Resources sector skills needs 2013

Australian Government

Australian Workforce and Productivity Agency

Resources sector skills needs

2013

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Letter to the Minister

Dear Minister

On behalf of the Australian Workforce and Productivity Agency (AWPA), I am pleased to present the *Resources sector skills needs 2013* report. This report is an important aspect of AWPA's commitment to report on skills needs and workforce development in the Resources Sector.

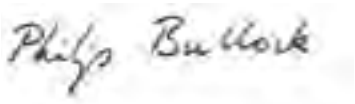
Against a backdrop of global economic uncertainty, slowdown in global growth, and a drop in commodity prices affecting resources project pipelines and development, Australia's Resources Sector has been resilient. To develop this report, which is the third annual Resources Sector workforce report prepared by AWPA, we commissioned a comprehensive five-year outlook model to estimate trends in employment growth and occupational supply for the Resources Sector against three economic growth scenarios. The report examines the implications of these changing circumstances on the demand for, and the supply of, skills and the workforce capacity required to deliver major mining and oil and gas projects.

Although representing a small proportion of national employment, the Resources Sector is a powerful driver of our national wealth and has a major impact on employment and opportunity in regional Australia and in support industries across the country. The nature of work in the sector is changing as companies respond to economic pressures by reducing operating costs and improving productivity through technology. The changing profile of the Resources Sector presents significant challenges related to skills and workforce development. Although employers appear to be experiencing less difficulty recruiting skilled workers in comparison to previous years, and wage pressures remain relatively contained in the Resources Sector, we anticipate that the scale of growth, especially as oil and gas projects ramp up, will place pressure on the labour market.

Australia will need to develop innovative policy solutions to address the Resources Sector's rapidly growing labour and skills needs and the flow-on effects in the broader economy. The story for the future will be about our ability to help secure the skilled workforce required to build and operate major Resources Sector projects over the next five years. In order to facilitate this, the report provides recommendations for the Resources Sector and stakeholders to address critical skills needs and plan for future growth.

In preparing the report AWPA consulted widely with Resources Sector companies, industry associations, state government officials and unions. I would like to express my gratitude to stakeholders across the industry, the tertiary education sector, governments, and especially members of the Resources Reference Group convened to steer preparation of the report, for their invaluable insights and guidance. In particular, I would like to acknowledge the work of the chair of the Resources Reference Group, AWPA Board member Mr Keith Spence, for his expert leadership and the AWPA Secretariat which has brought considerable energy and dedication to this challenging and critical study.

Yours sincerely



Philip Bullock
Chair, Australian Workforce and Productivity Agency
November 2013

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Abbreviations and acronyms

ABS	Australian Bureau of Statistics
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industrial Classification
AWPA	Australian Workforce and Productivity Agency
BREE	Bureau of Resources and Energy Economics
DAE	Deloitte Access Economics
FLNG	floating liquefied natural gas
LNG	liquefied natural gas
MCA	Minerals Council of Australia
METL	Maritime Employees Training Limited
NCVER	National Centre for Vocational Education Research
nfd	not further defined
OECD	Organisation for Economic Co-operation and Development
OPITO	Offshore Petroleum Industry Training Organisation
RBA	Reserve Bank of Australia

Executive summary

For the best part of a decade, the Resources Sector has been an engine of economic growth in Australia. Exploration, extraction and processing of mineral and energy resources make a significant contribution to the Australian economy. In 2011–12, exports of mineral and energy commodities were valued at $187.1 billion (using chain volume measures), accounting for 60 per cent of the total value of Australian exports.[1]

Strong investment in major projects, particularly in Western Australia and Queensland, and record commodity prices driven by intense demand from China and India, have created a period of unprecedented prosperity in the industry.

Many media commentators have speculated the boom is coming to an end, as commodity prices slacken, investment declines and global competition intensifies. Industry experts dispute this view—as does the Australian Workforce and Productivity Agency (AWPA)—and instead describe an industry in transition, as some of the biggest projects ever undertaken in Australia move from the construction phase to the less labour- and capital-intensive operations phase. In April 2013 the Bureau of Resources and Energy Economics valued committed investment in resources and energy major projects at $268 billion and estimated uncommitted investment at $379 billion. Developing and maintaining the capacity and expertise required to drive the operations phase will be vital to Australia's ongoing prosperity.

In this report, the third annual report prepared by AWPA on Resources Sector employment and skills needs, we consider the implications of these changing circumstances on the demand for, and the supply of, the skills and workforce capacity required to deliver major mining and oil and gas projects. AWPA commissioned a comprehensive employment demand and supply outlook model for the Resources Sector. This model—using Bureau of Resources and Energy Economics data available as at April 2013—details projections for 2014–18 across three subsectors (Resources Project Construction, Mining Operations and Oil and Gas Operations) under three economic growth scenarios (base case, high growth and low growth).

- A highly volatile phase lies ahead for *Resources Project Construction*, which is expected to see employment plateau at first and then decline rapidly in coming years. Under the low growth scenario (considered the most likely due to the lower probability of projects proceeding to the committed stage), employment is expected to drop slightly from 85,819 workers in 2013 to 83,321 workers in 2014 and then decrease quickly to 7,708 by 2018. This decline is common to all three scenarios, and is likely to force many thousands of trades workers from the domestic workforce to seek employment in other industries, unless their skills can be transferred to mining and oil and gas operational roles.
- Commodity prices will play an important role in shaping the demand for labour within *Mining Operations*. Under all three growth scenarios, Mining Operations employment is projected to increase every year from 2014 to 2018. Under the most likely base case scenario, employment is expected to increase from 236,690 workers in 2013 to 254,260 in 2018, which is a 7.4 per cent increase.
- All three growth scenarios anticipate significant annual employment growth of 9.4 per cent in the *Oil and Gas Operations* sector from 2014 to 2018. Employment under the most likely base case scenario is expected to experience robust growth from 38,943 workers in 2013 to 61,212 in 2018, which is a 57 per cent increase. This is due to many of the major liquefied natural gas projects currently under construction moving into their production phase.

The transition from construction to operations will increase the demand for high-level, specialist operators including roles that require deep and relevant experience. It will be difficult to source many of these skills domestically. Rapid growth will also stretch experienced supervisory capability, which could affect productivity and safety.

1 Bureau of Resources and Energy Economics (BREE), 2013, *Resources and energy quarterly*, June, bree.gov.au/documents/publications/req/REQ-2013-06.pdf, accessed 18 November 2013, p. 57.

The organisation of work is also changing across the Resources Sector. Companies are increasingly turning to technological solutions to increase productivity, improve safety, discover new ore bodies, improve recovery rates, remove waste and decrease energy use. Retraining and upskilling employees to use these technologies—and the increasing ability to locate workers in urban rather than remote locations as a result of implementing these technologies—present significant workforce development and planning challenges for resources companies.

The modelling projects an overall increase in skills supply in the period up to 2018, but that increase may not be sufficient to meet the projected demand for the outlook period in Mining and Oil and Gas Operations. While the extent and severity of skills shortages in occupations relevant to the Resources Sector have eased in recent years, some shortages exist for highly experienced, highly skilled roles in critical occupations, and a range of shortages are forecast in coming years for vital operations occupations. The modelling shows 25 occupations in short supply over 2014–18. Many of these skills may be employed in other industries; however, Drillers, Miners and Shot Firers; Mining Engineers; and Chemical, Gas, Petroleum and Power Generation Plant Operators cannot be sourced from other industries and will require a range of different supply responses from employers, industry and the tertiary education sector.

These responses can build on the good work already underway by industry and employers to address key issues in the skills pipeline to resources employment. At the level of schools, participation in science, technology, engineering and mathematics subjects has declined considerably in recent years, and strategies and frameworks to increase participation in these subjects will strengthen pathways to resources careers. Training and support for career development practitioners—ensuring they have the skills and knowledge to provide relevant advice and communicate the value of professional and trade qualifications—would also benefit the Resources Sector.

There are many good examples of resources companies effectively promoting career opportunities to students in the higher education sector and offering graduate programs and cadetships. Collaboration between industry and the higher education sector to deliver qualifications specific to the Mining and Oil and Gas sectors is also well established. In coming years, this collaboration will be vital to meeting emerging skills needs as the industry continues to change. In particular, as companies increasingly turn to automated solutions, the opportunity exists for industry and higher education providers to scope the development of a postgraduate qualification in automation for a range of engineering graduates.

The vocational education and training sector is also a vital source of skills supply for the Australian Resources Sector, and the sector is a significant investor in training. A 2013 study commissioned by the Minerals Council of Australia found the minerals sector spent more than $1.1 billion on training during the financial year ending 30 June 2012, equivalent to almost 5.5 per cent of total payroll.[2] A separate study on the Resources Sector's take-up of apprenticeships and traineeships found the sector's share grew from 2.4 per cent of all trade apprentices in June 2005 to 6.8 per cent at the end of 2012.[3]

However, industry needs to continue to play an active role in ongoing skills formation strategies for the existing workforce, and consider new approaches to reskilling staff to transition between construction and operations roles, particularly those in the burgeoning Oil and Gas Operations sector. This report examines a range of programs and case studies that could serve as useful models to attract workers with transferrable skills from other sectors and train apprentices and trainees in key disciplines, particularly to improve the supply of long-term trade and technical occupations vital to the Australian Oil and Gas sector.

More can also be done in relation to the high-end, specialist skills needs of the Oil and Gas sector to improve the domestic supply of the skills required for long-running operations occupations. A new, collaborative and strategic approach will be required from industry to grow the pool of workers with

2 National Centre for Vocational Education Research (NCVER), 2013, *Training and education activity in the minerals sector*, NCVER consultancy report to the Minerals Council of Australia, minerals.org.au/file_upload/files/reports/Final_Report_Minerals_Council_2013.pdf, accessed 18 November 2013, p. 11.

3 NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', report commissioned by AWPA, unpublished, p. 10.

these skills. The development of a comprehensive oil and gas workforce development strategy to promote collaboration and coordinate training, reskilling and upskilling will support this objective.

While the average worker in the Resources Sector is a middle-aged male who works full-time, is well remunerated and is highly skilled, the industry has made considerable progress on improving the engagement of under-represented groups in the workforce including women, Indigenous Australians and mature-aged workers. This engagement has been driven—and will continue to be driven—by the increasing need for skilled workers.

The changing profile of the Resources Sector presents a set of key challenges related to skills and workforce development. With adequate planning, the domestic workforce can provide a strong source of skills supply alongside highly experienced personnel from overseas recruited to supervise inexperienced workers and fill gaps in niche, specialist skills. However, this planning must proceed quickly to ensure domestic workers are available to fill time-critical shortages in the second half of this decade. The current environment provides a perfect opportunity for industry and education and training providers to develop strategic, collaborative responses to these skills supply challenges. In the case of the continued adoption of automation across the Resources Sector, it is not just a matter of increasing necessary skills formation strategies for the workforce—it is also a matter of developing the capacity of the education and training sector to provide the skills required by industry. The continued prosperity of the sector, as activity transitions from construction to operations, depends on the effectiveness of these responses.

Recommendations

Recommendation 1

That resources companies and peak organisations engage with the proposed industry working group for schools–industry science, technology, engineering and mathematics skills initiatives; and contribute to the development of a national strategy and framework for these initiatives.

Recommendation 2

That industry work with tertiary education providers to fund, develop and implement a strategy to deliver training and support to career development practitioners. This will ensure they have skills and knowledge to provide current and relevant advice to students on the resources labour market and raise awareness of the value of professional and trade qualifications.

Recommendation 3

That the Minerals Tertiary Education Council member universities and specialist oil and gas university faculties work with industry to scope the development of a postgraduate qualification in automation for mechanical, electrical, mining and oil and gas engineering graduates.

Recommendation 4

That the Australian Government, industry and the tertiary education sector pilot a program based on the United Kingdom's successful Transition Training Programme with the aim of improving the supply of long-term technical operational skills to the Oil and Gas sector.

Recommendation 5

That the Australian Government, in collaboration with industry stakeholders, develop and pilot a national program for apprentices and trainees, modelled on the UK Oil and Gas Upstream Technician Training Scheme and the Western Australian Energy Apprenticeship Group joint venture, to provide clear pathways to the liquefied natural gas sector and ensure supply of long-term technical skills.

Recommendation 6

That industry stakeholders and the tertiary education sector collaborate to develop an industry-driven workforce development strategy to support the development of a domestic workforce to meet future demand for long-running oil and gas operations occupations.

1 Introduction

1.1 Background

The Australian Workforce and Productivity Agency (AWPA) reports annually on the Resources Sector's likely demand for labour and the supply of skills available to meet the sector's needs. The 2013 resources report is the third annual report prepared by AWPA for the Australian Government.

The resources boom which began in 2004 was characterised by high commodity prices for Australian coal and iron ore exports, due to strong demand from China and India as those countries rapidly industrialised and urbanised their economies. Resources companies responded to the increased demand by greatly increasing their investment in new mines and facilities. That was particularly true for iron ore and natural gas, and to a lesser extent coal.[4] Throughout the boom, resources construction activity has been a key factor driving economic growth in Australia. However, since 2012 the environment in which the Resources Sector operates has changed significantly. The Resources Sector in Australia is facing a number of challenges that constrain growth. In particular, it faces the prospect of intensifying competition for global capital against a backdrop of changing policy settings both in Australia and overseas.[5]

The world economy is in an unsettled period, with heightened concerns over the euro-zone debt crisis; a moderation in China's economic growth and a sharp fall in its export growth; weakness in investment, jobs and manufacturing in Europe; and reduced growth in India.[6] These factors indicate a moderating demand for Australian commodities coupled with lower investment by resources companies, as projected by the Bureau of Resources and Energy Economics in its report on major minerals and energy projects being or expected to be developed over the medium term.[7]

In previous reports, we modelled short-term trends in employment growth across the Resources Sector and skills shortages at the national level. Our 2013 report departs from this approach by developing a comprehensive five-year employment demand and supply outlook model. The current model takes into account the planned major resource and energy projects at the national, state, territory and regional level and their employment requirements.

Predicting future activity in the Resources Sector is difficult, and lists of proposed projects must be treated with caution. This is because, as noted by AWPA's research[8] and other reports,[9] final investment decisions—where companies commit to investing in a project—are influenced by changes in commodity prices, markets, technology, joint venture alignment, global supply and competing investment priorities. Therefore, while this report provides projections of expected skills and labour needs of major resources projects for the next five years, it does so on the basis of experience that some projects will likely be delayed or changed, others will not proceed at all and new projects may arise.

4 Gittins R, 2013, 'Mining boom too big to go bust just yet', *Sydney Morning Herald*, 24 August, smh.com.au/business/mining-boom-too-big-to-go-bust-just-yet-20130823-2sh1j.html, accessed 24 August 2013.

5 Penney K, Melanie J, Stark C and Sheales T, 2012, 'Opportunities and challenges facing the Australian resources sector', *Australian Journal of Agricultural and Resource Economics* 56, pp. 152–170.

6 Organisation for Economic Co-operation and Development (OECD), 2012, *Looking to 2060: a global vision of long-term growth*, OECD Economics Department Policy Notes, No. 15, Novemberkeepeek.com/Digital-Asset-Management/oecd/economics/looking-to-2060-long-term-global-growth-prospects_5k8zxpjsggf0-en#page1, accessed 19 November 2013.

7 BREE, 2013, *Resources and energy major projects—April 2013*, bree.gov.au/documents/publications/remp/REMP-2013-04.pdf, accessed 18 November 2013, pp. 33–35.

8 AWPA, 2012, *Resources Sector skill needs*, awpa.gov.au/publications/documents/Resources%20Sector%20Skill%20Needs%20-%202012.pdf, accessed 18 November 2013.

9 Minerals Council of Australia (MCA), 2012, *Opportunity at risk: regaining our competitive edge in minerals resources*, Port Jackson Partners, minerals.org.au/file_upload/files/presentations/mca_opportunity_at_risk_FINAL.pdf, accessed 18 November 2013; Ernst & Young, 2013, *Business risks facing mining and metals 2012–2013*, ey.com/Publication/vwLUAssets/Business-risk-facing-mining-and-metals-2012-2013/$FILE/Business-risk-facing-mining-and-metals-2012-2013.pdf, accessed 7 November 2013; Penney K, Melanie J, Stark C and Sheales T, 2012, 'Opportunities and challenges facing the Australian resources sector', pp. 152–170.

In developing its recommendations, AWPA has focused on *specialised occupations* in the Resources Sector that will be in shortage over the outlook period, consistent with the National Workforce Development Strategy. We advocate targeted measures to improve the supply of skills available through workforce planning and development.[10]

In addition, this report explores topics such as automation and the impact on skills, and the various phases and skills requirements of the project lifecycle—exploration/planning, construction, operations, maintenance/shutdowns and decommissioning.

1.2 Scope of this report

This report examines demand for skills from the Resources Sector and the supply of skills available to meet that demand. Preparation of the report was guided by the Resources Sector Reference Group (see Appendix A for membership of the group).

AWPA commissioned Deloitte Access Economics to model a five-year, short-term outlook on trends in employment growth and occupational supply under three economic growth scenarios: base case, high growth and low growth. Three subsectors were analysed at the national, state, territory and regional level over the five years to 2018, and under the economic growth scenarios:

- Resources Project Construction (including construction services)
- Mining Operations
- Oil and Gas Operations (including extraction and supply).

In addition to the modelling, AWPA drew on the latest research and data to analyse trends in employment, education and migration. Consultations were also undertaken with a number of industry bodies, employers and unions to better understand the sector's workforce needs and issues of concern to the sector.

Throughout this report, we refer to the Resources Sector as identified by the Australian and New Zealand Standard Industrial Classification 2006 definition of the Mining industry, which is divided into seven sectors: Coal Mining; Oil and Gas Extraction; Metal Ore Mining; Construction Material Mining; Other Non-Metallic Mineral Mining; Exploration; and Other Mining Support Services.[11] Two Construction industry subsectors, Heavy and Civil Engineering Construction and Construction Services, are used as a proxy for Resources Sector Construction.

1.3 Structure of the report

The report is presented in two parts.

Part One sets the context within which the Resources Sector operates, by examining the broad economic drivers influencing the sector at both the international and national level, the characteristics of the sector and the impact of new technologies on work. The location and values of major resources projects that are expected to begin within the next five years are mapped, and the labour and skills needs for the various phases of the projects are analysed and modelled at both the national and regional level against the three economic growth scenarios.

The extent of existing skills shortages, the likely replacement demand for skills, and the potential skills supply to the Resources Sector from higher education, vocational education and training and migration are also discussed. Part One concludes with an assessment of whether the expected supply of skills will be sufficient to meet the demand. By drawing on the results of the modelling, we identify the future skills supply–demand balances and imbalances in certain occupations in the period ahead.

10 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, awpa.gov.au/our-work/national-workforce-development-strategy/Pages/default.aspx, accessed 18 November 2013, pp. 9–17.

11 Australian Bureau of Statistics (ABS), 2006, *Australian and New Zealand Standard Industrial Classification (ANZSIC), Revision 2.0,* cat. no. 1292.0.

Part Two focuses on workforce planning and development. It discusses targeted measures to increase the supply of skills in the Resources Sector, enhance industry approaches to workforce planning and development, and promote collaborative arrangements between industry, governments and other stakeholders. Part Two also examines strategies by resources companies to increase the participation of under-represented groups in the sector, including women and Indigenous Australians. A feature of Part Two is the use of case studies to highlight best practice approaches to skills formation in the industry.

The report also contains AWPA's recommendations, which focus on measures to improve the supply of skills available through workforce planning and development. The recommendations are integrated into the report and collated in Chapter 9.

Part One:

Skills needs of the Resources Sector

2 Australia's Resources Sector

2.1 Introduction

In this chapter, we set the context within which the Resources Sector operates in Australia, and examine the economic drivers influencing it. We draw attention to the sector as one of the most important and economically influential industries in Australia despite its relatively small share of employment compared with other industries. The characteristics and occupational profile of the sector and the impact of new technologies on work are also examined.

2.2 Overview of Australia's Resources Sector

In Australia, mining has been economically important since the mid-1800s and a key driver of economic activity over the past few decades. A combination of factors such as substantial mineral and energy resources, including international demand for—and world supply of—mining products, a skilled workforce, technological innovation and low sovereign risk have contributed to Australia's dominant position in the global market.

Australia's mineral endowment is particularly valuable and diverse—our Economic Demonstrated Resources[12] of mineral sands (rutile and zircon), nickel, zinc and lead are among the largest in the world, and bauxite, copper, gold, iron ore and industrial diamond production rank in the top six worldwide.[13] Manganese, platinum, silver, tungsten, phosphorus, sand, salt, tantalum and rare earth minerals are also extracted in exportable quantities.[14] Iron ore is Australia's largest export commodity in terms of revenue (surpassing metallurgical coal in 2010) and 85–90 per cent of Australia's annual iron ore product is exported.[15]

Our coal reserves are significant. As of 2010, Australia had approximately 6 per cent of the world's recoverable black coal and was one of the world's leading exporters of black coal[16] and the fourth largest producer.[17] Australia currently has around 107 coal mines, with many more proposed or under construction.

Australia's energy resources are also significant. Even though deposits of crude oil are small by world standards (about 0.3 per cent), their value is supported by substantial condensate and gas resources associated with the major largely undeveloped gas fields in the Carnarvon, Browse and Bonaparte basins off the northwest coast of Western Australia.[18]

Production of natural gas in Australia has increased over the past decade, albeit from a low base, and is expected to increase significantly in coming years.[19] In 2011–12, Australian gas production was about 55.8 billion cubic metres, of which 1.7 billion was sourced from coal seam gas. In 2012–13, production is forecast to increase by 17 per cent, relative to 2011–12, to a total of 65.4 billion cubic metres, and in 2013–14 production is projected to be about 78.3 billion cubic metres.[20] When the seven new liquefied natural gas processing facilities currently under construction are completed

12 Economic Demonstrated Resources are the quantity of resources judged to be economically extractable, either broadly for a resource or in a particular deposit.

13 Department of Industry, 2012, *Australian mineral commodities*, ret.gov.au/resources/mining/australian_mineral_commodities/Pages/AustraliaMineralCommodities.aspx, accessed 14 November 2013.

14 Geoscience Australia, 2013, *Australia's identified mineral resources*, ga.gov.au/minerals/mineral-resources/aimr.html, accessed 26 August 2013.

15 Department of Industry, 2012, *Australian mineral commodities*.

16 International Energy Agency, 2012, *Key world energy statistics*, iea.org/publications/freepublications/publication/kwes.pdf, accessed 18 November 2013.

17 Geoscience Australia, 2013, *Coal resources*, ga.gov.au/energy/coal-resources.html, accessed 26 August 2013.

18 Geoscience Australia, 2013, *Oil*, ga.gov.au/energy/petroleum-resources/oil.html, accessed 26 August 2013.

19 Reserve Bank of Australia (RBA), 2013, *Australian exports: global demand and the high exchange rate*, June, rba.gov.au/publications/bulletin/2013/jun/1.html, accessed 24 October 2013.

20 BREE, 2013, *Resources and energy quarterly*, June, p. 18.

over the next few years, Australia will move from being the world's third largest to second largest exporter of liquefied natural gas.[21]

The recent growth in Australia's gas production is mainly due to the rapidly increasing demand for liquefied natural gas from the Asian market, with 77 per cent of Australia's liquefied natural gas exports going to Japan and a further 13 per cent going to China.[22] The Bureau of Resources and Energy Economics projects the value of Australia's liquefied natural gas exports to increase to about $15.2 billion in 2012–13 and $18 billion in 2013–14.[23]

While Australia does not use uranium in its electricity production, it is still a substantial energy export market. Australia holds the world's largest Reasonably Assured Resources[24] (31 per cent), accounts for 16 per cent of the world's production and is the third largest producer after Kazakhstan and Canada.[25] Production in Australia is set to double by 2030, and, barring changes in Australia's electricity production mix, all of Australia's uranium is exported (except for extremely small amounts retained for medical and research use). In 2010–11, Australia exported 6,950 tonnes of uranium, valued at $610 million.[26]

2.3 Economic drivers influencing the Resources Sector

Exploration, extraction and processing of mineral and energy resources make a significant contribution to the Australian economy. In 2011–12, exports of mineral and energy commodities were valued at $187.1 billion (using chain volume measures), accounting for 60 per cent of the total value of Australian exports.[27] The global economic outlook is of major significance to the Resources Sector.

However, Australia's dominant position in the global resources market can no longer be taken for granted due to a number of challenges, as outlined below.

Challenging global economic environment

The Organisation for Economic Co-operation and Development noted in 2012 that the global economy currently faces serious challenges and that policy action is needed to restore confidence and put global economic recovery onto a sustainable growth path. It also indicated that many countries face a long period of adjustment to absorb the after-effects of the global financial crisis, particularly in terms of high unemployment, excess capacity and large fiscal imbalances.[28]

The International Monetary Fund, in its October 2013 *World economic outlook*, projects global output growth to remain subdued.[29] The prevailing environment of global economic uncertainty, softening commodity prices, higher input costs, and strengthening local currencies in many mining and metals jurisdictions, is increasing the pressure on operating margins in the Resources Sector.

According to Ernst & Young, the risks facing the global Resources Sector have become complex over the past 12 months due to a combination of factors including the fast-changing investment and operational environment. Softening commodity prices and capacity changes in terms of skills and

21 If development of the Browse gas fields goes ahead in Woodside's proposed floating LNG facility, Australia may become the world's largest exporter.

22 US Energy Information Administration, 2013, *Australia analysis brief*, eia.gov/countries/analysisbriefs/Australia/australia.pdf, accessed 18 November 2013.

23 BREE, 2013, *Resources and energy quarterly*, June, p. 18.

24 Reasonably Assured Resources refers specifically to deposits of uranium with a size, grade and configuration that is recoverable within given production cost ranges.

25 Geoscience Australia, 2013, *Uranium resources*, ga.gov.au/energy/uranium-thorium/uranium-resources.html, accessed 26 August 2013.

26 Department of Industry, 2012, *Australia's uranium industry*, ret.gov.au/resources/Documents/Mining/uranium/Uranium-Industry-factsheet.pdf, accessed 18 November 2013.

