

Despite potential worries that technology advancements may result in job losses, estimates suggest 48 per cent of mining jobs are likely to be redesigned or enhanced rather than automated, resulting in the creation of new jobs that focus on data and digital knowledge (EY, 2019b). There are estimates that an additional 22,279 roles will be needed within the mining industry by 2030, with highest demand for future work forecast to centre on mining operators, mining engineers, geologists, geophysicists, and hydrogeologists (AREEA, 2025; AUSMASA, 2024).

To maximise future technology advances within mining, the capability and skills of the workforce must be upgraded to include enhanced digital skills and data literacy to fill the increased number of jobs that will rely heavily on these skills. Shortages of skills in data literacy and analysis, along with necessary changes to workplace rules and regulations, may slow down effective technology adoption and management, and thus the potential that technological innovation can bring to mining (EY, 2019a; EY, 2019b). This raises pressing issues of how to find technologically competent employees, as well as how to upskill the current workforce so that they can transition into more technologically demanding roles.

Addressing changing skills needs

In their 2019 report, EY found that mining in the future will need employees skilled in mathematical and data analysis, critical thinking, collaboration, persuasion, systems evaluation, and system analysis. Demand for more technical skills such as vehicle operations, materials extraction, operation monitoring, equipment maintenance, and blast hole drilling is likely to fall. This directly highlights the changing landscape of future work in the mining sector as a result of technology adoption, where employees will be increasingly required to become more adept in areas outside of traditional physical skills, in favour of the skills necessary for planning and decision making (EY, 2019b). The sector will need to transition towards an even more highly skilled workforce, creating greater impetus to attract, retain, and develop qualified professionals.

An increasing number of mining occupation groups in the future will require a bachelor's degree. Occupations requiring higher-level qualifications will be more secure, while those requiring only Certificate II or III will be more exposed to automation (EY, 2019b). Unfortunately, enrolments in higher education pathways relevant to mining have been falling in recent years, particularly in mining engineering which involves specialised skills required to meet future production capabilities (Knights, 2019, see Section 3).

Along with the need for upgraded skills, implementation of new technologies will require an increased frequency of off-site work and added flexibility in work structure (Minerals Council of Australia [MCA], 2022). While the reduction in physical, on-site work will decrease the need for traditional operators, with the future demand for field geologists, surveyors, and drill operators expected to shrink, more work done off-site will evolve the mining workplace structure beyond fly-in-fly-out. This development is expected to attract more people to the mining industry who may have previously been deterred by the remote locations and long hours, particularly women and young people (EY, 2019b; MCA, 2022).

To increase enrolment and interest in higher education pathways, such as engineering or earth science, research recommends the mining industry partner with government and universities to build new pathways into the sector, whether that be through higher education, more apprenticeships, internships, cadetships, or work experience for university credit, ensuring students experience the practical side of work in the industry (AusIMM 2025; Mitchell, 2025; AUSMASA, 2024).

Additionally, creation of vocational education and training (VET) courses or training programs, whether through TAFE or independently, can allow for greater specialised skill development for those already employed in the industry or with strong interest in a particular area of the workforce (Minerals Council of Australia, 2025). To target skills needed for the future of the sector, existing mining, engineering, or earth science programs should have increased data and digital skills embedded within them to ensure students aren't left behind by technology adoption and automation. Additionally, encouraging and funding enrolment in science, technology, engineering, and mathematics (STEM) courses, alongside embedding this knowledge in mining courses, will boost knowledge outside of traditional mining operations for future jobs that require specialised technology or system skills, particularly if these efforts are focused on women who currently face low rates of enrolment in or completion of STEM courses.

However, increasing enrolment in relevant courses is only the first step. Further effort is needed to encourage those with these new skills to pursue a career in mining, particularly given increasing competition for graduates with STEM and data skills (Knights, 2019; MCA, 2022). This is a particularly relevant issue given a lack of interest in mining among young people, with reasons for hesitancy to work in the sector including concern for the sustainability of mining work, reluctance to work in a challenging and rigorous environment with fly-in-fly-out or potential health risks, and awareness of negative environmental and social performance of mining companies (Goetsch & Meldrum, 2020). This opens opportunities for education or public campaigns to highlight the increased flexible work options and emerging jobs in the industry as it evolves, aiming to capture the interest of the future workforce (AusIMM 2025; AUSMASA, 2024; AusIMM, 2021).

Purpose of this report

This report offers a comprehensive picture of trends in the supply and demand of workers with key skills required by the mining industry, plus detailed analyses of the working experiences of the mining and metallurgy workforce in Australia and how those experiences have changed over time. It provides a baseline picture of the resources sector labour market built upon currently available secondary data – primarily in the form of Australian Bureau of Statistics (ABS) Census data and panel data from the Household, Income and Labour Dynamics in Australia (HILDA) survey.

The following sections set out definitions of the scope of the mining and metallurgy workforce. Referred to in aggregate as 'the resources sector', this includes the mining industry as defined in standard existing industry classifications, plus manufacturing activities that are closely aligned with mining activities, which we refer to as 'resource-aligned manufacturing'. Key resource sector skilled occupations are also identified. The report then looks at the demographic characteristics of the resources sector workforce, and how it has evolved over the past 10 years, benchmarked against the wider Australian labour force.

Section 3 focuses on the supply and demand of key skilled workers for the resources sector, presenting employment projections and data on the number of new entrants. Eight main fields of study are identified as closely aligned with the mining industry, and the industry and occupational destination of university graduates in those fields are examined, along with an assessment of potential alternative sources of supply of professional workers to the mining industry.

Sections 4 to 6 look at selected aspects of the working lives of people in the resources sector: wage determination, job satisfaction, retention and turnover, and participation in workplace and external training. Extensive multivariate regression modelling is conducted using the HILDA panel data to generate new insights into the nature of employment in the resources sector. The main findings from the regression analyses are discussed in the body of the report, with detailed modelling results presented in the Appendix.

The report fills some of the information gaps highlighted in AusIMM's (2025) White Paper. The concluding section canvasses the implications of those new insights for policy and practice, highlights key challenges facing the sector, and issues for future research and data collection. Chief among these are an ongoing erosion of Australia's capabilities in downstream processing (or value-added), a looming skills shortages resulting from low enrolments in resources-related VET and higher education courses, and entrenched barriers to female employment. A major potential avenue for further research and monitoring of labour market conditions and emerging skills gaps is provided by the recently established PLIDA data.

Evolving workforce profile – Census data

This report focusses on Australia's resources sector workforce, taken to include workers directly involved in mining, immediate downstream processing of mining output, and immediate supporting activities to the mining sector. It is not possible to exactly delineate resources sector employment from all other employment, and Table 1 sets out the industry sectors included in the definition used for this report.

The jobs of many workers employed in other industries - such as professional services, catering services, and transport – will also depend directly on the resources sector. However, the definition has been formulated to include only industry classifications for which most of the employment is based directly on economic activities of the resources sector.

In simple terms, the report focuses on direct employment in mining and downstream industrial activities, such as the manufacture of coal and petroleum products, basic chemical manufacturing, and iron and steel forging (see also the key skilled occupations in the resources sector identified in Table 5.)

Table 1: Definition of the resources sector by industry classification

ANZSIC Division, subdivision, group, and class	2011	2021	Pct growth
B: Mining (all)	176,560	214,759	21.6
C: Manufacturing			
17: Petroleum & Coal Product Manufacturing (all)	6,977	2,439	-65.0
18: Basic Chemical & Chemical Product Manufacturing			
181: Basic Chemical Manufacturing (all)	7,063	3,981	-43.6
19: Polymer Product & Rubber Product Manufacturing (all)	36,722	24,946	-32.1
20: Non-Metallic Mineral Product Manufacturing (all)	40,337	30,346	-24.8
21: Primary Metal & Metal Product Manufacturing (all)	77,036	54,198	-29.6
22: Fabricated Metal Product Manufacturing			
221: Iron and Steel Forging (all)	378	178	-52.9
23: Transport Equipment			
239: Other Transport Equipment Manufacturing			
2393: Railway Rolling Stock Manufacturing & Repair Services (all)	5,923	4,718	-20.3
Resources sector total	**350,996**	**335,565**	**-4.4**

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Resources sector workforce – the changing landscape

The industry classification set out Table 1 yields an estimated 335,600 persons employed in the resources sector in the 2021 Census of Population and Housing, the most recent census data available. In total, employment in the sector declined by 4.4 per cent over the 10 years from 2011 to 2021, amounting to 15,400 fewer workers. There was a distinct compositional shift within the sector itself over that decade: employment directly in mining grew by 21.6 per cent, or 38,200 workers, but declined in each of the associated manufacturing sectors. Across all the manufacturing industries included in the scope of the resources sector, employment fell by 53,600 workers to be down 30.7 per cent over the 10 years.

A major constraint in the labour supply to the resources sector is that work in the sector continues to be highly male dominated. Just 18.7 per cent of the 2021 resources workforce were female. This represents a very marginal lift in female representation from 10 years earlier, when 16.5 per cent of the resources sector workforce were women. By comparison, women made up 48.5 per cent of the employed workforce nationally in 2021. Male concentration is evident in both the mining industry and the aligned manufacturing industries, with women holding only 18.7 per cent of jobs in each case.

A lack of flexibility in working hours is likely to be one factor contributing to lower female employment. As shown in Table 2, only 11.5 per cent of jobs in the resources sector in 2021 were part-time, compared to 35.8 per cent for all employed persons. Female resource sector workers are much more likely to be working part-time than their male counterparts, but the incidence of part-time work is much lower for both men and women working in resources compared to the wider workforce. From a low base, there has been a significant increase in the proportion of men in the resources sector working part-time between 2011 and 2021 (from 6 per cent to 9 per cent) in line with broader trends in the labour market.

Table 2: Share of employed persons working part-time by gender, 2011 and 2021 (per cent)

	Resources sector		All industries	
	2011	2021	2011	2021
Male workers	6.0	9.0	19.4	24.4
Female workers	22.1	22.1	47.5	48.2
All workers	8.7	11.5	32.5	35.8

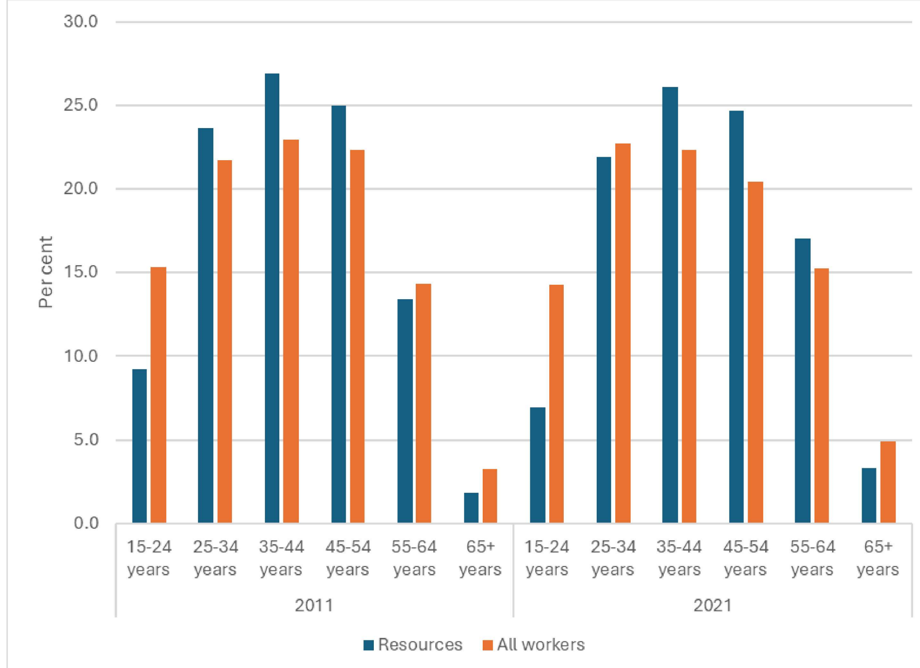
Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

The age profile for the resources sector employment shows an aging workforce in both absolute and relative terms (see Figure 1). In 2011, a relatively high proportion of workers in the resources sector were aged in the prime working years from 25 to 54 years, and those workers accounted for three-quarters of resources workers. Accordingly, younger workers (aged 15-24 years) and older workers (55 and over) were under-represented in the resources sector. This feature of the sector's age profile seems to be largely a cohort effect: ten years on in 2021 that 'middle-aged bubble' had shifted into older categories from 35 to 64 years.

The under-representation of younger workers aged 15 to 24 years had become more marked by 2021, making up just 7 percent of resources sector workers compared to 14.3 per cent of the wider workforce. The sector saw a shift from a slight over-representation of 25-34 year old workers in 2011 to a slight under-representation in 2021. The reverse is observed for workers aged 55-64, with the resources sector employing a relatively higher share of those workers by 2021.

The average age for resources sector workers stood at 42.8 years in 2021, compared to 40.0 years for the Australian workforce overall. That gap of 1.8 years had widened marginally from 0.7 years in 2011 (41.0 years versus 40.3 years overall).

Figure 2: Age profile of the resources sector and total workforce: 2011 and 2021



Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Either younger workers are eschewing employment in the resources sector, or resource sector employers have shifted their preferences in favour of more mature workers. This may have occurred as a result of increased requirements for higher qualifications in the resources sector. While that may be the case in some roles, the hypothesis can be rejected as an overall explanation for the sector's low and falling employment of younger workers by looking at data on post-school qualifications. As Table 3 shows, the resources sector has a relatively high share of workers with qualifications at the Certificate III and IV level, and a relatively low share of workers holding higher qualifications. This pattern accentuated between 2011 and 2021. As at the latest (2021) census, 22.0 per cent of resources sector workers held a university degree or higher qualification compared to 36.2 per cent for the wider workforce, with that gap having widened by almost five percentage points over the preceding 10 years.

Hence, while the resources sector workforce is becoming more highly qualified in absolute terms, by and large this simply reflects growing educational attainment of the overall Australian labour force. In relative terms, educational attainment in the sector has fallen. The major change has been a fall of around 10 percentage points in the proportion of workers with no post-school qualifications, an economy wide change. That declining share has seen small increases in the share of workers at each level of qualification.

Table 3: Highest post-school qualification: resources sector workers and all workers, 2011 and 2021 (per cent)

	Resources sector		All workers		Difference	
	2011	2021	2011	2021	2011	2021
Doctoral degree	0.4	0.5	1.0	1.3	-0.6	-0.8
Masters/postgraduate not further defined	3.1	5.0	4.3	8.0	-1.2	-2.9
Graduate diploma/certificate	1.1	1.5	2.5	3.2	-1.4	-1.7
Bachelor's degree	12.8	15.0	19.2	23.8	-6.3	-8.8
Advanced diploma/associate degree	2.9	3.0	4.6	3.9	-1.6	-0.9
Diploma/diploma level not further defined	4.2	5.5	5.9	7.4	-1.7	-1.9
Certificate III or IV	33.6	36.9	20.3	20.0	13.3	16.9
Certificate I or II/Certificate not further defined	2.5	2.8	3.3	3.1	-0.7	-0.3
No post-school qualification	39.2	29.8	39.0	29.3	0.2	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**0.0**	**0.0**

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder. Notes: not further defined – level of qualification not further defined.

Based on 2021 Census data enumerated by reported 'place of work', Western Australia had the largest share of jobs in the resources sector, at almost 120,000 employed persons representing just over one-third of the national total (Table 4). WA was followed by Queensland (23.1 per cent) and NSW (20.6 per cent) as the main mining states. Unfortunately, the place of work data are not coded by remoteness levels. As the table shows, the majority of resource sector jobs are based outside of the major capital cities in each state and territory, apart from Victoria.

Table 4: Location of resources sector jobs, 2021 Census by 'place of work'

	Total employment		Section of state (%)	
State/Territory	Number	National share (%)	Greater Capital city	Rest of State
New South Wales	**68,983**	**20.6**	**36.4**	**63.6**
Victoria	40,463	12.1	73.8	26.2
Queensland	77,671	23.1	29.6	70.4
South Australia	19,965	5.9	48.4	51.6
Western Australia	117,898	35.1	46.1	53.9
Tasmania	5,253	1.6	23.6	76.4
Northern Territory	4,610	1.4	27.1	72.9
Aust. Capital Territory	625	0.2	n.a.	n.a.
Other Territories	95	0.0	n.a.	n.a.
Total	**335,563**	**100.0**	**43.0**	**57.0**

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Profiles of key skilled occupations

From the above definition of resources sector workers by industry classification (Table 1), the 2021 Census data are used to identify key skilled occupations within the sector. Occupations are coded to the Australian and New Zealand Standard Classification of Occupations (ANZSCO). An occupation was included if the resources sector accounted for 25 per cent or more of total employment in the occupation in 2021, when coded at the 4-digit ANZSCO level. Among the professions, this led to the identification of 'chemical and materials engineers', 'mining engineers', and 'geologists, geophysicists and hydrogeologists' as key skilled occupations. The occupation of metallurgist was not identified through this process, as it is coded as a sub-group within the 4-digit ANZSCO group 'Other Natural and Physical Science Professionals'. Hence, metallurgist is added as a separate 6-digit occupation. Three technician and trades occupations were identified, as shown in Table 5.

Table 5: Key skilled occupations in the resources sector

ANZSCO (4-digit) category	Number employed in Resources sector in 2021	Resources sector share of total employment in occupation in 2021
Professionals		
2331 Chemical & Materials Engineers	1,004	26.4%
2336 Mining engineers	5,345	63.4%
2344 Geologists, geophysicists, & hydrogeologists	8,381	60.4%
2349 Other natural & physical science professionals		
234912 Metallurgist	726	67.0%
Technician and Trades workers		
3129 Other Building & Engineering Technicians	12,708	49.8%
3222 Sheet metal Trades Workers	1,484	33.4%
3232 Metal fitters & Machinists	25,752	29.8%

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Profiles for the professional occupations in 2011 and 2021 are set out in Table 6, benchmarked against all professional workers nationally in those years. Note metallurgist was not included in its own category in the available 2011 Census data. Corresponding profiles for technical and trade occupations, benchmarked against all technician and trades workers, are presented in Table 7.

The key professions in the resources sector are heavily male dominated, although with a significant increase in the proportion of women in the two engineering professions between 2011 and 2021. Female under-representation is even more apparent in the technical and trade occupations. Respectively, women represented just 1 per cent and 2 per cent of sheet metal trades workers and metal fitters and machinists in 2021. Female representation in the other building and engineering technicians occupations (14 per cent) was close to that observed for technician and trades workers overall (16.7 per cent).

Table 6: Profile of key professional occupations in the resources sector, 2011 and 2021

	Chemical & materials engineers		Mining engineers		Geologists, geophysicists, hydrogeologists		Metallurgists		All professionals	
	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021
Female (%)	17.0	22.4	10.7	24.6	24.6	25.6	—	19.0	53.9	56.3
Works PT (%)	8.0	13.5	6.9	12.0	12.0	16.8	—	15.0	26.2	27.5
Age distribution (%)										
15-24 years	9.9	7.3	9.1	9.5	9.5	4.2	—	4.9	6.7	6.3
25-34 years	32.7	32.5	35.4	31.4	31.4	28.2	—	30.7	27.8	28.0
35-44 years	24.2	24.8	25.2	23.7	23.7	27.3	—	22.1	25.7	27.2
45-54 years	17.8	18.5	17.5	19.0	19.0	20.0	—	18.8	22.2	20.4
55-64 years	11.9	11.8	10.6	13.0	13.0	13.6	—	14.6	14.4	13.5
65 years and over	3.0	4.9	2.3	3.4	3.4	6.6	—	7.3	3.1	4.7
Average age (years)	**38.7**	**40.5**	**38.8**	**40.1**	**40.1**	**42.5**	**¬—**	**43.0**	**41.4**	**41.6**
Main qualifications (%)										
Postgraduate degree	21.3	30.2	17.9	33.3	33.3	38.1	—	24.9	14.5	21.9
Bachelor, grad dip/cert	60.6	61.2	62.1	60.3	60.3	57.5	—	63.3	55.5	56.2
Diploma/Assoc degree	5.1	2.5	6.9	1.4	1.4	1.1	—	4.6	11.6	8.3
Certificate III/IV	4.1	2.0	5.8	0.7	0.7	0.5	—	2.5	5.2	4.1
Certificate I/II, Cert not further defined	0.6	0.2	0.4	0.3	0.3	0.1	—	0.6	1.2	0.9
No post-school qual	6.3	2.8	5.1	3.0	3.0	1.4	—	1.8	9.4	6.4
Citizenship status (%)										
Australian	79.2	82.8	76.5	82.8	74.6	83.6	—	87.4	88.2	86.9
Not Australian	20.0	17.1	22.7	17.0	24.6	16.2	—	12.0	10.9	12.9
Main region of birth										
Oceania & Antarctica	56.8	53.8	56.8	53.7	61.7	62.2	—	66.0	70.4	65.8
North-West Europe	11.7	7.0	13.7	10.3	18.3	15.6	—	5.9	9.2	7.4
Southern & Eastern Europe	3.5	2.3	2.0	2.2	2.5	2.6	—	2.5	2.1	1.9
North Africa & Middle East	3.2	4.2	2.0	3.2	1.0	1.7	—	1.7	1.2	1.7
South-East Asia	5.6	7.9	6.6	7.4	3.0	2.9	—	7.2	4.4	5.2
North-East Asia	4.3	6.1	2.8	5.5	1.6	2.1	—	3.3	3.5	4.9
Southern & Central Asia	6.5	9.0	4.9	6.9	2.6	3.2	—	4.2	4.0	7.7
Americas	3.7	3.9	5.7	5.1	5.4	4.8	—	3.0	2.0	2.3
Sub-Saharan Africa	4.6	5.5	5.0	5.5	3.6	4.7	—	5.6	2.4	2.7
Total employment	**2,388**	**3,799**	**8,979**	**8,435**	**8,913**	**8,381**	**—**	**1,083**	**2.15m**	**2.89m**

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Table 7: Profile of key technician and trades occupations in the resources sector, 2011 and 2021

	Other building and engineering technicians		Sheet meta trades workers		Metal fitters and machinists		All technician and trades workers	
	2011	2021	2011	2021	2011	2021	2011	2021
Female (%)	11.2	14.0	1.1	1.0	0.7	2.0	14.9	16.7
Works PT (%)	5.9	7.4	6.6	9.5	5.6	7.1	17.2	21.6
Age distribution (%)								
15-24 years	5.0	3.3	23.6	18.5	17.0	13.9	19.3	16.4
25-34 years	18.9	18.7	21.8	20.6	22.9	25.1	24.1	26.2
35-44 years	29.7	29.2	21.2	19.0	22.5	21.6	22.4	21.7
45-54 years	29.7	27.5	19.9	20.5	22.4	19.6	20.0	18.4
55-64 years	15.2	18.5	11.4	17.9	13.3	16.3	12.0	13.6
65 years and over	1.4	2.9	2.1	3.8	1.9	3.4	2.2	3.6
Average age (years)	43.0	44.3	37.6	40.6	39.3	40.5	38.3	39.3
Main qualifications (%)								
Postgraduate degree	1.5	3.5	0.1	0.4	0.1	0.3	0.9	2.1
Bachelor, grad dip/cert	8.8	13.0	1.0	1.8	1.5	2.3	5.3	8.7
Diploma/Assoc degree	15.0	15.6	1.3	3.0	3.4	5.2	7.5	9.6
Certificate III/IV	45.3	45.3	61.1	62.4	76.8	75.4	54.3	52.3
Certificate I/II, Cert not further defined	3.6	3.3	0.9	1.7	0.8	1.6	1.9	2.2
No post-school qual	22.8	17.4	32.8	29.5	15.3	14.1	27.0	23.4
Citizenship status (%)								
Australian	89.7	90.0	90.1	90.1	90.2	92.0	88.1	86.4
Not Australian	9.5	9.8	8.7	9.6	8.8	7.8	10.6	13.4
Main region of birth								
Oceania & Antarctica	79.4	77.5	80.8	80.7	81.3	82.4	76.3	74.0
North-West Europe	9.4	7.5	8.6	6.6	7.4	5.8	7.6	6.1
Southern & Eastern Europe	1.5	1.3	2.2	1.5	2.3	1.4	3.1	2.3
North Africa & Middle East	0.5	0.8	0.5	0.3	0.3	0.4	1.2	1.4
South-East Asia	2.6	3.6	3.8	6.5	2.0	2.8	3.3	4.6
North-East Asia	0.6	1.1	0.7	0.8	0.4	0.5	2.4	3.3
Southern & Central Asia	1.5	3.2	0.9	1.3	2.0	2.4	2.3	4.8
Americas	1.0	1.3	0.6	1.1	0.8	0.7	1.0	1.4
Sub-Saharan Africa	2.5	3.4	0.4	0.8	2.2	3.0	1.3	1.5
Total employment	19,639	25,517	6,511	4,443	86,966	86,520	1.42m	1.55m

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Matching demand and supply: Employment projections and the supply of skilled workers

The economic outlook for the resources sector is inherently uncertain, with responses to commodity price swings often exacerbating volatility due to long lead times between exploration activities, capital investment in project development, and eventual employment impact. This makes it difficult to project future employment demand and creates uncertainty for those considering investing in skills for the mining industry – for both training institutions and individuals deciding on education and training pathways.