27 BREE, 2013, *Resources and energy quarterly*, June, p. 57.

28 OECD, 2012, *Looking to 2060: a global vision of long-term growth*, pp. 1, 6–8.

29 International Monetary Fund, 2013, *World economic outlook October 2013: transitions and tensions*, October, imf.org/external/pubs/ft/weo/2013/02/pdf/text.pdf, accessed 13 November 2013, p. xv.

infrastructure are cited among the factors that have affected organisations' commitment to capital projects, resulting in mining and metals companies taking on more risk relative to the short-term returns.[30]

Despite macroeconomic uncertainty and the potential for a softening in demand, global supply is increasing. For example, the Peruvian government is forecasting investment in its mining sector of US$53 billion over the next five years,[31] and increasing mining developments are also projected in emerging markets in Asia, other Latin American economies, the South Pacific and Africa.[32]

Demand from emerging economies due to urbanisation and industrialisation

The Minerals Council of Australia has noted that the fundamental drivers of growth in the demand for minerals are urbanisation and industrialisation, given that the world's urban population is set to rise by 70 million people each year from 2010 to 2050. These drivers are particularly strong in the current resource-hungry nations of China and India. The Minerals Council of Australia also noted that, by some estimates, increasing urbanisation of China will result in 163 cities in the country with one million inhabitants or more by 2025, compared with just 63 cities of that size in Europe.[33] Accordingly, increasing Chinese demand has led to a large and sustained increase in the prices paid for Australia's steelmaking and energy resources, increasing mining sector profits and attracting capital and labour resources from other parts of the Australian and global economies into the Australian mining and mining services industries.[34]

However, there are mixed views on the outlook for Chinese growth. Some commentators have concerns about the slowdown in Chinese growth, though it should be noted China achieved record growth of 9.9 per cent over the three decades to 2008.[35] This growth has since declined by 2 per cent to 7.6 per cent in the second quarter of 2012.[36] Even though China's gross domestic product is expected to increase by around 7.5 per cent in 2013, compared with 7.8 per cent in 2012, this figure will taper off to 5–6 per cent annually by the end of the decade.[37] It has also been suggested that Chinese policy makers want to push ahead with broader, longer term reforms to boost the role of domestic consumption and reduce reliance on exports and investment—thus negatively affecting Australia's resource exports.[38]

Commodity prices

High commodity prices have been the mainstay of the resources boom in Australia; they have been steadily increasing since 2003 (Figure 1). However, commodity prices have fluctuated since 2012, creating a difficult and different environment for the Resources Sector compared to the commodity price peak in mid-2011. Even though the Reserve Bank of Australia observed in November 2013 that commodity prices overall remain at historically high levels, the prices of those commodities (for which there has been significant investment in capacity in Australia and globally) are projected to decline gradually over the coming years.[39]

30 Ernst & Young, 2013, *Business risks facing mining and metals 2012–2013,* pp. 32–38.

31 Batten K, 2012, 'Peru dangles its investment credentials', *MiningNews*, 23 May, m.miningnews.net//story?id=8683916, accessed 26 August 2013.

32 BREE, 2012, *Australian bulk commodity exports and infrastructure—outlook to 2025*, bree.gov.au/documents/publications/_other/export-infrastructure-report.pdf, accessed 18 November 2013, pp. 54–104.

33 MCA, 2013, *Submission to the Productivity Commission mineral and energy resource exploration inquiry*, pc.gov.au/__data/assets/pdf_file/0020/122636/sub027-resource-exploration.pdf, accessed 18 November 2013, p. 10.

34 Ergas H and Owen J, 2012, *Rebooting the boom*, Minerals Council of Australia, minerals.org.au/file_upload/files/publications/mca_rebooting_the_boom_FINAL.pdf, accessed 18 November 2013, p. 5.

35 Liu M, 2011, *Understanding the pattern of growth and equity in the People's Republic of China*, Asian Development Bank Institute Working Paper 331, adbi.org/files/2011.12.08.wp331.understanding.pattern.growth.equity.prc.pdf, accessed 18 November 2013, p. 4.

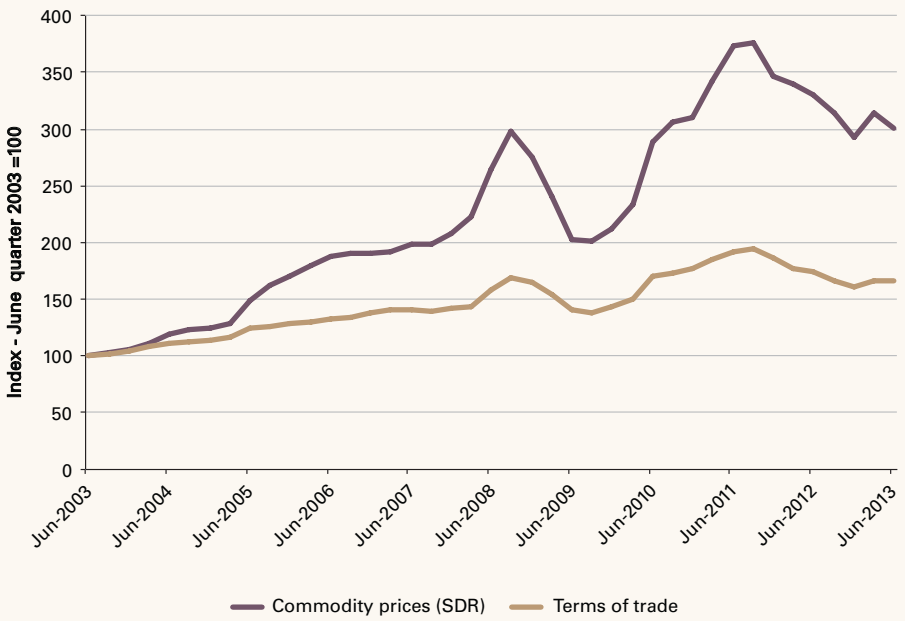
36 British Broadcasting Corporation, 2012, 'Chinese growth slows to 7.6% in second quarter', *BBC News*, 13 July, bbc.co.uk/news/business-18824088, accessed 27 September 2012.

37 Flannery R, 2013, 'China faces years of slowing GDP growth, top strategist says', *Forbes*, 11 August, forbes.com/sites/russellflannery/2013/08/11/china-faces-years-of-slowing-gdp-growth-top-strategist-says, accessed 26 August 2013.

38 Kazer W, 2013, 'Data suggest China's economy stabilizing', *Wall Street Journal*, 9 August, online.wsj.com/article/SB10001424127887323477604579001581589066934.html, accessed 26 August 2013.

39 RBA, 2013, *Statement on monetary policy*, November, rba.gov.au/publications/smp/2013/nov/pdf/1113.pdf, accessed 18 November 2013, pp. 11–12.

Figure 1 Commodity price index—all items (SDR) and Australian terms of trade, June quarter 2003 to June quarter 2013



Notes:
Commodity price index—all items (SDR) and Australian terms of trade have been re-indexed (June quarter 2003 = 100). Commodity price index data—all items (SDR) has been converted from monthly data to quarterly data by taking a three-month average.

SDR—Special Drawing Right. Used as an international reserve asset to settle transactions between countries and help balance international liquidity.

Sources: RBA, 2013, Other price indicators—G4 and RBA, 2013, Index of commodity prices—G5, Statistical Tables.

The spot prices for iron ore and coking coal have declined sharply since 2012, largely as a result of the slowing of the rate of urbanisation in Asian economies.[40] The decline has caused a number of mining companies to delay final decisions on investment projects under consideration, or review projects for which they had earlier made commitments to proceed.[41] From late 2012, mining companies such as BHP Billiton,[42] Xstrata (now trading as Glencore Xstrata plc),[43] Fortescue Metals Group,[44] and Rio Tinto[45] announced job cuts due to delayed or cancelled projects.

Despite recent falls in commodity prices, and subsequent scaling back of some investment plans, the outlook for investment and growth in the Mining industry (and related sectors) remains strong. Indeed, while mining investment is expected to peak in 2013–14 at record highs, it is projected to remain elevated through to at least the middle of the decade, mainly because a number of significant resource projects are either currently under construction or soon to commence construction,

40 Plumb M, Kent C and Bishop J, 2012, *Implications for the Australian economy of strong growth in Asia*, RBA, rba.gov.au/publications/rdp/2013/pdf/rdp2013-03.pdf, accessed 18 November 2013, pp. 3, 38.

41 BREE, 2013, *Resources and energy major projects—April 2013*, p. 1.

42 ABC, 2013, 'BHP slashes jobs at Olympic Dam mine', ABC News, 7 February, abc.net.au/news/2013-02-06/bhp-billiton-slashes-jobs-at-sa27s-olympic-dam/4504834, accessed 1 November 2013.

43 Garvey P, 2013, 'Coal gloom as Glencore cuts 450 jobs', *The Australian*, 28 June, theaustralian.com.au/business/mining-energy/coal-gloom-as-glencore-cuts-450-jobs/story-e6frg9df-1226671088011, accessed 1 November 2013.

44 ABC, 2012, 'Fortescue delays expansion, cuts "several hundred' jobs", *ABC News*, 4 August, abc.net.au/news/2012-09-04/fortescue-delays-expansion-plans-due-to-price-fall/4241848, accessed 1 November 2013.

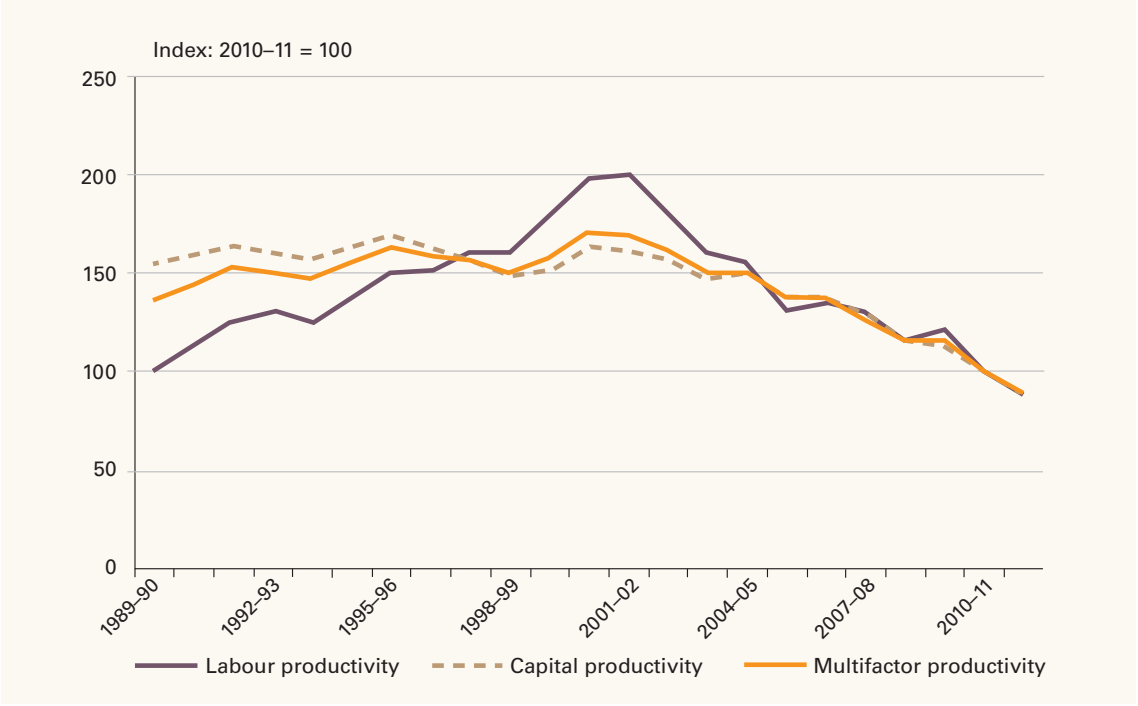
45 ABC, 2013, 'Rio Tinto cuts iron ore jobs', *ABC News,* 19 June, abc.net.au/news/2013-06-19/rio-job-cuts/4763634, accessed 1 November 2013.

including the ongoing $52 billion Gorgon LNG project, Inpex's $34 billion Darwin gas project and Origin Energy's $23 billion Australian Pacific LNG project at Gladstone.[46] In September 2013, the Minister for Industry, the Hon Ian Macfarlane MP, advised mining companies to 'use it or lose it'—that is, companies that shelve development projects will be in danger of losing their retention leases on deposits to other companies unless they go ahead with the projects. The Australian Government's aim is to boost resources investment by preventing resources companies from sitting on undeveloped deposits.[47]

Productivity and innovation

In AWPA's 2012 Resources Sector report, we suggested there was likely to be strong growth in productivity in the Resources Sector.[48] While it is a high-productivity industry in general, the sector's productivity has suffered in recent years. Both capital and labour productivity in the Mining sector in Australia have been experiencing an apparent downward trend over the last decade; labour productivity is half of what it was in 2000–01, and capital productivity is not much healthier (Figure 2).[49] Much of this apparent decline can be attributed to the nature of the industry: as deposits are depleted, the remaining resources take more effort—in labour, time and capital expense—to extract, providing diminishing returns for the life of the mine. In addition, resources projects can be very expensive and take a long time to build before they start producing output, which can affect labour productivity figures.[50]

Figure 2 Resources Sector* productivity index, 1989–90 to 2011–12



* Due to the lack of available data, productivity estimates in the Mining industry have been used as a proxy for productivity in the Resources Sector.

Source: ABS, 2013, Estimates of industry multifactor productivity, Australia: detailed productivity estimates, cat. no. 5260.0.55.002.

46 BREE, 2013, *Resources and energy major projects—April 2013*.

47 Crowe D, 2013, 'Use it or lose it, miners warned by Coalition', *The Australian,* 18 September, theaustralian.com.au/national-affairs/use-it-or-lose-it-miners-warned-by-coalition/story-fn59niix-1226721368923, accessed 25 August 2013.

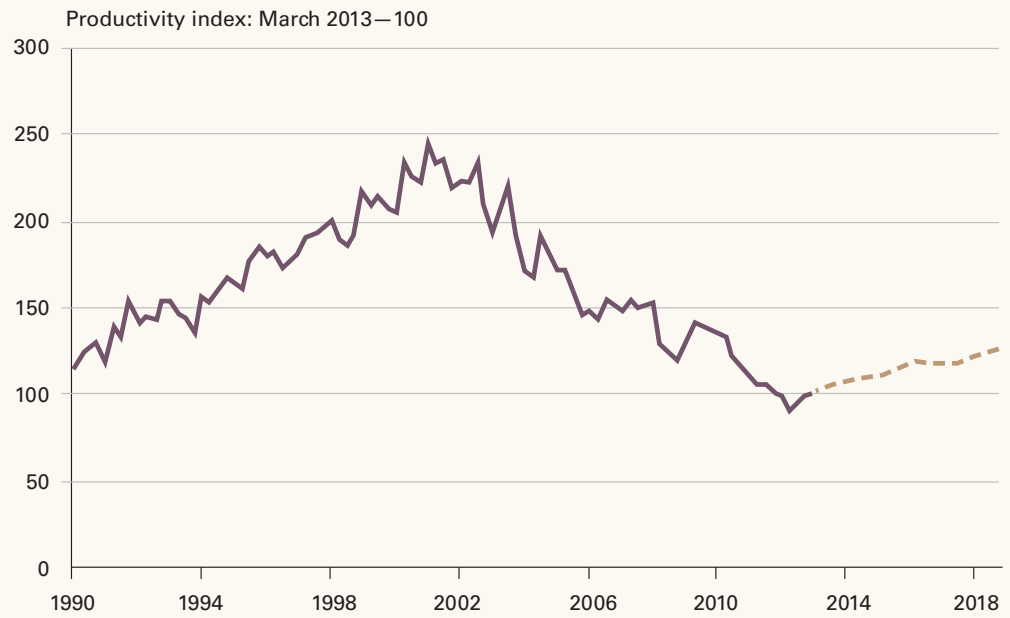
48 AWPA, 2012, *Resources Sector skill needs*, p. 13.

49 Deloitte Access Economics (DAE), 2013, *Modelling employment demand and supply in the Resources Sector*, report commissioned by AWPA, awpa.gov.au, pp. 12–16.

50 Topp V, Soames L, Parham D and Bloch H, 2008, *Productivity in the mining industry: measurement and interpretation*, Productivity Commission Staff Working Paper, December, pc.gov.au/__data/assets/pdf_file/0005/84911/mining-productivity.pdf, accessed 18 November 2013, pp. 35–64.

However, Deloitte Access Economics modelling projects an improvement in labour productivity from 2013 onwards, as the recent boom in resources investment turns into significant production dividends. The projections for labour productivity growth in the Resources Sector are shown in Figure 3.

Figure 3 Resources Sector labour productivity, actual 1990–2013 and forecasts to 2018



Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

In a report for the Minerals Council of Australia on opportunities in minerals resources, Port Jackson Partners asserted that improving labour productivity and innovation are keys to future growth in the Mining sector. The report noted that competitors to Australian resources products, such as the Middle East and China, were demonstrating the effectiveness of new technology and new investment models as keys to their success.[51]

Stakeholders consulted by AWPA in preparing this report observed that companies are increasingly turning to technological solutions to increase productivity, improve safety, discover new ore bodies, improve recovery rates, remove waste and decrease energy use. Rio Tinto's 'Mine of the Future' program, for example, invested US$518 million in driverless trains[52] and trucks for its Australian iron ore business, as well as large-scale testing of new technologies in underground tunnelling and recovery.[53] The Oil and Gas sector has also seen similar technological investment. Examples include Woodside Petroleum's use of remotely operated gas processing and production platforms off Western Australia's Pilbara coast.[54] These technological trends and their impact on work requirements in the Resources Sector are discussed in further detail later in this chapter.

51 MCA, 2012, *Opportunity at risk: regaining our competitive edge in minerals resources,* minerals.org.au/file_upload/files/presentations/mca_opportunity_at_risk_FINAL.pdf, accessed 18 November 2013, pp. 28–30.

52 Rio Tinto, 2012, *Rio Tinto invests US$518 million in autonomous trains for Pilbara iron ore rail network in Western Australia*, media release, 20 February, riotinto.com/media/media-releases-237_1039.aspx, accessed 26 August 2013.

53 Rio Tinto, 2012, *Rio Tinto expands Mine of the Future™ programme with new technologies in underground tunnelling and mineral recovery*, media release, 21 February, riotinto.com/documents/120221_Rio_Tinto_updates_Mine_of_the_FutureTM_programme_with_new_technologies_in_underground_tunnelling_and_mineral_recovery.pdf, accessed 18 November 2013.

54 Woodside Petroleum, 2013, *Angel*, woodside.com.au/Our-Business/North-West-Shelf/Offshore/Pages/Angel.aspx, accessed 26 August 2013.

2.4 Impact of the Resources Sector on states and territories

The Reserve Bank's analysis suggests the Resources Sector as a whole currently accounts for around 18 per cent of Australia's gross value added in 2011–12, with about a third coming from resource-related activities.[55] However, the benefits of resources growth have not been evenly distributed across all states and territories, resulting in an ongoing multi-speed economy. Table 1 indicates the contribution of the Mining industry to the gross state product[56] of each state and territory. The 'resources states' are clearly identifiable: the Mining industry accounts for over 35 per cent of Western Australia's gross state product, 19 per cent of the Northern Territory's, and just under 10 per cent of Queensland's. As a whole, the Mining industry accounts for 9.6 per cent of Australia's gross domestic product.

Table 1 Contribution of Mining to gross state product, 2011–12

State/territory	Mining ($m)	Total GSP ($m)	Mining contribution to GSP (%)
New South Wales	14,225	446,169	3.2
Victoria	6,456	322,833	2.0
Queensland	27,884	280,622	9.9
South Australia	4,384	91,217	4.8
Western Australia	83,136	236,338	35.2
Tasmania	408	24,345	1.7
Northern Territory	3,436	18,086	19.0
Australian Capital Territory	18	31,511	0.1

Note: The definition of the Mining industry used for this table is its ANZSIC definition, i.e. excluding Heavy and Civil Engineering Construction and Gas Supply.

Source: ABS, 2012, *Australian national accounts: state accounts, 2011–12*, cat. no. 5220.0.

2.5 Resources Sector characteristics

Throughout this report AWPA refers to the Resources Sector as identified by the Australian and New Zealand Standard Industrial Classification 2006 definition of the Mining industry as well as subsectors from the Construction industry—Heavy and Civil Engineering Construction and Construction Services. The Construction industry subsectors are used as a proxy for Resources Sector construction.[57]

Mining is one of the most important industries in Australia due to its sizeable economic contribution, even though the number of people directly employed in the industry is small relative to most other industries (261,800, or 2.2 per cent of the total workforce). Despite its employment size, Mining contributes substantially to employment in other industries, such as Construction (development of mine sites and infrastructure), Transport, Postal and Warehousing (materials handling and transport), Manufacturing (downstream processing) and Professional, Scientific and Technical Services (engineering and technical support services).[58] The Reserve Bank notes the Resources Sector directly and indirectly employs almost 10 per cent of Australian workers, around two-thirds of

55 Kent C, 2013, 'Reflections on China and mining investment in Australia', address to the Committee for Economic Development of Australia, Perth, 15 February, rba.gov.au/speeches/2013/sp-ag-150213.html, accessed 7 November 2013; Rayner V and Bishop J, 2013, *Industry dimensions of the resource boom: an input-output analysis*, RBA, rba.gov.au/publications/rdp/2013/pdf/rdp2013-02.pdf, accessed 18 November 2013.

56 Gross state product, or GSP, is a measurement of the economic output of a state or territory. It is the sum of all value added by industries within the state or territory.

57 ABS, 2006, *Australian and New Zealand Standard Industrial Classification (ANZSIC), Revision 2.0*, cat. no. 1292.0.

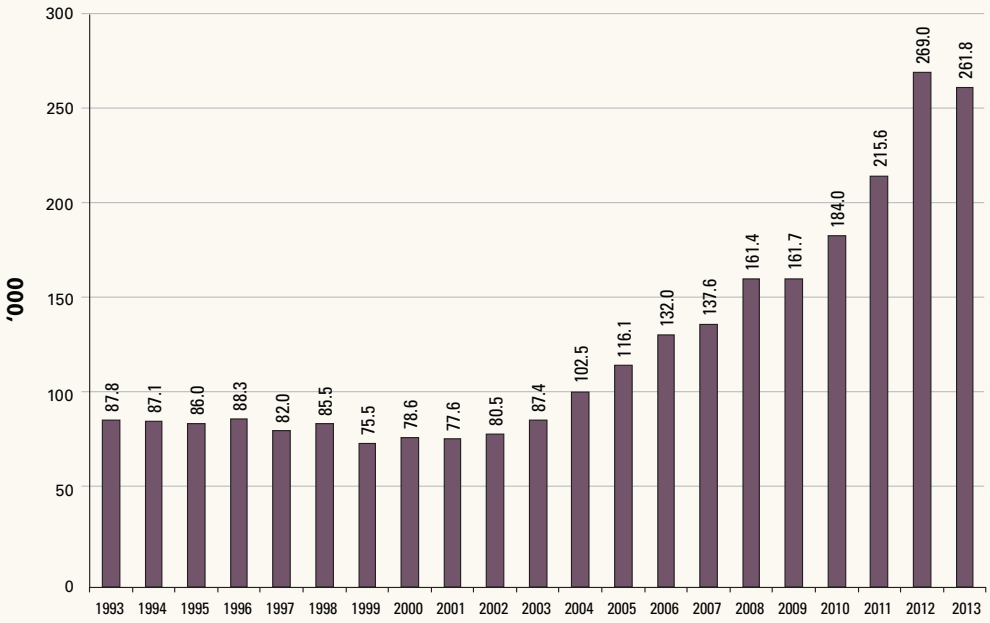
58 ABS, 2013, *Labour force, Australia, detailed, quarterly,* cat. no. 6291.0.55.003, May.

whom are engaged in resource-related activities.[59] The Resources Project Construction workforce characteristics are presented in Appendix B.

Employment growth

Mining has experienced the fastest rate of jobs growth of all industries over the past decade.[60] In the 10 years to May 2013, employment in Mining increased by 174,400—an annual growth rate of 11.6 per cent (see Figure 4).

Figure 4 Number employed in Mining, May 1993 to May 2013



Source: ABS, 2013, *Labour force survey*, cat. no. 6291.0.55.003, trend data.

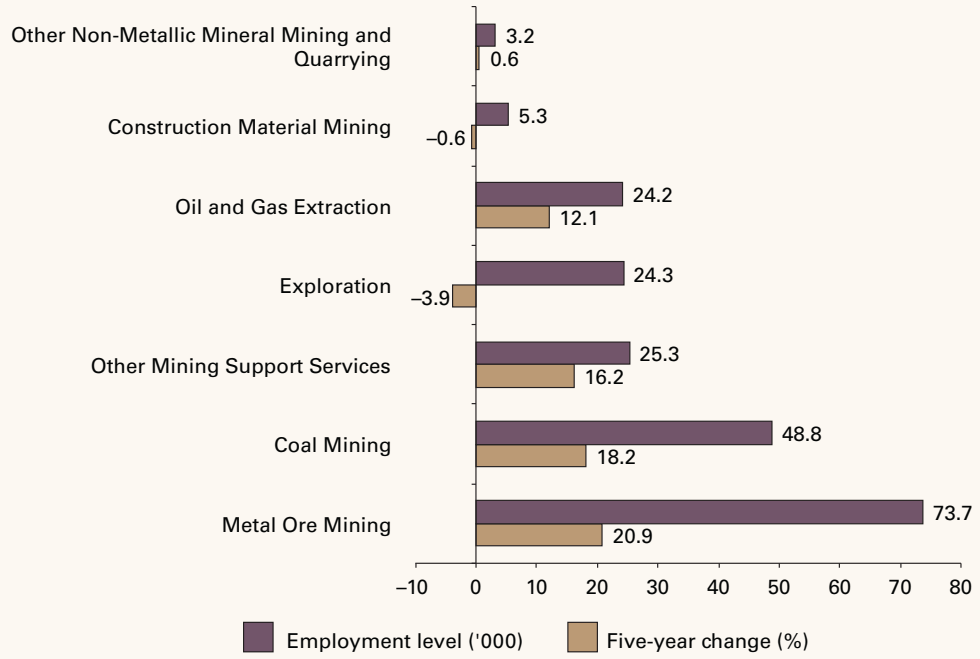
Over the past year, however, employment has declined (down by 7,200 people, or 2.7 per cent). In part the softening of employment conditions reflects the completion of large projects as mines transition from a construction phase to a less labour-intensive operations phase.

59 Kent C, 2013, 'Reflections on China and mining investment in Australia'; Rayner V and Bishop J, 2013, *Industry dimensions of the resource boom: an input-output analysis*.

60 Department of Employment, 2013, *Industry outlook—mining*, lmip.gov.au/PortalFile.axd?FieldID=1394575, accessed 7 November 2013.

The largest contributor to employment in the Mining industry is the Metal Ore Mining sector, which employs 73,700 people (or 36.0 per cent of industry employment), followed by Coal Mining (48,800 people or 23.8 per cent) and Other Mining Support Services[61] (25,300 or 12.4 per cent). Figure 5 shows that growth in employment over the past five years has been strong in the Metal Ore Mining sector (which grew by 20,900 people) and in the Coal Mining sector (18,200).

Figure 5 Employment level at May 2013 and percentage change between 2007–08 and 2012–13 by Mining sector

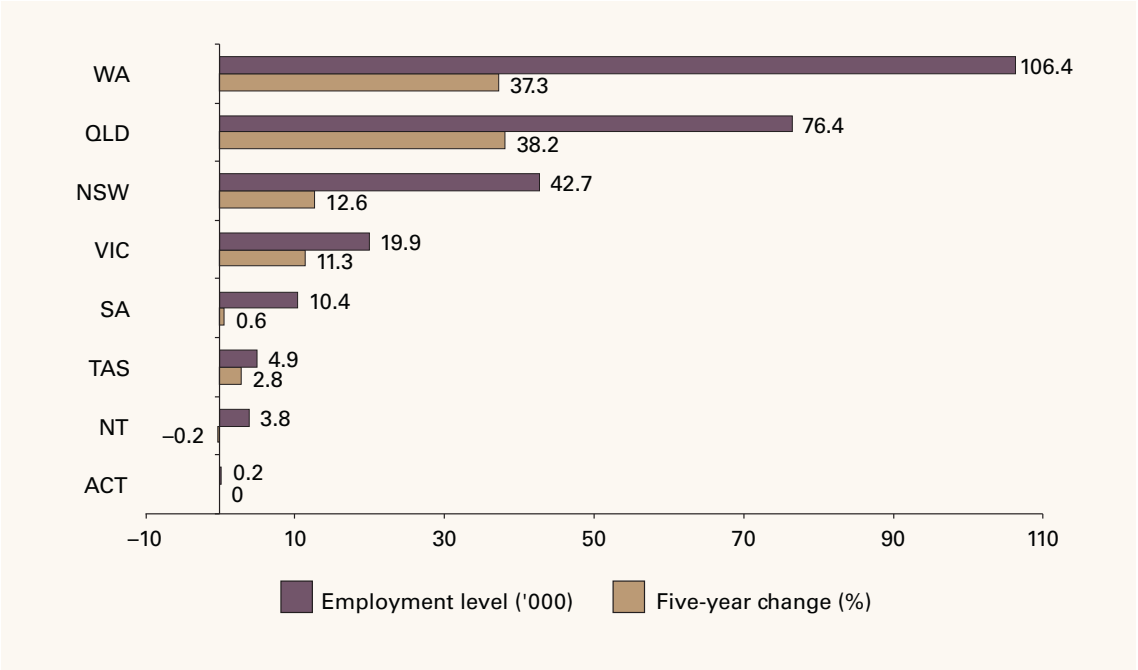


Sources: ABS, 2013, *Labour force survey*, cat. no. 6291.0.55.003; Department of Employment trend data.

61 Other Mining Support Services includes directional drilling and redrilling; mining draining and pumping services; and oil and gas field support services.

Three states account for the vast majority of Mining employment in Australia: Western Australia (106,400 workers), Queensland (76,400) and New South Wales (42,700). Together, these states account for 85.2 per cent of national employment in Mining and have accounted for 85.9 per cent of the growth in Mining employment over the past five years (see Figure 6).

Figure 6 Mining employment level at May 2013 and percentage change between 2007–08 and 2012–13 by state/territory

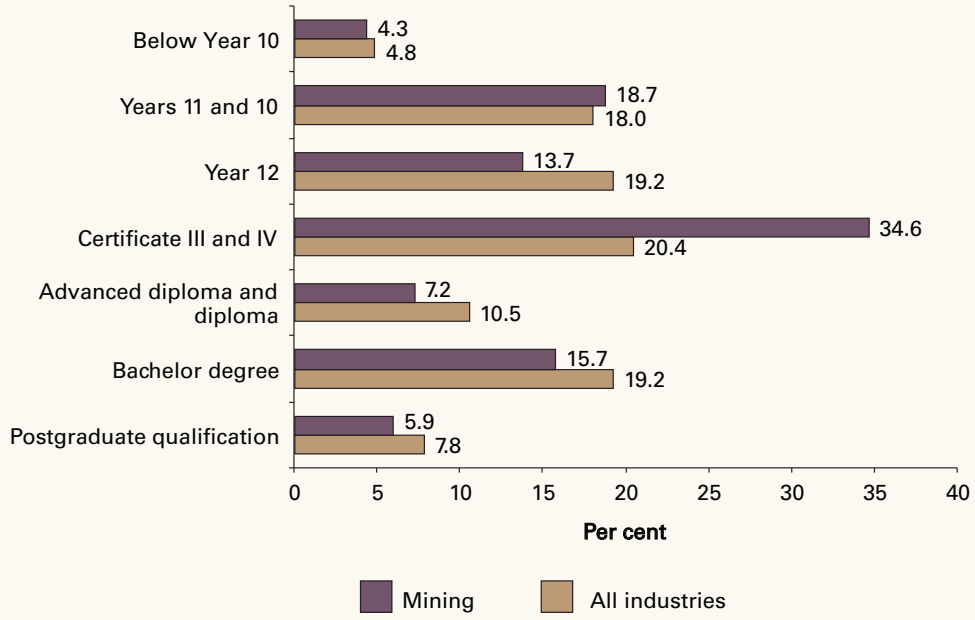


Sources: ABS, 2013, *Labour force survey*, cat. no. 6291.0.55.003; Department of Employment trend data.

Educational qualifications

Overall, a high proportion of Mining sector workers are highly skilled—63.3 per cent have attained a Certificate III level qualification or higher, compared with 58.0 per cent across all industries. Nonetheless, more than one-third (36.7 per cent) of workers employed in the industry have a formal educational attainment level of Year 12 or below, indicating the industry provides employment opportunities at all skill levels. Just over one-third (34.6 per cent) of workers in the Mining industry hold a Certificate III or IV qualification (compared with 20.4 per cent of workers across all industries), reflecting the importance of vocational education and training qualifications to the Mining industry (see Figure 7).[62]

Figure 7 Highest educational attainment by percentage share of employment, Mining versus all industries, 2011 Census



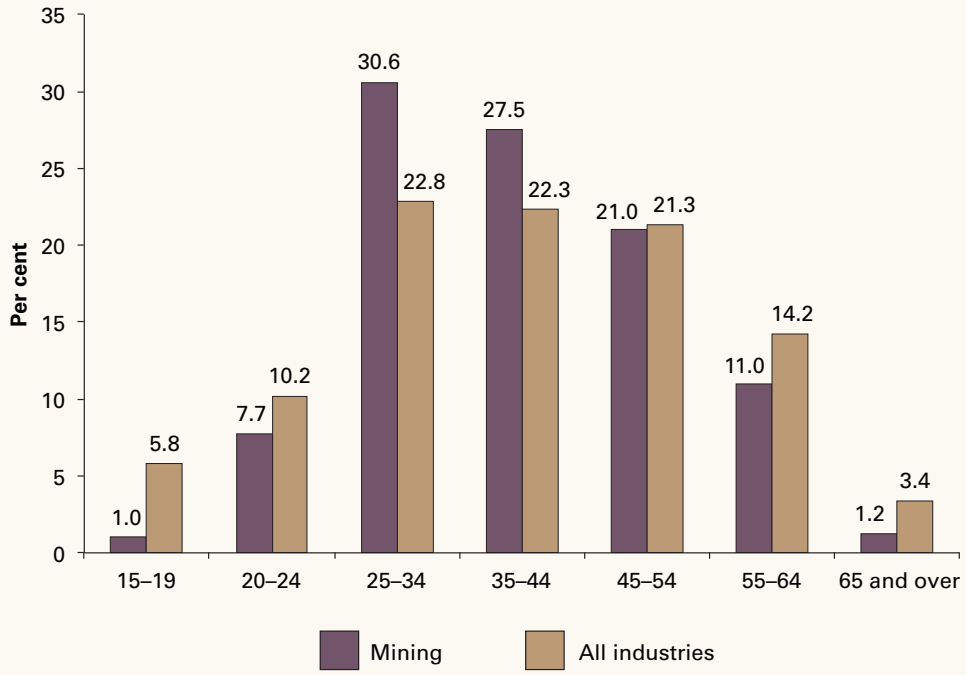
Source: ABS, 2011, *Census of population and housing*.

62 Based on ABS 2011 Census data on level of highest educational attainment, which combines non-school qualification, level of education, and highest year of school completed to produce a single measure of a person's overall level of educational attainment.

Workforce ageing

The age profile of the Mining industry is quite different from that of employment as a whole (see Figure 8). The Mining industry employs a significantly higher proportion of workers aged 25 to 44 years (58.1 per cent) than the all industries average (45.1 per cent). By contrast, the proportion aged 15 to 19 years is well below the all industries average (1.0 per cent compared with 5.8 per cent for all industries), reflecting the industry's need and/or preference for qualified and experienced workers. The over-55 age group is also well below the all industries average (12.2 per cent compared with 17.6 per cent).

Figure 8 Employed persons by age, Mining versus all industries, percentage share of employment, May 2013

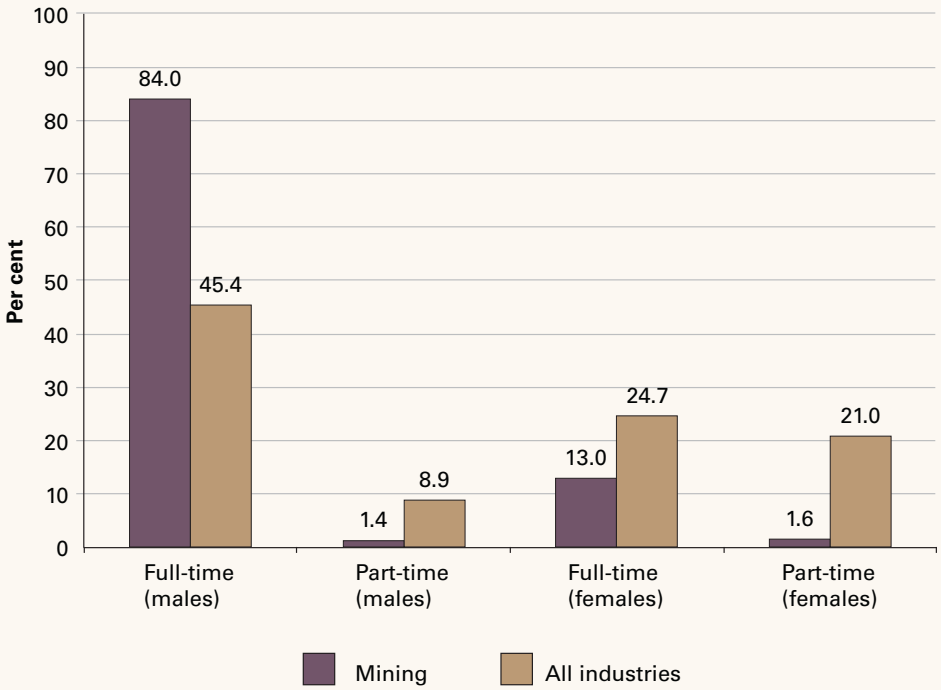


Source: ABS, 2013, *Labour force survey*, cat. no. 6291.0.55.003, four-quarter average.

Gender and full-time/part-time status

Almost all jobs in the Mining industry (97.0 per cent) are full-time, the largest proportion of all industries (see Figure 9). Males account for the vast majority of employment in the industry (85.4 per cent), compared with 54.3 per cent for all industries. While females only account for a small proportion of employment, their share has increased over the past 10 years, up from 11.1 per cent in May 2003, to 14.6 per cent in May 2013.

Figure 9 Full-time/part-time workers by gender, Mining versus all industries, percentage share of employment, May 2013

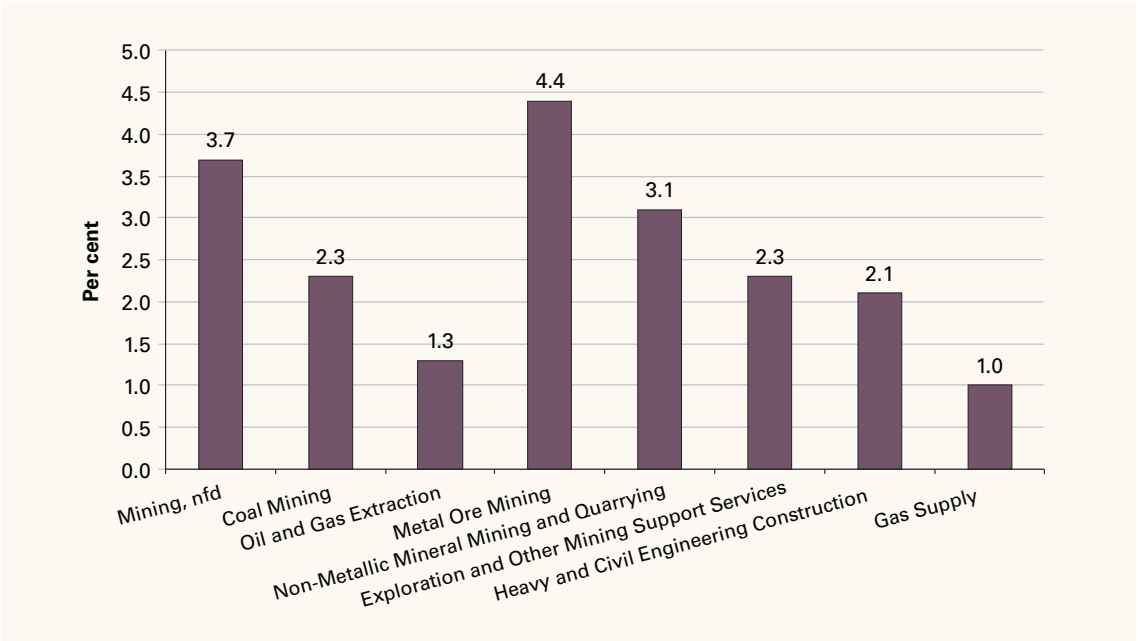


Source: ABS, 2013, *Labour force survey*, cat. no. 6291.0.55.003, four-quarter average.

Indigenous employment

The Mining industry employs a higher proportion of Indigenous workers in relation to its total workforce (3.1 per cent) than the all industries average (1.4 per cent). Based on 2011 Census data, there were 7,214 Indigenous workers employed in the Resources Sector. Figure 10 breaks down employment by sector, and shows that the majority of Indigenous workers are employed in Metal Ore Mining (4.4 per cent), followed by Mining, not further defined (3.7 per cent). The Oil and Gas Extraction and Gas Supply sectors have the lowest Indigenous participation rates.

Figure 10 Indigenous workers employed in Mining by sector and percentage share of employment, 2011 Census

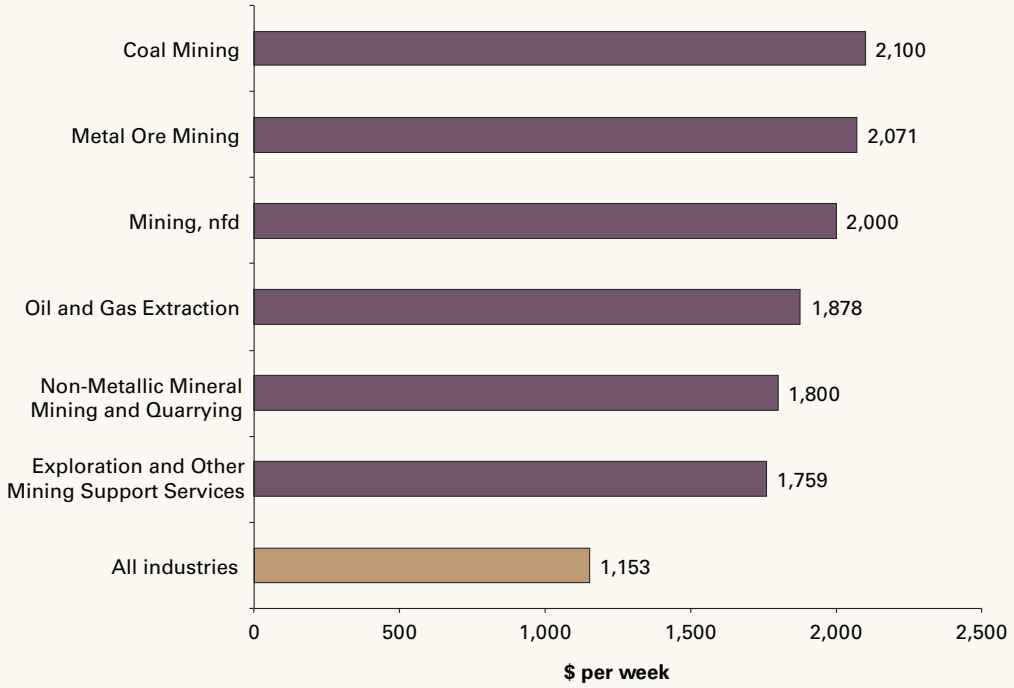


Source: ABS, 2011, *Census of population and housing*. Excludes inadequately described, not stated.

Earnings

In 2012, median weekly earnings of full-time employees in Mining were higher than for any other industry and 73.5 per cent higher than the all industries median ($2,000 compared with $1,153 for all industries). All of the sectors in the industry have median full-time weekly earnings above the all industries median, with earnings ranging from $2,100 for Coal Mining to $1,759 for Exploration and Other Mining Support Services (see Figure 11).

Figure 11 Mining sectors, median weekly earnings (full-time and before tax), August 2012



Source: ABS, 2012, *Employee earnings, benefits and trade union membership, August 2012,* cat. no. 6310.0, custom data request.

Occupational profile of the Resources Sector

This section provides a brief overview of the occupations in the Resources Sector using the 2011 Census data. At the time of the census, employment in the Mining industry covered more than 300 occupations. Of these, only 16 occupations employed more than 2,000 people. The 16 occupations are presented in Table 2. Together they make up more than 60 per cent of total employment in the Mining industry.[63]

The occupations listed in Table 2, and other occupations relevant to the sector, are examined in detail in Appendix C.

63 ANZSCO occupations are examined at the four-digit level in this report due to data limitations at the six-digit level. Note that the four-digit ANZSCO occupations do not always capture nuances within occupations at the six-digit level. For example, the unit group Mining Engineers (2336) includes both Mining Engineers (233611) and Petroleum Engineers (236612), who largely work in separate industry subsectors. Similarly, the unit group Production Managers (1335) includes three occupations, of which only Production Managers (Mining) (133513) is directly relevant to the Resources Sector.

Table 2 Occupations in Mining with employment of 2,000 or more, 2011 Census

Occupation		No. employed in the Mining industry	No. employed outside the Mining industry	% of the occupation employed in the Mining industry	% of total Mining industry employment
7122	Drillers, Miners and Shot Firers	39,280	8,690	82	22
3132	Metal Fitters and Machinists	14,570	72,390	17	8
3129	Other Building and Engineering Technicians	8,370	11,270	43	5
7331	Truck Drivers	7,310	138,890	5	4
3411	Electricians	5,510	105,210	5	3
2336	Mining Engineers	5,210	3,770	58	3
1335	Production Managers	5,140	42,560	11	3
2344	Geologists and Geophysicists	4,950	3,960	56	3
8129	Other Construction and Mining Labourers	3,790	4,490	46	2
3223	Structural Steel and Welding Trades Workers	3,140	62,850	5	2
7212	Earthmoving Plant Operators	2,920	35,410	8	2
5311	General Clerks	2,910	233,470	1	2
7129	Other Stationary Plant Operators	2,820	16,340	15	2
2211	Accountants	2,780	135,520	2	2
5111	Contract, Program and Project Administrators	2,510	102,140	2	1
2513	Occupational and Environmental Health Professionals	2,030	16,890	11	1
Total		**113,240**	**993,850**	**–**	**65**

Source: ABS, 2011, *Census of population and housing*.

Overall trends in wages growth in Australia

The wage price index measures the price of wages in the Australian economy and is a key macroeconomic indicator. The stability of the index relative to other measures such as average weekly earnings makes it the preferred indicator of wage trends for the Australian Bureau of Statistics and the Reserve Bank.

The wage price index increased by 2.9 per cent over the year to the June quarter 2013 (seasonally adjusted), down from 3.2 per cent over the year to the March quarter 2013. The latest annual increase is below long-term historical trends. The annual average growth rate was 3.7 per cent over the last 10 years.

Wages are expected to increase gradually in line with projected modest employment growth over the months ahead.

Wage growth trends by industry

In industry terms, the highest rates of increase in the wage price index over the year to the June quarter 2013 were in Electricity, Gas, Water and Waste Services (3.9 per cent), Mining (3.5 per cent) and Health Care and Social Assistance (3.4 per cent). The lowest annual wages growth for the June quarter 2013 was recorded in Education and Training (2.5 per cent).

Annual wages growth in the Mining industry at 3.5 per cent was down from 4.2 per cent in the March quarter 2013. The current annual result of 3.5 per cent is below the 10-year average annual increase of 4.7 per cent.

Wages in the Construction industry increased by 3.1 per cent over the year to the June quarter 2013, up from 2.9 per cent over the 12 months to the March quarter 2013. The current annual result of 3.1 per cent is significantly below the 10-year average annual increase of 4.3 per cent.[64]

In relation to federal enterprise agreements, the overall average annualised wage increase for all current wage agreements was 3.7 per cent in the June quarter 2013, decreasing marginally from 3.8 per cent in the March quarter 2013.

The average annualised wage increase for the Mining industry was 4.6 per cent for all current agreements in the June quarter 2013, remaining unchanged from the previous quarter, but up marginally from 4.5 per cent in the June quarter 2012.

The average annualised wage increase for the Construction industry in the June quarter 2013 was 5.3 per cent, up marginally from 5.2 per cent in the March quarter 2013 and the June quarter 2012.

Overall, by industry, the highest increases for all current agreements in the June quarter 2013 were in Construction (5.3 per cent), Mining (4.6 per cent), Rental, Hiring and Real Estate Services, and Other Services (both 4.4 per cent). The lowest increases were recorded in Retail Trade, Arts and Recreation Services, and Financial and Insurance Services (all 3.3 per cent).[65]

The latest available data suggests wages growth in the Resources Sector remains contained. The annual wages growth rates for both the Mining industry and the Construction industry are currently below their 10-year annual averages. The Department of Employment's workplace agreements database, which provides data on wage movements under enterprise agreements for the period ahead, suggests that in the medium term wage movements under enterprise agreements in the Resources Sector and across the economy will be contained.

Nevertheless, the potential for further employment growth in mining operations and in construction for major projects highlights the need for a continued strong focus on skills formation to meet the Resources Sector's likely needs for skilled labour if wages growth and broader inflationary pressure are to remain contained.

2.6 Trends in Resources Sector employment work patterns

Patterns of employment in the Resources Sector, when compared to other industries, are quite different and (in some cases) controversial. The resources workforce can be highly mobile, in terms of both work patterns and job tenure. The workforce is also geographically mobile, with workers moving to regional locations and established mining towns to work on remote sites and an increasing trend towards extensive commuting. This sort of commuting is commonly referred to as 'fly-in, fly-out', although it also includes other modes of long-distance travel, such as cars, buses and ships.

The long-distance commuting workforce across Australia

Research based on the 2011 Census found that 15.3 per cent of workers (39,600) are counted as fly-in, fly-out workers. The most common Resources Sector fly-in fly-out worker occupations are Drillers, Miners and Shot Firers (comprising 18.3 per cent of fly-in, fly-out workers), Metal Fitters and Machinists (7.9 per cent), Truck Drivers (4.5 per cent), Other Building and Engineering Technicians (3.8 per cent) and Electricians (3.6 per cent).[66]

The Australian Petroleum Production and Exploration Association and the Minerals Council of Australia commissioned a report on the long-distance commuter workforce which presented a

64 ABS, 2013, *Wage price index*, cat. no. 6345.0, June.

65 Department of Employment, *Trends in federal enterprise bargaining,* June, docs.employment.gov.au/node/33197, accessed 7 November 2013.

66 Department of Employment, 2013, *Employment characteristics of fly-in fly-out workers,* lmip.gov.au/default.aspx?LMIP/Publications/OtherReports, accessed 7 November 2013.

demographic analysis and addressed gaps in data. Long-distance commuters are defined as those individuals who travel 100 kilometres or more between where they usually live and work. The data suggests in 2011 there were 44,610 long-distance commuters in the Mining industry, comprising approximately one-quarter of the total Mining workforce and representing an 86 per cent increase (20,649 workers) in long-distance commuters since 2006. The growth in the long-distance commuter workforce is significantly higher than the overall growth of the Mining sector workforce for this period.[67]

In 2011, there were 18,370 Oil and Gas workers,[68] 18 per cent of whom were long-distance commuters. However, the growth in the Oil and Gas long-distance commuter workforce was less than the growth of the total Oil and Gas workforce between 2006 and 2011 (92 per cent, compared with 105 per cent). This may reflect an increase in coal seam gas projects that enable a residential workforce, in contrast to the entirely long-distance commuter nature of offshore and remote oil and natural gas projects.