This section collates projections for the key resources sectors and mining occupations from existing employment projections for the Australian economy to 2035. While any forecasting or modelling approach will come with considerable uncertainty, it is still necessary to try to look forward in order to minimise gaps between the demand and supply of workers and skills in the industry. The section then draws upon available data to look at trends in completions from VET and higher education courses aligned with mining, before focusing on potential sources of professional workers to meet future skill needs of the resources sector based on 2021 Census data.

Employment projections, 2025-2035

This section draws on employment projections for the Australian economy published by Jobs and Skills Australia (JSA)[1]. The projections are generated from the Victoria University Employment Forecasting Model and derived from a computable general equilibrium model of the Australian economy (see Dixon 2017). While no projection method for employment in a sector is perfect, computable general equilibrium models do offer desirable properties over other projection methods that treat sectors in isolation. This is because estimates from computable general equilibrium models across all sectors are constrained to be compatible in aggregate and with plausible ranges for key macroeconomic forecasts.

At the time of writing, JSA employment projections were available for 10 years from a baseline of May 2025. Over that decade total employment in Australia is projected to grow by 13.3 per cent, equating to an annual growth rate of 1.0 per cent per annum. This seems quite a low rate of growth in the context of both the recent performance of the Australian labour market and historical trends. Over the past 30 years national employment has grown by close to 2.0 per cent per annum, and by around 2.2 per cent per annum over the past decade. A key factor influencing employment growth will be the rate of immigration and policies around migration and skilled migration in particular. The civilian working-age population has been expanding by around 2 per cent per annum in recent years, driven largely by immigration, and there have been calls for a reduction in the rate of immigration due to the housing shortage and perceived effects of immigration on housing availability and affordability.

The projections for the resources sector are set out in Table 8. Summing the projections for the relevant industries returns a projected growth of 11.7 per cent for the resources sector, marginally below the estimated growth for aggregate employment.

Employment in mining is projected to grow by 8.6 per cent, well below total national employment. In contrast, employment in resource-aligned manufacturing industries is projected to grow at above average rates, at 16.9 per cent over the 10 years. This would represent a marked turnaround from employment changes experienced between 2011 and 2021 as documented in Section 2. Between those census years, mining employment grew by 21.6 per cent, while employment in resource-aligned manufacturing fell by 30.7 per cent. The projected slowdown in employment growth in mining stems largely from low projected growth in coal mining of just 500 jobs, or 1.1 per cent over the 10 years and a projected fall in employment in oil and gas extraction by 1,300 jobs (6.6 per cent). In contrast, the JSA projections include a strong rebound in

1 See https://www.jobsandskills.gov.au/data/employment-projections

employment in petroleum and coal product manufacturing, as well as in basic chemical manufacturing, and primary metal and metal product manufacturing. This reflects an anticipated push from the sector into downstream minerals processing.

Table 8: JSA employment projections for the resources sector: 2025-2035

Sector	Employment level ('000)		10-year change	
	May 2025	May 2035	Number	Per cent
Resources sector:				
Mining	322.6	350.4	27.8	8.6%
Resource-aligned manufacturing:				
Petroleum and Coal Product Manufacturing	5.9	7.9	2.1	35.2%
Basic Chemical Manufacturing	4.6	6.0	1.4	30.0%
Polymer Product & Rubber Product Manufacturing	23.1	25.7	2.6	11.4%
Non-Metallic Mineral Product Manufacturing	29.7	32.3	2.7	8.9%
Primary Metal and Metal Product Manufacturing	63.2	76.4	13.3	21.0%
Iron and Steel Forging	0.6	0.7	0.0	7.6%
Railway Rolling Stock Manuf. & Repair Services	4.7	5.0	0.3	6.1%
Total - resources sector	**454.4**	**504.6**	**50.10**	**11.0%**
Total - Resource-aligned manufacturing	131.8	154.2	22.34	16.9%
Total – Manufacturing	874.3	976.3	102.0	11.7%
All Industries	**14,701.0**	**16,655.5**	**1,954.5**	**13.3%**

Notes: Projections for railway rolling stock manufacturing and repair services are not generated by JSA. Figures presented are based on applying JSA's projected growth rate for the '239 Other Transport Equipment Manufacturing' to that industry's employment figure from the 2021 Census (see Table 1).

In terms of the number of jobs (as opposed to growth rates), primary metal and metal product manufacturing is projected to expand by 13,300 jobs over the 10 years, accounting for 55 per cent of jobs growth in the resource-aligned manufacturing sectors. Mining employment is projected to expand by 27,800 jobs.

The associated projections for employment in the main resources sector occupations are set out in Table 9. Across the whole labour market, employment is projected to grow more quickly in professional occupations than in the other major occupational categories, at 21.4 per cent over the ten years to 2035 compared to 13.3 per cent across all occupations. The main mining and metallurgy professionals have similarly strong growth projections, ranging from 16.6 per cent for geologists, geophysicists, and hydrologists to 23.2 per cent for chemical and materials engineers. Note separate projections are not available for the 6-digit occupational category of metallurgist, and the 24.7 per cent growth assumed for metallurgists is based on the projection for the wider category of other natural and physical science professionals.

Projected growth rates are below average for the key trades workers. In absolute terms, however, the biggest expansion in demand among the key resources sector occupations is for metal fitters and machinists, projected to increase in number by 8,900 workers by 2035.

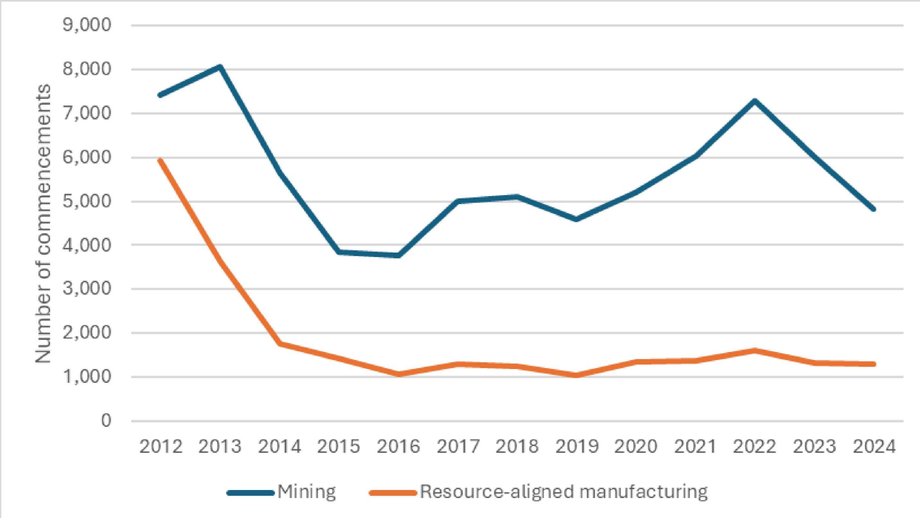
Table 9: JSA employment projections for resource sector occupations: 2025-2035

	Employment level ('000)		10-year change	
	May 2025	May 2035	Number	Per cent
Professionals (All)	**3,953.3**	**4,798.6**	**845.3**	**21.4%**
2331 Chemical & Materials Engineers	7.1	8.8	1.7	23.2%
2336 Mining engineers	15.5	8.4	2.9	18.5%
2344 Geologists, geophysicists, & hydrogeologists	14.0	16.3	2.3	16.6%
2349 Other natural & physical science professionals:				
234912 Metallurgist	1.1	1.4	0.3	24.7%
Technician and Trades workers (All)	**1,994.1**	**2,189.9**	**195.9**	**9.8%**
3129 Other Building & Engineering Technicians	39.4	44.0	4.6	11.7%
3222 Sheet metal Trades Workers	5.7	6.3	0.6	10.5%
3232 Metal fitters & Machinists	123.0	131.8	8.9	7.2%
All Occupations	**14,701.0**	**16,655.5**	**1,954.5**	**13.3%**

Trends in VET

The National Centre for Vocational Education Research (NCVER) collects statistics on apprenticeships and traineeships, including completions from courses across the VET sector. We have identified training activity aligned to the mining industry as accurately as possible. The apprenticeship data is coded to the industry category of the employer, allowing us to align commencements in apprenticeships to the mining industry and the definition of resource-aligned manufacturing as set out in Table 1. As can be seen in Figure 3, apprenticeship training numbers in resource sector firms have declined substantially over the past decade. This is most pronounced for the resource-aligned manufacturing sector, and declines are evident in all industry subgroups of that sector. From 2016 to 2024 commencements have levelled off at around one-fifth of the almost 6,000 recorded for 2012.

Figure 3: Apprenticeship commencements, resources sector, 2012-2024

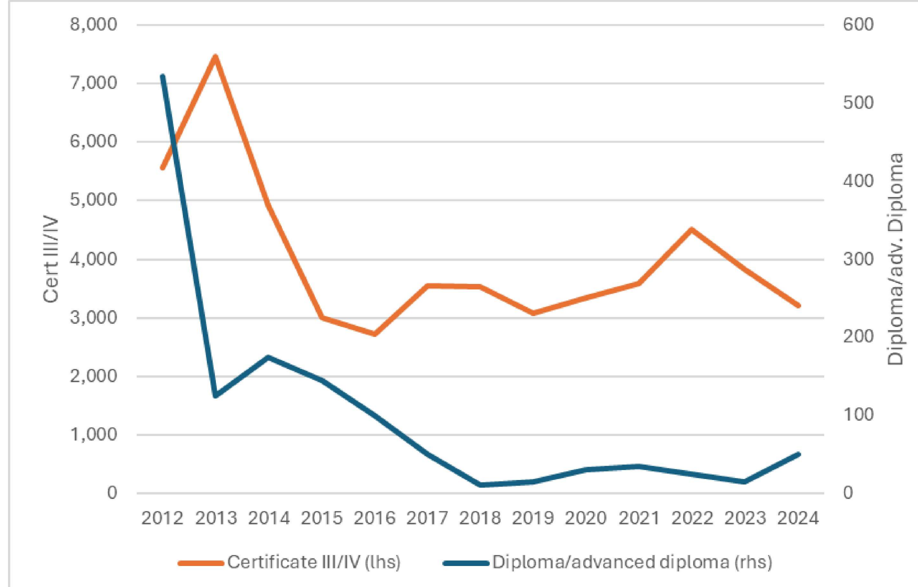


Source: Authors' calculations from NCVER's apprentices and Trainees collection.

Apprenticeship commencements in the mining sector also dropped off sharply after 2013. Thanks to something of a rally in entrants after 2019, the longer-term decline in numbers has not been as substantial as in the related manufacturing sector. However, given employment in resource-aligned manufacturing fell by around 30 per cent in the intercensal years from 2011 to 2021, while employment in mining increased by around 21 per cent, the fall in mining apprenticeships would compare less favourably if expressed as a training rate.

In mining, VET students studying at the Certificate III/IV level greatly outnumber those enrolled at the higher diploma or advanced diploma level. Numbers at both levels have seen declines. Noting the different scales of the axes in Figure 4, Certificate III/IV commencements have accounted for the vast bulk of the fall in training numbers in mining, roughly levelling off between 3,000 to 4,000 since 2015. In proportionate terms, however, commencements at the diploma and advanced diploma level have seen the most pronounced decline.

Figure 4: Apprenticeship commencements in mining, by level of study, 2012-2024



Source: Authors' calculations from NCVER's apprentices and Trainees collection.

The supply of mining professionals

As discussed in Section 1, analysts anticipate that technological and other changes will mean that an increasing number of mining occupations in the future will require a bachelor's degree. Occupations with higher-level qualification jobs are seen as more secure, while occupations requiring only Certificate II or III level qualifications are more at risk of being automated (EY, 2019b).

Unfortunately, enrolments in higher education pathways relevant to mining appear to have been falling in recent years. Accurate data on completions relating directly to mining are hard to find, in part because of a trend for institutions to move to offering more broadly based earth sciences courses in preference to courses specifically tailored for entry into the mining industry. This applies to the geological discipline.

Direct data on completions collated from higher education institutes could be identified for only one mining-aligned degree, that of mining engineering, and is reproduced in the following section. As shown in Table 5, mining engineers are one of the most critical professional occupations for the industry. The remainder of this section utilises detailed census data by field of study and level of education to explore the labour market destinations of those with mining-aligned degrees and potential sources of supply of professional workers for the mining industry.

Higher education completions in mining engineering

Analysis from Knights (2019) and recent data taken from MCA (2022) (see AusIMM 2025, appendix), show that nationally the number of people graduating from mining engineering degrees has fallen from an average of 230 per year from 2009 to 2018 to an average of just 85 per year in the five years from 2019 to 2024 (see Table 10).

This 63 per cent decline stands in stark contrast to recent growth in overall mining employment and the average projected growth in demand for mining engineers of 23 per cent in the coming ten years as presented above (Table 9). It also represents a significant shortfall relative to other predictions that 160 graduates each year will be needed to keep up with project approvals, with demand for mining graduates further expected to increase by 21 per cent between 2020 and 2040 (Knights, 2019; MCA, 2022).

Knights presents additional evidence that there has been some pick-up in completions from mining engineering courses at the master's level, such that the decline in total graduations is less severe (AusIMM 2025, Appendix). However, many of these are international students of whom an unknown proportion intend to, or will be able to, remain in Australia.

Table 10: Graduates from accredited undergraduate mining engineer courses, by university, 2009-2024

University	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CQU															2	0
Monash							11	10	12	8	6	10	6	4	0	0
Fed U							4	9	18	6	3	2	0	2	4	1
UoW	16	27	23	34	49	24	35	31	30	29	12	12	6	15	9	9
Curtin	61	43	69	61	71	52	56	53	36	26	22	20	27	20	32	42
UQ	45	57	50	44	46	73	65	53	40	22	14	18	12	19	22	5
UNSW	50	53	50	54	52	50	78	68	86	58	32	21	14	12	16	12
Adelaide		36	34	39	47	42	33	33	26	19	7	3	3	6	13	11
Total	**172**	**216**	**226**	**232**	**265**	**241**	**282**	**257**	**248**	**168**	**96**	**86**	**68**	**78**	**98**	**80**

Source: AusIMM 2025 Appendix, prepared by Professor Peter Knights, School of Mechanical and Mining Engineering, University of Queensland, with data taken from Minerals Council of Australia (2022)'s The Digital Mine report. CQU - Central Queensland University, Fed U - Federation University, UoW – University of Wollongong, UQ – University of Queensland, UNSW – University of New South Wales.

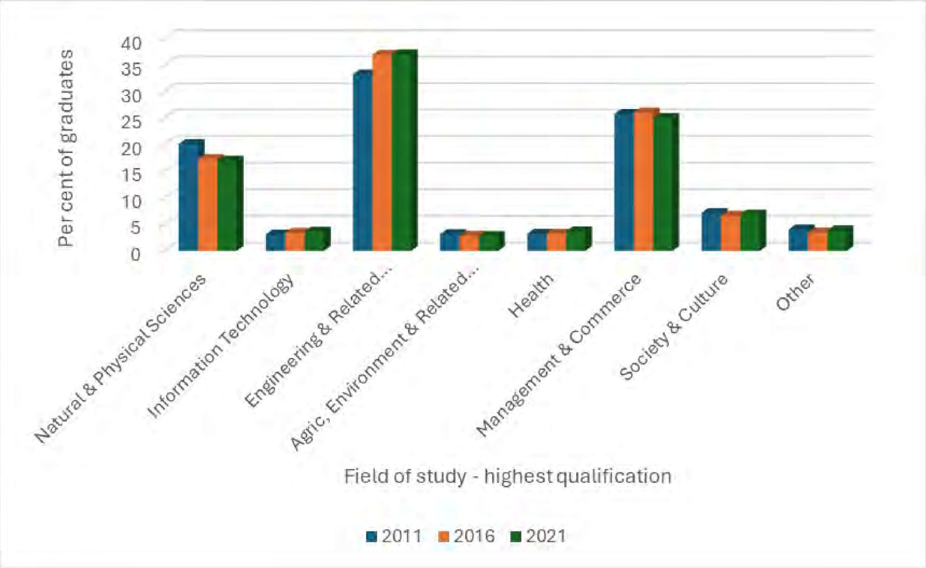
Identifying mining graduates in census data

While direct data on the number of graduates completing mining-related courses are not readily available, further information on supply and demand for graduates can be gleaned from census data. University graduates can be identified using individuals' reported level of highest non-school qualification, encompassing those with a bachelor's degree, graduate diploma, graduate certificate, or postgraduate degree. A cross-tabulation of these data with field of study, at various levels of detail, and industry of employment, can be used to identify 'mining graduates'. This allows changes in the supply of such graduates and their industry of destination to be estimated from census data.

Figure 5 shows the broad field of study of graduates employed in the mining industry, and how the profile has evolved from 2011 to 2021. The most common field of study of graduates working in mining is engineering and related technologies (ERT), accounting for around one-third of tertiary qualified workers in mining, followed by management and commerce (around 25 per cent), and the natural and physical sciences. The profile of graduates working in mining in terms of the broad field of study remained relatively constant across 2011, 2016, and 2021, albeit with a 3-4 percentage point increase in the proportion holding degrees in ERT and a comparable fall in the proportion with qualifications in the natural and physical sciences.

It is evident that mining is particularly intensive in its demand for STEM (science, technology, engineering, and mathematics) skills. Although definitions vary, STEM is typically taken to include the natural and physical sciences, information technology, and ERT (see Dockery and Bawa 2018). In 2011, by this definition, 56.6 per cent of tertiary qualified workers in mining held STEM qualifications, rising to 57.7 per cent in 2021[2].

Figure 5: Field of study for graduates working in mining (%); 2011, 2016, and 2021



Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Based on the number and concentration of graduates working in the mining industry in 2021 at the most detailed available field of study classification, we identify eight different degree fields as key mining fields. These are shown in Table 11. Two of these are the rather less informative 'not further defined' categories: 'Earth Sciences not further defined', a field for which a relatively high proportion (27.5 per cent) of graduates work in mining; and 'Engineering and Related Technologies not further defined', a field from which a very high number of graduates work in mining. The 'not further defined' categories indicate the field of that qualification is within that general discipline, but without being assigned to one of the more specialist sub-fields within the category[3].

The graduate fields of study are listed in Table 11 in order of concentration in mining (the proportion of all workers with degrees in that field who are employed in mining). Two fields of study stand out clearly as mining specific degrees: mining engineering and geology, with both a high number and high proportion of workers in the industry.

2 STEM is also sometimes defined to include agriculture, environmental, and related studies, which would lift the STEM proportion in mining to 60.5 per cent in 2021.

3 In the census coding, a not further defined category is assigned when enough information exists to partially code a response, but insufficient information exists to code it to the most detailed category in the classification.

Table 11: Key fields of study of degree holders working in mining, 2021

Field of study	Number employed in mining	Concentration of employment in mining
Mining Engineering	3,343	53.1
Geology	4,780	42.1
Geophysics	307	27.8
Earth Sciences, not further defined	616	27.5
Geotechnical Engineering	107	16.6
Materials Engineering	668	16.4
Chemical Engineering	1,184	9.8
Engineering and Related Technologies, not further defined	8,007	5.5

Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

As a proxy for the supply of new mining graduates, Table 12 shows changes over the last decade in the number of persons aged 25 to 34 with a bachelor's degree or higher in the key mining fields. By way of comparison, total employment in mining grew by 21.6 per cent between 2011 and 2021. For all except two of the identified mining degrees, the supply of young workers increased by substantially more, and typically by a factor of two- or three-times more. The exceptions are geology, with the supply of young graduates increasing by just 13.3 per cent over the decade, and geophysics, which saw a decline of almost 20 per cent. The latter may reflect a shift in university course structures away from specialist geophysics majors to more general earth science courses.

A caveat is warranted regarding this apparent growth in supply of recent mining graduates. The vast bulk of the growth occurred from 2011 to 2016. This is particularly the case for graduates in mining engineering, for which there was minimal growth in the latter five-year period, and materials engineering which saw a decline from 2016 to 2021.