Fly-in, fly-out is an increasingly popular form of employment in the Resources Sector, with a variety of shift styles and arrangements that allow flexibility and substantially more pay than traditional shifts.[69] Shift lengths can range between eight and 12 hours, and are grouped in varying patterns.[70] However, recent studies by Murdoch University have highlighted issues such as fly-in, fly-out mining workers being 'uncommitted to their employers' and unsatisfied with their employment conditions.[71] Other studies note that rates of physical illness, fatigue and depression are higher among these workers than in the general population, and the demand for accompanying support services may outstrip what is available in the rural and regional communities that support remote mine sites.[72] Workers in the Cairns-based Fly-in Fly-out Coordinator Pilot Project identified an above-average pay packet, long off-roster periods and a clear work–life balance as the positives of their work; the downsides were being away from home and family, the inability to be present for important family events or emergencies and the long shift hours.[73]

2.7 Innovation and the increasing use of technology

Australian mining has been at the forefront of technological advancements since the 1960s. Examples include the expansion of open-cut mining, the development of longwall operations in underground coal mining, and greater automation and scale of plant and equipment.[74] Changing market conditions, depletion of global oil and gas resources, the need to develop technology that enables access to more challenging exploration, production and processing, global competition, pressure on operating margins, and the need to increase workforce capacity and safety are just some of the factors that are driving the need for better work practices and use of technology in this sector.

67 KPMG, 2013, *Analysis of the long distance workforce across Australia*, report commissioned by the Minerals Council of Australia, minerals.org.au/file_upload/files/reports/MCA-13-LDCWorkforceStudy0308-MYR_%282%29.pdf, accessed 18 November 2013, p. 10.

68 Note that the definition of 'oil and gas' used in the KPMG analysis does not include 'gas supply', which is in a different industry classification from Mining.

69 House of Representatives Standing Committee on Regional Australia, 2013, *Cancer of the bush or salvation for our cities? Fly-in, fly-out and drive-in, drive-out workforce practices in regional Australia*, aph.gov.au/parliamentary_business/committees/house_of_representatives_committees?url=ra/fifodido/report.htm, accessed 18 November 2013, pp. 9–26.

70 Ibid., p. 53; Australian Coal and Energy Survey, 2012, First Phase Report No. 1: Work and hours amongst mining energy workers, Centre for Work, Organisation and Wellbeing, Griffith University, griffith.edu.au/__data/assets/pdf_file/0007/472588/Work-and-hours-in-M-and-E-ACES-report-no-1-Nov-2012.pdf, accessed 18 November 2013, pp. 24–27.

71 Walford M, 2012, *The uncommitted workforce: development of organisational commitment in fly-in, fly-out (FIFO) workforces through organisational and supervisor support*, School of Psychology, Murdoch University.

72 Ibid.

73 Welters R, Lynch P, Pryce J, Blackman A and Murphy L, 2013, *FIFO workforce in Cairns: perspectives from Cairns-based FIFO workers employed in North-West QLD and Groote Eylandt in NT*, The Cairns Institute, James Cook University, pp. 15–20.

74 Topp V, Soames L, Parham D and Bloch H, 2008, *Productivity in the mining industry: measurement and interpretation*.

In the past, high commodity prices were an incentive to mining companies to extract more-marginal deposits, that is, deposits that are of lower quality and difficult to access and therefore require more effort per unit of output to extract (and therefore would ordinarily not be accessed).[75] Sustained higher prices also provide an incentive to expand exploration for new deposits, which would increase average productivity. However, the time lags between discovery and extraction may be so long that the impact would only be noticeable after a considerable period.

The falling commodity prices and rising operational costs make introducing new technologies an imperative for sustainable production. Mining companies such as Rio Tinto, BHP Billiton and Fortescue Metals Group are investing heavily in technologies such as autonomous trucks and trains, which are expected to become a common feature across mines in northwest Australia.[76] Autonomous trucks and trains have lower error rates and better productivity, and reduce the costs of employing and accommodating drivers in remote mine sites. They also help streamline maintenance planning and scheduling.

The Rio Tinto–operated West Angelas iron ore mine near Newman, Western Australia, currently uses five autonomous trucks equipped with vehicle controllers, a high-precision global positioning system, an obstacle detection system and a wireless network.[77] Rio Tinto also commissioned a new tunnel boring technology in October 2012 to replace traditional human-driven drilling and blasting equipment.[78] This technology is one way to reduce up-front capital costs and decrease construction time for underground operations. Moves towards automation have also been found to be an effective response to meeting some of the significant challenges facing the industry.[79] These include addressing skills and labour shortages and improving safety.

BHP Billiton announced in late 2012 that it was expecting to implement a fleet of automated trucks at its new Jimblebar mine, and is also investigating completely truckless solutions at future operations such as in-pit crushing and conveying systems.[80]

While automation will reduce skills shortages in some areas, it may lead to new skills challenges. A 2010 Mining Industry Skills Centre report observed that the rise of automation in the Australian resources industry will cause a major skills shortage in the next decade unless it invests in specialist training.[81] The report also noted that the industry was marching towards automation, but that many organisations were not prepared for the impact automation would have on their businesses. Figure 12 estimates the take-up of automation in the Resources Sector over the next 20 years; the strongest growth in automation is expected in around 2020.

75 Ibid., pp. 35–82.

76 ABC, 2012, 'Technology set to change face of mining boom', *7:30*, 21 February, abc.net.au/7.30/content/2012/s3436268.htm, accessed 4 June 2013.

77 Komatsu, 2005, *Autonomous haulage system—Komatsu's pioneering technology deployed at Rio Tinto mine in Australia*, komatsu.com/ce/currenttopics/v09212, accessed 7 November 2013.

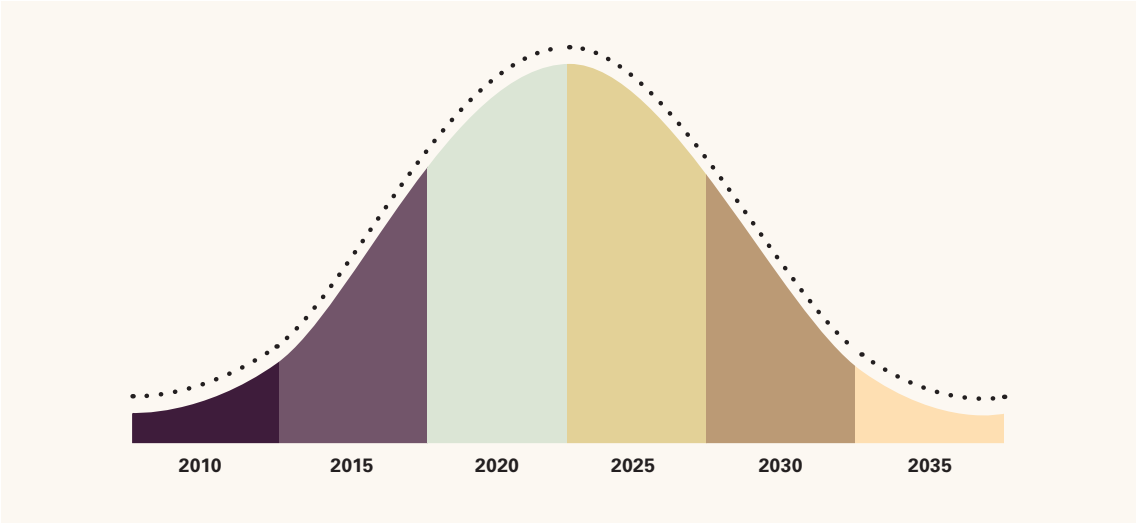
78 Rio Tinto, 2012, *Annual report 2012,* riotinto.com/reportingcentre2012/pdfs/rio_tinto_2012_annual_report.pdf, accessed 18 November 2013.

79 Fisher BS and Schnittger S, 2012, *Autonomous and remote operation technologies in the mining industry: benefits and costs*, BAE Research Report 12.1, baeconomics.com.au/wp-content/uploads/2010/01/Mining-innovation-5Feb12.pdf, accessed 19 November 2013, pp. 40–48.

80 Latimer C, 2012, 'BHP going automated and truckless', *Australian Mining*, 1 November, miningaustralia.com.au/features/bhp-going-automated-and-truckless, accessed 10 May 2013.

81 Kinetic Group, 2010, *Automation for success*, report commissioned by the Mining Industry Skills Centre, kineticgroup.org.au/wp-content/uploads/2011/11/Automation-for-Success.pdf, accessed 18 November 2013, p. 7.

Figure 12 Progression of automation implementation



Source: Kinetic Group, 2010, *Automation for success*, p. 7.

The extent of automation implementation is at varying levels within the industry, as illustrated in Table 3. AWPA's consultations and other evidence indicate that most companies have at least some degree of automation on site, though, as discussed earlier, companies such as Rio Tinto and BHP are working towards a more fully automated process.

Table 3 Degrees of automation in the Australian Resources Sector

Source: Kinetic Group, 2010, *Automation for success*, p. 7.

New technologies and the impact on work

The increasing implementation of remotely controlled and automated systems means that an increasing number of mining jobs are likely to be located in capital cities.[82] The urbanisation of the mining workforce, reduced reliance on long-distance commuting, more flexible shifts, less physically demanding work and a more professional workplace culture may help to increase workforce participation of women and older workers and retention of the existing workforce. On the other hand, it may also reduce the participation of people living in regional areas who do not wish to relocate.

The impact of automation and changing work processes extends beyond the level of the company; it also influences education programs and qualifications (both higher education and vocational education and training) that provide the industry with an appropriately skilled workforce.[83]

82 McNab K, Onate B, Brereton D, Horberry T, Lynas D and Franks DM, 2013, *Exploring the social dimensions of autonomous and remote operation mining: applying social licence in design*, report prepared for the Commonwealth Scientific and Industrial Research Organisation by the Centre for Social Responsibility in Mining and the Minerals Industry Safety and Health Centre, Sustainable Minerals Institute, University of Queensland, csrm.uq.edu.au/publications?task=download&file=pub_link&id=501, accessed 19 November 2013, p. 19–20.

83 Australian Venture Consultants, 2012, *Rise of the machines?*, report commissioned by the Resources Industry Training Council, ritcwa.com.au/LinkClick.aspx?fileticket=Fx-PV2FK8no%3D&tabid=135, accessed 18 November 2013.

The implementation of an extensive automation system and the change process need to be managed carefully. The move towards highly skilled technical jobs has some consequences for related jobs, as it requires a change from traditional skill sets to an increase in the number of knowledge-worker and technician roles.[84]

Contrary to expectations, there is little evidence to suggest that a move to automation will result in a significant reduction in overall employee numbers. Indeed, a report commissioned by Rio Tinto found the Australian Mining Equipment, Technology and Services sector labour force almost doubled from 17,300 in 2000–01 to 31,300 in 2008–09, suggesting the move towards robotics is creating more jobs.[85]

However, some roles will be reduced or redundant, the most obvious being operators of the equipment that becomes automated, such as drill rigs, loaders, haul trucks and trains. But even in these cases, some of that workforce will most likely be retained and retrained to operate equipment or sets of equipment remotely, and to oversee components of the automated system.[86] It is suggested that with increased automation, the number of electrical tradespeople required on site to support ICT systems will also increase. However, the Kinetic Group notes that other occupations such as mechanical fitters and automotive mechanics could also be trained in operating automated systems.[87]

AWPA discussed automation and the effect on skills requirements with the Resources Industry Training Council during the consultation process for this report. These discussions highlighted that the different demands on tradespeople for increased and different skill sets will need to be addressed through the education and training system. As automation and remote control technology are increasingly adopted by the minerals industry, its workforce will increasingly resemble the Oil and Gas sector's workforce, with a smaller portion of unskilled and semi-skilled labour and a larger portion of technical professionals and technicians working in a process-oriented culture.

While technological change increases skills demand and requires new work practices, it is acknowledged these changes may not always benefit everyone. Consideration needs to be given to developing strategies for retraining workers displaced by new technologies.

A report commissioned by the Resources Industry Training Council notes that these changes will involve new forms of working and new standards for teamwork and communications. Teams will become increasingly cross-operation and cross-function oriented, often involving multiple locations and jurisdictions. There will be a need for greater cultural awareness in the workforce, especially as remotely located operators interact with each other and with those in central headquarters who are overseeing operations.[88] This is particularly evident in operations where the automation system spans multiple sites and is at least in part centrally controlled from a 'remotely operated centre'.

The report also notes that a critical challenge facing 'passive operators' of an automated system could be the lack of situational awareness, leading to deskilling over time and the inability to take appropriate corrective action in the event of equipment failure.[89]

A greater emphasis on employee training and development will be required if employees are to remotely operate and supervise machines and maintain the whole process. According to the Mining Industry Skills Centre, the automation skills shortage will be chronic because of the long lead time required to develop the requisite skills and competencies.[90] The shortage may also worsen over time due to anticipated growth in demand, particularly in the emerging liquefied natural gas and coal seam gas industries.[91]

84 Ibid.; ABC, 2012, 'Technology set to change face of mining boom'.

85 Fisher BS and Schnittger S, 2012, *Autonomous and remote operation technologies in the mining industry: benefits and costs*.

86 ABC, 2012, 'Technology set to change face of mining boom'.

87 Kinetic Group, 2012, Automation skills strategy formation, cited in Australian Venture Consultants, 2012, *Rise of the machines?,* p. 86.

88 Australian Venture Consultants, 2012, *Rise of the machines?*, p. 68.

89 Ibid., p. 69.

90 Kinetic Group, 2010, *Automation for success*.

91 Bell A, 2013, 'Automation in mining—examining perceived and actual challenges for the evolution of automation', *MiningIQ*, 2 March, miningiq.com/technical-services-production-and-logistics/articles/automation-in-mining-examining-percieved-and-actua, accessed 29 August 2013.

The occupations of Mechatronics Engineer, Operations Optimisation Manager and Automation Technician are difficult to train for in the Resources Sector because development and delivery of courses by training and education organisations depend on market demand and there is no strong demand at present. In addition, most of the extensive automation programs are being developed by large multinational mining companies with the intention of gaining advantage over their competitors, which means they are usually commercial-in-confidence. The training and development required to enable staff to use and maintain these technologies is typically undertaken by a tertiary education provider working in close partnership with a resources company, or by the original equipment manufacturer for a particular automated technology. This makes it difficult for other tertiary education providers to integrate these skills and competencies into their course offerings.[92]

Automation, innovation and the rise of mining support industries

A significant flow-on effect of the resources boom has been the increasing development of the Mining Equipment, Technology and Services sector in Australia, mainly consisting of small to medium-sized businesses (employing 50 or fewer people) specialising in:

- equipment manufacture and supply—including electrical, electronic equipment and heavy plant machinery for exploration mining and processing
- specialist technology and related service supply—including technologies for exploration, mineral processing, mineral assessment, mine planning and management software, and mining maintenance technologies such as remote sensing, airborne and ground exploration technologies, mine communications, and safety
- consulting services—including geological and geotechnical assessment surveying, scientific research, laboratory and testing, environmental management and project management
- contract services—including specialist on- and off-site service contractors.[93]

The trend towards new systems and procedures has emphasised the growing role of ICT throughout exploration and mining and has led to new patterns of demand for equipment and services. An International Data Corporation report, *Resources ICT market forecast and analysis 2011 to 2015*, states resource sector ICT spending was at least $2.51 billion in 2011, representing 6 per cent of the ICT sector's total activity,[94] and is set to increase to $3 billion in 2012.[95]

Firms at the forefront of the implementation of ICT applications in the Mining industry are generally small employers pursuing niche markets with one of a small number of specialised ICT products.[96] There has certainly been evidence of mining companies investing in technology that allows them to operate mines, wells, processing and transportation autonomously, thereby reducing the costs of production. For example, in early 2013 Oz Minerals announced a five-year whole-of-company ICT strategy to drive its core mining processes that includes initiatives across operations, risk management, automated dispatch, data management and underground mine control.[97]

92 Australian Venture Consultants, 2012, *Rise of the machines?*, p. 17.

93 Scot-Kemmis D, 2011, *Australian story: the formation of Australian mining technology services and equipment suppliers*, United States Studies Centre, University of Sydney, ussc.edu.au/ussc/assets/media/docs/publications/1111_Scott_Mining.pdf, accessed 19 November 2013.

94 International Data Corporation, 2012, *Resources ICT market forecast and analysis 2011 to 2015*, cited in *Rust Report*, 2012, 'ICT spending by the Australian resources sector', 27 August, rustreport.com.au/issues/ict-spending-by-the-australian-resources-sector, accessed 17 August 2013.

95 Sadauskas A, 2012, 'Mining boom flowing through to ICT sector', *SmartCompany*, 17 August, smartcompany.com.au/information-technology/051264-mining-boom-flowing-through-to-ict-sector-australian-resource-sector-ict-spending-to-reach-3-billion-by-2015-4.html, accessed 17 August 2013; Glance D, 2012, 'The mining sector's automation agenda', *Business Spectator*, 20 August, businessspectator.com.au/article/2012/8/20/technology/mining-sectors-automation-agenda#ixzz2U5QGoI3A, accessed 20 August 2013.

96 Scot-Kemmis D, 2011, *Australian story: the formation of Australian mining technology services and equipment suppliers*, pp. 43–44.

97 Clarke T, 2013, 'Mining company looks to tech horizon', *The Age*, 27 July, theage.com.au/it-pro/cloud/mining-company-looks-to-tech-horizon-20130211-2e8o9.html, accessed 27 August 2013.

2.8 Conclusion

In this chapter we examined the context within which the Resources Sector operates in Australia and the characteristics of its workforce. Notably, the sector's workforce has more than doubled in size over the last decade. Because of this growth and the geography of Resources Sector projects, the sector continues to favour flexible working conditions such as fly-in, fly-out arrangements.

The major challenge to continued growth is maintaining the sector's competitiveness in the face of growing global competition and a high-cost local environment. Since the second half of 2012 there have been concerns about the slowing commodity prices, increases in the costs of doing business and challenges in recruiting a skilled workforce in Australia. These recent developments have resulted in major mining companies announcing job cuts and scaling back their mining operations and expansion plans. Even though the Bureau of Resources and Energy Economics' analysis indicates that committed projects will continue to add to the growth projections in the short term, all indications are that key issues around productivity and innovation will influence the future skills trajectory of Australia's Resources Sector.

As the resources boom transitions to the operations phase and costs continue to rise, the pressure to improve productivity through technology is increasing. New technologies offer the potential for lower labour and operating costs, improved operational efficiency and a safer, more attractive working environment, all contributing to a more competitive industry.

The implementation of remote operation technologies will change the future workforce requirements of the sector. The challenge from a workforce planning perspective is managing the uncertainty of these still emerging technologies and work practices, the nature of the new roles, and the numbers and type of skills required. Industry working with education providers can help to identify and design training programs to meet future workforce needs.

3 Trends in demand for labour nationally and regionally

3.1 Introduction

In this chapter we examine current and future major projects in Australia's Resources Sector based on Bureau of Resources and Energy Economics data available as at April 2013. In a departure from previous reports, we present a brief overview of a resources project lifecycle because an understanding of the size and staging of the various mining and gas project components and how companies approach each phase helps to understand these phases and their workforce needs during a project's lifetime.

3.2 Major projects in the Resources Sector

The Bureau of Resources and Energy Economics prepares a report on resources and energy major projects in April and October each year. The report lists major minerals and energy projects expected to be developed over the medium term. It provides details on project name, location, expected start-up date, capital cost, proponent or joint venture, project status, additional output capacity, and additional employment, where available. Projects are divided into four categories:

(1) publicly announced—where projects are either at a very early stage of planning, have paused in progressing their feasibility studies or have an unclear development path

(2) feasibility—where initial feasibility studies have been completed and the results support further development

(3) committed—where all commercial, engineering and environmental studies have been completed, all required regulatory approvals have been received and a positive final investment decision has been made

(4) completed—where projects have substantially finished their construction and commissioning activities and initial commercial-level production has commenced.

The project list released in April 2013 categorises 388 projects. Of these, $232 billion worth of projects were at the feasibility stage and over $120 billion worth of projects were at the publicly announced stage. There were 73 committed projects with a combined value of $268 billion. As shown in Table 4, the number of committed and completed projects decreased over the period from April 2012 to April 2013. For example, in April 2013 there were 14 fewer committed projects than in October 2012; however, the value of committed investment remained constant because of cost increases to several high-value projects.[98]

98 BREE, 2013, *Resources and energy major projects—April 2013*.

Table 4 Summary of projects in the investment pipeline, April 2012, October 2012 and April 2013

	Publicly announced		Feasibility		Committed		Completed	
	No.	Range* $m	No.	Value $m	No.	Value $m	No.	Value $m
Total April 2012**	295	243,287			98	260,770	25	23,578
Total October 2012	106	91,010–133,185	171	291,891	87	268,378	24	11,872
Total April 2013	113	121,372–170,872+	174	232,485	73	267,579	21	15,344

* Value of publicly announced projects given in cost range, with projects over $5 billion having no upper bound.

** Prior to October 2012, major projects were listed under three categories only (less advanced, advanced and completed). Less advanced approximates the publicly announced and feasibility stages in the October 2012 and April 2013 reports.

Source: BREE, *Resources and energy major projects—April 2012, —October 2012, —April 2013*.

Details of the projects in each category by commodity are listed in Table 5. Projects at the publicly announced and feasibility stages are potential capital investments, not necessarily all of which will progress to the committed stage, as progression depends on market conditions and project economics, particularly capital cost pressures.

Table 5 Summary of projects in the investment pipeline as at April 2013

	Publicly announced		Feasibility		Committed		Completed	
Commodity	No.	Range* $m	No.	Value $m	No.	Value $m	No.	Value $m
Aluminium, bauxite, alumina	4	2,500–4,500	3	3,780	0	0	0	0
Coal (all)	19	24,335–28,085+	57	56,695	16	14,194	1	166
Copper	6	7,503–9,253	9	3,088	2	343	1	300
Gold	12	1,779–2,279+	12	1,621	6	1,416	6	2,296
Infrastructure	13	18,750–31,250+	20	31,670	15	21,067	4	3,462
Iron ore	19	35,400–55,650+	21	46,542	8	22,022	5	4,870
Lead, zinc, silver	4	135–635	2	417	4	1,933	1	310
LNG, gas, petroleum	12	25,300–28,050+	11	72,200	18	204,912	1	1,700
Nickel	5	2,500–5,000	7	5,490	0	0	0	0
Uranium	4	2,170–4,170	5	2,100	1	98	0	0
Other commodities	15	1,000–2,000	27	8,882	3	1,595	2	2,240
Total	**113**	**121,372–170,872+**	**174**	**232,485**	**73**	**267,579**	**21**	**15,344**

* Value of publicly announced projects given in cost range, with projects over $5 billion having no upper bound.

Note: These figures are drawn directly from the April 2013 report and reflect the figures at that time; DAE modelling contains additional information as at August 2013.

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Overall, the April 2013 data highlights a decrease in the number of projects advancing to the committed stage. According to the report, this is due to proponents delaying, scaling back or even cancelling projects in Australia. In spite of this, there still exist significant opportunities for investment in the Resources Sector depending on market factors relating to commodity prices, construction and labour costs, and productivity.

Table 6 presents a summary of major projects by state and territory. Resources projects are not evenly distributed across the states and territories, with the majority of mega projects located in Western Australia and Queensland. Demand for skills is likely to be most acute and concentrated around these mega projects and this presents opportunities for governments to support workforce development strategies and work in partnership with industry to address skills needs.

Table 6 Summary of resources and energy major projects in the investment pipeline by state and territory, April 2013

	Publicly announced		Feasibility		Committed		Completed	
State	No.	Range* $m	No.	Value $m	No.	Value $m	No.	Value $m
NSW	16	4,565–7,065	29	17,689+	15	6,736	3	3,027
QLD	29	29,491–38,991+	68	105,748+	21	80,780	5	1,151
WA	47	58,896–91,646+	51	77,476+	28	141,675	12	9,396
NT	7	2,284–2,784	10	7,869	4	33,810	0	0
SA	7	8,386–11,136+	6	5,540+	2	298	0	0
VIC	3	1,564–2,064	5	762+	2	3,600	1	1,700
TAS	1	0–250	4	609	0	0	0	0
Other**	3	15,000+	1	13,000	1	680	0	0
Total	**113**	**120,163–168,936+**	**174**	**228,693+**	**73**	**267,579**	**21**	**15,274**

* Value of publicly announced projects given in cost range, with projects over $5 billion having no upper bound.

** Offshore projects not allocated to a state; includes Joint Petroleum Development Area.

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Figure 13 shows the location of committed projects by state and territory. The majority of projects are located in Western Australia and Queensland, and centred in a few key regions (such as the Pilbara in Western Australia and Gladstone in Queensland).

Figure 13 Major resources projects, Australia, April 2013

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Figures 14 to 17 show the number of projects at different stages.

Figure 14 Projects at the publicly announced stage, April 2013

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Figure 15 Projects at the feasibility stage, April 2013

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Figure 16 Projects at the committed stage, April 2013

Source: BREE, 2013, *Resources and energy major projects—April 2013*.

Figure 17 Projects at the completed stage, April 2013

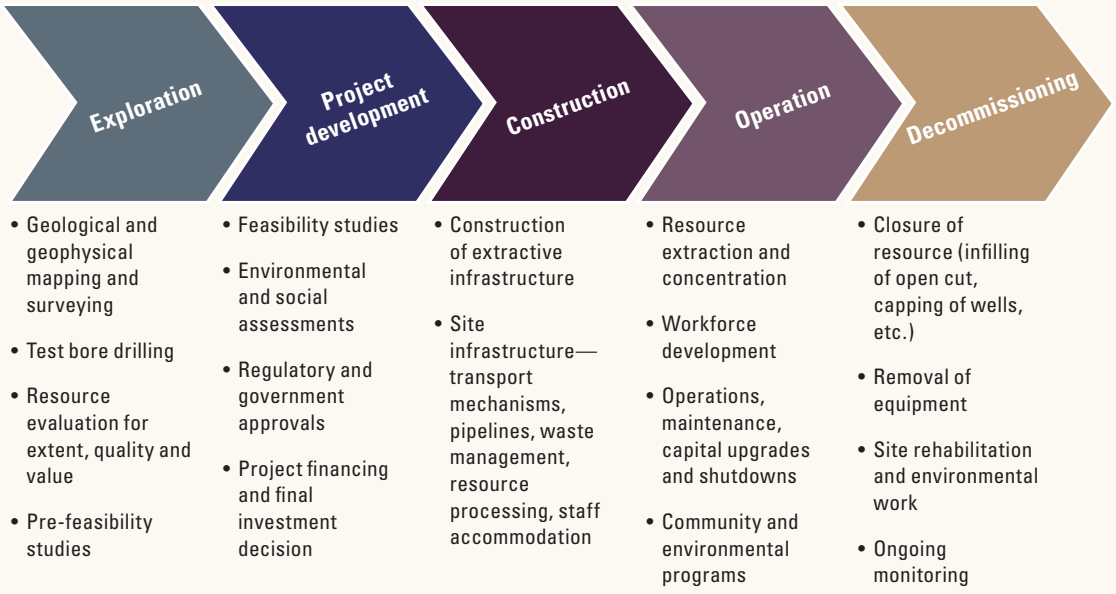
Source: BREE, 2013, *Resources and energy major projects—April 2013*.