Table 12: Persons aged 25-34 with mining-related degrees: 2011, 2016, and 2021

	Number of persons			Percent change
Field of study	2011	2016	2021	2011-2021
Mining Engineering	1,478	2,360	2,382	61.2
Geology	2,684	2,970	3,042	13.3
Geophysics	296	279	238	-19.6
Earth Sciences, not further defined	435	661	856	96.8
Geotechnical Engineering	88	140	174	97.7
Materials Engineering	718	1,148	1,132	57.7
Chemical Engineering	2,597	3,519	4,839	86.3
Engineering and Related Technologies, not further defined	34,929	42,888	54,906	57.2

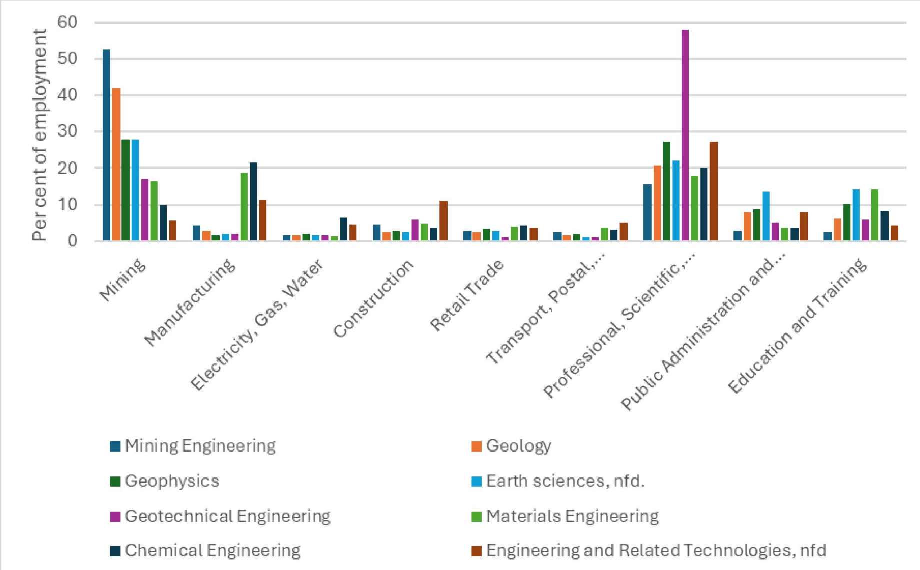
Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Industry destination of mining graduates

Figure 6 shows the main industries of employment for graduates from the eight key mining-related degree courses as recorded in the 2021 Census. The field of study clusters are ordered from that with the highest share of employment in mining (mining engineering at 52.7 per cent) to lowest (ERT-not further defined at 5.5 per cent). Across each of these degree fields, the industry of professional, scientific, and technical services is a major employment destination. As an alternative industry of employment, this is rivalled by manufacturing for graduates from materials engineering, chemical engineering, and ERT-not further defined, with the latter also having significant employment in the construction industry. Other destinations for these graduates include public administration (notably those with degrees in earth sciences-not further defined, geophysics, and geology) and education and training (notably those with degrees in earth sciences not further defined. and materials engineering).

The findings indicate the industries from which prospective mining professionals may be sourced in the future, and the cross-industry value chains across which future mining professionals may work. With appropriate continuous professional development, STEM professionals working in the mining sector can apply their skills to the development of other key Australian industries, in turn developing further skills relevant for a more technologically-driven and advanced mining and materials industrial base.

Figure 6: Industry share of employment for graduates with selected mining-related degrees, 2021



Source: ABS Census of Population and Housing, accessed on-line through TableBuilder.

Industry destination by age

Figure 7 shows the distribution of employment across industries conditional on field of study and age of the graduate, with a separate panel for each of the eight fields selected as closely aligned with mining. For comparability, the scale on the vertical axis ranges from zero to 70 per cent in each panel, and industries are shown only if the shares in each age group sum to over 6 per cent. Based on the number of employing industries that cross this threshold, employment is relatively diversified for university graduates with degrees in the fields of chemical engineering, ERT-not further defined, and materials engineering. In contrast, employment for geotechnical engineering graduates is heavily concentrated in the professional, scientific and technical services industry.

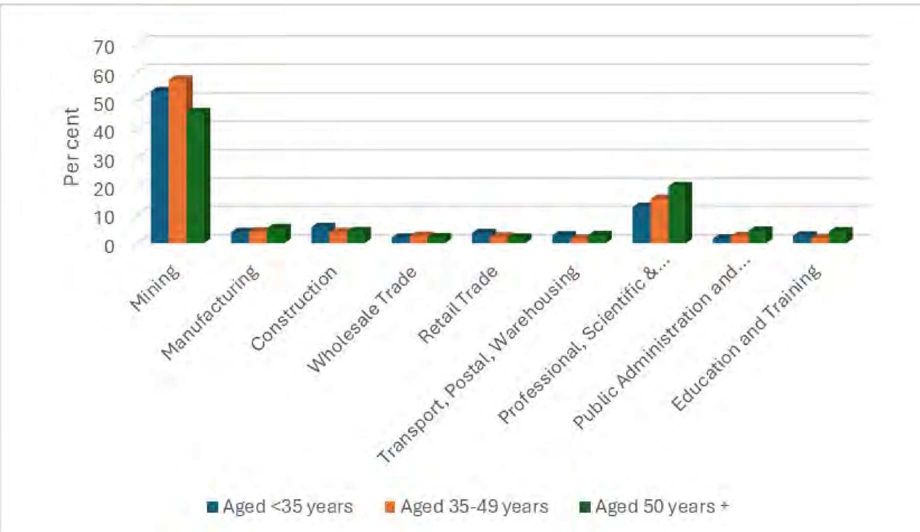
Industry shares of employment are shown for three age groups: persons aged up to 34 years, who will be relatively recent graduates; 'prime-aged' or mid-career workers from 35 to 49 years; and those aged 50 years and older. For people holding a degree in each of those eight fields, there is a noticeable shift out of the mining industry as they age.

This is particularly so for geology graduates, for whom the proportion employed in mining declines from 51.8 per cent for younger workers to 43.0 per cent for mid-career workers, and just 34.5 per cent for older workers (Figure 7, panel b). Steady declines with age are also observed for geotechnical engineering (panel e) and chemical engineering graduates (panel g). For some fields there is an initial increase in the proportion employed in mining with age, notably the share of mining engineers employed in mining increases from 53.3 percent for younger workers to 57.3 per cent in mid-career (Figure 7, panel a). However, for workers in each of the eight fields of study, the mining sector's share of employment is lower among the older worker cohort than the younger cohort of workers.

For many fields those leaving the mining industry as they age appear to move into the professional, scientific and technical services sector, and to a lesser extent into public administration and safety, and education and training. The transition from mining into professional, scientific and technical services may reflect more experienced workers progressing from being an employee for a mining company into consultancy services or self-employment as a consultant. In those cases their skills may not be lost to the mining industry. Similarly, regulatory or policy roles in public administration, and research or teaching roles in education and training may mean workers transitioning into those industries are still servicing the mining sector.

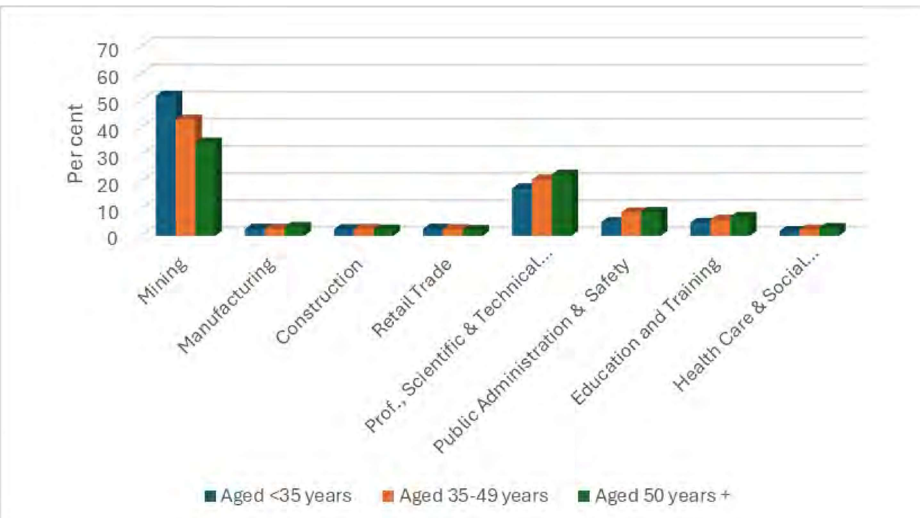
An increasing share of employment in manufacturing with age is also observed for a number of fields, including materials engineering and ERT-not further defined. The highly diversified field of ERT-not further defined is the only field in which the proportion of graduates employed in professional, scientific and technical services declines with age.

Figure 7: Major employing industries by field of study, 2021
(a) Mining engineering graduates



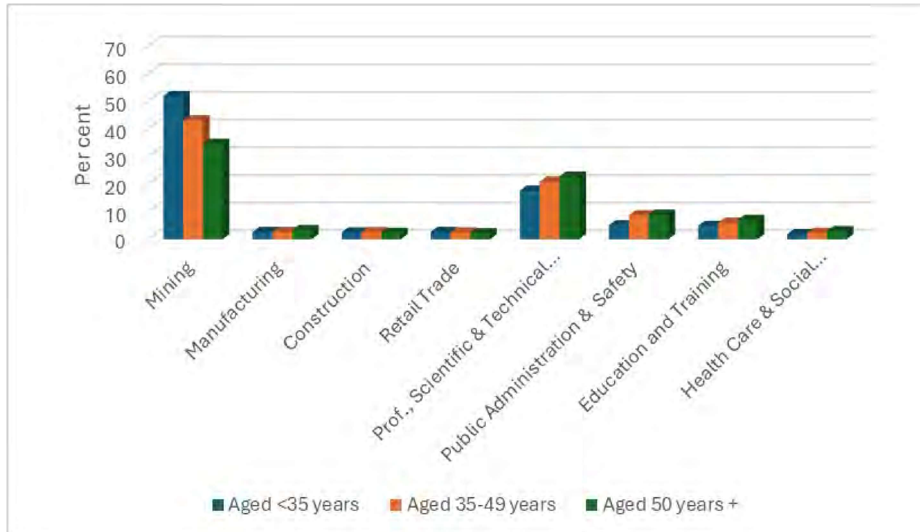
Notes: Number of employed persons: < 35 years=2,950; 35-49 years=4,170; 50+ years=4,240.

(b) Geology graduates



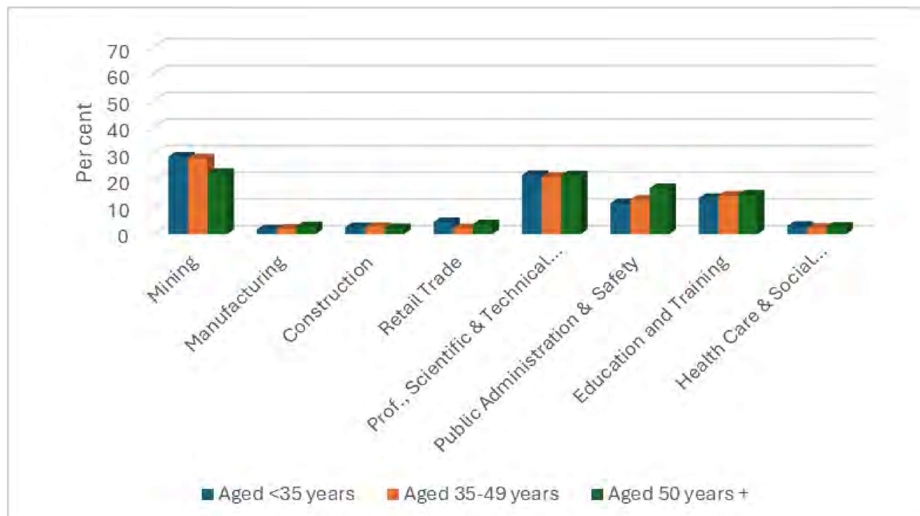
Notes: Number of employed persons: < 35 years=2,170; 35-49 years=2,560; 50+ years=1,540.

Figure 7: Major employing industries by field of study, 2021
(c) Geophysics graduates



Notes: Number of employed persons: < 35 years=200; 35-49 years=450; 50+ years=410.

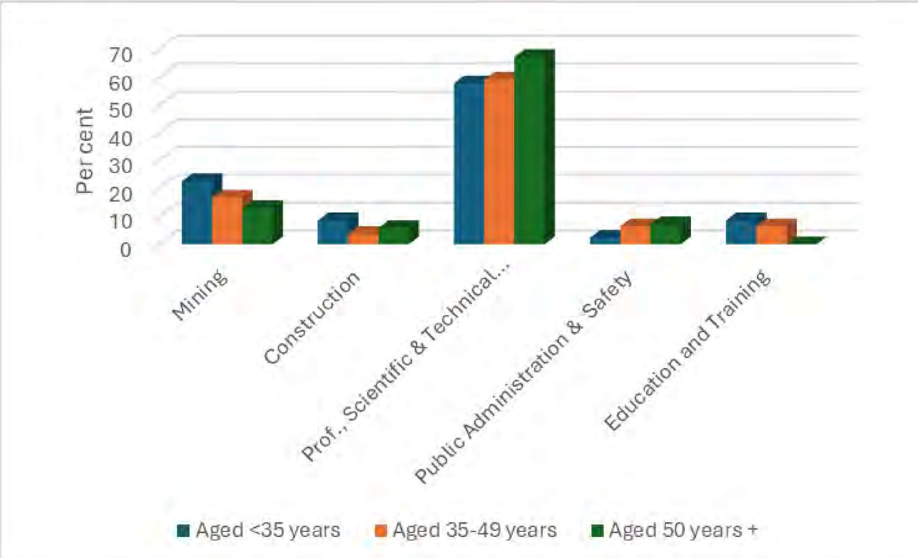
(d) Earth sciences not further defined (not further defined) graduates



Notes: Number of employed persons: < 35 years=820; 35-49 years=870; 50+ years=550.

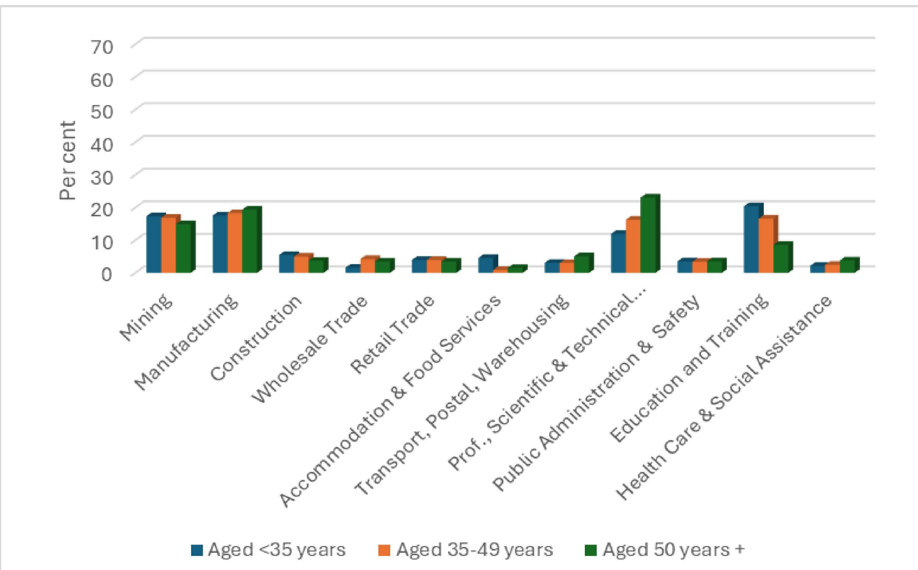
Figure 7: Major employing industries by field of study, 2021 (Continued)

(e) Geotechnical engineering graduates



Notes: Number of employed persons: < 35 years=130; 35-49 years=320; 50+ years=150.

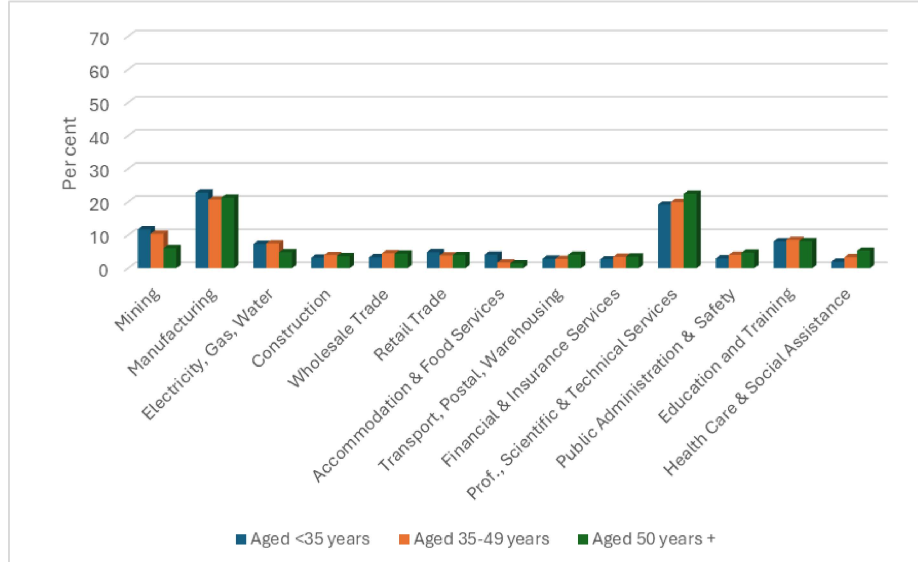
(f) Materials engineering graduates



Notes: Number of employed persons: < 35 years=880; 35-49 years=1,580; 50+ years=1,580.

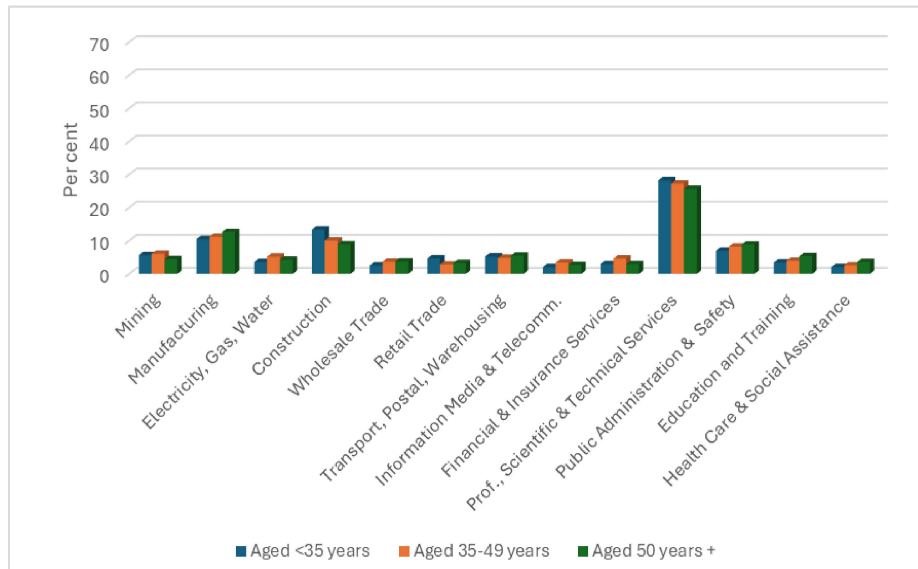
Figure 7: Major employing industries by field of study, 2021 (Continued)

(g) Chemical engineering graduates



Notes: Number of employed persons: < 35 years=4,510; 35-49 years=4,580; 50+ years=2,900.

(h) Engineering and related technologies - not further defined graduates

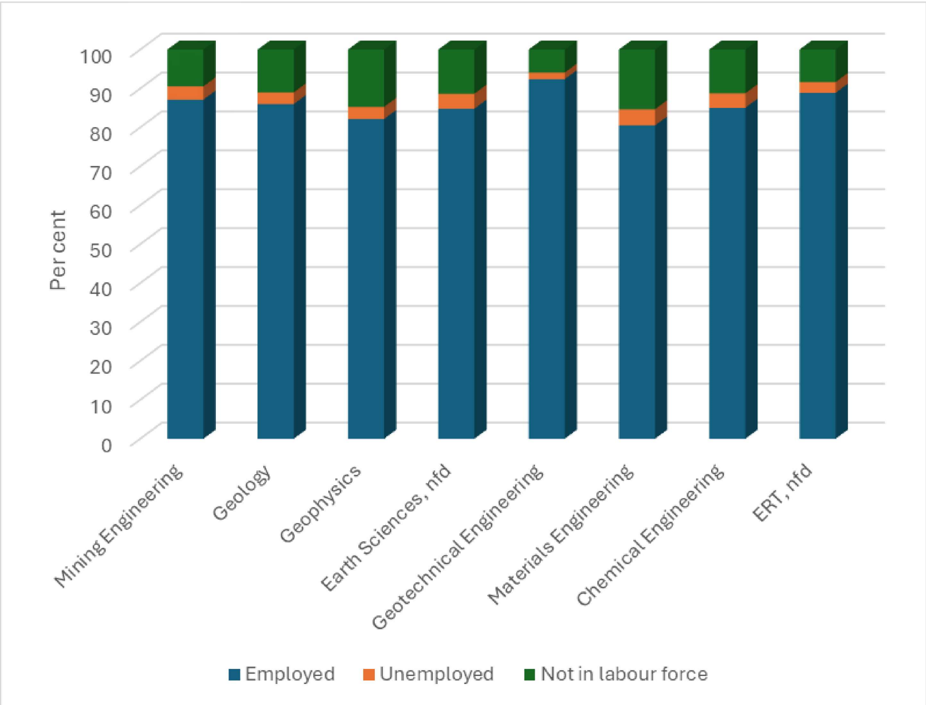


Notes: Number of employed persons: < 35 years=52,010; 35-49 years=59,380; 50+ years=32,890.

Mining graduates' labour force status

Looking at persons aged from 15 to 64 years, typically 80 to 90 per cent of university graduates with degrees in the eight key mining fields were in employment as of the 2021 Census (Figure 8). This ranged from a low of 80.5 per cent for materials engineering graduates to a high of 92.4 per cent for geotechnical engineering graduates. Unemployment rates for these graduates are relatively low, with most of those who were not in employment having left the labour force (meaning they were neither working nor actively looking for work).

Figure 8: Labour force status of mining graduates, persons aged 15-64 years, 2021



Notes: Total number of graduates aged 15-64: mining engineering 7,100; geology 12,460; geophysics 1,260; earth sciences-not further defined 2,560; geotechnical engineering 660; materials engineering 4,860; chemical engineering 14,160; ERT-not further defined 165,720.

Materials engineering graduates and geophysics graduates were the most likely to have dropped out of the labour force, with 15.3 per cent and 14.7 per cent respectively, not participating in 2021. Unemployment was relatively low for these graduates, with unemployment rates ranging from 1.8 per cent for those with degrees in geotechnical engineering, to 4.9 per cent for those with a degree in materials engineering[4]. Across these fields, there were typically 3 to 4 times as many non-participants as unemployed persons. Materials engineering graduates stand out as having the softest labour market conditions in 2021, with the highest proportions of persons unemployed (4.2 per cent) and not participating in the labour force (15.3 per cent). However, it is important to note that differences in labour force status may also reflect differences in the age profile of graduates.