3.3 Phases of resource extraction projects

In order to understand the particular requirements and challenges relating to resources project investments, AWPA has developed a generic project lifecycle with associated skills requirements for resources projects (Figure 18). The aim of the model is to demonstrate the complex nature of resources extraction and the long lead times between investments in new capacity in the sector (whether in the form of new mines or mine expansions) and the corresponding output. AWPA's interest lies in examining the staging of the various project elements, which will assist in understanding workforce requirements over the lifetime of projects, especially in the context of persistent skills shortages in certain occupations.

There is no 'typical' resources project as projects vary according to the type and amount of mineral or energy commodity being extracted; the method of extraction used; the geographic location and its proximity to infrastructure (including community, energy and transport); environmental, social and other constraints; and the type of company and its contracting and workforce strategies. That said, in general, all resource extraction projects go through a similar lifecycle involving several phases, as depicted in Figure 18. A detailed description of each stage of the lifecycle is in Appendix D.

Figure 18 Features of resources project development and lifecycle



Source: Adapted from Topp V, Soames L, Parham D and Bloch H, 2008, *Productivity in the mining industry: measurement and interpretation*.

In view of the construction phase coming to a peak as forecast by the Bureau of Resources and Energy Economics[99] and Treasury observations that future resources investment will be underpinned by liquefied natural gas projects already under construction,[100] a hypothetical coal seam gas to liquefied natural gas case study is presented in Appendix D to illustrate the different phases, timing and workforce requirements.

99 BREE, 2013, *Resources and energy major projects—April 2013*, p. 1.

100 Department of the Treasury, 2013, *Economic statement August 2013,* accessed 19 November 2013, p. 3.

The shutdown workforce

Ongoing operations include periodic shutdowns of the site to facilitate maintenance and repair work on equipment. Resource companies schedule regular major and minor shutdowns to undertake repairs (both planned and unplanned), replacement and maintenance activities on production equipment. Due to disruptions to operations facilities, shutdowns are time-critical.

Shutdown work includes roles for qualified managers and engineers who have skills in maintenance planning, people management, budgeting and contributing to continuous improvement of plant processes and procedures. Common trades worker roles include Boilermakers, Fitters, Riggers, Blasters/Painters, Electricians, Scaffolders and Labourers.

Almost all shutdown work is done onsite, often in remote locations. Large resource companies employ some specialised shutdown staff, particularly for routine maintenance schedules, but a significant proportion of shutdown work is conducted by contracting firms. Because of the temporary, contract nature of the work, workers are often employed through specialist contractors on a short-term casual basis. The work is frequently of a fly-in, fly-out nature, and staff can be called away at short notice.

Shutdown work varies depending on the type of project and the equipment used. For instance, shutdown crews servicing a gas train may be very different from those servicing an iron ore or coal mine site. Liquefied natural gas shutdown work is particularly lengthy and complex, involving hydrostatic testing, flushing and hot oil flushing, chemical cleansing, explosive venting, valve testing and leak detection, and installing or replacing extra equipment. These activities may require a workforce with a high skill level or years of experience. Major liquefied natural gas train shutdown work can take several months to complete.

The wide range of employers, the different types of companies who employ workers permanently and casually, and the rolling contract nature of shutdown services make estimating the size of the workforce extremely difficult. A large number of casual workers may register with more than one potential employer, and hours worked in shutdown activities are often recorded at the contractor level rather than on the site of the shutdown.[101]

Occupations during project phases

AWPA's consultations indicate that the majority of employment opportunities occur during the construction and start-up phases of mine sites, which generally span the first three to five years of the life of the mine. Almost two-thirds of the positions created are in the start-up phase, and one-third continue once the mine site becomes operational.[102] Some of the key occupations required during the various phases, derived from AWPA's consultations, are presented in Table 7. While there is considerable overlap in occupations required during the construction and operations phases, the shift to operations will result in a reduction in the number of jobs for overlapping occupations, though more highly skilled workers will be required (but at a reduced number).

101 This information was provided during AWPA's consultations for this report.

102 Ibid.

Table 7 Selected occupations required during various phases of a project lifecycle

Occupations	Exploration	Project planning	Construction	Operations	Decommissioning
Professions					
Geoscientists/Geologists	✓	✓	✓	✓	✓
Project Managers	✓	✓	✓	✓	✓
Production Managers		✓		✓	
Engineering Managers	✓	✓	✓	✓	✓
Mining Engineers		✓	✓	✓	✓
Mechanical Engineers		●	✓	✓	✓
Petroleum Engineers		●	✓	✓	
Electrical Engineers		●	✓	✓	✓
Civil Engineers			✓	✓	✓
Surveyors	✓		✓	✓	●
Environmental Scientists	✓	✓	✓	✓	✓
Health and Safety Officers			✓	✓	✓
Technicians and tradespeople					
Geotechnicians	✓	✓	✓	✓	✓
Drillers, Miners and Shot Firers	✓		✓	✓	
Electricians			✓	✓	●
Earthmoving Plant Operators			✓	✓	✓
Mobile Plant Operators			✓	✓	●
Pipeline Workers			✓	✓	●
Rig Operators			✓	✓	
Metal and Instrument Trades Workers			✓	✓	
Boilermakers			✓	✓	
Process/Plant Operators				✓	✓
Truck Drivers			✓	✓	●
Train Drivers			✓	✓	

Source: Based on AWPA analysis; ● indicates some expertise needed in this area.

3.4 Trends in demand for labour at the national and regional levels

Modelling approach

AWPA commissioned Deloitte Access Economics to model the demand for and supply of labour and skills for the Resources Sector under a series of different future economic scenarios. The modelling draws on data from the Australian Bureau of Statistics and the Bureau of Resources and Energy Economics to define the historical (or base) employment performance of the Resources Sector and establish defined growth scenarios based on projected major project outcomes to 2018.[103]

Modelling projections are based on the April 2013 Bureau of Resources and Energy Economics data and represent a snapshot of identified projects at that point in time. The modelling also takes into account the changes in project status that have been announced since the publication of the April 2013 data. A detailed explanation of the modelling methodology is presented in the Deloitte Access Economics report.

The modelling developed projections for employment levels and growth to 2018 across three components of the Resources Sector—Resources Project Construction; Mining Operations; and Oil and Gas Operations, which covers extraction and supply. The industry structure is presented in Table 8.

Table 8 Industry structure

Resources Sector components	Corresponding ANZSIC industry
Resources Project Construction	A component of 31—Heavy and Civil Engineering Construction and 32—Construction Services
Mining Operations	B—Mining (less 07—Oil and Gas Extraction)
Oil and Gas Operations	07—Oil and Gas Extraction, 27—Gas Supply

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Projected employment is based on three economic growth scenarios—base case, high growth and low growth—which relate primarily to the proportion of major projects on the Bureau of Resources and Energy Economics' April 2013 project list that are assumed to proceed over time. The growth scenarios also relate to different projected growth paths for commodity prices, which will influence the base level of employment in the Resources Sector. The parameters for the growth scenarios are presented in Table 9.

Table 9 Growth scenarios

Scenario	Publicly announced (%)	Feasibility stage (%)	Committed stage (%)
High growth	75	100	100
Base case	50	75	100
Low growth	25	50	75

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

103 DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, pp. 82–91.

Recent trends in employment demand

Trends in employment growth in the Resources Sector from 2006 to 2012, based on Australian Bureau of Statistics labour force and census data, are provided in Table 10.[104]

Table 10 Employment levels and annual growth for Resources Project Construction, Mining Operations and Oil and Gas Operations, 2006–12

	Resources Project Construction		Mining Operations		Oil and Gas Operations	
	Employment level ('000)	Annual growth (%)	Employment level ('000)	Annual growth (%)	Employment level ('000)	Annual growth (%)
2006	57.4	10	122.7	9	16.5	38
2007	67.8	18	127.6	4	20.1	21
2008	64.2	–5	153.9	21	22.0	10
2009	67.7	5	150.0	–3	24.4	11
2010	70.3	4	172.6	15	24.4	0
2011	69.9	0	209.5	21	23.4	–4
2012	68.4	–2	249.6	19	28.3	21

Source: ABS census and labour force data.

Significant employment growth occurred in all three sectors from 2006 to 2012:

- Resources Project Construction increased from 57,400 in 2006 to 68,400 in 2012 (19.2 per cent growth). However, growth has slowed in recent years.
- Mining Operations increased from 122,700 in 2006 to 249,600 in 2012 (103 per cent growth). Growth continued to be strong in this sector in the last two years.
- Oil and Gas Operations increased from 16,500 in 2006 to 28,300 in 2012 (71 per cent growth). This sector shows larger fluctuations, albeit from smaller base numbers.

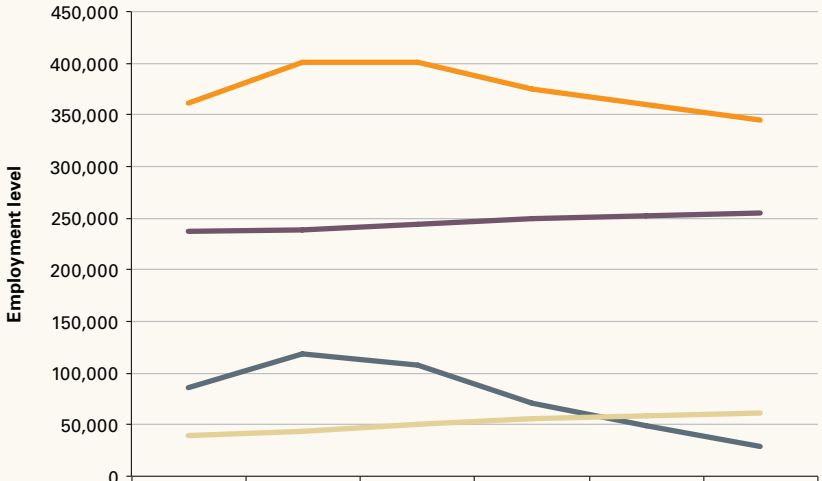
104 Note the sum of the two- and four-digit ANZSCO information may not exactly equal totals shown in the tables in this report. The differences are due to rounding.

Projected growth in demand, 2014–18

This section presents employment projections in Resources Project Construction, Mining Operations, and Oil and Gas Operations.

Under the base case scenario, total Resources Sector employment is projected to rise to a peak of over 401,000 in 2014 and 2015, and then steadily decline to around 344,000 in 2018 (Figure 19).

Figure 19 Projected employment level by resources industry sector, base case, 2013–18

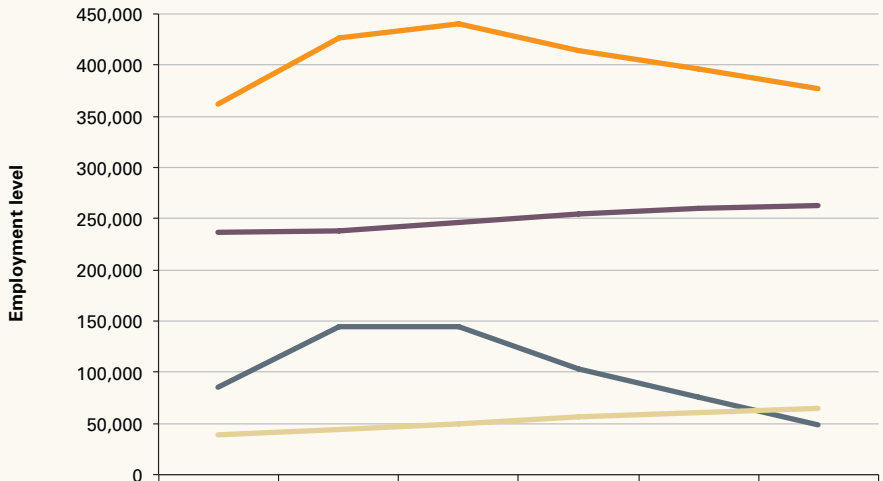


	2013	2014	2015	2016	2017	2018
Resources Project Construction	85,819	118,825	107,710	70,903	49,325	28,857
Mining Operations	236,690	238,537	243,525	249,111	252,456	254,260
Oil and Gas Operations	38,943	44,087	49,908	55,349	58,666	61,212
Total	361,452	401,449	401,143	375,363	360,448	344,328

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

The high growth scenario trajectories echo those of the base case, but are more pronounced (Figure 20). Total Resources Sector employment is projected to increase much more sharply than in the base case and rises to a peak of over 440,000 in 2015 before tapering to 376,500 in 2018.

Figure 20 Projected employment level by resources industry sector, high growth, 2013–18

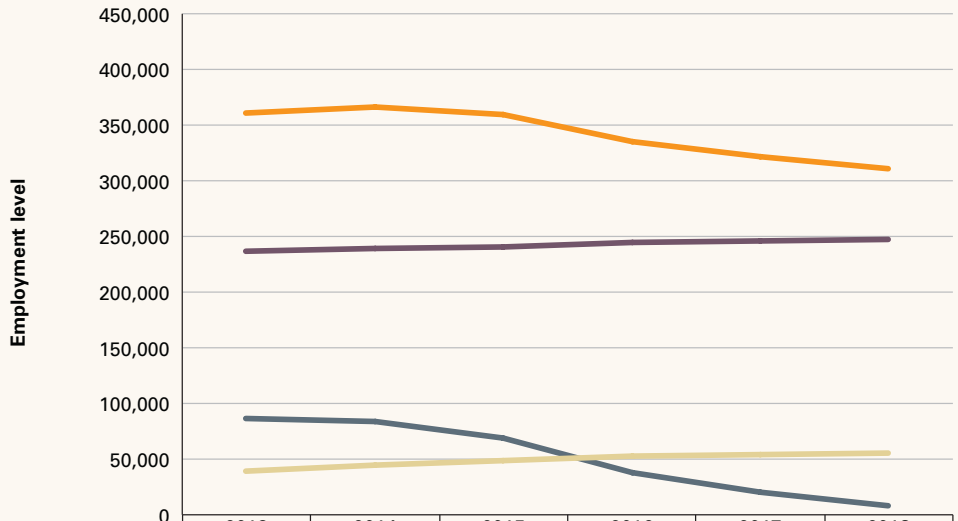


	2013	2014	2015	2016	2017	2018
Resources Project Construction	85,819	144,043	144,046	102,887	76,230	48,685
Mining Operations	236,690	238,759	246,128	254,120	259,471	262,927
Oil and Gas Operations	38,943	43,924	50,275	56,740	61,210	64,891
Total	361,452	426,726	440,450	413,747	396,912	376,502

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Under the low growth scenario, total Resources Sector employment is projected to drop steadily from 361,452 in 2013 to 310,730 in 2018 (Figure 21).

Figure 21 Projected employment level by resources industry sector, low growth, 2013–18



	2013	2014	2015	2016	2017	2018
Resources Project Construction	85,819	83,321	69,444	37,661	20,288	7,708
Mining Operations	236,690	238,553	241,088	244,710	246,580	247,148
Oil and Gas Operations	38,943	44,299	48,434	52,290	54,422	55,875
Total	361,452	366,173	358,966	334,662	321,290	310,730

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Resources Project Construction

The modelling forecasts a highly volatile profile associated with Resources Project Construction, which is expected to see employment levels increase at first and then decline in coming years. This drives an overall contraction in Resources Sector employment between now and 2018 in all scenarios.

In the case of Resources Project Construction, the low growth scenario appears to be more likely due to the lower probabilities of projects proceeding to the committed stage. Under this scenario, employment is expected to peak in 2013 with 85,819 workers and then decrease to 7,708 in 2018. The fall in growth over the outlook period appears to be in line with Treasury projections for investment.

During 2013 and 2014, the majority of oil and gas projects currently underway are still expected to be under construction. However, from 2015 onwards sharp drops in employment are expected consistent with the completion of the bulk of major projects currently underway, and a low number of new projects coming on board. This decline is apparent under each of the scenarios, even the high growth scenario.

In the base case, Resources Project Construction employment peaks in 2014 with 118,825 workers and declines to 28,857 in 2018. In the high growth scenario, employment peaks at 144,043 in 2014, which is sustained to 2015 and then drops significantly to 48,685 workers in 2018.

Mining Operations

Commodity prices will play an important role in shaping the future growth of the Australian economy, and specifically demand for labour within Mining Operations. Under the base case scenario, employment in Mining Operations is expected to increase from 236,690 workers in 2013 to 254,260

in 2018, representing a 7.4 per cent increase. Under all three scenarios, Mining Operations employment is projected to increase every year from 2014 to 2018.

Under the high growth scenario, Mining Operations employment mirrors the base case trend of moderate employment increases, increasing from 236,690 workers to a peak of 262,927 in 2018. The low growth scenario also projects a slight rise from 236,690 to 247,148 workers in 2018.

Oil and Gas Operations

Employment in the Oil and Gas Operations sector under the base case is expected to experience robust growth from 38,943 workers in 2013 to 61,212 in 2018, representing a 57.2 per cent increase. This is because many of the major liquefied natural gas projects under construction will move into their production phase.

All three growth scenarios anticipate annual growth in every year from 2014 to 2018. In the high growth scenario, Oil and Gas Operations employment increases to 64,891 workers in 2018. The low growth scenario projects a smaller increase, with a peak workforce of 55,875 in 2018.

Strong employment growth within Mining Operations and Oil and Gas Operations relates to large expansions in productive capacity in these sectors. Deloitte Access Economics estimates that the value added per additional worker across these sectors is very high. Australian Bureau of Statistics national accounts data suggests that gross value added per person employed in Oil and Gas Extraction in 2012 amounted to $873,000. For Mining Operations and Oil and Gas Operations, gross value added per person in 2012 amounted to $462,000.[105]

Regional trends in demand

Deloitte Access Economics identified key mining regions across Australia that employ a large share of the resident population (Figure 22). Major mining regions in Western Australia are the Pilbara, the Kimberley, and the Goldfields and Mid-West. In Queensland, Mackay, Fitzroy and Darling Downs – Maranoa are identified as major mining regions, while in New South Wales and South Australia, the Hunter and Outback – North East regions respectively are considered the only major mining regions in those states.

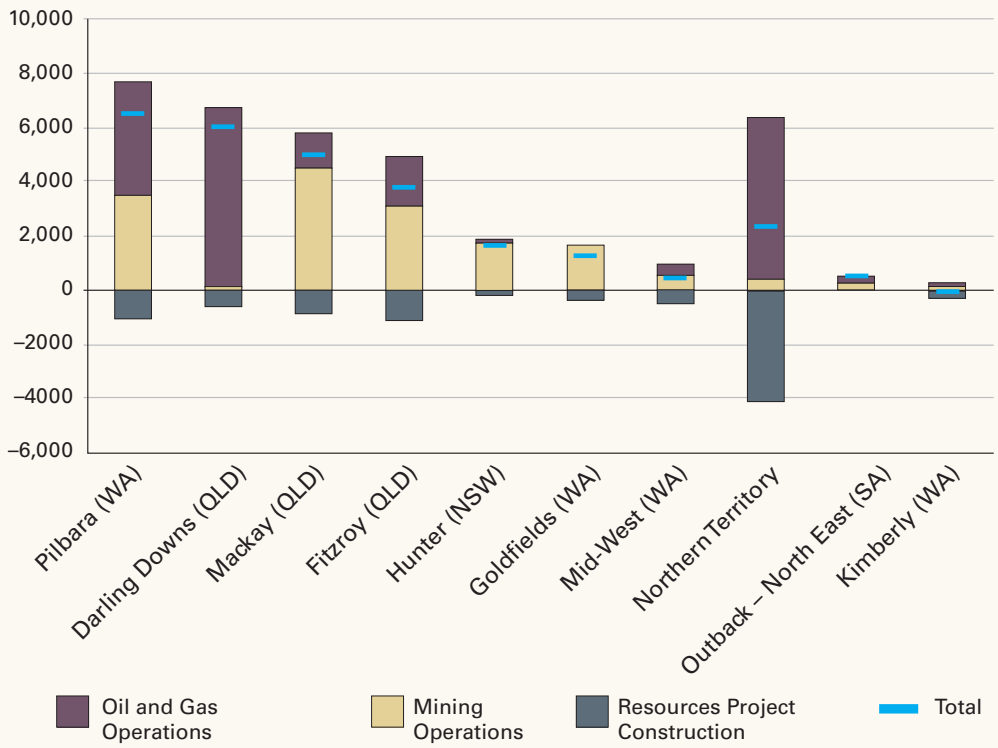
Figure 22 Australian mining regions

Source: Developed by AWPA, based on Deloitte Access Economics modelling.

105 DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, p. 28.

Figure 23 and Table 11 display the expected change in employment between 2013 and 2018 in the major mining regions under the base case scenario. Regional employment demand tables for the high and low growth scenarios are in the Deloitte Access Economics report.[106] Detailed regional employment demand tables by sector and scenario are in Appendix E.

Figure 23 Change in number of employed persons by resources industry sector, base case, 2013 to 2018



Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

106 Ibid., Tables 4.9 and 4.10, pp. 33–34.

Table 11 Projected employment level by region, all resources industry sectors, base case scenario, 2013–18

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	2,284	2,403	2,386	2,348	2,312	2,261
Pilbara (WA)	21,407	23,356	25,279	26,610	27,408	27,941
Mid-West (WA)	5,262	5,633	5,718	5,749	5,770	5,742
Goldfields (WA)	9,911	10,217	10,529	10,846	11,069	11,214
Balance (WA)	102,917	109,159	100,904	92,878	87,838	82,200
WA	**141,781**	**150,768**	**144,816**	**138,431**	**134,397**	**129,359**
Darling Downs (QLD)	4,266	6,406	8,224	9,238	9,828	10,298
Fitzroy (QLD)	15,430	16,932	17,923	18,550	19,063	19,234
Mackay (QLD)	20,062	21,351	22,635	23,754	24,635	25,054
Balance (QLD)	63,252	78,663	74,580	63,054	55,637	47,197
QLD	**103,011**	**123,353**	**123,362**	**114,596**	**109,162**	**101,783**
Hunter (NSW)	15,776	16,659	17,183	17,193	17,302	17,451
Balance (NSW)	45,842	50,529	52,431	44,877	40,895	38,238
NSW	**61,618**	**67,188**	**69,615**	**62,070**	**58,197**	**55,690**
Outback – North East (SA)	3,810	3,836	3,780	3,887	4,105	4,303
Balance (SA)	12,674	14,707	15,919	14,392	13,255	12,299
SA	**16,484**	**18,543**	**19,699**	**18,279**	**17,360**	**16,602**
VIC	**21,093**	**22,346**	**22,474**	**21,326**	**21,112**	**21,085**
TAS	**6,066**	**6,265**	**6,203**	**6,078**	**6,059**	**6,046**
NT	**10,590**	**12,150**	**14,135**	**13,738**	**13,316**	**12,927**
ACT	**556**	**560**	**550**	**542**	**536**	**530**
Offshore	253	275	290	301	307	307
Australia	**361,452**	**401,449**	**401,143**	**375,363**	**360,448**	**344,328**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Employment is expected to be strongest in the Pilbara in Western Australia and the Darling Downs and Mackay regions of Queensland. Across all regions there is a shift away from construction jobs over time towards operational jobs.

The Pilbara accounts for the major share of resources projects in Western Australia, with its iron ore projects and large-scale liquefied natural gas projects (North West Shelf and Pluto). There have also been some major project completions in the region, such as the $1.3 billion Hope Downs iron ore mine, and Fortescue Metals Group recently announced the completion of work on the expansion of its Firetail deposit (part of the Chichester Hub project) by the end of 2013. Pilbara Resources Sector employment rises by 6,500 under the base case scenario to 2018 and by over 8,200 in the high growth scenario, reflecting strong demand over this period as construction continues on the large iron ore and liquefied natural gas projects. Even under the low growth scenario, employment levels are expected to increase by more than 4,500 by 2018.

While the Kimberley region has seen the completion of Rio Tinto's $1.7 billion Argyle Diamond Mine expansion, it still has some large liquefied natural gas developments underway off the coast, led by Shell's $12.6 billion Prelude FLNG (floating liquefied natural gas) project in the Browse Basin. However, Woodside's decision to shelve plans for an onshore processing facility at James Price Point to investigate an FLNG option has delivered a significant blow to short-term construction

employment prospects for the Kimberley.[107] In the absence of this project, Resources Sector employment is projected to remain relatively stable in the Kimberley under all three scenarios, reflecting the low growth in employment for existing and operating projects.

In the eastern states, resource-related investment in recent years has focused on developments in the coal and coal seam gas sectors. The Bowen Basin in the Mackay region is one of Australia's largest high-quality coal basins, and it has some major projects at the feasibility stage such as North Queensland Bulk Ports Corporations' $12 billion Dudgeon Point Coal Terminal and GVK Hancock's $10 billion Alpha Coal Project. In the base case scenario, Resources Sector employment in Mackay will grow by approximately 5,000 workers to 2018, and in the high growth scenario employment grows by approximately 7,200 over the same period. Reflecting the sensitivity of these projects to changes in commodity prices, under the low growth scenario employment grows by only 2,800 to 2018.

The Fitzroy region has three liquefied natural gas projects: the Australian Pacific LNG project, the Queensland Curtis LNG project and the Gladstone LNG project. Other large projects in the pipeline for Fitzroy include the $8 billion China First Coal project and Vale's $2.8 billion Belvedere underground coal project. Under the base case scenario, employment rises by 3,800 to 2018, and in the high growth scenario it rises by 5,600. The liquefied natural gas projects provide a small buffer relative to the other regions in the low growth scenario—employment grows by approximately 2,000 to 2018.