The labour force status of graduates in mining fields is broadly in line with outcomes for university graduates aged 15-64 years overall. In 2021, across all fields, 85.9 per cent of working-age graduates were employed, with 2.9 per cent unemployed and 11.3 per cent outside the labour force.

Mining graduates and immigration

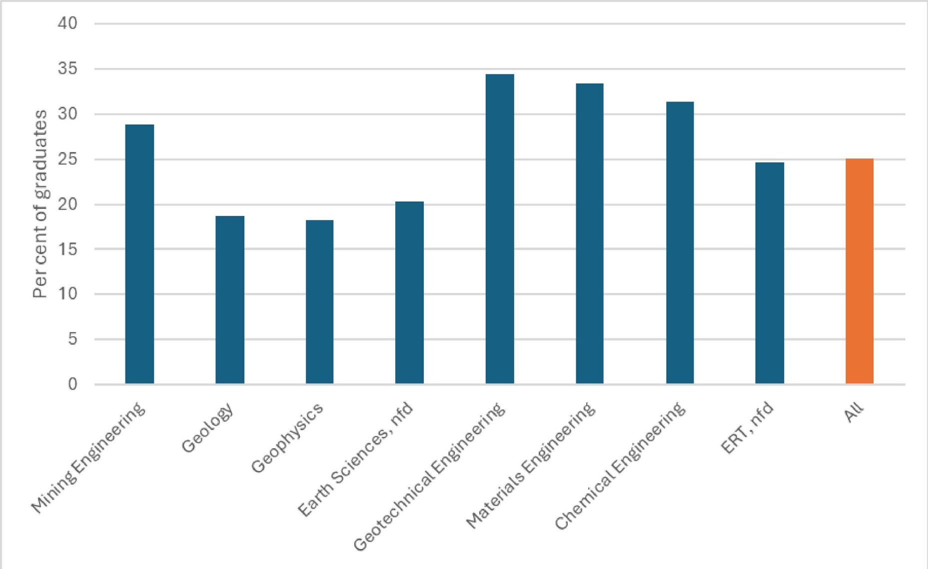
Across the eight mining aligned fields of study, 25 per cent of graduates in 2021 were not citizens of Australia. This was lower for geology and geophysics graduates at just under 20 per cent, and relatively high for several of the engineering fields, including geotechnical engineering (34.4 per cent), materials engineering (33.4 per cent), and chemical engineering (31.3 per cent - see Figure 9). By definition, these graduates will be immigrants, but data on visa categories (such as permanent or temporary residence status) are not available in the census data. They do not reflect the full contribution of immigration to the supply of mining professionals given the figures do not include immigrants who have subsequently become Australian citizens.

The major regions of origin for those graduates are Southern Asia (14,90 graduates), Chinese Asia (10,390), Maritime South-East Asia[5] (6,360), South America (3,640), the Middle East (2,490), and United Kingdom (2,470).

4 The unemployment rate is the number of unemployed persons expressed as a percentage of the sum of employed and unemployed persons. It does not take into account persons who are not participating in the labour force.

5 Includes island states of Soth East Asia, such as Indonesia, the Philippines, Singapore, Brunei, Malaysia and East Timor.

Figure 9: Proportion of mining graduates who are not Australian citizens: persons aged 15-64 years, 2021



Notes: Denominator includes citizenship not stated. Total number of graduates aged 15-64: mining engineering 7,130; geology 12,480; geophysics 1,260; earth sciences-not further defined 2,580; geotechnical engineering 670; materials engineering 4,840; chemical engineering 14,170; ERT-not further defined 166,020.

Aboriginal and Torres Strait Islander graduates

Very few working-age persons (15-64 years) holding mining related degrees reported being of Aboriginal or Torres Strait Islander descent in the 2021 Census. Across graduates from the eight core mining fields of study, just under 600 Indigenous persons were recorded among a total of almost 210,000 graduates, equating to 0.3 per cent. The highest rates of Indigenous representation were recorded for the fields of earth sciences-not further defined at 0.7 per cent, and geology at 0.5 per cent.

Indigenous representation among graduates across the key mining fields is lower than for all university graduates, which stood at 0.8 per cent for working-age persons in 2021.

It should be noted that there are well acknowledged limitations associated with the enumeration of Aboriginal and Torres Strait Islander people in the census (Colquhoun and Dockery 2012, Taylor 2006). One limitation relates to individuals' propensity to identify as being of Aboriginal or Torres Strait Islander descent (see Markham and Biddle 2018). Among 15-64 year olds in the 2021 Census, there were around one-and-a-half times as many people with Indigenous status recorded as 'not stated' as there were who positively identified as being of Aboriginal or Torres Strait Islander descent, making potential error margins around counts very large. Further, the census is known to undercount Indigenous persons, notably younger adults in more remote regions (Martin et al. 2002).

Potential sources of professional workers for the mining industry

The 2021 Census data presented above highlight a number of latent pools of workers with mining related skills who are not working within the mining industry. To illustrate the general magnitude of the supply of workers who could potentially be attracted to the resources sector, we consider graduates currently employed in other industries, graduates who are not in employment, and a potential increase in migrant numbers.

The labour supply implications for mining from the following changes are calculated for each of the eight mining-related fields:

1. Ten per cent of graduates currently employed in other industries are redeployed to mining. Given the possibility that workers in professional, scientific and technical services may already be servicing the mining industry, the supply response is calculated using two definitions of 'non-mining' workers: one including graduates working in professional, scientific and technical services and one excluding those graduates.
2. Ten percent of non-employed working-age graduates (aged 15-64 years) are attracted into mining. The non-employed include both those unemployed and not participating in the labour force.
3. A 10 per cent increase in the number of skilled migrants, based on the number of non-Australian citizens of working-age currently holding mining-related tertiary qualifications.

The results are presented in Table 13.

For each field of study, the largest potential pool of tertiary qualified workers is attained under the scenario in which workers are attracted from other industries. However, if we exclude the professional, scientific and technical services industry from the scope of 'other industries', on the grounds that many of those workers may already be servicing the mining industry, the 10 per cent increase in migration leads to the largest additional supply of workers with degrees in geology and in geotechnical engineering.

These potential sources of supply of mining professionals need to be assessed in light of the feasibility of each scenario. Immigration numbers under the skilled migrant category and identified priority occupations are largely determined by government policy. While attracting people currently out of work into employment in mining may seem viable, this offers a relatively small supply increase in terms of numbers and, as set out above, typically around two-thirds of those workers are not in the labour force, meaning they are not actively seeking work. Relative to existing levels of employment of graduates in mining, the pool of graduates who are not employed is largest for the fields of ERT-not further defined, chemical engineering, and materials engineering.

Table 13: Potential sources of supply of graduates: based on 2021 Census data

Supply source	Graduates in other industries		Non-employed	Immigration
Assumed supply increase to mining	10% of graduates redeploy to mining 2016		10% of non-employed graduates	10% increase in skilled migrants
	(a)	(b)		
Mining Engineering	300	202	91	206
	9.0%	6.0%	2.7%	6.1%
Geology	658	422	174	234
	13.8%	8.8%	3.6%	4.9%
Geophysics	80	50	22	23
	26.0%	16.2%	7.3%	7.5%
Earth Sciences-not further defined	161	112	39	52
	26.1%	18.1%	6.3%	8.5%
Geotechnical Engineering	52	16	5	23
	48.9%	14.7%	4.7%	21.5%
Materials Engineering	338	266	95	162
	50.6%	39.8%	14.2%	24.2%
Chemical Engineering	1,086	844	211	444
	91.7%	71.3%	17.9%	37.5%
Engineering & Related Tech-not further defined	13,630	9,693	1841	4092
	170.2%	121.1%	23.0%	51.1%
Total	**16,305**	**11,603**	**2,479**	**5,235**
	85.8%	**61.0%**	**13.0%**	**27.5%**

Notes: (a) based on the number of graduates employed in all other industries aside from mining; (b) based on the number of graduates employed in all other industries aside from mining and professional, scientific and technical services. Percentages are expressed as a proportion of existing mining employment of graduates in each field.

The scenarios indicate very large latent sources of workers with ERT-not further defined degrees. However, it is unclear how well their skills are matched to those required by mining professionals. In addition to needing to be induced away from existing jobs in other industries, many may require significant up-skilling or 'bridging' in order to meet the needs of mining employers.

This report does not include a scenario for increasing Aboriginal and Torres Strait Islander employment in the mining industry, although that is undoubtedly a very important goal in its own right. The data demonstrate that the proportion of Aboriginal and Torres Strait Islander (ATSI) individuals working in resources professions, as distinct from the overall ATSI workforce in mining, is lower than for the broader workforce. In practice, this tells us that there is an opportunity to support ATSI professionals in moving from trade and vocational employment (often project-specific) to more advanced professional careers and leadership roles. This reflects the imperative outlined in separate AusIMM research regarding ATSI participation and joint ownership in future mining and related manufacturing projects, delivering greater socio-economic impact compared to traditional (but meritorious) procurement and employment strategies.

Mining graduates and occupational match by gender

Focusing on all university graduates with degrees in one of the eight fields of study identified as strongly mining related, this section draws on the 2021 Census to assess occupational match. Figure 10 shows the proportion of employed male and female graduates in 2021 who were working in selected occupations.

The ANZSCO classification is structured such that the major classifications are in order of skill level, ranging from managers as typically the most highly skilled, followed by professionals, technicians and trades workers, and so on to labourers as the occupation requiring the lowest skill levels. The share of graduates employed in managerial occupations is reported as a single category. For professional occupations the shares employed in design, engineering, science and transport professional occupations are reported (labelled 'engineering professionals'), along with the share working as business professionals, education professionals, ICT professionals, and other professionals. The share in all other (lower skilled) occupations is included as a single category.

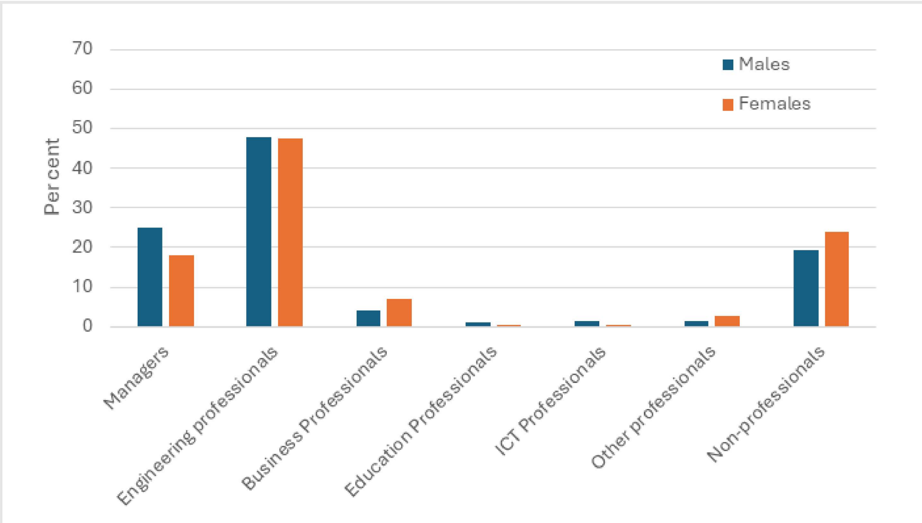
Broadly speaking, graduates who are employed as engineering professionals can be considered 'well-matched', along with those in managerial positions. Generally, a relatively high proportion of graduates are employed as engineering professionals, with the share ranging from around 74 per cent for geotechnical engineering graduates to around 27 per cent for materials engineering graduates. Graduates employed in non-professional occupations (which includes non-managerial positions) can be considered to be 'over-educated' in the sense that their level of qualification is higher than is normally required in their jobs. Graduates employed in other professions, such as business, ICT, or education professions, may well make extensive use of their tertiary education in those roles. They can be considered 'vertically' matched in terms of their level of education, but may face varying degrees of 'horizontal mismatch' in terms of the types of skills utilised.

There is a distinctive gender pattern for graduates across the mining-related fields of study. For all eight fields, a higher share of males than females had progressed to managerial positions in 2021, and a higher share were in 'well-matched' engineering professional occupations. In all fields, a higher share of female workers than males were employed in jobs for which they are over-qualified, with the exception of geotechnical engineering graduates.

Geotechnical engineering appears as the field with the most equitable distribution of employment by gender across occupations. A high proportion of working male (74.1 per cent) and female (73.1 per cent) graduates were employed in a professional engineering occupation, with similar proportions by gender in managerial roles (14.1 per cent of males versus 12.5 per cent of females). Mining engineering graduates also display similar proportions employed as professional engineers by gender (47.8 per cent of men, 47.4 per cent of women), but substantially more male graduate progressed to managerial occupations.

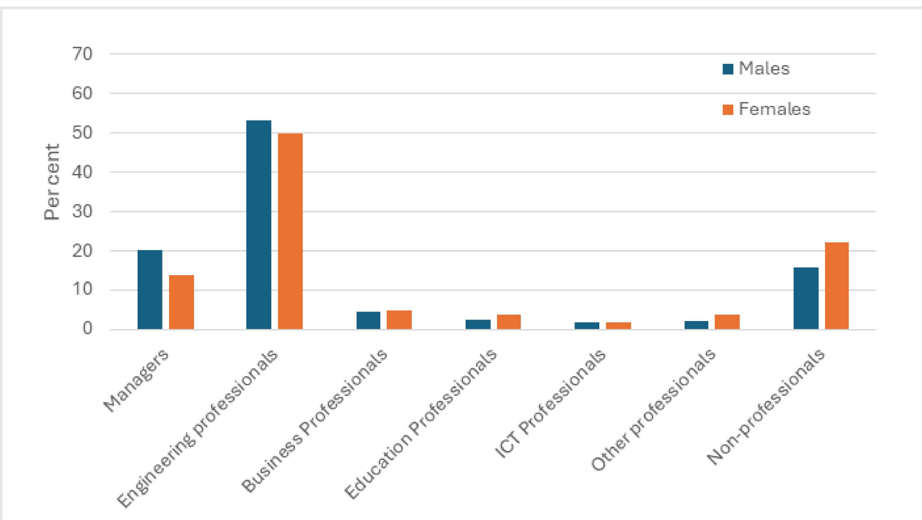
Figure 10: Graduates' share of employment by occupation and gender; 2021[6]

(a) Mining engineering graduates



Notes: Number of employed persons: males=5,695; females=763.

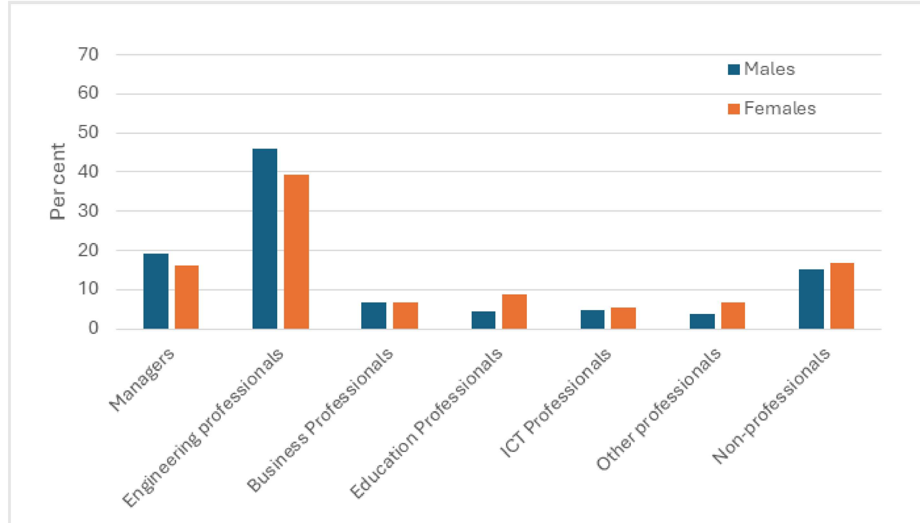
(b) Geology graduates



Notes: Number of employed persons: males=8,387; females=3,164.

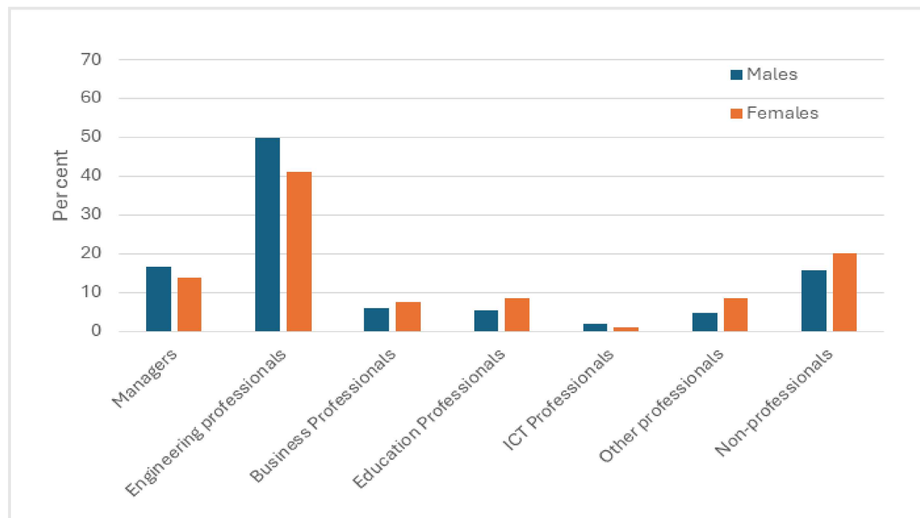
Figure 10: Graduates share of employment by occupation and gender, 2021 (continued)

(c) Geophysics graduates



Notes: Number of employed persons: males=938; females=204.

(d) Earth sciences-not further defined graduates

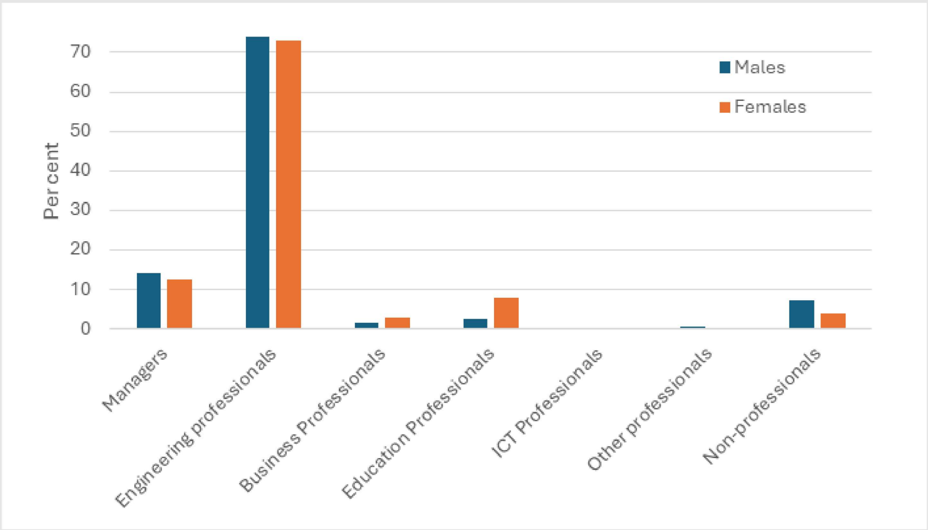


Notes: Number of employed persons: males=1,515; females=735

6 Engineering professionals include design, engineering, science, and transport professionals. Business professionals include business, human resource, and marketing professionals. Other professionals include arts and media professionals; health professionals; legal, social and welfare professionals; and professionals-not further defined. Non-professionals include technician and trades workers; community and personal service workers; clerical and administrative workers; sales workers; machine operators and drivers, and labourers.

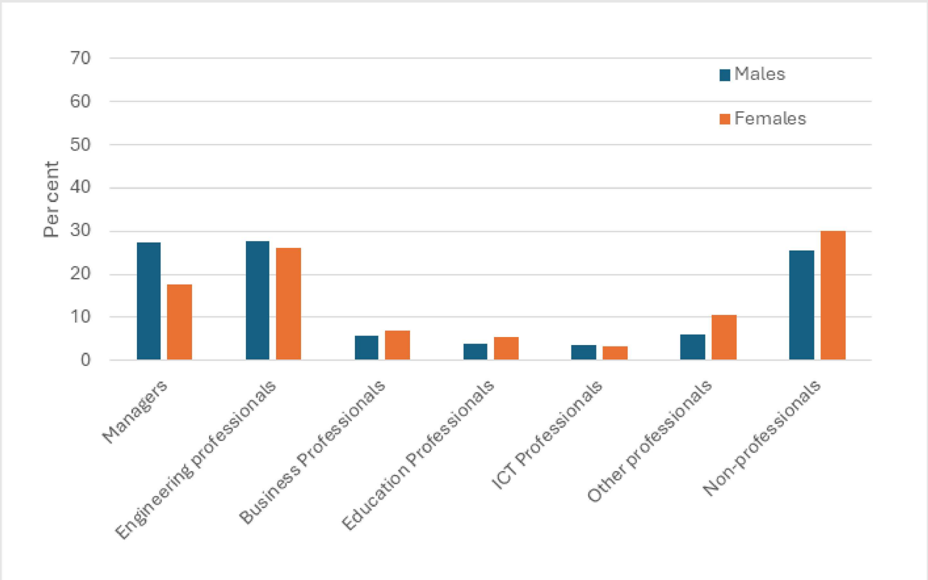
Figure 10: Graduates share of employment by occupation and gender, 2021 (continued)

(e) Geotechnical engineering graduates



Notes: Number of employed persons: males=525; females=104.

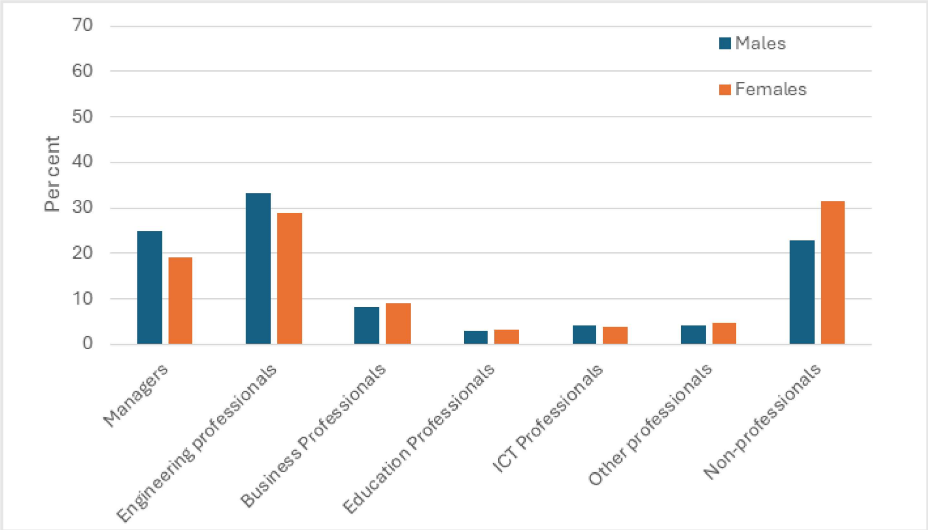
(f) Materials engineering graduates



Notes: Number of employed persons: males=3,323; females=879.