The modelling notes that the level of resources-related employment in the Darling Downs is lower than in Mackay or Fitzroy. However, there are some large projects at the feasibility stage, including Arrow Energy's $1.5 billion Surat Gas Project, which has an estimated combined construction and operations workforce of 1,400. These projects are expected to provide strong employment growth in the region: in the base case scenario to 2018, employment grows by over 6,000 and in the high growth scenario by just over 7,200. The low growth scenario also shows reasonable growth in the Darling Downs, with Resources Sector employment projected to more than double between 2013 and 2018.

The Hunter Valley is the dominant mining region in New South Wales and has large coal and coal seam gas projects. Coal projects in the region are led by Glencore Xstrata's $1.4 billion Ravensworth expansion, and its $1.1 billion Ulan West underground coal project. Coal seam gas projects in the region are led by Santos's $1.3 billion Narrabri Coal Seam Gas project, which is at the feasibility stage. Resources Sector employment is projected to rise by 1,700 in the base case scenario and by 2,600 in the high growth scenario to 2018. In the low growth scenario employment rises by 880 workers to 2018.

Much of the volatility regarding the future of the workforce is reflected in the growth scenarios by region. In Victoria, for example, where many Resources Sector companies have their head office functions and there is at least one large gas project in development (the $4.4 billion Kipper-Tuna-Turrum project, due for completion in 2016), Resources Sector employment is expected to grow by over 4,500 to 2018 in the high growth scenario. On the other hand, in the low growth scenario, Resources Sector employment falls by 4,800 in Victoria in the period to 2018.

Similarly, in the Northern Territory there is a single large project representing the bulk of construction work on resources projects—the $34 billion Ichthys liquefied natural gas project. Relative to the size of the Northern Territory's economy, this represents a larger project value than for all major project construction work in Queensland and Western Australia combined.[108] Unsurprisingly, employment projections for the high growth scenario show considerable increases, with growth over the period 2013–18 of more than 3,500 workers. The low growth scenario projects an increase of around 800 workers over the same period.

107 Macmillan J and Ceranic I, 2013, 'Premier Colin Barnett admits failing WA on Woodside's plans for James Price Point project', *ABC News*, 21 August, abc.net.au/news/2013-08-20/premier-colin-barnett-admits-failing-wa-on-woodside27s-plans-f/4900964, accessed 9 October 2013.

108 DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, p. 35.

Trends in demand by occupation

Tables 12 to 15 present data on the profile of the Resources Sector by broad occupational level across the three subsectors under the different scenarios. In 2013, Machinery Operators and Drivers (24.5 per cent of the workforce), and Technicians and Trades Workers (33.5 per cent) are well represented in the Resources Sector. The sector also employs a number of Professionals (15.4 per cent), Clerical and Administrative Workers (10.2 per cent), Managers (9.3 per cent) and Labourers (6.0 per cent).

Deloitte Access Economics modelling shows that by 2018 the occupational mix is expected to shift to include a higher proportion of Professionals and Machinery Operators and Drivers and a lower proportion of Technicians and Trades Workers. However, under the base case and high growth scenarios the most well-represented broad occupational group in 2018 remains Technicians and Trades Workers, followed by Machinery Operators and Drivers, while in the low growth scenario these positions are reversed.

Table 12 Projected employment level by occupation, all sectors,* base case

Broad occupation	2013	2014	2015	2016	2017	2018
Managers	33,742	37,099	38,309	37,896	38,003	37,994
Professionals	55,662	59,688	63,364	66,061	68,004	69,457
Technicians and Trades Workers	121,261	142,414	136,539	115,296	102,945	91,283
Community and Personal Service Workers	1,421	1,544	1,579	1,543	1,540	1,530
Clerical and Administrative Workers	37,028	41,315	41,307	38,446	36,726	34,901
Sales Workers	2,074	2,379	2,384	2,184	2,066	1,937
Machinery Operators and Drivers	88,602	91,014	92,600	93,005	92,722	91,204
Labourers	21,661	25,994	25,061	20,933	18,442	16,022
Total	**361,451**	**401,447**	**401,143**	**375,364**	**360,448**	**344,328**

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.
Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 13 Projected employment level by occupation, all sectors,* high growth

Broad occupation	2013	2014	2015	2016	2017	2018
Managers	33,742	38,399	40,561	40,378	40,635	40,617
Professionals	55,662	60,342	64,954	68,392	71,040	73,079
Technicians and Trades Workers	121,261	158,026	159,444	135,910	120,939	105,509
Community and Personal Service Workers	1,421	1,603	1,678	1,651	1,651	1,638
Clerical and Administrative Workers	37,028	43,694	45,089	42,268	40,444	38,253
Sales Workers	2,074	2,557	2,663	2,463	2,336	2,176
Machinery Operators and Drivers	88,602	93,113	96,564	97,711	97,878	96,410
Labourers	21,661	28,992	29,496	24,974	21,988	18,821
Total	**361,451**	**426,726**	**440,449**	**413,747**	**396,911**	**376,503**

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.
Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 14 Projected employment level by occupation, all sectors,* low growth

Broad occupation	2013	2014	2015	2016	2017	2018
Managers	33,742	35,269	35,787	35,153	35,121	35,238
Professionals	55,662	58,819	61,316	63,125	64,413	65,413
Technicians and Trades Workers	121,261	120,619	112,428	93,926	83,784	76,422
Community and Personal Service Workers	1,421	1,462	1,470	1,429	1,422	1,422
Clerical and Administrative Workers	37,028	37,933	37,099	34,227	32,592	31,294
Sales Workers	2,074	2,124	2,071	1,869	1,758	1,671
Machinery Operators and Drivers	88,602	88,165	88,442	88,241	87,594	86,224
Labourers	21,661	21,782	20,351	16,691	14,607	13,047
Total	**361,451**	**366,173**	**358,964**	**334,661**	**321,291**	**310,731**

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.
Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Figures for average annual growth by occupation in the Resources Sector clearly demonstrate the shift from a broadly construction-based workforce to a broadly operations-based workforce. Managers and Professionals grow 2.4 per cent and 4.5 per cent respectively per year to 2018 in the base case scenario, Technicians and Trades Worker occupations decline 5.5 per cent per year and Labourers decline 5.9 per cent per year over the same period. The high growth scenario follows a similar pattern, with only Technicians and Trades Workers and Labourers declining (at about half the rate of the base case), while in the low growth scenario only Managers and Professionals increase, at a much reduced rate.

Table 15 Projected employment average annual growth by occupation, all sectors,* 2013–18

Broad occupation	Base case (%)	High growth (%)	Low growth (%)
Managers	2.4	3.8	0.9
Professionals	4.5	5.6	3.3
Technicians and Trades Workers	–5.5	–2.7	–8.8
Community and Personal Service Workers	1.5	2.9	0.0
Clerical and Administrative Workers	–1.2	0.7	–3.3
Sales Workers	–1.4	1.0	–4.2
Machinery Operators and Drivers	0.6	1.7	–0.5
Labourers	–5.9	–2.8	–9.6

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.
Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Resources Project Construction

Table 16 presents data on employment demand in Resources Project Construction by broad occupation under the different scenarios. Under all the scenarios there is a significant decrease in demand. The greatest decrease occurs under the low growth scenario, with total employment peaking in 2013 to reach a total of 85,820 workers before decreasing significantly to 7,708 workers in 2018. In 2013 the demand for Technicians and Trades Workers is the highest (51,417), followed by Labourers (10,083) and Clerical and Administrative Workers (8,683). Employment across all the occupations decreases significantly from 2015 onwards. The implications of this decreased demand

in Resources Project Construction employment—and strategies to respond to it—are considered in Chapters 5 and 7 of this report.

Table 16 Projected employment levels in Resources Project Construction by broad occupation, 2013–18

	2013	2014	2015	2016	2017	2018
Base case						
Managers	4,676	6,567	6,221	4,293	3,116	1,912
Professionals	2,699	3,761	3,564	2,467	1,788	1,092
Technicians and Trades Workers	51,417	71,281	63,929	41,491	28,537	16,492
Community and Personal Service Workers	215	298	282	196	143	87
Clerical and Administrative Workers	8,683	11,922	11,013	7,427	5,256	3,133
Sales Workers	671	912	845	574	410	246
Machinery Operators and Drivers	7,376	10,013	9,051	6,011	4,193	2,446
Labourers	10,083	14,071	12,806	8,444	5,882	3,448
Total	**85,820**	**118,825**	**107,711**	**70,903**	**49,325**	**28,856**
High growth						
Managers	4,676	7,880	8,210	6,165	4,784	3,219
Professionals	2,699	4,510	4,700	3,542	2,745	1,840
Technicians and Trades Workers	51,417	86,731	85,925	60,456	44,227	27,852
Community and Personal Service Workers	215	357	371	281	219	147
Clerical and Administrative Workers	8,683	14,310	14,539	10,668	8,069	5,274
Sales Workers	671	1,093	1,113	824	629	414
Machinery Operators and Drivers	7,376	12,108	12,068	8,704	6,473	4,126
Labourers	10,083	17,054	17,120	12,246	9,085	5,813
Total	**85,820**	**144,043**	**144,046**	**102,886**	**76,231**	**48,685**
Low growth						
Managers	4,676	4,684	4,080	2,307	1,291	512
Professionals	2,699	2,686	2,339	1,326	740	292
Technicians and Trades Workers	51,417	49,666	40,945	21,939	11,704	4,401
Community and Personal Service Workers	215	213	185	105	59	23
Clerical and Administrative Workers	8,683	8,500	7,220	3,989	2,177	839
Sales Workers	671	655	558	311	171	66
Machinery Operators and Drivers	7,376	7,052	5,858	3,199	1,726	653
Labourers	10,083	9,868	8,260	4,488	2,421	921
Total	**85,820**	**83,324**	**69,445**	**37,664**	**20,289**	**7,708**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

The top 10 employing occupations in Resources Project Construction under the low growth scenario (Table 17) show high levels of employment for occupations relevant to other sectors such as Construction, indicating that these occupations are not necessarily Resources Sector–specific. Occupational numbers decline significantly by the end of the outlook period—for example,

10,795 Electricians will be in demand in 2014, easing significantly to 957 in 2018. In the case of Plumbers the demand is projected to be 8,482 in 2014, decreasing to 752 by 2018.

Table 17 Projected employment levels of the top 10 employing occupations in Resources Project Construction, low growth, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
3411 Electricians	11,175	10,795	8,899	4,768	2,544	957
3341 Plumbers	8,781	8,482	6,993	3,747	1,999	752
3312 Carpenters and Joiners	8,300	8,017	6,610	3,541	1,889	710
3322 Painting Trades Workers	4,979	4,810	3,965	2,125	1,133	426
7212 Earthmoving Plant Operators	3,979	3,804	3,160	1,726	931	352
8212 Concreters	3,766	3,686	3,085	1,676	904	344
3332 Plasterers	3,558	3,436	2,833	1,518	810	305
3311 Bricklayers and Stonemasons	2,771	2,677	2,207	1,182	631	237
8211 Building and Plumbing Labourers	2,265	2,216	1,855	1,008	544	207
3334 Wall and Floor Tilers	2,020	1,951	1,609	862	460	173
Total	**51,594**	**49,874**	**41,216**	**22,153**	**11,845**	**4,463**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 18 shows projections for employment demand in Resources Project Construction during the outlook period in selected occupations under the low growth scenario. Construction Managers are in greatest demand among Professional occupations, while Truck Drivers, Structural Steel and Welding Trades Workers (which includes Boilermakers and Welders), and Metal Fitters and Machinists are in greatest demand among the Trades Workers. All the occupations, however, are projected to have significantly declined in demand by 2018. Projections under the base case and high growth scenarios are provided in Appendix F.

Table 18 Projected employment levels for other selected Resources Sector occupations in Resources Project Construction, low growth, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	1,480	1,483	1,291	730	409	162
1332 Engineering Managers	164	165	143	81	45	18
1335 Production Managers	245	245	213	121	68	27
2322 Cartographers and Surveyors	101	100	87	50	28	11
2332 Civil Engineering Professionals	543	541	471	267	149	59
2333 Electrical Engineers	196	195	169	96	54	21
2335 Industrial, Mechanical and Production Engineers	183	182	158	90	50	20
2336 Mining Engineers	22	21	19	11	6	2
2343 Environmental Scientists	20	20	17	10	5	2
2344 Geologists and Geophysicists	4	4	4	2	1	0
2513 Occupational and Environmental Health Professionals	128	127	111	63	35	14
Subtotal	**3,086**	**3,083**	**2,683**	**1,521**	**850**	**336**

Table 18 (continued)

Occupation		2013	2014	2015	2016	2017	2018
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	95	92	76	41	22	8
3126	Safety Inspectors	34	33	27	14	8	3
3212	Motor Mechanics	167	161	133	71	38	14
3223	Structural Steel and Welding Trades Workers	980	947	781	418	223	84
3232	Metal Fitters and Machinists	786	759	626	335	179	67
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	16	15	12	7	4	1
7122	Drillers, Miners and Shot Firers	175	167	139	76	41	15
7313	Train and Tram Drivers	2	2	2	1	0	0
7331	Truck Drivers	1,534	1,467	1,219	665	359	136
Subtotal		**3,789**	**3,643**	**3,015**	**1,628**	**874**	**328**
Total		**6,875**	**6,726**	**5,698**	**3,149**	**1,724**	**664**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Some other non–Resources Sector occupations are also relevant to the analysis, such as those that relate to head office and support roles. This includes a range of processing and transport-related support occupations. Employment levels in 2013 across some of these occupational categories are shown in Table 19.

Table 19 Employment level of key processing and transport occupations, 2013

Occupation		Resources Project Construction	Mining Operations	Oil and Gas Operations	Total
1336	Supply and Distribution Managers	83	938	443	**1,464**
5911	Purchasing and Supply Logistics Clerks	236	3,098	701	**4,035**
5912	Transport and Despatch Clerks	38	671	159	**868**
8391	Metal Engineering and Process Workers	114	347	35	**496**
8399	Other Factory and Process Workers	84	52	–	**135**
Total		**555**	**5,106**	**1,338**	**6,999**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 20 presents the projected employment levels in 2018 under the base case for the same occupations. All show a notable decline over the period 2013 to 2018; however, a ramp-up in capacity in the Oil and Gas Operations sector is expected to support overall solid demand growth for the first three occupations.

Table 20 Employment level of key processing and transport occupations, base case, 2018

Occupation	Resources Project Construction	Mining Operations	Oil and Gas Operations	Total
1336 Supply and Distribution Managers	34	1,062	759	**1,855**
5911 Purchasing and Supply Logistics Clerks	85	3,154	1,207	**4,446**
5912 Transport and Despatch Clerks	14	679	234	**927**
8391 Metal Engineering and Process Workers	39	359	52	**450**
8399 Other Factory and Process Workers	29	53	–	**82**
Total	**201**	**5,307**	**2,252**	**7,760**

Sources: ABS census and labour force data; DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Mining Operations

Table 21 presents data on employment demand in Mining Operations by broad occupation across the three scenarios. Occupations in Mining Operations are more diverse than Resources Project Construction occupations and include many specialist professional and managerial roles. The demand for Machinery Operators and Drivers is consistently high under the base case scenario (from 77,821 in 2014 to 84,377 in 2018), followed by Technicians and Trades Workers (from 61,958 in 2014 to 62,887 in 2018) and Professionals (from 41,068 in 2014 to 46,563 in 2018).

The fact that the expected employment demand in the high growth and low growth scenarios is not dissimilar to the base case suggests that the operations workforce is less sensitive to the shifts that affect the Resources Project Construction workforce.

Table 21 Projected employment levels in Mining Operations by broad occupation, 2013–18

	2013	2014	2015	2016	2017	2018
Base case						
Managers	23,549	24,194	24,834	25,469	26,132	26,783
Professionals	39,960	41,068	42,700	44,318	45,539	46,563
Technicians and Trades Workers	61,679	61,958	62,388	62,681	62,816	62,887
Community and Personal Service Workers	1,059	1,080	1,108	1,136	1,171	1,203
Clerical and Administrative Workers	21,177	21,349	21,344	21,275	21,274	21,252
Sales Workers	836	836	837	839	845	849
Machinery Operators and Drivers	78,350	77,821	79,957	82,979	84,285	84,377
Labourers	10,082	10,231	10,356	10,414	10,394	10,345
Total	**236,692**	**238,537**	**243,524**	**249,111**	**252,456**	**254,259**
High growth						
Managers	23,549	24,207	25,053	25,892	26,740	27,569
Professionals	39,960	41,049	43,058	45,108	46,727	48,115
Technicians and Trades Workers	61,679	62,125	63,175	64,000	64,568	64,992
Community and Personal Service Workers	1,059	1,080	1,117	1,154	1,197	1,238
Clerical and Administrative Workers	21,177	21,372	21,543	21,630	21,765	21,865

Table 21 (continued)

	2013	2014	2015	2016	2017	2018
Sales Workers	836	836	844	852	864	874
Machinery Operators and Drivers	78,350	77,840	80,877	84,882	86,963	87,624
Labourers	10,082	10,249	10,463	10,602	10,647	10,650
Total	**236,692**	**238,758**	**246,130**	**254,120**	**259,471**	**262,927**
Low growth						
Managers	23,549	24,210	24,650	25,136	25,674	26,199
Professionals	39,960	41,167	42,354	43,581	44,499	45,242
Technicians and Trades Workers	61,679	61,783	61,629	61,543	61,390	61,215
Community and Personal Service Workers	1,059	1,082	1,101	1,123	1,152	1,179
Clerical and Administrative Workers	21,177	21,346	21,176	21,000	20,914	20,807
Sales Workers	836	837	832	830	832	832
Machinery Operators and Drivers	78,350	77,915	79,098	81,256	81,944	81,587
Labourers	10,082	10,215	10,249	10,242	10,175	10,087
Total	**236,692**	**238,555**	**241,089**	**244,711**	**246,580**	**247,148**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

The top 10 employing occupations in Mining Operations under the base case are presented in Table 22. Drillers, Miners and Shot Firers top the list, with demand peaking in 2018 (from 48,806 in 2014 to 53,311). They are followed by Metal Fitters and Machinists (23,766 in 2014 to 24,188 in 2018). Demand for all of the relevant managerial and professional roles is projected to increase over the period, some significantly—for example, Production Managers increase from 8,765 workers to 10,065 in 2018, Mining Engineers from 5,673 to 6,651, and Geologists and Geophysicists from 7,249 to 8,299.

Table 22 Projected employment levels of the top 10 employing occupations in Mining Operations, base case, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	49,125	48,806	50,263	52,300	53,210	53,311
3232	Metal Fitters and Machinists	23,664	23,766	23,950	24,085	24,153	24,188
3129	Other Building and Engineering Technicians	13,281	13,358	13,486	13,587	13,636	13,663
7331	Truck Drivers	11,864	11,773	12,047	12,445	12,606	12,602
1335	Production Managers	8,765	9,016	9,281	9,546	9,811	10,065
3411	Electricians	8,474	8,519	8,625	8,717	8,768	8,794
2344	Geologists and Geophysicists	7,249	7,441	7,697	7,942	8,132	8,299
2336	Mining Engineers	5,673	5,830	6,073	6,316	6,500	6,651
3223	Structural Steel and Welding Trades Workers	5,817	5,836	5,846	5,839	5,831	5,827
7212	Earthmoving Plant Operators	5,496	5,446	5,565	5,742	5,813	5,809
Total		**139,408**	**139,791**	**142,833**	**146,519**	**148,460**	**149,209**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 23 shows projections for employment demand in selected Resources Sector occupations in Mining Operations under the base case scenario. Overall, there is an increase in demand up to 2018. Among the Technical and Trades Workers and Machinery Operators and Drivers occupations, the demand for Motor Mechanics is high throughout the period; of particular note are Train and Tram Drivers (in this case, specifically referring to freight trains), with employment growing from 634 workers in 2013 to 686 in 2018. Projections under the low growth and high growth scenarios are provided in Appendix F.

Table 23 Projected employment levels for other selected Resources Sector occupations in Mining Operations, base case, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
Managers and Professionals						
1331 Construction Managers	696	715	733	751	769	788
1332 Engineering Managers	824	847	873	900	926	951
2322 Cartographers and Surveyors	1,412	1,454	1,519	1,585	1,635	1,674
2332 Civil Engineering Professionals	1,249	1,282	1,329	1,376	1,412	1,443
2333 Electrical Engineers	1,104	1,136	1,192	1,251	1,294	1,328
2335 Industrial, Mechanical and Production Engineers	1,985	2,041	2,131	2,222	2,289	2,344
2343 Environmental Scientists	1,242	1,280	1,338	1,397	1,440	1,475
2513 Occupational and Environmental Health Professionals	2,243	2,307	2,400	2,493	2,563	2,621
Subtotal	**10,755**	**11,062**	**11,515**	**11,975**	**12,328**	**12,624**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	211	211	210	208	206	205
3126 Safety Inspectors	614	617	622	626	628	629
3212 Motor Mechanics	1,819	1,825	1,829	1,827	1,825	1,824
3992 Chemical, Gas, Petroleum and Power Generation Plant Operators	519	519	516	511	508	506
7313 Train and Tram Drivers	634	633	651	675	685	686
Subtotal	**3,797**	**3,805**	**3,828**	**3,847**	**3,852**	**3,850**
Total	**14,552**	**14,867**	**15,343**	**15,822**	**16,180**	**16,474**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Oil and Gas Operations

Employment in Oil and Gas Operations is projected to grow significantly during the outlook period. Table 24 shows projected total employment peaking at 61,211 in 2018 from 44,086 in 2014 under the base case scenario. This sector is different from Resources Project Construction and Mining Operations in the occupational composition of its workforce. In Oil and Gas Operations under the base case, Professionals consistently comprise the majority of the workforce (from 33.7 per cent in 2014 to 35.6 per cent in 2018), followed by Technicians and Trades Workers (from 20.8 per cent in 2014 to 19.4 per cent in 2018).

Similar to Mining Operations, Oil and Gas Operations employment projections are affected only marginally in the high and low growth scenarios, showing the relative stability of the operations workforces across broad occupations.

Table 24 Projected employment levels in Oil and Gas Operations by broad occupation, 2013–18

	2013	2014	2015	2016	2017	2018
Base case						
Managers	5,518	6,339	7,255	8,134	8,755	9,298
Professionals	13,003	14,859	17,100	19,276	20,677	21,802
Technicians and Trades Workers	8,166	9,175	10,222	11,125	11,592	11,904
Community and Personal Service Workers	147	167	189	211	227	239
Clerical and Administrative Workers	7,168	8,044	8,950	9,744	10,196	10,517
Sales Workers	568	631	703	770	811	841
Machinery Operators and Drivers	2,876	3,179	3,592	4,015	4,244	4,381
Labourers	1,497	1,693	1,899	2,075	2,166	2,229
Total	**38,943**	**44,087**	**49,910**	**55,350**	**58,668**	**61,211**
High growth						
Managers	5,518	6,312	7,298	8,321	9,111	9,829
Professionals	13,003	14,783	17,197	19,742	21,568	23,124
Technicians and Trades Workers	8,166	9,170	10,344	11,454	12,144	12,665
Community and Personal Service Workers	147	166	190	216	236	253
Clerical and Administrative Workers	7,168	8,012	9,006	9,969	10,609	11,114
Sales Workers	568	628	706	787	843	889
Machinery Operators and Drivers	2,876	3,165	3,620	4,125	4,442	4,660
Labourers	1,497	1,688	1,913	2,126	2,257	2,357
Total	**38,943**	**43,924**	**50,274**	**56,740**	**61,210**	**64,891**
Low growth						
Managers	5,518	6,375	7,057	7,711	8,156	8,527
Professionals	13,003	14,966	16,623	18,219	19,173	19,879
Technicians and Trades Workers	8,166	9,170	9,854	10,445	10,689	10,806
Community and Personal Service Workers	147	168	184	200	211	220
Clerical and Administrative Workers	7,168	8,087	8,704	9,238	9,501	9,648
Sales Workers	568	635	684	731	756	772
Machinery Operators and Drivers	2,876	3,199	3,485	3,785	3,924	3,984
Labourers	1,497	1,699	1,842	1,961	2,011	2,039
Total	**38,943**	**44,299**	**48,433**	**52,290**	**54,421**	**55,875**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

The 'boom' in Oil and Gas Operations is evident in the significant employment growth in several occupations. The top 10 employing occupations are presented in Table 25. Not surprisingly, Mining Engineers (increasing from 2,282 in 2014 to 3,548 in 2018) and Chemical, Gas and Petroleum and Power Generation Plant Operators (increasing from 2,379 in 2014 to 3,265 in 2018) head the list. Accountants are important to this sector and are projected to increase from 1,937 in 2014 to 2,818 in 2018.

Table 25 Projected employment levels of the top 10 employing occupations in Oil and Gas Operations, base case, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
2336	Mining Engineers	1,940	2,282	2,695	3,092	3,345	3,548
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	2,060	2,379	2,718	3,009	3,162	3,265
2211	Accountants	1,702	1,937	2,221	2,497	2,675	2,818
2344	Geologists and Geophysicists	1,306	1,542	1,828	2,102	2,276	2,416
7122	Drillers, Miners and Shot Firers	1,328	1,528	1,790	2,051	2,195	2,284
3232	Metal Fitters and Machinists	1,219	1,399	1,589	1,752	1,837	1,895
5111	Contract, Program and Project Administrators	976	1,110	1,251	1,375	1,446	1,497
1335	Production Managers	791	948	1,128	1,299	1,417	1,518
2335	Industrial, Mechanical and Production Engineers	830	963	1,124	1,280	1,380	1,459
5511	Accounting Clerks	900	1,002	1,105	1,195	1,246	1,282
Total		**13,052**	**15,090**	**17,449**	**19,652**	**20,979**	**21,982**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Projected employment in other selected Resources Sector occupations (Table 26) indicate increased demand for Engineering Managers (from 534 in 2014 to 810 in 2018), Civil Engineering Professionals (from 498 in 2014 to 721 in 2018) and Occupational and Environmental Health Professionals (from 449 in 2014 to 650 in 2018).

It is important to understand that although the growth in some of these occupations is considerable, some critical occupations are not captured in the data. This is because they are highly specific occupations which engage small numbers of workers—such as specialised boilermakers (an occupation within Structural Steel and Welding Trades Workers) and petrogeologists (an occupation identified in AWPA's industry consultations but not specifically captured in the ANZSCO classifications). In addition, some new liquefied natural gas projects are likely to come on line later than 2016–17, meaning the additional demand for Chemical, Gas, Petroleum and Power Generation Plant Operators in particular may not be captured in these projections. Projections for the low growth and high growth scenarios are provided in Appendix F.

Table 26 Projected employment levels for other selected Resources Sector occupations in Oil and Gas Operations, base case, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	192	214	239	263	280	295
1332 Engineering Managers	458	534	620	703	760	810
2322 Cartographers and Surveyors	145	163	185	207	221	232
2332 Civil Engineering Professionals	439	498	570	639	684	721
2333 Electrical Engineers	329	363	403	442	468	490
2343 Environmental Scientists	261	302	351	399	430	455
2513 Occupational and Environmental Health Professionals	395	449	513	576	617	650
Subtotal	**2,219**	**2,523**	**2,881**	**3,229**	**3,460**	**3,653**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	36	40	46	50	52	54
3126 Safety Inspectors	130	140	150	158	162	165
3212 Motor Mechanics	194	219	245	267	279	286
3223 Structural Steel and Welding Trades Workers	281	319	358	391	409	420
3411 Electricians	574	642	713	774	806	827
7212 Earthmoving Plant Operators	83	89	96	105	109	111
7313 Train and Tram Drivers	0	0	0	0	0	0
7331 Truck Drivers	426	431	444	463	471	474
Subtotal	**1,724**	**1,880**	**2,052**	**2,208**	**2,288**	**2,337**
Total	**3,943**	**4,403**	**4,933**	**5,437**	**5,748**	**5,990**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

In addition to the occupations listed in the tables above, there are also maritime workers employed on drill rigs, tugs and support vessels in the offshore Oil and Gas Operations sector. This includes a range of Maritime Transport Professionals (Ship's Engineer, Ship's Master, Ship's Officer, Ship's Surveyor, Marine Safety Officer) and Deck and Fishing Hands (Deck Hand/Seafarer) involved in controlling, managing and maintaining the operations of ships, boats, marine equipment and structures. Table 27 shows the employment level of Maritime occupations relevant to the offshore Oil and Gas Operations sector at the four-digit ANZSCO occupation level.

Table 27 Employment level of key Maritime occupations, 2013

Occupation	Resources Project Construction	Mining Operations	Oil and Gas Operations	Total
2312 Maritime Transport Professionals	12	249	297	**559**
8992 Deck and Fishing Hands	7	93	178	**278**
Total	**19**	**342**	**475**	**837**

Sources: ABS census and labour force data; DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 28 presents the projected employment levels in 2018 under the base case for the same occupations. As expected, there is an increase in employment in the offshore Oil and Gas Operations sector due to the increased number of offshore oil and gas projects coming on line in the next few years.

Table 28 Employment level of key Maritime occupations, base case, 2018

Occupation	Resources Project Construction	Mining Operations	Oil and Gas Operations	Total
2312 Maritime Transport Professionals	5	278	492	**775**
8992 Deck and Fishing Hands	3	92	274	**369**
Total	**8**	**370**	**766**	**1,144**

Sources: ABS census and labour force data; DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

3.5 Trends in replacement demand for skills in the Resources Sector

In addition to employment projections for 2014–18, it is important to consider the rate of workers that exit the workforce permanently. The requirement to replace these workers creates additional demand for skills, and has implications for the provision of training and the demand for training services.[109] Projected average net replacement by broad occupation is shown in Table 29.

Table 29 Projected net replacement rate by broad occupation, all sectors,* average rate 2013–18

Occupation	Base case (%)	High growth (%)	Low growth (%)
Managers	2.5	2.4	2.6
Professionals	1.7	1.6	1.7
Technicians and Trades Workers	1.8	1.7	1.9
Community and Personal Service Workers	1.5	1.5	1.6
Clerical and Administrative Workers	2.1	2.0	2.2
Sales Workers	1.5	1.5	1.5
Machinery Operators and Drivers	2.1	2.0	2.2
Labourers	2.0	1.9	2.0
Total	**2.0**	**1.9**	**2.1**

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Projected average net replacement rates by four-digit ANZSCO occupational level are shown in Table 30. Looking at the base case scenario, the average replacement rate for the selected Manager occupations sits at 2.2 per cent, while the average replacement rate for Professional occupations is much lower, at about 1.4 per cent. In trades occupations, replacement rates are more variable.

In the high growth scenario, replacement rates are lower, as the higher implied wage growth and greater job opportunities encourage older workers, in particular, to stay in the workforce longer. In the low growth scenario, fewer job opportunities and lower wage growth reduce incentives to stay in the workforce, resulting in higher replacement rates. In the base case scenario, replacement rates

109 DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, p. 40.

are marginally higher than in the high growth scenario as there are fewer older workers willing to retrain or upskill, leading them to leave the workforce early rather than seek new employment in another industry.

Table 30 Projected net replacement rates by selected Resources Sector occupation, all sectors,* average rate 2013–18

Occupation	Base case (%)	High growth (%)	Low growth (%)
Manager/Professional			
1331 Construction Managers	2.2	2.1	2.3
1332 Engineering Managers	2.2	2.1	2.3
1335 Production Managers	2.2	2.1	2.3
2322 Cartographers and Surveyors	1.5	1.3	1.5
2332 Civil Engineering Professionals	1.4	1.3	1.4
2333 Electrical Engineers	1.4	1.3	1.4
2335 Industrial, Mechanical and Production Engineers	1.4	1.3	1.4
2336 Mining Engineers	1.4	1.3	1.4
2343 Environmental Scientists	1.4	1.3	1.4
2344 Geologists and Geophysicists	1.4	1.3	1.4
2513 Occupational and Environmental Health Professionals	1.3	1.4	1.4
Technicians and Trades Workers/Machinery Operators and Drivers			
3122 Civil Engineering Draftspersons and Technicians	2.2	2.1	2.3
3126 Safety Inspectors	2.2	2.1	2.3
3212 Motor Mechanics	1.8	1.8	1.9
3223 Structural Steel and Welding Trades Workers	1.7	1.7	1.8
3232 Metal Fitters and Machinists	2.0	1.9	2.0
3411 Electricians	1.5	1.4	1.6
3992 Chemical, Gas, Petroleum and Power Generation Plant Operators	1.7	1.7	1.8
7122 Drillers, Miners and Shot Firers	2.1	2.0	2.1
7212 Earthmoving Plant Operators	1.9	1.8	2.0
7313 Train and Tram Drivers	2.4	2.2	2.4
7331 Truck Drivers	2.4	2.2	2.4

* 'All sectors' refers to Resources Project Construction, Mining Operations and Oil and Gas Operations.

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

3.6 Conclusion

In this chapter we presented a brief overview of the lifecycle of a resources project to explain the size and staging of the various mining and gas project components and the workforce requirements during a project's lifetime. We then examined potential demand for skills in the Resources Sector in the period ahead under the various scenarios. The modelling suggests the low growth scenario (which is also in line with Treasury projections) as the most likely outcome for Resources Project Construction. This scenario projects declining employment over the outlook period from 85,820 in 2013 to 7,708 in 2018. In fact, between 2014 and 2018 all scenarios exhibit sharp drops in employment associated with Resources Project Construction, consistent with the bulk of major projects currently underway being completed, and a relative dearth of new projects coming on board to replace them.

Across all three scenarios, employment growth in Mining Operations is strong up until 2018. However, the extent of this growth is quite different across the scenarios. Under the base case scenario, employment in Mining Operations is expected to increase from 236,690 in 2013 to 254,260 in 2018, representing a 7.4 per cent increase. Growth is higher under the high growth scenario, increasing from 236,690 in 2013 to 262,927 in 2018.

Of the three subsectors examined, employment in Oil and Gas Operations is expected to experience the most robust growth as new gas trains come on line—from 38,943 in 2013 to 61,212 in 2018, representing a 57.2 per cent increase. Growth is even more robust under the high growth scenario, where an additional 25,948 workers are expected by 2018. The low growth scenario yields a conservative estimate that still projects 16,932 additional workers by 2018, or a 43 per cent increase from the 2013 levels.

Employment is projected to be strongest in the Pilbara in Western Australia and the Darling Downs and Mackay regions of Queensland. Across all regions there is a shift away from construction jobs over time towards operations jobs. Replacement rates in the base case scenario are marginally higher than in the high growth scenario, as more workers leave the workforce early rather than seek new employment in another industry.

As demonstrated by the modelling, we can expect employment growth to increase over the outlook period in Mining Operations and Oil and Gas Operations, which is consistent with the transitioning of the Resources Sector from the construction to the operations phase. However, this also means that the sector will need workers to maintain and expand production capacity. Does Australia have the skills supply that is essential to the Resources Sector? The following chapter examines existing and projected skills supply relevant to the sector.

4 Existing and projected skills supply

4.1 Introduction

The shortage of labour and the need for an appropriately skilled workforce are regularly reported as impediments to the growth of Australia's Resources Sector. In this chapter we examine both the existing and projected supply of skills from 2013 to 2018 in occupations relevant to the Resources Sector.

The data on existing skills supply presents a mixed picture for the sector. While recent increases in engineering commencements and completions are encouraging, these trends do not necessarily apply to the specialist engineering and geology disciplines that supply the bulk of domestic graduates to the Resources Sector. Trends for commencements and completions in vocational education and training, while largely positive, could be improved. Skilled migration data for key professional and trade and technical occupations in the Resources Sector indicates some reliance on this source of skills supply.

The supply projections suggest there are overall increases in skills supply in the period up to 2018. However, this increase in supply may not be sufficient to meet the projected demand during the outlook period.

It is important to remember, though, that in a diverse economy such as Australia's, with different regions having quite different industrial mixes and demographics, a national-level assessment of pressures in occupational labour markets can easily mask differences across regions. Some parts of the country may face a labour shortfall in an occupation, while other regions may have an excess supply in that same occupation. While AWPA's analysis is based on Deloitte Access Economics modelling and administrative data, supply projections are only indicative of potential trends and changes in economic conditions will impact on supply estimates.

4.2 Existing supply of skills

Skills for the Resources Sector are drawn from a range of sources including the existing pool of skilled workers in the national labour market (the unemployed and the employed), and new supplies of skilled workers or job seekers, including from vocational education and training, higher education, and migration.

Table 31 shows Australia's existing skills stocks relevant to the Resources Sector in selected Professional and Technician and Trades Worker occupations, including both employed and unemployed persons.

Table 31 Labour force figures in key occupations in the Resources Sector, four-quarter average to May 2013

Occupation		Unemployed ('000)	Employed ('000)	Labour force ('000)	Unemployment rate (%)
2	**Professionals**	**47.0**	**2,442.8**	**2,489.8**	**1.9**
233	Engineering Professionals	3.0	134.1	137.1	2.2
234	Natural and Physical Science Professionals	2.2	95.0	97.2	2.3
3	**Technicians and Trades Workers**	**54.4**	**1,662.0**	**1,716.4**	**3.2**
321	Automotive Electricians and Mechanics	2.4	97.3	99.6	2.4
312	Building and Engineering Technicians	3.2	123.1	126.3	2.6
3411	Electricians	2.4	138.1	140.5	1.7
342	Electronics and Telecommunications Trades Workers	3.0	93.1	96.1	3.1
322	Fabrication Engineering Trades Workers	3.0	93.5	96.4	3.1
323	Mechanical Engineering Trades Workers	3.1	141.7	144.8	2.1
399	Miscellaneous Technicians and Trades Workers	2.2	58.2	60.5	3.7
3341	Plumbers	1.9	82.3	84.2	2.1

Source: ABS, 2013, *Labour force, detailed, quarterly*, cat. no. 6291.0.55.003, unpublished data.

In the Professional occupations, the unemployment rate is low for Engineering Professionals at 2.2 per cent (compared to 2.6 per cent in 2012). There is a slight increase in the unemployment rate for Natural and Physical Science Professionals at 2.3 per cent, up from 1.9 per cent in 2012.

The unemployment rate for the Technician and Trades Worker occupations was 3.2 per cent in May 2013. In May 2013, there were 1,662,000 Technicians and Trades Workers in employment across Australia, and a further 54,400 unemployed. In some trades, such as Electricians and Mechanical Engineering Trades Workers, unemployment was quite low (1.7 per cent and 2.1 per cent respectively).

In previous reports, we drew attention to unemployment figures and suggested there were opportunities to fill vacancies in the Professional and Technician and Trades Worker occupations from the pool of unemployed workers.[110] The May 2013 unemployment figures for Professionals and Technicians and Trades Workers with the relevant experience indicate this source of supply will be more limited in the future.

Apart from attracting tradespeople from other industries, the main *short-term* options to increase the supply of skills to the Resources Sector include reskilling and upskilling people in related professions or trades (quick turn-around for retraining), recruiting from the unemployed, and utilising temporary or permanent migration. To address *longer term* skills needs, the sector may need to consider refocusing its training efforts, especially given its changing skills requirements as it moves from a construction to an operations phase and the increasing use of automation and technology in the sector. These issues are considered in more detail in Chapter 6.

110 AWPA, 2012, *Resources Sector skill needs*; Skills Australia, 2011, *2011 interim report on the Resources Sector skill needs*, awpa.gov.au/our-work/sector-specific-skill-needs/documents/InterimReport.pdf, accessed 18 November 2013.

The National Centre for Vocational Education Research notes that labour shortages in the trades are a recurring problem. However, solutions tend to focus on growing the labour pool rather than stemming the flow of already trained potential workers from it. In other words, increasing training and reducing non-completion of training appear to be standard proposals for reducing skills shortages, rather than reducing attrition in the industry.[111] Industry has a key role to play in attracting and indeed retaining skilled workers in the sector. The Australian Chamber of Commerce and Industry argues training is only one of four elements of a solution to skills shortages, the others being labour mobility, better skills utilisation and migration.[112]

The Construction and Manufacturing sectors are likely to continue to provide resources companies with access to a larger pool of relevant technical and professional skills, noting that not all occupational skills are transferable across sectors. Transferability of skills is discussed in later chapters.

4.3 Supply of skills from higher education

Recent increases in commencements in resources-related higher education courses are encouraging. These increases suggest prospective students have responded to positive labour market signals from the Resources Sector by enrolling in the relevant higher education courses in Engineering and Related Technologies and Natural and Physical Sciences. From 2009 to 2012, when employment levels in the industry increased significantly, commencements in Engineering and Related Technologies higher education courses increased by 40 per cent, and enrolments in Natural and Physical Sciences courses increased by 17 per cent, compared to modest year-on-year increases between 2001 and 2009.

However, the outcomes for higher education graduates are not always clear; the data indicates graduating students often find it difficult to secure relevant positions following graduation. In addition, significant numbers of graduates proceed to postgraduate qualifications before entering employment.

Current evidence and AWPA's consultations suggest that, contrary to common perceptions, newly qualified graduates (most especially in engineering) do not necessarily have a straightforward trajectory from completion of a degree to employment. For example, a significant number of engineering graduates go on to undertake a relevant postgraduate qualification or transfer their skills to a non-engineering occupation.

AWPA's stakeholder consultations and research by the Department of Employment on skills shortages confirm the evidence that most employers view experience as the most important criteria in recruitment, which severely limits the opportunities available to recent graduates. This may explain, in part, why many graduates seek employment in occupations not directly related to the discipline they are qualified in. This is especially the case for occupations in the Resources Sector, for which industry experience often serves as a prerequisite for entry-level employment.

In the case of engineers, some graduates may begin careers in traditional engineering occupations and then move into non-traditional occupations later in their careers. A proportion of engineering graduates also respond to normal labour market incentives and end up working in occupations where it is unlikely they will practise engineering. The 2012 Senate Education, Employment and Workplace Relations References Committees' inquiry report, *The shortage of engineering and related employment skills,* found high demand for graduate engineers from financial services, actuarial and management consultancy firms.[113] The data on higher education completions therefore only provides an indication of the available supply of graduates qualified to work in a particular occupation, as many graduates may choose not to work in jobs related to their degree.

The latest data available on commencements and completions in higher education courses relevant to the Resources Sector was prepared for 2012. Both the Engineering and Related Technologies and the Natural and Physical Sciences streams are sources of graduate professionals for the

111 Karmel T, Lim P and Misko J, 2011, *Attrition in the trades*, NCVER Monograph Series 07/2011, ncver.edu.au/publications/2420.html, accessed 7 November 2013, p. 9.

112 Australian Chamber of Commerce and Industry, 2006, 'Addressing skill shortages: an industry–government partnership', *ACCI Review*, 134, pp. 7–11.

113 Senate Education, Employment and Workplace Relations References Committee, 2012, *The shortage of engineering and related employment skills*, aph.gov.au/Parliamentary_Business/Committees/Senate/Education_Employment_and_Workplace_Relations/Completed%20inquiries/2010-13/engineering/index, accessed 6 November 2013, p. 76.

Resources Sector. The data presented in Table 32 indicates that in 2012 a total of 29,552 students commenced in Engineering and Related Technologies courses in Australia. This represents a growth in commencements of just over 53 per cent since 2001. The majority (67 per cent) of commencements were at the undergraduate level in 2012, consistent with figures from previous years. The majority (65 per cent) of commencements were also undertaken by domestic students.

Table 32 Student commencements in Engineering and Related Technologies higher education courses by citizenship and level of course, 2001–12

	Domestic		Overseas		
	Undergraduate	Postgraduate	Undergraduate	Postgraduate	Total
2001	11,170	2,756	3,396	1,884	**19,206**
2002	11,114	2,985	3,946	2,368	**20,413**
2003	10,898	3,050	4,370	3,413	**21,731**
2004	10,655	3,015	4,020	3,416	**21,106**
2005	10,619	2,810	3,967	3,323	**20,719**
2006	11,046	2,725	4,085	3,156	**21,012**
2007	12,084	2,737	4,935	3,458	**23,214**
2008	12,321	2,893	4,974	3,616	**23,804**
2009	13,215	3,491	6,037	4,477	**27,220**
2010	14,182	3,656	6,515	4,104	**28,457**
2011	14,710	3,589	6,482	3,901	**28,682**
2012	15,489	3,708	6,082	4,273	**29,552**

Source: Department of Education, 2001–12, *Selected higher education statistics*, innovation.gov.au/highereducation/HigherEducationStatistics/StatisticsPublications/Pages/default.aspx, accessed 19 November 2013.

Over the period from 2001 to 2012, total completions increased by approximately 58 per cent, from 10,713 students in 2001 to 16,912 in 2012 (Table 33). Domestic undergraduate completions increased by 5.5 per cent to 7,454 in 2012 from 7,064 in 2011. Between 2001 and 2012, an average of 6,475 domestic students and 2,695 overseas students completed undergraduate qualifications in Engineering and Related Technologies courses. Overall, postgraduate completions doubled over the period from 2001 to 2012, and undergraduate completions increased by 42 per cent.

Table 33 Student completions in Engineering and Related Technologies higher education courses by citizenship and level of course, 2001–12

	Domestic		Overseas		
	Undergraduate	Postgraduate	Undergraduate	Postgraduate	Total
2001	6,340	1,516	1,676	1,181	**10,713**
2002	6,199	1,487	1,789	1,361	**10,836**
2003	6,199	1,644	2,084	2,016	**11,943**
2004	6,548	1,627	2,290	2,285	**12,750**
2005	5,994	1,584	2,463	2,752	**12,793**
2006	6,371	1,630	2,471	2,402	**12,874**
2007	6,152	1,789	2,593	2,460	**12,994**
2008	6,312	1,852	2,987	2,714	**13,865**
2009	6,401	1,966	2,934	2,899	**14,200**
2010	6,666	2,269	3,301	3,354	**15,590**
2011	7,064	2,288	3,776	3,619	**16,747**
2012	7,454	2,442	3,971	3,045	**16,912**

Source: Department of Education, 2001–12, *Selected higher education statistics*.

In 2012, a total of 37,349 students commenced in Natural and Physical Sciences higher education courses, a growth of 55.5 per cent since 2001. Eighty-three per cent of commencements were undertaken by undergraduate students. Domestic students accounted for over 85 per cent of commencements (see Table 34).

Table 34 Student commencements in Natural and Physical Sciences higher education courses by citizenship and level of course, 2001–12

	Domestic		Overseas		
	Undergraduate	Postgraduate	Undergraduate	Postgraduate	Total
2001	18,488	2,524	2,192	816	**24,020**
2002	17,825	2,862	2,448	928	**24,063**
2003	17,708	3,047	2,516	1,082	**24,353**
2004	18,292	3,074	2,882	1,200	**25,448**
2005	17,692	2,881	2,775	1,147	**24,495**
2006	17,611	3,180	2,696	1,303	**24,790**
2007	17,701	3,286	2,882	1,828	**25,697**
2008	17,515	3,231	3,005	2,056	**25,807**
2009	19,885	3,660	3,326	2,411	**29,282**
2010	22,783	3,775	3,230	2,404	**32,192**
2011	24,460	3,659	3,388	2,208	**33,715**
2012	27,869	3,928	3,144	2,408	**37,349**

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Over the period from 2001 to 2012, total completions increased by approximately 43 per cent, from 14,133 students in 2001 to 20,151 in 2012 (Table 35). Domestic undergraduate completions increased by 17.2 per cent to 13,318 in 2012 from 11,362 in 2011. Between 2001 and 2012, an average of 11,712 domestic students and 1,840 overseas students completed undergraduate qualifications in Natural and Physical Sciences courses. Overall, postgraduate completions more than doubled over the period from 2001 to 2012, and undergraduate completions increased by 30 per cent.

Table 35 Student completions in Natural and Physical Sciences higher education courses by citizenship and level of course, 2001–2012

	Domestic		Overseas		
	Undergraduate	Postgraduate	Undergraduate	Postgraduate	Total
2001	11,362	1,569	758	444	**14,133**
2002	10,832	1,729	899	513	**13,973**
2003	10,866	1,885	1,087	605	**14,443**
2004	11,365	2,021	1,495	775	**15,656**
2005	11,727	2,044	1,914	854	**16,539**
2006	11,801	2,105	2,079	842	**16,827**
2007	11,674	2,177	2,294	960	**17,105**
2008	11,637	2,299	2,205	1,171	**17,312**
2009	11,331	2,307	2,134	1,321	**17,093**
2010	11,975	2,473	2,374	1,646	**18,468**
2011	12,656	2,796	2,379	1,756	**19,587**
2012	13,318	2,639	2,461	1,733	**20,151**

Source: Department of Education, 2001–12, *Selected higher education statistics*.

There are positive signs that both commencements and completions in the Engineering and Related Technologies and Natural and Physical Sciences streams are increasing. However, in view of what is known about the occupational outcomes for engineering graduates in particular, the challenge is to ensure these newly qualified graduates seek and gain employment in relevant Resources Sector occupations. The challenge for employers is to attract and retain their graduate employees if the Resources Sector is to meet its demand for professionals.

A detailed examination of student commencements and completions in 2001 and 2012 for specific courses relevant to the Resources Sector in Engineering and Related Technologies and Natural and Physical Sciences reveals where student growth is occurring. The following tables combine domestic and overseas students, noting that not all overseas students will be employed in the Australian labour market. A detailed breakdown of domestic and overseas student commencements and completions in selected Engineering and Related Technologies and Natural and Physical Sciences courses is provided in Appendix G.

In the Engineering and Related Technologies courses, growth is most apparent in Mechanical Engineering (43 per cent growth in undergraduate commencements and 30.8 per cent growth in undergraduate completions between 2001 and 2012) and Civil Engineering (133 per cent growth in undergraduate commencements and 29 per cent growth in undergraduate completions between 2001 and 2012) (tables 36 and 37).

However, the data does not present an encouraging picture in some disciplines relevant to the Resources Sector. For example, the number of students studying Geotechnical Engineering and Geophysics courses remains small and therefore not sufficient to address the sector's demand for these specialist skills.

In the case of completions, completions in Mining Engineering courses grew in the 11 years to 2012—by approximately 41 per cent in undergraduate courses and by 411 per cent in postgraduate courses. However, student numbers are very small, with just 220 undergraduates and 322 postgraduates completing in 2012.

Table 36 Summary of student commencements in specific Engineering and Related Technologies higher education courses by level of course, 2001 and 2012

	Undergraduate		Postgraduate	
Course	**2001**	**2012**	**2001**	**2012**
030300 Process and Resources Engineering	< 5	38	> 25	109
030301 Chemical Engineering	388	568	130	467
030303 Mining Engineering	> 172	492	140	620
030701 Mechanical Engineering	1,193	1,707	255	387
030703 Industrial Engineering	55	96	273	106
030900 Civil Engineering	754	1,757	507	533
030901 Construction Engineering	91	90	> 7	22
030911 Geotechnical Engineering	0	> 9	< 5	< 5
031100 Geomatic Engineering	> 34	> 37	> 23	> 17
031301 Electrical Engineering	638	872	405	417
031701 Maritime Engineering	0	172	> 5	> 31
039901 Environmental Engineering	222	266	63	59

Note: Figures between 0 and 5 are reported as < 5, which has been taken into account when combining domestic and overseas student figures.

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Table 37 Summary of student completions in specific Engineering and Related Technologies higher education courses by level of course, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
030300 Process and Resources Engineering	21	< 5	> 15	85
030301 Chemical Engineering	439	557	74	226
030303 Mining Engineering	> 156	220	63	322
030701 Mechanical Engineering	987	1,291	164	273
030703 Industrial Engineering	54	26	59	79
030900 Civil Engineering	843	1,084	234	340
030901 Construction Engineering	64	> 14	> 5	> 5
030911 Geotechnical Engineering	0	> 6	0	< 5
031100 Geomatic Engineering	> 33	> 29	< 5	> 9
031301 Electrical Engineering	630	528	171	303
031701 Maritime Engineering	0	44	0	> 22
039901 Environmental Engineering	205	132	62	54

Note: Figures between 0 and 5 are reported as < 5, which has been taken into account when combining domestic and overseas student figures.

Source: Department of Education, 2001–12, *Selected higher education statistics*.

In Natural and Physical Sciences courses the picture is similar. In Geology, undergraduate commencements increased by 83 per cent from 2001 to 2012, while postgraduate commencements remained stable (increasing a modest 5.4 per cent) (Table 38). Undergraduate completions remained stable with an approximate 6.9 per cent increase, but postgraduate completions dropped by 3.6 per cent (Table 39).