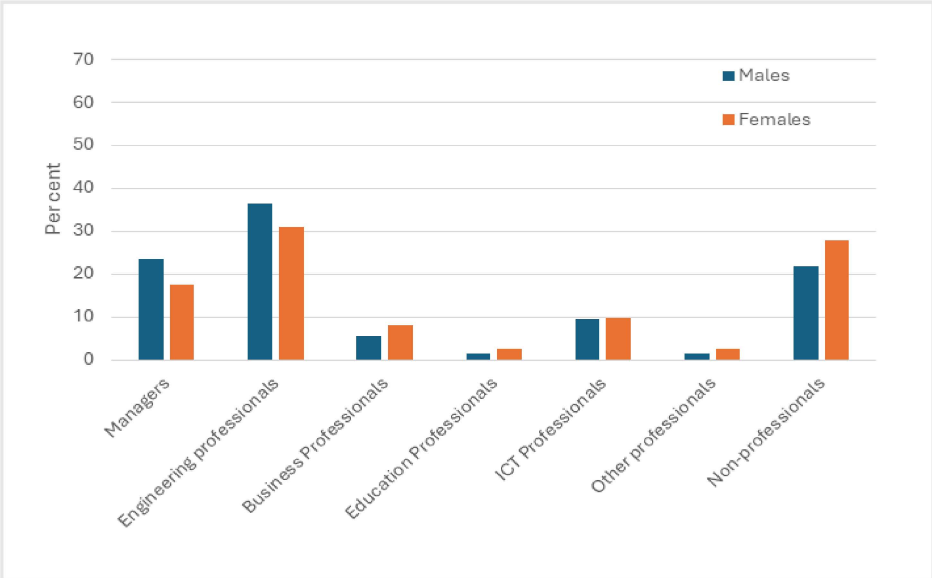
Figure 10: Graduates share of employment by occupation and gender, 2021 (continued)

(g) Chemical engineering graduates



Notes: Number of employed persons: males=8,342; females=4,086.

(h) Engineering and related technologies-not further defined graduates



Notes: Number of employed persons: males=126,350; females=24,237.

Earth sciences-not further defined graduates have the largest gender gap in the proportion of persons employed as a professional engineer (8.8 percentage points lower for female graduates). The proportion of graduates who are over-educated for their jobs is highest for females with chemical engineering degrees at 31.5 per cent, 8.6 percentage points higher than the proportion for males. Working in a non-professional job is also quite common for female ERT-not further defined graduates (28.0 per cent, 6.2 percentage points higher than for males).

Summary

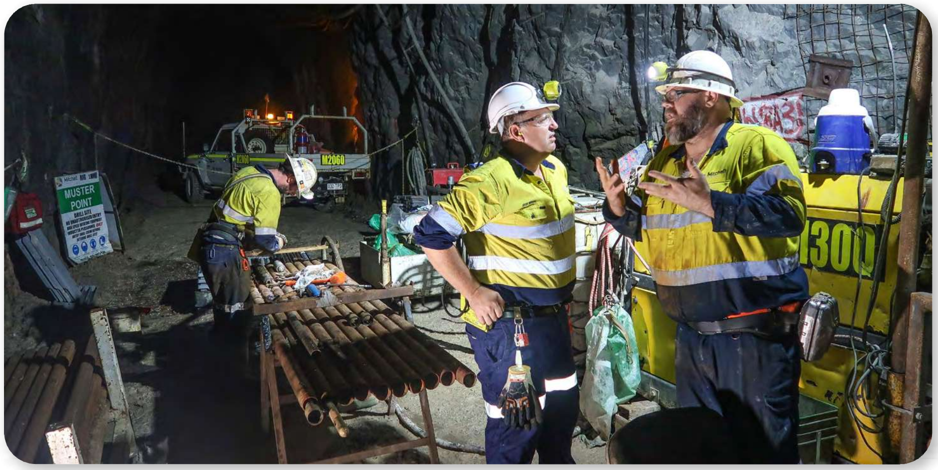
Projections from a formal computable general equilibrium model of the Australian economy, as well as simple extrapolation of current trends, indicate demand for key skilled workers in the resources sector is likely to grow strongly in coming years. Existing trends suggest this growth will occur mainly in the mining industry, and JSA's projections for stronger growth in resource-aligned manufacturing than in the mining sector itself would require a major turnaround from recent trends and seem contrary to emerging economic fundamentals. In our assessment, Jobs and Skills Australia projections for employment in resource-aligned manufacturing are optimistic, and we expect employment in the mining sector to continue to outgrow employment in downstream processing activities.

Given the expectation of ongoing robust demand for key mining professionals, available data point to a concerning decline in new graduates from mining related fields, notably since 2016. This includes falls in graduates from mining engineering courses and graduate geophysicists, and little growth in the supply of geology graduates.

Aside from boosting training rates, the major alternative source of mining professionals would appear to be the attraction of existing qualified workers from other industries. In all fields of speciality, degree qualified workers tend to drift out of direct employment in the mining industry and into jobs in alternative industries as they age. Professional, scientific and technical services is the major competing industry for most mining professionals along with manufacturing in the case of chemical engineering and materials engineering graduates.

Immigrants make up a significant share of the pool of graduates in mining related fields of study, and particularly in engineering fields (geotechnical, material, chemical, and mining engineering). Increased migration offers a further avenue to increase the supply of professionals to the mining industry.

There is a very large pool of workers with university degrees classified as engineering and related technologies-not further defined, and therefore with unknown areas of speciality. Through tailored courses, some of these graduates may potentially be upskilled to meet the skill needs of the mining industry. A further potential source of professionals which has not been investigated is the upskilling of persons who hold related technical qualifications at the diploma or Certificate III/IV level.



Working life in the resources sector: Evidence from HILDA

The Household, Income and Labour Dynamics in Australia Survey (HILDA) is Australia's first nationally representative household panel survey. The panel was established in 2001 through surveys of a random sample of private households in Australia, and within those households all persons aged 15 and over are interviewed (see Watson and Wooden, 2010). People from the families in those households are followed up and surveyed annually, with the tracking designed to allow the sample to grow in line with household formation and dissolution. For example, if a young adult from an initial HILDA household partners and moves out of home to form a new household, that new household comes within the scope of the survey. Around 13,000 individuals from over 7,000 households have responded each year, with year-on-year attrition rates averaging below 10 per cent.[7] In 2011 an additional top-up sample of 2,153 households encompassing 4,009 responding individuals was recruited to the survey sample (HILDA Survey Annual Report, 2012), largely to rebalance the sample to represent recent migrants to Australia who are not captured through natural sample evolution. At the time this report was compiled, 23 waves of HILDA data were available, collected in surveys spanning from 2001 to 2023.

For employed persons, HILDA collects extensive information about their jobs, covering both objective data and subjective data on people's attitudes about their working lives. This is supplemented by a wealth of data on respondents' demographic characteristics, their personal and family circumstances, and their labour force history. Coupled with the panel nature of the data, this makes HILDA a unique and powerful tool for addressing research questions relating to the Australian labour market.

The industry coding for employed persons in HILDA allows respondents to be matched to the resources sector as per the definition set out in Table 1. Around 250 respondents reported being employed in the resources sector in the early years of HILDA, peaking at 352 in 2011, and around 300 each year in recent waves.

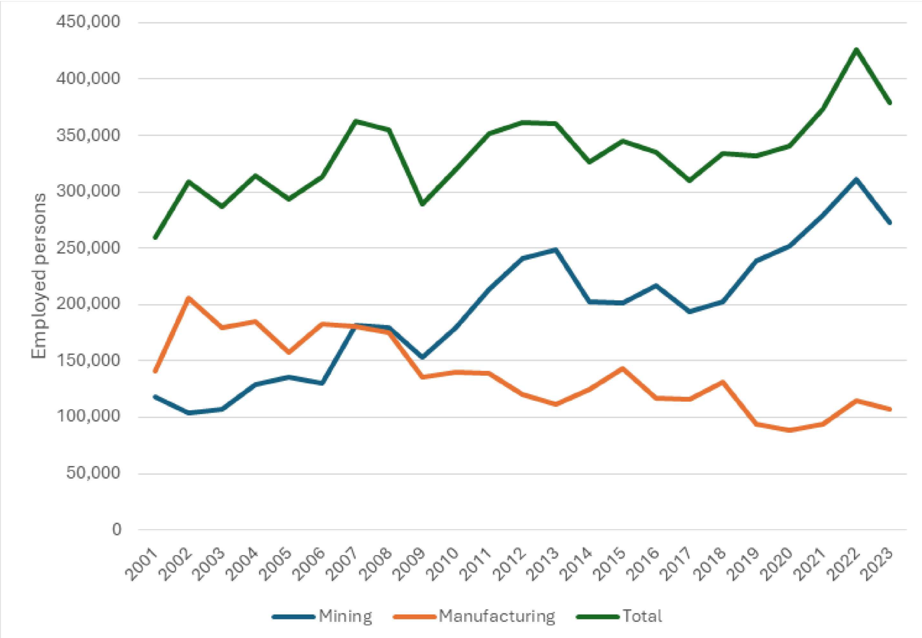
In total there are just over 6,500 observations on resource sector workers across the 23 waves. The proportion of those respondents employed in mining as opposed to resource-aligned manufacturing has risen from less than half initially to now nearing 75 per cent.

The HILDA data also provide a range of weights for households and individuals that allow population estimates to be generated from the sample frequencies. Using the responding person weights, Figure 11 shows trends in the estimated number of workers nationally in the resources sector. The rising share of the sector's workers employed directly in mining is plain to see. The HILDA estimates indicate that the resources sector employs around 3 per cent of all workers in the Australian economy, a share that has been roughly constant across the waves from 2001 to 2023. Unless otherwise stated, reported figures based on the HILDA data in the remainder of the report are based on population estimates using the responding person weights.[8]

7 See http://www.melbourneinstitute.com/hilda/ for further details

8 Weights are not used in the regression models.

Figure 11: Employment in the resources sector, 2001-23, HILDA



Notes: Population estimates derived using HILDA's responding person weights. Manufacturing refers to activities aligned to the resources sector (see Table 1), not all manufacturing.

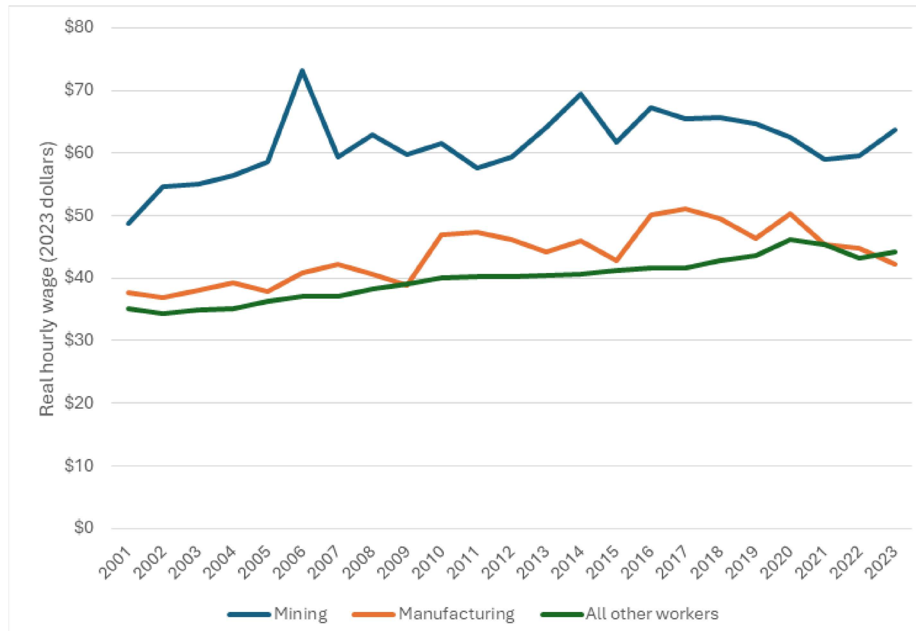
The estimates from HILDA confirm the gender imbalance in the resources sector workforce, with females comprising 16 per cent of workers in the pooled data, and only minimal evidence of any upward trend over time.

Earnings and wage determination

The HILDA data can be used to compare the wages of workers in the resources sector to other workers, as well as the processes of wage determination in the sector. The measure of wages used is the real hourly wages of workers, defined as their usual weekly gross earnings divided by the number of hours usually worked per week, with the amount adjusted by the Australian consumer price index to be expressed in real 2023 dollars.

Looking only at the raw means, workers in mining earn significantly higher wages than workers outside the resources sector, while the hourly wages of workers in the resource-aligned manufacturing sector are on par with those of other workers (see Figure 2). Although there is some year-to-year volatility in the estimates for the sub-sectors due to smaller sample sizes, mining industry employees have typically earned 50 per cent higher hourly wages than workers outside the resources sector, and that wage differential has remained relatively constant over time.

Figure 12: Average real hourly earnings: 2001-2023



Notes: Estimates derived using HILDA's responding person weights. Manufacturing refers to activities aligned to the resources sector (see Table 1), not all manufacturing.

These raw differences in average wage rates don't allow for potential differences in the characteristics of workers in each sector, such as their age and level of education. The rich set of background data on individuals and their jobs available in HILDA allows us to rigorously control for a wide range of observable characteristics. The panel nature of HILDA also enables us to control, to some extent, for unobserved individual characteristics, thanks to being able to observe how the wages of one individual change as their employment circumstances change.

The standard approach in labour economics to analysing differences in wages is to estimate wage equations, in which the log of wages is estimated as the dependent variable in a linear regression model.[9] This framework allows us to make a more valid comparison between the earnings of workers in different sectors and with different characteristics, but also to investigate differences between sectors in how factors affect wages. For example, is the gender wage gap or the return to higher qualifications similar in the resources sector as in the wider labour market?

Resource sector wages

The detailed regression results can be found in Table 17 of the Appendix. An initial model is estimated using the pooled sample of all employed persons observed in HILDA from 2001 to 2023 (model 17.1). The model is estimated as a panel model using the random effects specification and with the log of real hourly wages as the dependent variable. Explanatory variables included in the model include a dummy variable indicating whether the worker is employed in the resources sector, along with controls for workers' personal characteristics such as gender, age, and level of qualification. The estimated coefficient associated with being employed in the resources sector in this model is 0.17, which can be interpreted as resources sector workers receiving 17 per cent higher hourly wages than 'like' workers in other sectors.

If variables are included separately in this model for the sub-sectors of mining and resource-aligned manufacturing, the estimated wage premium associated with working in the mining industry is 24.8 per cent, and 7.2 per cent in resource-aligned manufacturing (both statistically significant at the 1 per cent level).

A range of additional control variables are added relating to workers' jobs, including occupation at the ANZSCO major category, contract status, part-time status, union membership, and tenure with current employer (Model 17.2). Even including this extensive range of characteristics, the premium associated with employment in the resources sector remains relatively unchanged at 16 per cent (24.8 per cent and 6.4 per cent, respectively, if the mining and manufacturing sub-sectors are included separately).

The results for other variables are in line with well-established influences on wages. A gender wage gap in the order of 10 per cent is observed for women despite the range of controls. Wages peak in the broad age range of 45-65 years, while wage penalties are observed for people with a disability and who were born overseas in a non-English speaking country. Migrants from one of the main English-speaking countries are in fact estimated to earn 5 per cent higher hourly wages than Australian-born workers. Holding a higher qualification is associated with higher earnings, notably university level qualifications, and part of that effect is captured in occupational sorting. Married workers also earn more than their single counterparts. Positive premiums in hourly wage rates are observed for workers who work part-time (8 per cent), union members (5 per cent), who work through a labour hire firm (8 per cent), and have supervisory duties (4 per cent).

9 Statistical inference in the standard linear regression model is based on the assumption that the dependent variable is normally distributed. Wage distributions tend to be highly skewed, with a long upper tail of higher wage earners, whereas the log of wages approximates a normal distribution.

Wage determination

To investigate differences in how personal and job characteristics affect wages in the resources sector relative to the wider labour market, the wage equations were estimated separately for the resources sector and for other workers. This allows the estimated coefficients to vary by sector. In the initial model for example, we observed that women receive around 9 per cent lower wages than men after controlling for individual characteristics, and 12 per cent lower wages if a more extensive set of employment related controls are included. However, the gender wage gap may not be the same within the resources sector, and estimating the model on separate samples allows that coefficient to take on sector specific values. Those regression results are also reported in Table 17 of the Appendix. Results for the model including only individual characteristics for the resources sector and non-resource sector workers are reported in models 17.3 (resource sector) and 17.4 (all other workers), and respective models with the expanded set of job-related controls in models 17.5 and 17.6.

The estimates show that the resources sector has a more pronounced gender wage gap than other sectors. The female 'penalty' is estimated at 20 per cent if only controls for personal characteristics are used, dropping to 18 per cent when controls for job characteristics are added. The fact that the gender penalty falls with the addition of job controls suggest that women are also disproportionately selected into lower paying roles in the resources sector, since those controls account for some of the wage gap. The addition of job-related controls has the opposite effect in the rest of the labour market, leading to a marginal increase in the estimate of the gender wage gap (from 9 per cent to 11 per cent).

A further stark difference is the very high rate of return to education for resources sector workers. The estimates show that relative to someone who has completed Year 12[10] but with no higher post-school qualifications, holding Certificate III/IV or higher qualifications is associated with much larger increases in wages for resource sector workers (see Appendix Table 17, models 17.3 and 17.4).

The return to holding a Certificate III/IV level – often a trade qualification – is 12 per cent for resource sector workers, while for other workers wages are typically lower than those of a Year 12 graduate by 2 per cent.

Resource sector wage premia for those with diploma graduates, bachelor degrees, and postgraduate degrees are 14 per cent, 32 per cent, and 58 per cent, respectively. These compare to 6 per cent, 20 per cent and 30 per cent for other workers. The higher returns to post-school qualifications are in fact accentuated with the inclusion of the extended controls for job-related characteristics. This suggests it is not just a result of higher qualifications providing entry into higher wage jobs in the resources sector, but they also result in higher wages within 'like' jobs.

The results for age variables indicate the earnings trajectory over the life course in the resources sector is quite typical of the general labour market. The effects of country of birth, marital status, and the presence of young children are also quite similar. For the general labour market wages are typically higher for people living in the major capital cities, but no such penalty is observed for resources sector workers who live in the regions.

Compared to other sectors, the occupational wage structure in the resources sector appears to be more favourable for technician and trades workers, sales workers, and drivers and machine operators; but offer lower wages for community and personal services workers. There is also a greater hourly wage premium for working part-time although, as noted above, part-time opportunities are much more limited in the resources sector. Working through a labour hire company is associated with around 9 per cent higher wages in the wider labour market, but no such premium is observed for resources workers. Wage effects associated with contract status, union membership, tenure with the current employer, and having supervisory responsibilities are otherwise broadly similar.

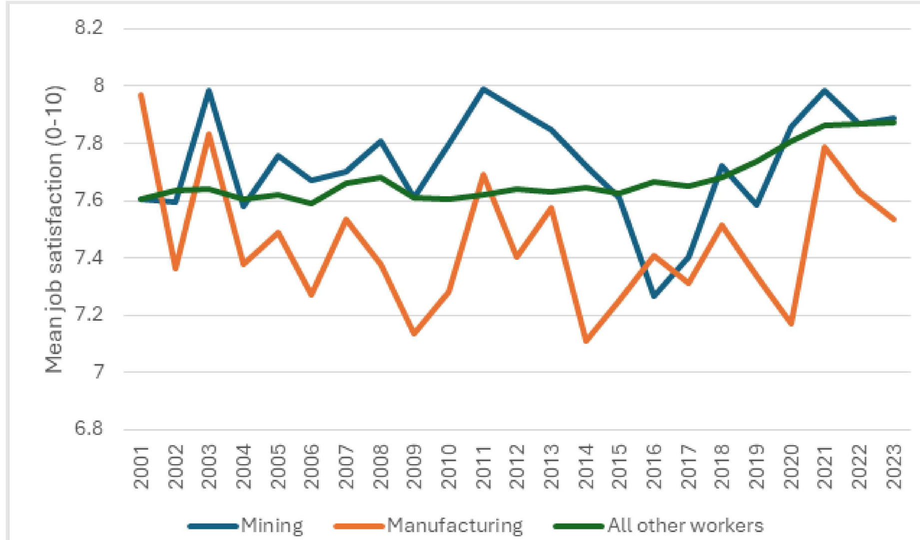
10 HILDA classifies completion of Year 12 as a higher qualification than a Certificate Level I/II. Hence some workers classified in the Year 12 or 'did not finish school' categories may also have completed Certificate I or II qualifications.

Job satisfaction

In each wave of HILDA, the survey has asked people who are employed to rate how satisfied they are with a number of aspects of their job, before asking 'All things considered, how satisfied are you with your job?'. Responses are recorded on an 11-point scale ranging from 0 (totally dissatisfied) to 10 (totally satisfied). The other aspects of their job respondents are asked to assess are their satisfaction with their total pay, job security, the work itself (or 'what you do'), hours worked, and the flexibility to balance work and non-work commitments.

Responses on the scale for overall job satisfaction tend to be tightly clustered around a modal response of 8 on the 0 to 10 scale. In the pooled data for all workers, almost three-quarters of responses lie between 7 and 9, inclusive. Therefore differences in mean satisfaction between groups tend to be very small in a numerical sense. Again looking at the pooled data, but using responding person weights, the mean response for resources sector workers was 7.62, marginally lower than the 7.68 for workers in other sectors, and the difference is statistically significant.[11] Within the resources sector, average job satisfaction was higher in the mining sector (7.75) than in aligned manufacturing jobs (7.45). As shown in Figure 13 there is considerable year to year volatility in the estimates, but over the past 23 years average job satisfaction in mining has typically been higher than for workers outside the resources sector, while in the resource-aligned manufacturing sector average job satisfaction has typically been lower than for other workers.

Figure 13: Mean job satisfaction, HILDA, 2001-2023



Notes: Estimates derived using HILDA's responding person weights. Manufacturing refers to activities aligned to the resources sector (see Table 1), not all manufacturing.

As with wages, it is possible to estimate multivariate regression models of job satisfaction to control for differences in the characteristics between workers in the resources sector and those in other jobs, such as age, gender, or level of education. In this case workers' ratings of their job satisfaction constitute the dependent variable, and we model satisfaction using a simple linear regression, with the full results reported in Appendix Table 18.[12]

Initially the models are estimated with control variables for the sector of employment and workers' personal characteristics (models 18.1 and 18.2), with the expanded set of controls relating to employment characteristics added in models 18.3 and 18.4.

11 The difference in means is significant at the one per cent level using the standard t-test and responding person weights.

12 The ordered, categorical nature of the dependent variable lends itself to estimation by the ordered probit model rather than by linear regression. A linear model assumes the scale is cardinal so, for example, the 'distance' between ratings of 4 and 5 is treated the same as the 'distance' between ratings of 7 and 8, when it is clear from the distribution these do not represent equivalent shifts in satisfaction. The ordered probit model does not impose that restriction, instead modelling the probability of individuals making higher rather than lower ratings. However, previous literature has demonstrated results are qualitatively very similar whether the models for such scales are estimated by linear regression (ordinary least squares [OLS]) or the more technically correct ordered probit specification. The OLS model is preferred here as the results are much more straightforward to interpret.

The modelling approach exploits the fact that there are repeat observations on individuals to partially control for unobserved individual effects. The linear wave variable is not included as, unlike real wages, there is no reason to expect a time trend in job satisfaction.

The coefficient on the dummy variable capturing employment in the resources sector in the initial model is small and only weakly significant (β=0.06, p<0.10). This indicates that workers in the resources sector are marginally more satisfied with their jobs than similar workers in other sectors. If the resources sector variable is expanded to differentiate between employment in mining and employment in aligned manufacturing, it becomes clear that this result is entirely due to the higher job satisfaction of workers in mining (β=0.12, p<0.01). Job satisfaction in resource-aligned manufacturing is insignificantly different to that for workers outside the resources sector.

The estimates for the sector overall and the two sub-sectors remain unchanged with the addition of job-related control variables. So the higher satisfaction in the mining sector applies to both comparable individuals and to comparable jobs, including within the same occupations. Job satisfaction increases modestly with hourly earnings, which will contribute to higher job satisfaction in the highly paid mining sector. However, the higher reported job satisfaction in the mining sector appears to be due to factors over and above what can be attributed to earnings, given the full models control for workers' real hourly wage (models 18.3 and 18.4).

The sources of differences in overall job satisfaction can be explored by running equivalent models for workers' ratings of their satisfaction with individual job domains: pay, security, hours worked, flexibility, and the nature of the work itself.

Key estimates from these models, summarised in Table 14, suggest higher satisfaction of resource sector workers is primarily a result of higher pay compensating for other negative attributes of their jobs. Of the job aspects covered, pay is the only one that resource sector workers appear more satisfied with when compared to other workers, and this applies only to mining.

Employment in mining is otherwise associated with relative dissatisfaction with job security, flexibility to balance work and non-work commitments, and the actual nature of the work (although the latter estimate is only weakly significant). However, the fact that mining workers are estimated to be more satisfied in models controlling for the hourly wage rate suggests there is some other non-pecuniary aspect of jobs in the industry that workers value. Workers employed in resource-aligned manufacturing sectors are relatively dissatisfied with their job security and with 'the work itself'.

Table 14: Effects of employment in the resources sector on satisfaction with individual job aspects, HILDA Waves 1-23

	Satisfaction with … (0=totally dissatisfied, 10=totally satisfied)				
Employment in	**Your pay[a]**	**Job security**	**Hours you work**	**Flexibility[b]**	**The work itself**
Resources sector	0.410***	-0.258***	-0.057	-0.123***	-0.061*
Sub-sectors:					
Mining	0.699***	-0.345***	-0.062	-0.216***	-0.021
Manufacturing	0.071	-0.156***	-0.051	-0.012	-0.107**

Notes: Random effects models with robust standard errors, *** p<0.01, ** p<0.05, * p<0.1. a. hourly wages are not included in the model of satisfaction with pay; b. the survey question relates to flexibility to balance work and non-work commitments.

Retention and turnover

We look at three dimensions of worker retention - or its flipside, worker turnover: retention in the one industry category, retention within an occupation, and the time workers have remained with the same employer. Turnover can be counter-productive because of the loss of skills and knowledge a worker has accumulated that is specific to their craft, firm, or sector; and the often high cost of recruitment to replace workers and train new staff.

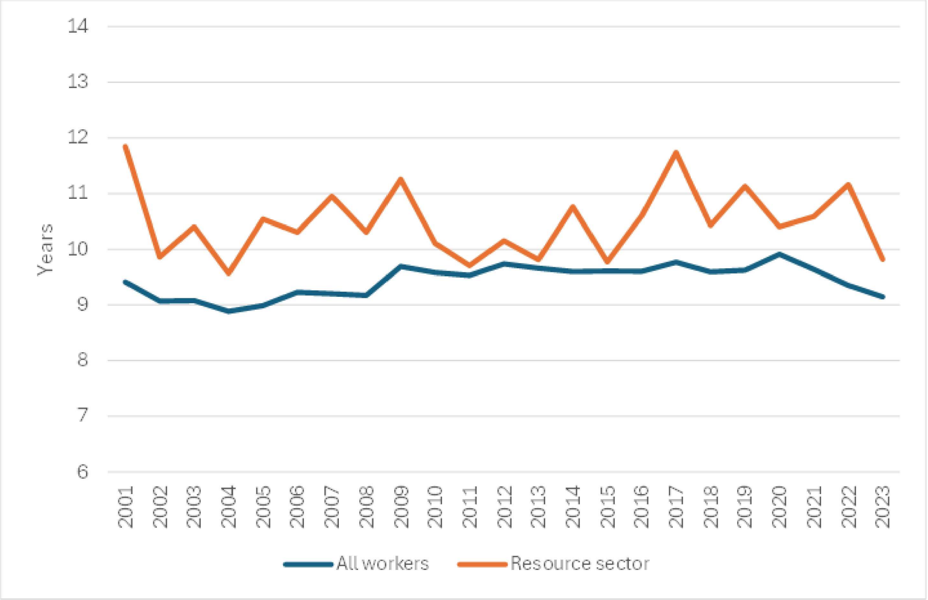
The HILDA survey asks individuals how long they have been working in their current occupation and how long they have been with their current employer. Based on the pooled data, workers in the resources sector report having worked in the same occupation for 10.5 years, higher than the 9.5 years for all workers in total. Figure 14 shows this higher occupational retention in the resources sector has been a relatively permanent feature since the turn of the century, with no obvious time trend. Typically, occupational longevity has also been notably higher in the manufacturing sector than in the mining industry, although smaller sample sizes make the estimates more volatile.

In terms of tenure with their current employer, Australian workers had typically been with the same firm for 6.2 years over 2001-2023, and again retention is higher in the resources sector at 7.2 years. That longer retention is again due to workers in the resource-aligned manufacturing industries, with durations in the mining industry lower than the economy wide average. Figure 15 shows that average job duration in the resources sector has been steadily declining in recent decades to converge with that of workers overall. Separate estimates show this has been due primarily to falling average duration in the mining industry, but compositional change may also have contributed given the declining share of manufacturing workers relative to mining workers within the resources sector

Differences in these average durations between sectors and changes over time may not be a direct reflection of turnover. For example, a sector which is growing rapidly may display falling average duration because of the shorter tenure of the new entrants.

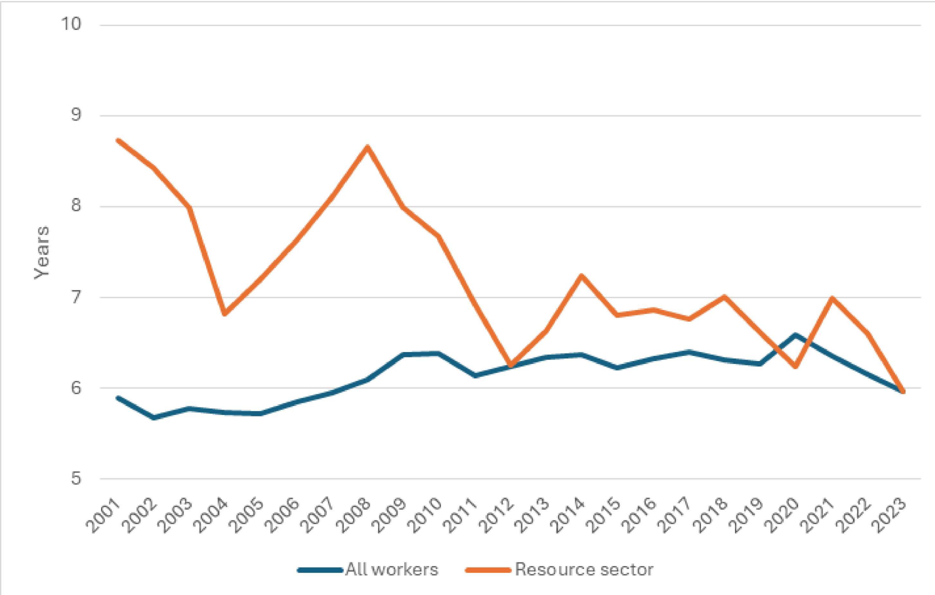
They may also be affected by compositional differences, such as age and gender. To assess retention in the resources sector in more detail, multivariate models of turnover are estimated using panel data from the 23 waves of the HILDA survey. To do this, we take individuals in employment in one year (year t) and model the probability that they have left that job or occupation in the following year (year t+1). To identify how characteristics of individuals, jobs, and workplaces are associated with turnover, relevant variables measured in the initial year (time t) are included in the model as predictors of the outcome (turnover) the following year.

Figure 14: Time in current occupation (mean) by sector: HILDA 2001-2023



Notes: Estimates derived using HILDA's responding person weights.

Figure 15: Time with current employer: HILDA 2001-2023



Notes: Estimates derived using HILDA's responding person weights.

Industry turnover

We commence by looking at the retention of workers within the resources sector, based on an individual's sector of employment as observed in consecutive years. For the pooled data on employed persons from 2001 to 2022, 73 per cent of workers were observed to be working in the same major industry category from one year to the following year. The corresponding 27 per cent annual industry turnover includes workers who were employed in a different industry category in the following year, along with those who were no longer employed. Industry turnover has declined over the duration of the HILDA panel, holding steady at around 30 per cent from 2001 to 2008, before falling to around 24 per cent in recent years, suggesting a fall in worker mobility.

In terms of individual industry sectors, wholesale trade (48 per cent p.a.) and administrative and support services (46 per cent p.a.) display the highest turnover rates, with almost half of workers leaving the industry each year, while health care and social assistance records the lowest turnover (15 per cent p.a.). Mining (29 per cent) and overall manufacturing (30 per cent) are estimated to have relatively typical annual industry turnover rates. However, taking the resources sector as a whole, annual worker departures from the sector are relatively high at 34 per cent. This is a result of the high rates of departure from the resource-aligned manufacturing sector, estimated to average 46 per cent per annum over the HILDA panel.

The estimate of high turnover from the resource-aligned manufacturing sector is not strictly a fair comparison to other industries. Since it is defined at a combination of 2-digit, 3-digit, and 4-digit industry classifications there is scope for workers to transition into other manufacturing classifications, movements which would not be counted as industry turnover at the more aggregated level. To account for this, and to control for other individual and workplace characteristics that may affect turnover, we estimate multivariate models of the probability of a worker leaving their major industry category of employment from one year to the next. Full results of the regressions are reported in Appendix Table 19.[13]

The model is estimated first with only dummy variables capturing employment in the mining industry and in the resource-aligned manufacturing sectors, plus a time trend among the control variables (model 19.1). This indicates turnover from the mining industry is quite low, and turnover from resource-aligned manufacturing is not significantly different to that in other industries. The high rate of turnover from those minor industry categories (noted above), therefore appears to be associated with movements to other manufacturing sub-sectors, rather than workers exiting the major industry category of manufacturing.

The lower rate of industry turnover in mining can largely be accounted for by differences in the demographic profile the workforce. Industry turnover is highest for workers in the younger and older age groups, and lowest for workers aged 45-54 years. It also decreases with workers' level of educational attainment. Job characteristics further account for some of the lower turnover from the mining industry.

13 Technically, a logistic regression model is estimated in which the dependent variable is the log of the odds that the worker is observed to change industry.

Turnover is higher among workers on casual contracts and who work part-time, which is relatively less common in the mining industry. Industry turnover from either the mining or resource-aligned manufacturing sectors is not significantly different from that in the wider labour market once both workers' characteristics and job characteristics are taken into account.

While the resources sector is not unusual in terms of the overall degree of industry turnover, there are some stark differences in the way individual and job characteristics affect turnover (see models 19.3 and 19.4). In terms of demographic characteristics, there are large differential effects of gender and age. Outside of the resources sector, women are significantly less likely to leave their industry of employment than males. In contrast, in the resources sector, women are much more likely to move to another industry. Not only is the resources sector male dominated, but female workers who enter tend not to remain very long. On average, 28 per cent of male workers leave their industry each year, and this rate is the same in the resources sector and in other sectors, and marginally lower for women in other sectors (26 per cent). For women in the resources sector, however, the rate is 35 per cent per annum. The multivariate results indicate this higher turnover for women in resources cannot be accounted for by other demographic differences, such as age or level of education (see model 19.4, Table 19).

Turnover by workers' level of education is another marked difference in the pattern of industry turnover. In the rest of the labour market, the likelihood of changing industry steadily falls with level of education, and is lowest for those with postgraduate qualifications, followed by those with a bachelor's degree. The opposite is observed for the estimates within the resources sector. Although differences by education level are not statistically significant for workers in the resources sector, the absence of any significant relationship still implies, in relative terms, an issue with the retention of more highly skilled workers in the resources sector.

In the wider labour market, workers employed through a labour hire firm have higher industry turnover, but this does not hold for the resources sector. Being self-employed also has contrasting effects: associated with a significant increase in the likelihood of changing industry for workers in the resources sector, but a reduction in industry turnover in the wider labour market.

Firm turnover

In each HILDA survey from Wave 2 onwards, persons who were employed at the time of the survey and in the previous wave are asked whether or not they are still working for the same employer. We analyse those responses conditional upon the worker's sector of employment in the initial year. Overall, the proportion of workers who report changing employer since the previous year is 14.2 per cent and is very similar in the resources sector (13.1 per cent) as for all workers (14.3 per cent). Multivariate models confirm no significant differences in firm separation rates for workers from the mining sector or the resource-aligned manufacturing sector compared to other sectors after controlling for workers' demographic characteristics (see Appendix Table 20).

The effects of individual and job characteristics on firm separations are more homogenous between the resources and non-resources sectors than is the case for industry turnover (models 20.3 and 20.4). Again, women are observed to be significantly less likely to leave their employer than men in the wider labour market. This is not the case in the resources sector, where they are more likely to depart, with the estimate not quite significant at the 10 per cent level. Workers become less likely to change employers as they age, and this effect is stronger outside of the resources sector with the differences particularly pronounced for workers aged 65 years and over. Hence, older workers who do remain in the labour force are relatively more likely to change employers if they are in the resources sector.

Holding one of the relatively rare part-time positions in the resources sector is associated with a substantially lower chance of leaving a current employer, an association which is not observed in the wider labour market.

Workers who changed employers were also asked the main reason for leaving their previous job. As shown in Table 15, the main reasons given are quite similar for those who left employers in the resources sector and other workers. Being laid off or made redundant was more common for resource sector workers, while leaving due to dissatisfaction with the job is marginally less common for workers in the resources sector.

Table 15: Main reason for changing employer - HILDA Waves 2-23

	Resources sector	Other workers
To obtain a better job/Just wanted a change/To start a new business	31.3	33.5
Not satisfied with job (e.g. unhappy with hours, pay, working conditions, etc.)	25.7	30.2
Laid off/No work available/Retrenched/Made redundant/Employer went out of business/Dismissed	27.3	16.0
Job was temporary or seasonal/Holiday job	5.4	5.4
Too much travel time/Too far from public transport	1.3	1.8
Returned to study/Started study/Needed more time to study	0.0	1.8.4
Other reasons/not classified	8.9	11.3
Total	**100.0**	**100.0**

Notes: Estimates derived using HILDA's responding person weights.

Changing occupation

Persons employed in consecutive years are also asked whether they are still working in the same occupation as in the previous year. The change of occupation is therefore based on workers' self-assessment, in contrast to the measure of industry turnover which is based on a change of the HILDA survey's classification of industry based on the worker's job description. We investigate reported occupational turnover in one year conditional upon the workers' occupation, industry, and other characteristics in the previous year. A change of occupation may or may not also involve a change of employer or industry. Note the measure relates only to workers who were employed in consecutive years and does not account for people leaving the labour force.

In total, 15.5 per cent of workers report having changed occupation each year, with no obvious trend in the turnover rate over time. Occupational turnover is marginally lower in the resources sector (14.8 per cent) than for the rest of the labour market (15.6 per cent). Table 5 identifies 6 occupations at the ANZSCO 4-digit level in which a high proportion of workers are employed within the resources sector. Table 16 reports the annual turnover rates from those 4-digit occupations, along with the turnover rates at the 'parent' 2-digit and 1-digit categories. With the caveat that sample numbers are limited when making comparisons at the 4-digit level, among professional occupations, chemical and materials engineers record relatively high departure rates from the occupation, while geologist, geophysicists, and hydrologists report low occupational turnover. Within the technician and trades workers major category, workers classified as other building and engineering trades workers also display relatively high turnover rates across the window of the HILDA data (18.1 per cent p.a.). Note that occupational turnover may not necessarily constitute 'wastage', as it may reflect upskilling or occupational progression, such as technicians or professional workers moving into managerial positions.

Table 16: Proportion of workers who report changing occupation in last year, by initial occupation, HILDA Waves 2-23

ANZSCO category	Changed occupation (per cent per annum)
2. Professionals	11.6
23. Design, Engineering, Science and Transport Professionals	10.8
2331 Chemical & Materials Engineers	16.6
2336 Mining engineers	14.1
2344 Geologists, geophysicists, & hydrogeologists	7.9
3. Technician and Trades Workers	12.2
31. Engineering, ICT and Science Technicians	14.5
3129 Other Building & Engineering Technicians	18.1
32. Automotive and Engineering Trades Workers	12.5
3222 Sheet metal Trades Workers	12.7
3232 Metal fitters & Machinists	12.9

Notes: Estimates derived using HILDA's responding person weights.

In estimating multivariate models of occupational turnover, dummy variables are included to capture workers' major (1-digit) occupational category (Appendix Table 21). The results indicate occupational turnover is not significantly different for those working in the resources sector once occupational structure is accounted for, and that holds for both the mining industry and resource-aligned manufacturing sectors. Separate estimates by sector (models 21.2 and 21.3) confirm some of the findings above: less job stability for women working in resources compared to women in other industries, and lower occupational turnover associated with part-time work in the resources sector contrasting with higher occupational turnover for part-time workers in the wider labour market.

Like firm turnover, occupational turnover falls off for older workers, but at a lower rate within the resources sector. Taking the results for industry, firm, and occupational turnover together, it appears that as workers enter the age groups of 55-64 years and 65 years and over, they are more likely to leave the resources sector, but for those who remain employed they are also relatively more likely to remain with the same employer and in the same occupation. This suggests the relatively higher rate of departure from the resources sector for older workers arises from older workers exiting the labour force, rather than from changing jobs.

Training for the resources sector

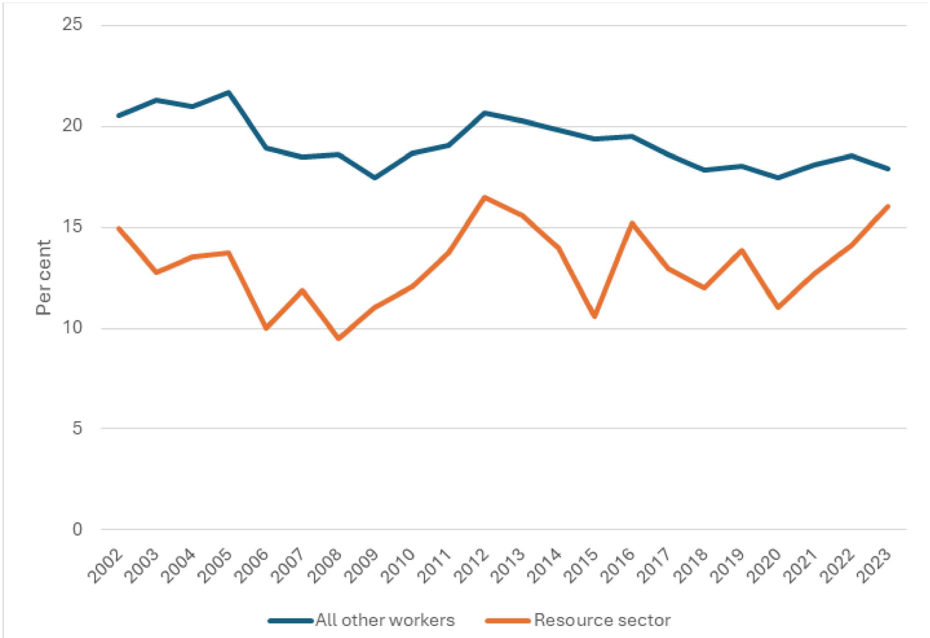
To compare training rates in the resources sector to other sectors the HILDA data are used to assess workers' participation in both external courses and training provided through their firm. This relates to participation rates for existing workers, as distinct from courses that students may undertake to prepare them for entry into the resources sector or other jobs as analysed in Section 3.

Participation in external training and education

From Wave 2 onwards, respondents in the HILDA survey are asked whether or not, since the last interview, they have spent any time enrolled in a course of study for a trade certificate, diploma, degree, or other educational qualification. Respondents are instructed not to include hobby or recreational courses. Among persons who were employed at the time of the survey, just under one in five reported having been enrolled in such a course at some time since their previous interview. However, participation in formal external training has been markedly and significantly lower in the resources sector over these years from 2002-2023, at 13.1 per cent in the resources sector compared to 19.1 per cent for other workers.

As shown in Figure 16, this lower training rate has been a long-standing feature of the resources sector. It is most pronounced for workers in the resource-aligned manufacturing sector (9.8 per cent), but is also lower in mining (15.4 per cent) than for non-resource sector workers.

Figure 16: Proportion of workers enrolled in external training in past 12 months, HILDA 2002-23



Notes: Estimates derived using HILDA's responding person weights.

Variously controlling for sectors' occupational structure, workers' previous educational attainment, or a full set of job- and individual-specific characteristics, multivariate models confirm workers in the resource-aligned manufacturing sector have significantly lower rates of participation in formal, external education and training. Lower participation rates of workers in mining can largely be accounted for by the occupational structure of the sector, and the estimate is insignificant when a fuller range of controls is included (Appendix Table 22, models 22.1 and 22.2).[14]

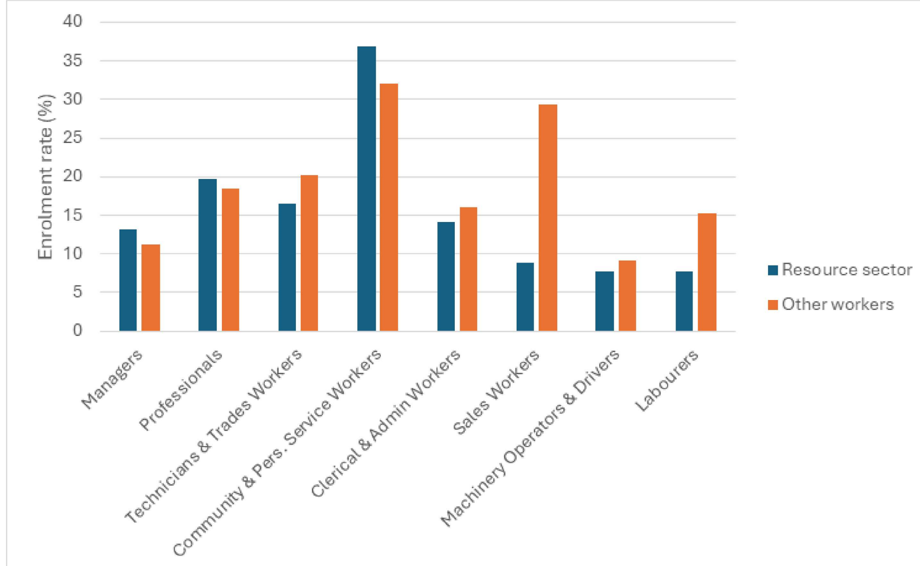
14 Models of the probability of the worker having participated in external training are estimated using logistic regression panel models with random effects.

Lower enrolment rates for workers in the resources sector may arise for a multitude of reasons: there may be lower need for additional qualifications, a lower perceived return on that investment, a lack of support by employers, or a lack of appropriate training courses that meet resource workers' needs. Estimating separate models of the effects of job- and individual-specific characteristics on the likelihood of having been enrolled in a course, reveals a large divergence in participation rates for workers in the major group occupations of technicians and trades workers, sales workers, machine operators and drivers, and labourers (models 22.3 and 22.4). In each of those occupational groups, the gap in course enrolment rates relative to professionals is much larger (more negative) in the resources sector than in the wider labour market. Those differences between workers within and outside the resources sector are widest for lower-skilled occupations, indicating relatively low external training opportunities of lower-skilled workers in the resources sector.

Potentially, that pattern may arise if enrolment rates for professionals were much higher in the resources sector. Figure 17 suggests this is not the case. In unadjusted terms, rates of participation in courses are only marginally higher for professionals and managers in the resources sector. The raw means confirm it is resources workers in lower-skilled occupations that are less likely to be actively pursuing further qualifications, and this gap is particularly pronounced for those in sales positions and labourers but also applies for technicians and trades workers.

Participation rates decline steadily with age and with a similar gradient in the resources and non-resources sectors. The multivariate analyses reveal relatively lower rates of enrolment in formal training and education courses for female workers in the resources sector. In the wider labour market, female workers participate at significantly higher rates than male workers, but there is no significant difference by gender within the resources sector.

Figure 17: External course enrolment in past 12 months, by occupation



Notes: Estimates derived using HILDA's responding person weights. We caution the resource sector estimates for community and personal service workers and sales workers are based on small sample sizes.

Workplace training

Commencing from Wave 7 (collected in 2007), the HILDA survey also asks employed persons whether Wor not they have taken part in any education or training schemes, as part of their employment, during the past 12 months. Those who indicate in the affirmative are further asked the main aim of that training. In this case, those in the resources sector are marginally more likely to be provided with such workplace training than other workers. Across the resources sector 34.3 per cent of workers reported having taken part in workplace training, with the training rate higher in the mining sector (38.4 per cent) than in resource-aligned manufacturing (27.1 per cent). For workers outside of the resources sector, 31.8 per cent reported having participated in workplace training.

Those differentials have been relatively consistent over 2007-2023, the years these data have been collected, with workers in mining consistently reporting relatively high rates of education and training undertaken as part of their employment. However, the provision of workplace training in the resource-aligned manufacturing sector appears to have been declining since around 2012. Only around 20 per cent of workers in those manufacturing jobs reported participating in training in each of the last two years for which data are available (2022 and 2023).

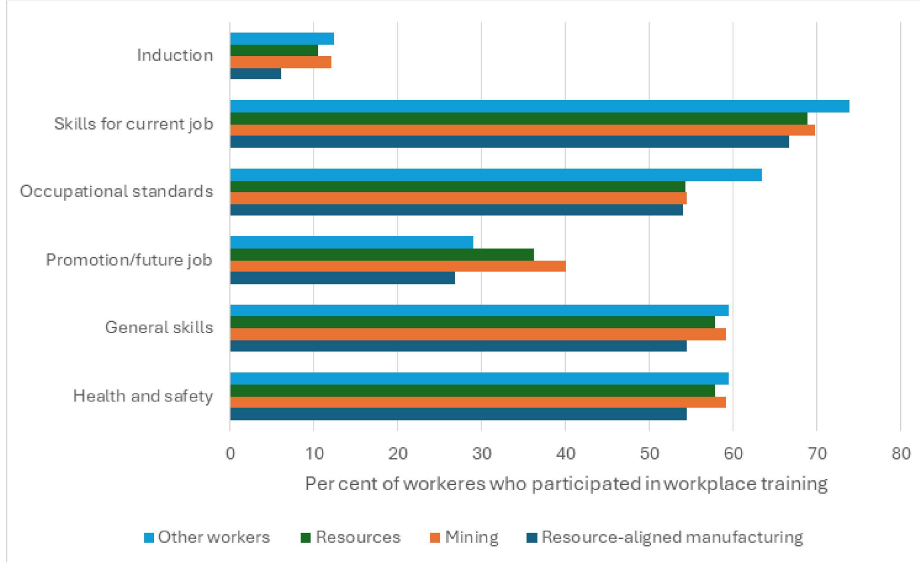
Regression estimates of the probability of a worker participating in training as part of their employment confirm the mining industry is significantly more likely to provide its workers with workplace training, while there is no significant difference between the resource-aligned manufacturing sector and the non-resources sectors. This holds after controlling simply for occupational structure or for an extended set of individual- and job-specific characteristics (Table 23, models 23.1 and 23.2).

Separate models estimated for the resources sector and other workers show the determinants of who gets access to workplace training are similar in the resources sector and in the wider labour market (models 23.3 and 23.4).

There is a more pronounced downward time trend in the resources sector. A significantly higher rate of participation in workplace training for women in the wider labour market is not observed in the resources sector, suggesting no gender difference in access to training after controlling for other factors.

With multiple responses permitted, workers who undertook workplace training are asked to indicate the main aims of the training. Common options are to help get started in the job; to improve skills in your current job; to maintain professional status or occupational standards; in preparation for a future job or for promotion; to develop skills generally; and because of a health and safety concern. Figure 18 shows the proportion of workers indicating each of these options, expressed as a per cent of workers who had participated in any workplace training.

Figure 18: Main aims of training - workers who undertook workplace training in last 12 months (%)



Notes: Estimates derived using HILDA's responding person weights.

Patterns in the objectives of training provided are quite consistent across each sector. Workers participating in training in the mining sector – and consequently in the resources sector overall – are more likely to report being provided training in skills that would prepare them for a future job or promotion. However, resources sector workers are less likely to undertake workplace training to improve their skills in their current job or for the purposes of maintaining professional registration or occupational standards. The resource-aligned manufacturing sector lags behind in the provision of each of the forms of training. In the case of training to get started in the job (labelled 'Induction' in Figure 18) this may reflect that recent hires are a smaller share of the workforce given declining employment in the sector.

Over-education and over-skilling

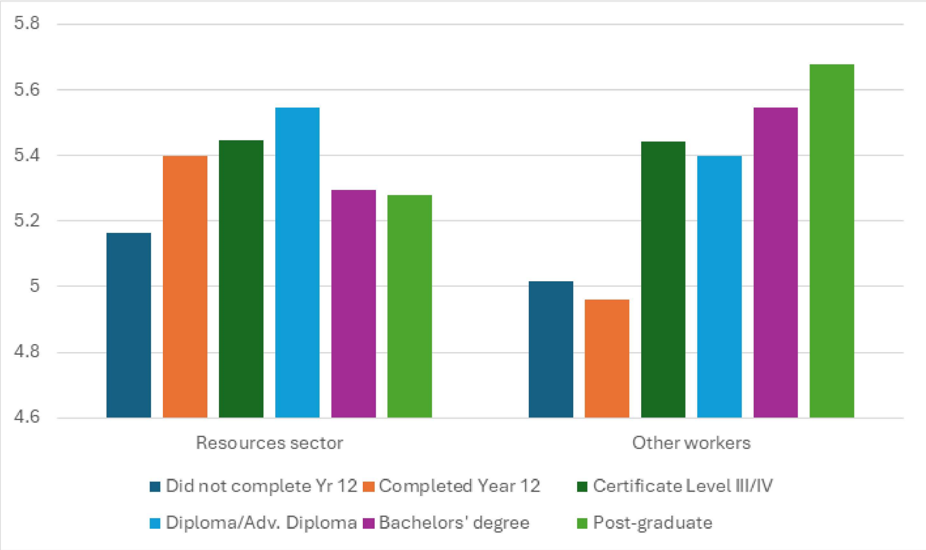
A further dimension to the adequacy of training within a sector relates to how well workers' formal qualifications and workplace training are aligned to the needs of their job. A growing literature on under- and over-education identifies over-education as an additional form of under-utilisation of labour along with unemployment and under-employment, where workers are working fewer hours than they would like. In terms of formal qualifications, over-education occurs when workers hold a higher level of qualification than is typically required for their current occupation. However, workers also have other skills and experience which may be underutilised in their roles. The HILDA survey has collected an indicator of over-education and over-skilling by directly asking workers their extent of agreement with the statement 'I use many of my skills and abilities in my current job'. Responses are recorded using a 7-point scale ranging from 1 'strongly disagree' to 7 'strongly agree'.

The mean of workers' responses to this question over the pooled 23 waves of data is 5.32, indicating most workers feel their skills and abilities are well utilised. By a simple comparison of means, agreement is marginally higher in the resources sector (5.36 compared to 5.32) and that small difference is statistically significant. Workers' above-average perception that their skills and abilities are well utilised in the resources sector applies only to the mining industry (mean of 5.47), with those in resource-aligned manufacturing expressing less agreement (5.22). In multivariate modelling, controlling for either workers' level of formal qualification or for their major occupational category accounts for the apparent over-skilling among workers in resource-aligned manufacturing (Table 24). However, the higher reported utilisation of workers' skills in the mining industry is robust to these controls. In the full models, the effect of working in the resource-aligned manufacturing sector is associated with marginally lower agreement (significant at the 5 per cent level – model 24.2).

When worker's assessments of the utilisation of their skills and abilities are modelled separately for the resources and non-resource sectors, there are some noticeable differences between the two populations. In the wider workforce, there is a steady fall in perceptions of over-skilling with age, so that younger workers feel their skills and abilities are, in relative terms, not well utilised, while older workers report the strongest agreement that their skills and abilities are well used. That age gradient is not so apparent within the resources sector such that, in relative terms, younger workers in the resources sector feel their jobs use many of their skills and abilities.

There is some evidence of greater skill mismatch in terms of workers' formal qualifications in the resources sector. In the general labour market holding formal qualifications and higher-level qualifications are associated with a worker being more likely to agree that their skills and abilities are well used: those with postgraduate qualifications report the highest agreement with the statement. In contrast, the models for the resources workforce indicate that those with VET diploma level qualifications and university qualifications are less likely to report their skills and abilities are well utilised, relative to someone who completed Year 12 without gaining further post-school qualifications. The contrast is highlighted in Figure 19, which shows the simple mean responses by workers' highest level of qualification in each sector. The positive gradient in skills utilisation with level of qualification is apparent for other workers. In the resources sector, those with vocational qualifications at the diploma or advanced diploma have the strongest agreement that their skills and abilities are well utilised, followed by those with trade level qualifications (Certificate level III or IV). Agreement is notably lower for university qualified workers, including both those with a bachelor's degree and those with postgraduate qualifications.

Figure 19: workers' reported skills utilisation; by highest level of qualification



Notes: Estimates derived using HILDA's responding person weights.

It is worth noting again the differences by gender. Outside of the resources sector there is little difference by gender in reported skills utilisation, with means for the agreement rating of 5.30 for women and 5.33 for men. After controlling for individual and job characteristics in a multivariate regression, women are in fact significantly more likely to agree they use many of their skills and abilities. This does not hold within the resources sector, for which the regression results return a negative though insignificant effect associated with being female (Table 24, models 24.3 and 24.4). The raw means show a gender gap (5.16 for women and 5.40 for men), which is highly significant based on a t-test.

Conclusions

This report contains an extensive examination of the resources sector workforce in Australia. It documents trends in employment numbers in the sector, in the supply of new graduates, and their industry and occupational destinations. It compares resource sector workers to the wider labour force on key aspects relating to wages, job quality, retention and turnover, and training opportunities, and associated trends over time, drawing upon key existing secondary datasets. The purpose is to provide insights into the measures required to ensure Australia continues to have a skilled mining and metallurgy workforce that is well-equipped to realise its economic potential as a resource rich nation.

The scope of the resources sector is defined to include the mining industry, as identified as one of 19 major ANZSIC categories in official employment statistics. It also includes a number of industry sub-categories within the major category of manufacturing assessed as being closely aligned with the mining industry. This subset is referred to as resource-aligned manufacturing and largely engages in downstream processing of mining output.

Analyses quickly revealed a stark bifurcation of fortunes between the workforces of these two branches of the resources sector. Employment in mining has been growing strongly, while employment in resource-aligned manufacturing has plummeted. During the intercensal years from 2011 to 2021 it fell by 30 per cent and, based on quarterly Labour Force Survey data available for the 2-digit sub-categories, has declined by around a further 10 per cent since the time of the 2021 Census.

Based on an extensive array of indicators of employment conditions, the quality of jobs in the mining sector is generally comparable or better than is typical in the wider labour market, but typically inferior in resource-aligned manufacturing. This includes substantially higher wages associated with working in mining. Mining workers earn around 50 per cent higher wages on the basis of a raw comparison of average hourly earnings, and a premium of around 25 per cent after controlling for individual- and job-specific characteristics. Employment in the resource-aligned manufacturing sector is associated with a modest hourly wage premium of around 6 per cent. Overall job satisfaction is significantly higher for workers in mining, but not for those in resource-aligned manufacturing jobs. Compared to workers outside of the resources sector, workers in mining are equally likely to participate in external training for further qualifications, more likely to receive workplace training, and feel they make better use of their skills and abilities in their jobs. In contrast, those employed in the manufacturing activities aligned with the resources sector are less likely to participate in formal external training and feel their skills and abilities are not as well utilised in their work. The period of declining overall employment may be contributing to some of the poor worker outcomes in resource-aligned manufacturing.

JSA's employment projections for the 10 years from 2025 to 2035 forecast total national employment to grow by 13.3 per cent. The projections for the resources sector are for jobs growth of 11.0 per cent, a result of relatively slow projected growth for the mining industry (8.6 per cent) and relatively high growth in resource-aligned manufacturing (16.9 per cent).

The projections regarding the growth of mining-aligned manufacturing demonstrates the sharp distinction between plans for future growth of downstream minerals processing and refining, and the trend of industry and workforce decline over recent decades. The corollary to this is that, without a concerted effort to attract, retain, and develop talent, the much-vaunted opportunity to move downstream will not be realised.

The benefits in terms of supporting a more diverse and dynamic industrial and research base, in terms of sovereign capability, and as a means of creating greater value for global partners by extending our sector's role as a provider of minerals, materials, and expertise are all clear, and well supported, in principle. A larger, more diverse and advanced workforce is the enabler.

Volatility in the mining industry means there will inevitably be considerable uncertainty associated with employment forecasts for that industry. However, achievement of the positive projections for resource-aligned manufacturing would require a significant reversal of recent historical trends.

The fall in new entrants and suitably qualified graduates extends to the mining sector, which has also seen sharp declines in apprenticeships and higher education graduates. The stagnation in the number of recent graduates with degrees in the three most mining-specialist fields – mining engineering, geology, and geophysics – is particularly concerning. While direct data on university graduation numbers from mining related courses is limited, available evidence confirms a substantial drop in the number of graduates completing mining engineering courses around the mid-2010's.

Census data indicate that graduates with mining related degrees are in strong demand, with few in unemployment or outside of the labour market. While there has been a strong policy push for increased participation in science, technology, engineering and mathematics (STEM) courses, it is not the case the case that graduates from all STEM fields achieve better outcomes than graduates from other disciplines, or that all STEM skills are in high demand (see, for example, Dockery, Phillimore and Bawa 2021). Rather than focussing on the somewhat ad hoc STEM umbrella of disciplines, efforts may be better invested in identifying demand for more specific degrees and their associated pathways to industry skills needs.

The decline in participation in resource-related higher education courses and VET programs may be partly attributed to the extractive industries having an 'image problem' with younger cohorts. However, this is unlikely to be true for apprenticeships, the availability of which is largely determined by employers.

Aside from restoring entry-level training rates, attracting workers from other industries appears to offer a potential means of increasing the supply of skilled workers to the mining industry.

Professionals with mining related degrees are drawn to the professional, scientific, and technical services sector, education and training sector, and to public administration and safety. There is a noticeable drift of workers with mining related degrees out of mining and into these alternative industries as they age.

There is also a relatively low rate of participation in external education and training by existing workers in the resources sector, and in mining this is apparent for lower skilled occupations. This lack of training opportunity may contribute to attrition by limiting career progression and pathways. Importantly, it may also limit the potential supply of higher-skilled workers to the resources sector in the form of up-skilling of workers with trade and technical level qualifications.

The fact that the decline in new graduates in mining-related fields has occurred at a time when mining employment has grown relatively strongly increases the likelihood of the sector facing constraints in the form of emerging skills shortages. If Australia's mining and energy industry is to continue to prosper and expand, it is likely to need to rely heavily on international migration to meet future skills needs.

Finally, as has often been noted before, the failure of the resources sector to attract female workers continues to be a major limitation to the available supply of skilled workers. The under-representation of women in resources has been well documented, and there has been minimal improvement on that front over the past 10 years. New evidence here shows that women are not only less likely to be employed in the sector, but those who are experience relatively worse vocational outcomes, including in terms of pay, access to training opportunities, and underutilisation of their skills and abilities. Female graduates from key mining-related courses, experience a greater degree of occupation mismatch and fewer progress to managerial positions compared to their male peers. Women who do enter the resources sector tend to leave relatively quickly. Clearly, addressing the relative exclusion of women would go a long way to addressing skills shortages in the sector.

Avenues for future research

The report has made extensive use of existing data from the ABS Census and HILDA to cast light on employment pathways in the resources sector. A limitation has been the inability to relate the dynamics of career paths to detailed information on participation in education and training, such as the level of courses workers participate in and their field of education at a granular level. Census data offers some granularity in terms of people's highest level and field of qualification attained, but not on the dynamics of skills accumulation or working careers. The panel nature of HILDA offers unique potential for observing labour market dynamics from year to year, but limited detail on actual courses studied, and sample sizes are restrictive when looking at specific occupations and qualifications.

HILDA does offer more detailed information in its supplementary education and skills module, which is collected every four years, and that offers the potential for some additional analyses, but the use of alternative datasets or primary data collection would appear to offer more fruitful avenues for further research.

One notable possibility for monitoring labour market conditions and emerging skills shortages in the resources sector is through the use of the Person Level Integrated Data Asset (PLIDA) managed by the ABS. PLIDA enables the linking of data on individuals across multiple administrative and survey datasets. These datasets include the Department of Education's Higher Education enrolments and completions collection, apprenticeship and traineeship registrations and completions, data from the Australian Tax Office, Department of Social Services data on benefit receipts, and Department of Home Affairs visa classifications.

The education data available in PLIDA is coded to narrow fields and level of study. These can be linked to individuals' outcomes in terms of earnings (imputed through tax records), their industry and occupation of employment, and experiences of unemployment (from benefit receipt data).

This would allow the generation of indicators on the supply of higher education and vocational graduates in relevant fields, labour market conditions in the resources sector for graduate and for workers overall, along with comparative aggregate indicators for other sectors and for the aggregate labour market. Such indicators could be generated as time series going back to at least 2010.

Primary collection of data from higher education institutions would also enable better assessment of training rates for professional occupations in the resources sector. It is telling that such data appear only to have been collated for graduates from mining engineering courses (see Section 3). While time intensive, it may be possible to approximate completions in other professions to gain a more comprehensive picture of the supply of graduates, with geologists, metallurgists, and chemical and materials engineers a priority.

A further priority for the resources sector - and for the labour market more generally – is the analyses of changes in job content in response to the growing use of Artificial Intelligence, robotics, and other forms of automation and advanced technologies. Understanding their impacts in terms of tasks undertaken and associated skills required will be paramount to the redesign of jobs and the tailoring of courses and course content to meet these changing needs.

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Appendix Tables

Table 17: Wage equations, HILDA waves 1-23

Control variables	(17.1) All workers	(17.2) All workers	(17.3) Resources sector only	(17.4) Other workers	(17.5) Resources sector only	(17.6) Other workers
Constant	3.44***	3.46***	3.54***	3.44***	3.52***	3.46***
Resources sector	0.17***	0.16***				
Wave (1-23)	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
Female	-0.09***	-0.12***	-0.20***	-0.09***	-0.18***	-0.11***
Age:						
15-24 years	-0.28***	-0.25***	-0.24***	-0.28***	-0.22***	-0.25***
25-34 years	-0.09***	-0.08***	-0.08***	-0.09***	-0.07***	-0.08***
35-44 years	–	–	–	–	–	–
45-54 years	0.02***	0.01***	-0.02	0.02***	-0.02	0.01***
55-64 years	0.01	-0.00	-0.05**	0.01*	-0.05**	0.00
65 years and over	-0.02	-0.04***	-0.09	-0.01	-0.13*	-0.03**
Has work limiting disability	-0.03***	-0.03***	-0.01	-0.02***	-0.02	-0.03***
Country of birth:						
Australia	–	–	–	–	–	–
English speaking country	0.05***	0.05***	0.08*	0.05***	0.08**	0.05***
Non-English spkg country	-0.08***	-0.06***	-0.07*	-0.08***	-0.06*	-0.06***
Highest qualification:						
Postgraduate	0.30***	0.24***	0.58***	0.30***	0.55***	0.24***
Degree	0.20***	0.15***	0.32***	0.20***	0.31***	0.15***
Diploma/Assoc. diploma	0.06***	0.05***	0.14***	0.06***	0.14***	0.05***
Certificate III/IV	-0.01*	-0.00	0.12***	-0.02**	0.11***	-0.01
Completed Year 12	–	–	–	–	–	–
Did not complete Year 12	-0.25***	-0.23***	-0.04	-0.26***	-0.03	-0.23***
Lives in:						
Major capital city	–	–	–	–	–	–
Inner regional	-0.07***	-0.06***	0.03	-0.07***	0.03	-0.07***
Outer regional/remote	-0.06***	-0.05***	0.04	-0.07***	0.04	-0.06***
Married	0.08***	0.08***	0.07***	0.08***	0.06***	0.08***
Has children aged 0-4	0.04***	0.03***	0.04**	0.04***	0.04**	0.03***
LM History: % unemployed	-0.00***	-0.00***	-0.01***	-0.00***	-0.01***	-0.00***
Occupation						
Manager		-0.04***			0.04*	-0.04***
Professional		–			–	–
Technicians, trades workers		-0.10***			0.02	-0.11***
Community & personal service		-0.12***			-0.31***	-0.12***
Clerical & administrative workers		-0.05***			-0.08***	-0.06***
Sales workers		-0.18***			-0.04	-0.18***
Machinery operators & drivers		-0.09***			-0.03	-0.11***
Labourers		-0.16***			-0.13***	-0.16***
Employment contract:						
Permanent/ongoing		–			–	–
Self-employed/employer		-0.14***			-0.15**	-0.14***
Fixed term contract		0.00			0.02	0.00
Casual contract		-0.03***			-0.01	-0.03***
Other		-0.10***			0.02	-0.09***
Works part-time		0.08***			0.14***	0.08***
Union member		0.05***			0.05***	0.05***
Years with current employer		0.01***			0.00	0.01***
Years with current employer squared		-0.02***			-0.00	-0.02***
Employed by labour hire firm		0.08***			0.01	0.09***
Has supervisory responsibilities		0.04***				
Observations	191,412	191,234	5,932	185,480	5,929	185,305
Number of individuals	25,587	25,580	1,569	25,349	1,569	25,342
Observations per individual						
Minimum	1	1	1	1	1	1
Average	7.5	7.5	3.8	7.3	3.8	7.3
Maximum	23	23	23	23	23	23
R-squared	0.2883	0.3274	0.2368	0.2851	0.2687	0.3252
Wald Chi-square	19,256***	24,456***	763***	18,460***	933***	23,657***

Notes: Estimated using STATA Corp's XTREG command with random effects and robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

Table 18: Overall job satisfaction rated on a 0-10 scale, OLS regression estimates, HILDA waves 1-23

	With individual controls		Job-related controls added	
Control variables	**(18.1)**	**(18.2)**	**(18.3)**	**(18.4)**
Constant	7.63***	7.63***	7.88***	7.88***
Employed in:				
Resources sector	0.06*		0.06*	
Mining		0.12***		0.12***
Manufacturing (resource-aligned)		-0.02		-0.01
Female	0.11***	0.11***	0.08***	0.08***
Age:				
15-24 years	-0.14***	-0.14***	-0.15***	-0.14***
25-34 years	-0.11***	-0.11***	-0.12***	-0.12***
35-44 years	–	–	–	–
45-54 years	0.10***	0.10***	0.13***	0.13***
55-64 years	0.26***	0.26***	0.29***	0.29***
65 years and over	0.65***	0.65***	0.70***	0.69***
Has work limiting disability	-0.22***	-0.22***	-0.21***	-0.21***
Country of birth:				
Australia	—	–	–	–
English speaking country	-0.12***	-0.12***	-0.13***	-0.13***
Non-English speaking country	-0.21***	-0.21***	-0.16***	-0.16***
Highest qualification:				
Postgraduate	-0.01	-0.01	-0.17***	-0.17***
Degree	-0.06***	-0.06***	-0.17***	-0.17***
Diploma/Assoc. diploma	0.01	0.01	-0.04	-0.04
Certificate III/IV	-0.00	-0.00	-0.02	-0.02
Completed Year 12	–	–	–	–
Did not complete Year 12	0.12***	0.13***	0.18***	0.18***
Lives in:				
Major capital city	–	–	–	–
Inner regional	0.11***	0.11***	0.13***	0.13***
Outer regional/remote	0.17***	0.17***	0.18***	0.18***
Married	0.02	0.02	0.00	0.00
Has children aged 0-4	0.02	0.02	0.02	0.02
LM History: % unemployed	-0.00	-0.00	-0.00	-0.00
Real hourly wage ($)			0.002***	0.002***
Occupation				
Manager			-0.09***	-0.09***
Professional			–	–
Technicians, trades workers			-0.09***	-0.09***
Community & personal service			-0.07***	-0.07***
Clerical & administrative workers			-0.11***	-0.11***
Sales workers			-0.32***	-0.32***
Machinery operators & drivers			-0.28***	-0.28***
Labourers			-0.35***	-0.35***
Employment contract:				
Permanent/ongoing			–	–
Self-employed/employer			0.16***	0.16***
Fixed term contract			0.00	0.00
Casual contract			-0.09***	-0.09***
Other			-0.17*	-0.17*
Works part-time			0.05***	0.05***
Union member			-0.08***	-0.08***
Years with current employer			-0.03***	-0.03***
Yrs with current employer squared			0.05***	0.05***
Employed by labour hire firm			-0.13***	-0.13***
Has supervisory responsibilities			-0.04***	-0.04***
Observations	217,703	217,703	191,160	191,160
Number of individuals	26,775	26,775	25,575	25,575
Observations per individual				
Minimum	1	1	1	1
Average	8.1	8.1	7.5	7.5
Maximum	23	23	23	23
Wald Chi-square	1,334***	1,339***	1,994***	1,999***

Notes: Estimated using STATA Corp's XTREG command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 19: Probability of changing employer, logistic regression results, HILDA Waves 1-22

		Full models		
	Base model	All workers	Resources sector	Other workers
Control variables	**(19.1)**	**(19.2)**	**(19.3)**	**(19.4)**
Constant	-0.74***	-1.00***	-1.27***	-0.98***
Wave	-0.02***	-0.02***	-0.01	-0.02***
Employed in:				
Mining	-0.26***	-0.06		
Manufacturing (resource-aligned)	-0.09	0.02		
Female		-0.16***	0.45***	-0.17***
Age:				
15-24 years		0.43***	0.27	0.43***
25-34 years		0.23***	0.17	0.23***
35-44 years		—	—	—
45-54 years		-0.09***	-0.00	-0.09***
55-64 years		0.07**	0.31*	0.06**
65 years and over		0.59***	1.32***	0.58***
Has work limiting disability		0.29***	0.61***	0.29***
Country of birth:				
Australia		—	—	—
English speaking country		0.16***	0.19	0.15***
Non-English spkg country		0.10***	0.38*	0.09**
Highest qualification:				
Postgraduate		-0.22***	0.54	-0.24***
Degree		-0.18***	0.23	-0.19***
Diploma/Assoc. diploma		-0.06	0.09	-0.06
Certificate III/IV		-0.06**	0.10	-0.07**
Completed Year 12		—	—	—
Did not complete Year 12		0.03	0.08	0.02
Lives in:				
Major capital city		—	—	—
Inner regional		-0.08***	0.13	-0.08***
Outer regional/remote		-0.06*	0.03	-0.06*
Married		-0.02	-0.14	-0.02
Has children aged 0-4		0.01	-0.11	0.02
LM History: % unemployed		0.01***	0.02***	0.01***
Employment contract:				
Permanent/ongoing		—	—	—
Self-employed/employer		-0.05*	0.70***	-0.06**
Fixed term contract		0.09***	0.09	0.09***
Casual contract		0.50***	0.74***	0.49***
Other		0.33***	0.59	0.33***
Works part-time		0.32***	0.27	0.32***
Union member		-0.50***	-0.23**	-0.50***
Employed by labour hire firm		0.47***	-0.20	0.52***
Has supervisory responsibilities		-0.11***	0.21**	-0.12***
Observations:	195,748	191,855	5,609	186,246
Number of individuals	22,752	22,308	1,436	22,125
Observations per individual				
Minimum	1	1	1	1
Average	8.6	8.6	3.9	8.4
Maximum	22	22	22	22
Wald Chi-square	346***	5,026***	124***	4,946***

Notes: Estimated using STATA Corp's XTLOGIT command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 20: Probability of changing employer, logistic regression results, HILDA Waves 1-22

		Full models		
	Base model	All workers	Resources sector	Other workers
Control variables	**(20.1)**	**(20.2)**	**(20.3)**	**(20.4)**
Constant	-1.74***	-2.01***	-2.24***	-2.00***
Wave	-0.03***	-0.01***	0.01	-0.01***
Employed in:				
Mining	-0.05	0.02		
Manufacturing (resource-aligned)	-0.17*	-0.08	0.45***	-0.17***
Female		-0.05**	0.22	-0.06***
Age:				
15-24 years		0.79***	0.88***	0.79***
25-34 years		0.45***	0.24*	0.46***
35-44 years		—	—	—
45-54 years		-0.39***	-0.32**	-0.40***
55-64 years		-0.83***	-0.42**	-0.84***
65 years and over		-1.61***	-0.51	-1.64***
Has work limiting disability		0.07**	0.03	0.07**
Country of birth:				
Australia		—	—	—
English speaking country		0.18***	0.33*	0.17***
Non-English spkg country		-0.05	-0.13	-0.05
Highest qualification:				
Postgraduate		0.12**	0.24	0.12**
Degree		-0.02	-0.17	-0.02
Diploma/Assoc. diploma		0.03	0.17	0.03
Certificate III/IV		0.11***	0.06	0.11***
Completed Year 12		—	—	—
Did not complete Year 12		-0.08***	-0.05	-0.09***
Lives in:				
Major capital city		—	—	—
Inner regional		-0.02	0.07	-0.02
Outer regional/remote		0.01	0.19	0.01
Married		-0.09***	-0.04	-0.09***
Has children aged 0-4		-0.09***	0.19	-0.10***
LM History: % unemployed		0.01***	0.02**	0.01***
Employment contract:				
Permanent/ongoing		—	—	—
Self-employed/employer		-0.63***	-0.84**	-0.64***
Fixed term contract		0.24***	0.44***	0.24***
Casual contract		0.64***	1.04***	0.64***
Other		0.59***		0.61***
Works part-time		-0.01	-0.79***	-0.00
Union member		-0.49***	-0.56***	-0.49***
Employed by labour hire firm		0.67***	0.55***	0.68***
Has supervisory responsibilities		0.01	-0.04	0.01
Observations:	181,127	177,667	5,310	172,353
Number of individuals	21,402	20,960	1,353	20,773
Observations per individual				
Minimum	1	1	1	1
Average	8.5	8.5	3.9	8.3
Maximum	22	22	22	22
Wald Chi-square	279***	7,475***	256***	7.273***

Notes: Estimated using STATA Corp's XTLOGIT command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 21: Probability of changing occupation, logistic regression results, HILDA Waves 1-22

		Full models	
	Base model	All workers	Resources sector
Control variables	(21.1)	(21.2)	(21.3)
Constant	-2.01***	-1.84***	-1.98***
Wave	-0.02***	-0.00	-0.01***
Sector of employment:			
Mining	0.06		
Manufacturing (resource-aligned)	-0.04		
Occupation:			
Managers	0.21***	-0.03	0.34***
Professionals	—	—	—
Technicians and trades workers	0.14***	-0.14	-0.00
Community & personal service workers	0.57***	0.24	0.21***
Clerical and admin. workers	0.53***	0.26	0.43***
Sales workers	0.89***	0.03	0.38***
Machinery operators & drivers	0.43***	-0.01	0.34***
Labourers	0.80***	0.36*	0.46***
Female		0.22	-0.00
Age:			
15-24 years		0.56***	0.69***
25-34 years		0.33***	0.32***
35-44 years		—	—
45-54 years		0.03	-0.33***
55-64 years		-0.32*	-0.75***
65 years and over		-0.78	-1.42***
Has work limiting disability		0.25	0.14***
Country of birth:			
Australia		—	—
English speaking country		0.09	0.16***
Non-English spkg country		0.06	-0.11***
Highest qualification:			
Postgraduate		0.00	0.14***
Degree		-0.21	0.02
Diploma/Assoc. diploma		0.09	0.07*
Certificate III/IV		-0.23	-0.06**
Completed Year 12		—	—
Did not complete Year 12		-0.16	-0.17***
Lives in:			
Major capital city		—	—
Inner regional		0.19	0.01
Outer regional/remote		0.26**	-0.04
Married		-0.05	-0.05**
Has children aged 0-4		0.10	-0.10***
LM History: % unemployed		0.01	0.01***
Employment contract:			
Permanent/ongoing		—	—
Self-employed/employer		-0.91***	-0.41***
Fixed term contract		0.06	0.17***
Casual contract		0.60***	0.44***
Other			0.52***
Works part-time		-0.45**	0.08***
Union member		-0.40***	-0.34***
Employed by labour hire firm		0.15	0.35***
Has supervisory responsibilities		-0.00	-0.02
Observations	181,811	5,323	173,003
Number of individuals	21,439	1,358	20,810
Observations per individual			
Minimum	1	1	7
Average	8.5	3.9	8.3
Maximum	22	22	22
Wald Chi-square	1,476***	164***	6.684***

Notes: Estimated using STATA Corp's XTLOGIT command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 22: Probability worker participated in external training, logistic regression results, HILDA Waves 1-22

		Full models		
	Base model	All workers	Resources sector	Other workers
Control variables	(22.1)	(22.2)	(22.3)	(22.4)
Constant	-1.50***	-1.59***	-1.64***	-1.62***
Wave	-0.07***	-0.03***	-0.02	-0.03***
Sector of employment:				
Mining	-0.10	0.10		
Manufacturing (resource-aligned)	-0.33***	-0.20*		
Occupation:				
Managers	-0.22***	-0.05	-0.33	-0.05
Professionals	—	—	—	—
Technicians and trades workers	0.65***	0.47***	-0.34	0.49***
Community & personal service workers	1.16***	0.62***	0.44	0.63***
Clerical and admin. workers	0.18***	-0.07*	-0.42	-0.07
Sales workers	0.64***	0.00	-1.43**	0.01
Machinery operators & drivers	-0.26***	-0.35***	-0.79***	-0.36***
Labourers	0.02	-0.31***	-1.09***	-0.30***
Female		0.20***	-0.05	0.20***
Age:				
15-24 years		1.79***	1.88***	1.80***
25-34 years		0.59***	0.21	0.61***
35-44 years		—	—	—
45-54 years		-0.50***	-0.65***	-0.50***
55-64 years		-1.28***	-1.64***	-1.28***
65 years and over		-2.49***	-3.37***	-2.47***
Has work limiting disability		0.06*	-0.32	0.07*
Country of birth:				
Australia		—	—	—
English speaking country		-0.06	0.13	-0.07
Non-English spkg country		-0.10**	0.01	-0.10**
Highest qualification:				
Postgraduate		-0.07	0.05	-0.05
Degree		-0.06	-0.05	-0.05
Diploma/Assoc. diploma		0.11**	0.12	0.12**
Certificate III/IV		-0.29***	-0.36	-0.28***
Completed Year 12		—	—	—
Did not complete Year 12		-1.88***	-1.30***	-1.89***
Lives in:				
Major capital city		—	—	—
Inner regional		-0.03	0.27	-0.04
Outer regional/remote		-0.07	0.17	-0.06
Married		-0.35***	-0.13	-0.35***
Has children aged 0-4		-0.41***	-0.04	-0.42***
LM History: % unemployed		0.00***	0.00	0.00***
Employment contract:				
Permanent/ongoing		—	—	—
Self-employed/employer		-0.44***	0.16	-0.44***
Fixed term contract		0.29***	0.28	0.29***
Casual contract		0.23***	-0.37*	0.25***
Other		0.40***	-0.61	0.42***
Works part-time		0.53***	0.32	0.53***
Union member		0.04	-0.18	0.05
Employed by labour hire firm		0.13**	0.33	0.12**
Has supervisory responsibilities		-0.15***	0.01	-0.15***
Observations	202,659	197,052	5,814	191,238
Number of individuals	23,141	22,514	1,483	22,324
Observations per individual				
Minimum	1	1	1	1
Average	8.8	8.8	3.9	8.6
Maximum	22	22	22	22
Wald Chi-square	2,444***	9,725***	236***	9,576***

Notes: Estimated using STATA Corp's XTLOGIT command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 23: Probability worker participated in workplace training, logistic regression results, HILDA Waves 1-22

		Full models		
	Base model	All workers	Resources sector	Other workers
Control variables	**(23.1)**	**(23.2)**	**(23.3)**	**(23.4)**
Constant	0.05	-0.49***	-0.34	-0.50***
Wave	-0.03***	-0.03***	-0.06***	-0.03***
Employed in:				
Mining	0.49***	0.34***		
Manufacturing (resource-aligned)	0.06	-0.03		
Occupation:				
Managers	-0.70***	-0.51***	-0.42**	-0.52***
Professionals	–	–	–	–
Technicians and trades workers	-0.81***	-0.48***	0.07	-0.50***
Community & personal service workers	-0.02	0.39***	1.41**	0.39***
Clerical and admin workers	-0.85***	-0.62***	-0.74***	-0.61***
Sales workers	-1.08***	-0.57***	-1.13**	-0.57***
Machinery operators & drivers	-1.11***	-0.63***	-0.25	-0.65***
Labourers	-1.34***	-0.73***	-0.39	-0.74***
Female		0.24***	-0.04	0.24***
Age:				
15-24 years		0.35***	0.88***	0.34***
25-34 years		0.10***	0.57***	0.09***
35-44 years		–	–	–
45-54 years		-0.07**	-0.17	-0.07**
55-64 years		-0.11***	-0.30	-0.11***
65 years and over		-0.15**	-0.44	-0.15**
Has work limiting disability		0.07**	0.14	0.07**
Country of birth:				
Australia		–	–	–
English speaking country		0.02	0.43**	0.01
Non-English spkg country		-0.14***	-0.29	-0.13***
Highest qualification				
Postgraduate		0.55***	0.97**	0.54***
Degree		0.60***	0.55**	0.59***
Diploma/Assoc. diploma		0.38***	0.75***	0.37***
Certificate III/IV		0.18***	0.27	0.18***
Completed Year 12		–	–	–
Did not complete Year 12		-0.15***	0.03	-0.16***
Lives in:				
Major capital city		–	–	–
Inner regional		0.10***	0.06	0.10***
Outer regional/remote		0.15***	0.16	0.15***
Married		0.01	0.01	0.01
Has children aged 0-4		-0.14***	0.01	-0.16***
LM History: % unemployed		-0.00***	-0.01	-0.01***
Employment contract:				
Permanent/ongoing		–	–	–
Self-employed/employer		-1.06***	-1.02***	-1.06***
Fixed term contract		0.07***	-0.14	0.08***
Casual contract		-0.55***	-0.61***	-0.55***
Other		-0.23	1.70	-0.24
Works part-time		-0.31***	-0.57**	-0.31***
Union member		0.60***	0.08	0.61***
Employed by labour hire firm		0.01	0.10	0.00
Has supervisory responsibilities		0.21***	0.26***	0.21***
Observations	172,221	167,014	4,797	162,217
Number of individuals	22,813	22,146	1,307	21,937
Observations per individual				
Minimum	1	1	1	1
Average	7.5	7.5	3.7	7.4
Maximum	17	17	17	17
Wald Chi-square	2,351***	6,346***	197***	6,289***

Notes: Estimated using STATA Corp's XTLOGIT command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table 24: Agreement that abilities and skills are well utilised, linear regression results, HILDA Waves 1-23

		Full models		
	Base model	All workers	Resources sector	Other workers
Control variables	(24.1)	(24.2)	(24.3)	(24.4)
Constant	5.76***	5.56***	5.54***	5.56***
Wave	0.00***	-0.00***	-0.01**	-0.00**
Sector of employment:				
Mining	0.12***	0.05		
Manufacturing (resource-aligned)	-0.05	-0.08**		
Occupation:				
Managers	-0.27***	-0.29***	-0.04	-0.29***
Professionals	—	—	—	—
Technicians and trades workers	-0.31***	-0.24***	-0.14*	-0.24***
Community & personal service workers	-0.51***	-0.29***	-0.50	-0.29***
Clerical and admin. workers	-0.67***	-0.56***	-0.41***	-0.57***
Sales workers	-1.10***	-0.82***	-0.14	-0.83***
Machinery operators & drivers	-1.06***	-0.91***	-0.49***	-0.94***
Labourers	-1.19***	-0.95***	-0.67***	-0.96***
Female		0.05***	-0.12	0.05***
Age:				
15-24 years		-0.09***	0.16*	-0.10***
25-34 years		-0.03***	0.01	-0.04***
35-44 years		—	—	—
45-54 years		0.05***	-0.04	0.05***
55-64 years		0.12***	0.01	0.12***
65 years and over		0.20***	0.17	0.20***
Has work limiting disability		-0.02	0.07	-0.02
Country of birth:				
Australia		—	—	—
English speaking country		-0.01	0.15*	-0.02
Non-English spkg country		-0.17***	-0.11	-0.17***
Highest qualification				
Postgraduate		0.28***	-0.09	0.27***
Degree		0.19***	-0.23**	0.19***
Diploma/Assoc. diploma		0.12***	-0.13	0.13***
Certificate III/IV		0.19***	0.05	0.19***
Completed Year 12		—	—	—
Did not complete Year 12		0.13***	-0.03	0.14***
Lives in:				
Major capital city		—	—	—
Inner regional		0.09***	0.13*	0.09***
Outer regional/remote		0.13***	0.22***	0.13***
Married		0.06***	0.13**	0.06***
Has children aged 0-4		0.02	-0.12*	0.02
LM History: % unemployed		0.00	-0.01***	0.00
Employment contract:				
Permanent/ongoing		—	—	—
Self-employed/employer		0.08***	0.23**	0.08***
Fixed term contract		0.08***	-0.01	0.08***
Casual contract		-0.20***	-0.16**	-0.20***
Other		-0.03	-0.04	-0.03
Works part-time		-0.28***	-0.04	-0.28***
Union member		0.05***	-0.05	0.05***
Employed by labour hire firm		-0.04	0.08	-0.05*
Has supervisory responsibilities		0.15***	0.22***	0.14***
Observations:				
Number of individuals	193,710	189,578	5,523	184,055
Observations per individual	25,244	24,852	1,482	24,617
Minimum	1	1	1	1
Average	7.7	7.6	3.7	7.5
Maximum	23	23	23	23
R-squared	0.09	0.12	0.08	0.13
Wald Chi-square	4,417***	7,034***	214***	6,974***

Notes: Agreement assessed on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). Estimated using STATA Corp's XTREG command with random effects and robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Disclaimer

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