The number of completions in undergraduate Earth Sciences dropped dramatically from 2001 to 2012, but postgraduate completions increased by 22 per cent, reflecting a potential shift away from 'base' Earth Sciences undergraduate courses into more specialised undergraduate and postgraduate studies.

The point to note is that in spite of increases in student completion numbers in disciplines relevant to the Resources Sector, the numbers of graduating students remain low and not sufficient to address specific skills needs.

Table 38 Summary of student commencements in specific Natural and Physical Sciences higher education courses by level of course, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
010700 Earth Sciences	778	> 52	69	117
010703 Geology	80	466	111	117
010705 Geophysics	np	29	< 5	np
010707 Geochemistry	< 5	0	< 5	0
010711 Hydrology	0	0	> 18	> 47
010713 Oceanography	0	0	< 5	0

np = not published.

Note: Figures between 0 and 5 are reported as < 5, which has been taken into account when combining domestic and overseas student figures.

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Table 39 Summary of student completions in specific Natural and Physical Sciences higher education courses by level of course, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
010700 Earth Sciences	453	np	50	61
010703 Geology	> 148	159	75	55
010705 Geophysics	13	17	< 5	17
010707 Geochemistry	7	0	0	< 5
010711 Hydrology	9	0	np	< 5
010713 Oceanography	0	0	0	< 5

np = not published.

Note: Figures between 0 and 5 are reported as < 5, which has been taken into account when combining domestic and overseas student figures.

Source: Department of Education, 2001–12, *Selected higher education statistics*.

The labour market outcomes for higher education graduates are captured in the Australian Graduate Survey, and examined in the following section.

Employment destinations for higher education graduates

The 2012 Australian Graduate Survey of students completing their degree in the calendar year 2011 indicates good labour force outcomes for graduates from disciplines relevant to the Resources Sector (although whether these graduates find employment in the Resources Sector is unknown). Within four months of graduating, the percentages of these graduates who found full-time employment were as follows:

- 93.9 per cent of Mining Engineering graduates
- 90.5 per cent of Civil Engineering graduates
- 88.4 per cent of Mechanical Engineering graduates
- 88 per cent of Electrical Engineering graduates
- 74.6 per cent of Physical Sciences graduates
- 83.7 per cent of Geology graduates
- 79.5 per cent of Electronic/Computer Engineering graduates.[114]

Training of professionals

The Minerals Tertiary Education Council was set up in 1999 by the Minerals Council of Australia with the aim of fostering the development of a world-class tertiary learning environment for the education of professionals for the Australian minerals industry. The council has been a major driver in establishing national higher education programs in Mining Engineering, Minerals Geoscience and Metallurgy across 15 Australian universities, which now produce the bulk of new, highly skilled technical professionals from those disciplines.

114 Graduate Careers Australia, 2012, *Gradstats*, graduatecareers.com.au/wp-content/uploads/2011/12/GCA-GradStats-2012_FINAL1.pdf, accessed 18 November 2013, p. 6.

A network of selected university partners cooperate in the development and delivery of undergraduate and postgraduate programs in the three specialist disciplines. Through its university partners, the council currently supports and runs a range of educational programs in the Australian minerals tertiary education sector, including:

- Mining Education Australia
- Minerals Geoscience Masters
- Metallurgical Education Partnership
- Minerals Industry National Associate Degree Project.

The Minerals Tertiary Education Council also runs support programs and projects to assist with attracting, retaining and upskilling professionals for the Australian minerals industry. The data indicates a successful partnership between industry, government and academia as evidenced by the following results:

- The earth science Minerals Geoscience Masters program has resulted in a 68 per cent increase in honours student numbers, from 95 in 2007 to 160 in 2013.
- The metallurgy Metallurgical Education Partnership program has resulted in a 9 per cent increase in final year student numbers, from 34 in 2007 to 37 in 2013.
- The mining engineering Mining Education Australia program has resulted in a 123 per cent increase in final year student numbers, from 127 in 2007 to 283 in 2013.[115]

Graduate destinations for the partner universities show that:

- 37 per cent of graduates from the Earth Science partner universities joined the minerals industry in 2012
- 26 per cent of Earth Science graduates went on to further study or research (a common trend), and 30 per cent joined either big or small mining companies
- 79 per cent of all Metallurgy graduates from 2012 joined the minerals industry, with 68 per cent of the overall cohort joining big or small mining companies
- 62 per cent of Mining Engineering graduates surveyed in 2012 had entered the minerals industry, with 47 per cent joining big or small mining companies and 12 per cent taking roles with contractors or consultants.[116]

4.4 Supply of skills from vocational education and training

Data from the National Centre for Vocational Education Research shows that the total number of apprentices and trainees in training in Australia as at 31 March 2013 was 443,300, a 5.6 per cent decrease from the preceding year.[117] This reflected a decrease of 9.4 per cent in commencements to 296,300, and a 4 per cent increase in completions to 191,400 over the 12 months to 31 March 2013, compared with the preceding year.[118] Table 40 presents commencements by occupations relevant to the Resources Sector in the 12 months to 31 March 2013.

115 Minerals Tertiary Education Council, 2013, *Key performance measures report 2013*, mtec.org.au/media/pdf/MTEC%20Key%20Performance%20Measures%20Report%202013.pdf, accessed 18 November 2013. Note that universities offer programs in earth science, metallurgy and mining energy under different disciplines.

116 Ibid.

117 NCVER, 2013, *Apprentices and trainees, March quarter*, ncver.edu.au/publications/2654.html, accessed 8 November 2013, p. 4.

118 Ibid.

Table 40 Apprentice and trainee commencements by selected occupations and state/territory, 12 months to 31 March 2013 ('000)

Occupation	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Australia
Professionals	**0.4**	**0.7**	**0.7**	**0.4**	**0.2**	**0.1**	**0.0**	**0.0**	**2.5**
Business, Human Resource and Marketing Professionals	0.3	0.6	0.3	0.1	0.2	0.0	0.0	0.0	1.4
Design, Engineering, Science and Transport Professionals	0.1	0.0	0.2	0.0	0.0	0.0	0.0	–	0.4
ICT Professionals	0.0	0.0	–	0.0	–	0.0	–	0.0	0.0
Technicians and Trades Workers	**25.2**	**24.8**	**21.0**	**5.7**	**11.6**	**2.1**	**1.0**	**1.3**	**92.7**
Engineering, ICT and Science Technicians	1.3	1.3	2.9	0.4	1.9	0.2	0.2	0.1	8.2
Automotive and Engineering Trades Workers	5.7	3.7	5.6	1.4	3.0	0.4	0.3	0.2	20.2
Construction Trades Workers	4.9	6.2	2.9	0.9	1.4	0.3	0.1	0.3	17.0
Electrotechnology and Telecommunications Trades Workers	4.1	3.2	2.6	0.9	2.0	0.2	0.2	0.2	13.4
Machinery Operators and Drivers	**5.8**	**4.8**	**3.9**	**1.8**	**2.5**	**0.2**	**0.1**	**0.2**	**19.3**
Machine and Stationary Plant Operators	0.7	0.3	0.9	0.3	0.6	0.0	0.0	–	2.8
Mobile Plant Operators	**0.6**	**0.1**	**0.7**	**0.1**	**0.3**	**0.0**	**–**	**–**	**1.7**
Road and Rail Drivers	1.4	1.2	1.2	0.9	0.7	0.1	0.0	0.1	5.6
Labourers	**5.5**	**7.4**	**4.1**	**1.8**	**3.1**	**0.5**	**0.2**	**0.3**	**23.1**
Construction and Mining Labourers	0.2	0.0	0.4	0.1	0.7	0.0	0.0	0.1	1.6

Source: NCVER, 2013, *Apprentices and trainees, March quarter*, Table 17.

As the Resources Sector is a relatively small employer of tradespeople, it is correspondingly a small provider of trade apprenticeships. However, as discussed later in this chapter, the number of apprenticeship and traineeship commencements in 2013 in occupations relevant to the Resources Sector is encouraging and represents an improvement on the numbers engaged in 2010.[119]

There is not much information on the types of training provided by Resources Sector employers. However, research undertaken by the National Centre for Vocational Education Research in 2013 on behalf of the Minerals Council of Australia examined the contributions of minerals operators to training. The research was commissioned in response to the perception that the sector is not undertaking its 'fair share' of training.[120]

The report suggests that the industry under-reports the number of apprentices and trainees that it engages. One of the main reasons for this is that the Resources Sector does not fit neatly within one Industry Skills Council, but rather draws on occupations across a wide spectrum of industries.[121] For example, some onsite activity may be classified under industries other than Mining (such as apprentice chefs). Other reasons given during AWPA's consultations suggest mining companies

119 National Resources Sector Employment Taskforce, 2010, *Resourcing the future: National Resources Sector Employment Taskforce report July 2010*, innovation.gov.au/skills/SkillsTrainingAndWorkforceDevelopment/NationalResourcesSectorWorkforceStrategy/NationalResourcesSectorEmploymentTaskforce/Documents/FinalReport.pdf, accessed 18 November 2013, pp. 29–35.

120 NCVER uses the term 'fair share' to denote employment share.

121 NCVER, 2013, *Training and education activity in the minerals sector*, p. 14.

may undertake a significant amount of training outside of the publicly funded vocational education and training system, which is not reported.[122] It is also important to note there are many different models of apprentice and trainee employment in the Mining industry, including sponsorship of apprentices employed by contractors and employment through group training organisations, some of which may not be captured in the data.

The National Centre for Vocational Education Research found the minerals sector[123] spent more than $1.1 billion, or an average of 5.5 per cent of payroll, on training in the 12 months to 30 June 2012.[124] Moreover at least 98 per cent of this training expenditure is industry funded, with only 2 per cent coming from government subsidies.[125]

More recent data from the National Centre for Vocational Education Research indicates that in 2013 there were 4,400 apprentices and trainees commencing training in occupations related to the resources and infrastructure sectors (as represented by SkillsDMC), compared with 16,600 undertaking trades training in the construction and property sector and 21,000 in the manufacturing sector (see Table 41).[126]

Table 41 Apprentice and trainee commencements by Industry Skills Councils, trades and non-trades, 12 months to 31 March 2013 ('000)

Industry Skills Council	Trades	Non-trades	Total
AgriFood	9.0	12.2	**21.3**
Auto Skills Australia	11.2	2.6	**13.8**
Community Services and Health	1.3	23.4	**24.6**
Construction and Property Services	16.6	6.4	**23.0**
E-Oz Energy	10.5	0.1	**10.6**
ForestWorks	0.2	0.3	**0.5**
Government Skills Australia	0.0	2.7	**2.7**
Innovation and Business Skills Australia	7.3	65.4	**72.7**
Manufacturing Skills Australia	21.0	8.6	**29.6**
Service Skills Australia	11.1	59.7	**70.8**
SkillsDMC	4.4	2.7	**7.2**
Transport and Logistics Industry Skills Council	–	19.3	**19.3**
Training package qualifications total	92.6	203.3	**295.9**
Non-training package qualifications total	0.1	0.2	**0.4**
Total	**92.7**	**203.5**	**296.3**

– = a true zero figure, with no contracts reported in these categories.

Source: NCVER, 2013, *Apprentices and trainees, March quarter*, Table 18.

As noted above, occupations relevant to the Resources Sector do not fit neatly beneath one single Industry Skills Council and in fact can span several, such as Manufacturing Skills Australia, Construction and Property Services and Service Skills Australia. Therefore, a number of trainees who will work in the Resources Sector may undergo training drawn from a training package that is indirectly related to the Resources Sector. However, this training is not reported against the Resources Sector.

122 This information was provided during AWPA's consultations for this report.

123 Term used by NCVER.

124 NCVER, 2013, *Training and education activity in the minerals sector*, p. 11.

125 Ibid, p. 12.

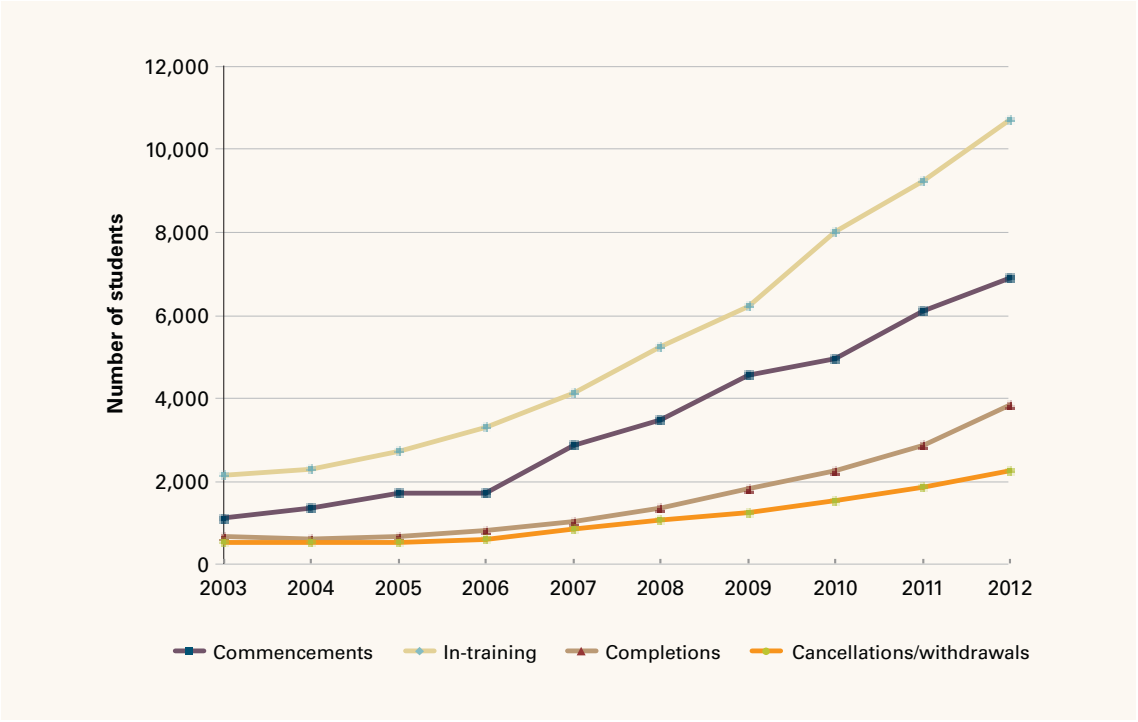
126 NCVER, 2013, *Apprentices and trainees, March quarter*, p. 14.

Apprenticeships and traineeships

Trainee and apprentice data for the Mining industry is drawn from the National Centre for Vocational Education Research's VOCSTATS database as at the December 2012 quarter (the latest available data).

According to the data presented in figures 24 and 25, the numbers of trainees and apprentices engaged in the Mining industry have continued to grow overall. Commencements in traditional trades apprenticeships and traineeships (including electricians, metal trades, automotive trades and construction trades)[127] appear to have recovered from commencement and completion volatility between 2008 and 2011.

Figure 24 Mining industry apprentices and trainees, December quarter 2003–12



Source: NCVER, 2013, *Apprentices and trainees*, VOCSTATS.

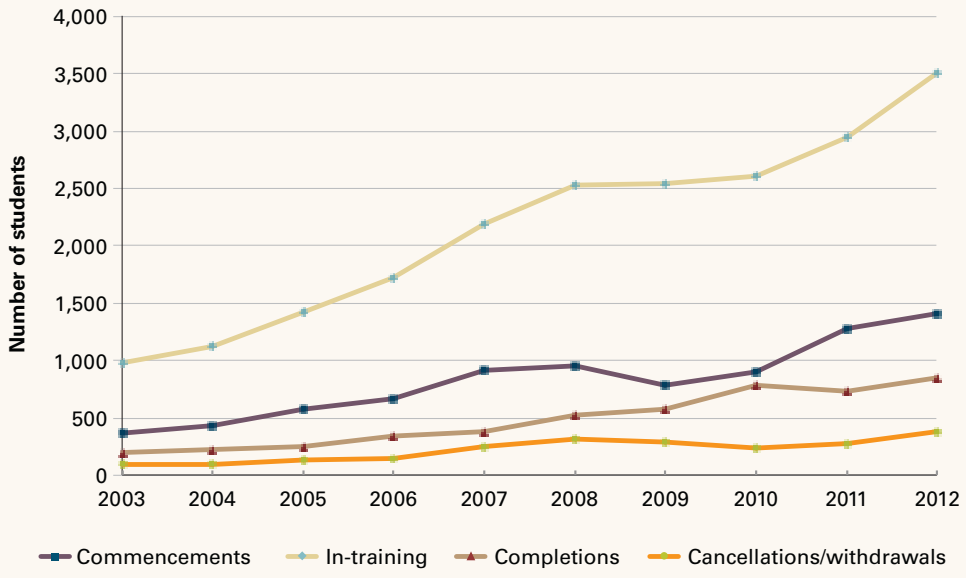
127 NCVER divides all ANZSCO occupations at the four-digit level into three categories: 'Traditional trades', 'Other trades and technicians' and 'Non-trades'. Traditional trades include all ANZSCO Major Group 3 occupations, namely Technicians and Trades Workers, with the exception of all but one of the Technician occupations (ICT technicians), along with animal handling trades and a variety of miscellaneous trades. In general, traditional trades relate to persons employed in the automotive, construction, manufacturing, telecommunications and hospitality sectors. On the other hand, the non-trade category refers to all occupations outside of ANZSCO Major Group 3.

Comparing the December quarter 2012 with the December quarter 2011 (figures 24 and 25) shows the following:

- Overall commencements in mining apprentices and trainees increased by 12.8 per cent (from 6,103 in 2011 to 6,882 in 2012), with 1,410 undertaking a traditional trade (up 10.8 per cent from 2011).
- Overall, apprentices and trainees in training increased by 16 per cent (from 9,208 in 2011 to 10,682 in 2012), with 14,001 in training in the traditional trades (up 18.9 per cent from 2011).
- Completions increased by 34.6 per cent (from 2,844 in 2011 to 3,828 in 2012), with 842 completions in traditional trades (up 14.6 per cent from 2011).
- The number of apprentices and trainees who cancelled or withdrew from their training in 2012 increased by 22.6 per cent (from 1,841 in 2011 to 2,257 in 2012), with 381 cancellations or withdrawals in the traditional trades (representing a 41.1 per cent jump in cancellations or withdrawals in traditional trades since 2011).

Traditional trades apprentices and trainees represented 20.5 per cent of all mining apprentice and trainee commencements, 32.8 per cent of all mining apprentices and trainees in training, 22 per cent of all mining apprentice and trainee completions, and 16.9 per cent of all mining apprentice and trainee cancellations.

Figure 25 Mining industry traditional trades, December quarter 2003–12



Source: NCVER, 2013, *Apprentices and trainees*, VOCSTATS.

As large organisations often provide training outside of the publicly funded vocational education and training system, these apprentices and trainees are not captured in the statistics. Therefore the data only partially represents what is happening in the training system at any point in time. Table 42 presents a snapshot of selected Resources Sector occupational training completions.

Table 42 Apprenticeship and traineeship completions in selected Resources Sector occupations, 2008–12

Occupation		2008	2009	2010	2011	2012
312	Building and Engineering Technicians	158	419	582	997	1,841
321	Automotive Electricians and Mechanics	5,173	5,005	5,565	5,136	5,098
323	Mechanical Engineering Trades Workers	3,286	3,576	3,865	3,797	3,905
341	Electricians	4,549	5,405	6,074	6,321	5,859
342	Electronics and Telecommunications Trades Workers	1,322	1,418	1,664	1,447	1,934
7121	Crane, Hoist and Lift Operators	3	9	2	15	6
7122	Drillers, Miners and Shot Firers	527	796	887	1,040	1,041
7212	Earthmoving Plant Operators	172	86	165	495	781
82	Construction and Mining Labourers	753	863	833	684	877

Source: NCVER, 2008–12, *Apprentices and trainees*, VOCSTATS.

The data shows that completion numbers in several occupations such as Building and Engineering Technicians; Mechanical Engineering Trades Workers; Electronics and Telecommunications Trades Workers; Drillers, Miners and Shot Firers; and Earthmoving Plant Operators increased significantly over the period from 2008 to 2012. These figures are encouraging, as they suggest there is increased capacity to ease remnant shortages in these occupations in the years ahead. The increased completion figures may also indicate more apprentices and trainees are completing these qualifications instead of leaving their training and undertaking partial training, as examined below.

Non-completion of training

As discussed earlier, solutions to labour shortages in the trades focus on growing the labour pool rather than stemming the flow of already trained potential workers from it. It is equally important to ensure apprentices and trainees complete their training. Projected contract completion rates for all Technicians and Trades Workers decreased from 49.7 per cent in 2010 to 48.5 per cent in 2012.[128] Table 43 shows projected completion rates for selected Resources Sector–related trade occupations.

Table 43 Projected contract completion rates, by selected Resources Sector–related occupation, for contracts commencing in December quarter 2010–12 (%)

Occupation		2010	2011	2012
3	**Technicians and Trades Workers**	**49.7**	**50.0**	**48.5**
31	Engineering, ICT and Science Technicians	36.0	33.1	35.3
32	Automotive and Engineering Trades Workers	48.3	49.2	49.2
33	Construction Trades Workers	53.6	55.6	53.9
34	Electrotechnology and Telecommunications Trades Workers	41.4	43.4	45.0
39	Other Technicians and Trades Workers	44.4	42.9	43.5

Source: NCVER, 2012, *Completion and attrition rates for apprentices and trainees*, Table 11, p. 17.

128 NCVER, 2012, *Completion and attrition rates for apprentices and trainees*, ncver.edu.au/publications/2632.html, accessed 8 November 2013, p. 11.

Research on this issue suggests several business-cultural factors relating to why apprentices and trainees do not complete their training. It shows completion rates are dependent on employer size: employers with more than 25 apprentices have much higher apprenticeship completion rates than employers with less than 10 apprentices.[129] Another factor is the social background of apprentices and trainees. For instance, apprentices who live in areas where there is a high concentration of trade employment have higher completion rates than those who live in areas with a low concentration of trade employment.[130]

The research finds that greater support for apprentices will lead to improved completion rates. Large organisations with large cohorts of apprentices are more likely to provide this support than small employers, who are likely to have fewer resources to devote to apprentice support.[131] To address this issue and improve support for apprentices, particularly in the first 12 months of training, the Australian Apprenticeships Mentoring Package was introduced.[132] A range of employers, Industry Skills Councils and training providers have accessed funding under the program to provide mentoring services to apprentices in the Mining and Construction sectors.[133]

4.5 Industry training of apprentices and trainees to meet demand for skills

As discussed earlier, the Resources Sector is historically a relatively small employer of apprentices.[134] In order to examine whether this situation has changed, AWPA commissioned further analysis of existing data over the period 2005 to 2013.[135] The results provide a positive view of training in the Resources Sector.

Table 44 shows the number of tradespeople employed across the various Resources Sector industries. In February 2013, the Resources Sector employed 110,200 tradespeople, representing 6.5 per cent of the total (twice what it was in 2005). The largest employers were Other Construction Services (36,800 or 2.2 per cent), Metal Ore Mining (22,200 or 1.3 per cent), Heavy and Civil Engineering Construction (13,900 or 0.8 per cent), and Coal Mining (13,000 or 0.8 per cent). Another growing industry is Other Mining Support Services, which increased its employment of tradespeople from 1,000 in 2005 to 10,300 in 2013. However, the National Centre for Vocational Education Research notes these figures overstate the importance of the Resources Sector as an employer of tradespeople because the construction industries cover more than just the Resources Sector.

129 Karmel T and Roberts D, 2012, *The role of 'culture' in apprenticeship completions*, NCVER, ncver.edu.au/publications/2498.html, accessed 7 November 2013, pp. 14–15.

130 Ibid., p. 13.

131 Ibid., p. 18.

132 Australian Apprenticeships, 2013, *Australian Apprenticeships Mentoring Package*, australianapprenticeships.gov.au/program/australian-apprenticeships-mentoring-package, accessed 8 November 2013.

133 Australian Apprenticeships, 2013, 'Current projects', *Australian Apprenticeships Mentoring Program*, australianapprenticeships.gov.au/program/australian-apprenticeships-mentoring-program, accessed 8 November 2013.

134 Karmel T and Mlotkowski P, 2010, *Trades persons for the resources sector: projections 2010–2020*, technical paper, NCVER, voced.edu.au/content/ngv53866, accessed 14 November.

135 NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', p. 8. Note that NCVER uses the June quarters when examining trade apprentices and May quarters when examining their employment.

Table 44 Trade employment by selected Resources Sector industries, May 2005–12 and February 2013 ('000)

Industry	2005	2006	2007	2008	2009	2010	2011	2012	2013
Coal Mining	5.3	9.2	5.6	8.8	7.8	9.3	12.0	17.9	13.0
Oil and Gas Extraction	1.8	2.2	3.1	3.5	5.9	6.1	3.2	3.8	4.0
Metal Ore Mining	11.8	13.0	12.3	10.8	15.2	14.6	22.8	22.1	22.2
Exploration	1.9	2.2	3.3	4.0	3.7	3.7	1.8	6.1	5.2
Other Mining Support Services	1.0	2.8	4.5	2.4	2.4	4.9	7.0	8.6	10.3
Heavy and Civil Engineering Construction	11.1	11.6	13.3	15.0	13.1	11.3	14.0	12.0	13.9
Land Development and Site Preparation Services	3.1	4.2	3.6	4.9	4.9	3.7	1.9	3.7	4.7
Other Construction Services	21.1	34.0	29.0	27.8	20.0	27.4	35.0	27.8	36.8
Total resource industries	**57.1**	**79.2**	**74.7**	**77.2**	**73.0**	**81.0**	**97.7**	**101.8**	**110.2**
Total other industries	**1,455.0**	**1,476.9**	**1,540.0**	**1,556.7**	**1,580.1**	**1,554.9**	**1,575.9**	**1,595.8**	**1,586.7**
Total	**1,512.1**	**1,556.1**	**1,614.7**	**1,633.9**	**1,653.0**	**1,635.9**	**1,673.6**	**1,697.6**	**1,696.9**

Note: Total trade employment includes all occupations listed under ANZSCO major group 3 Technicians and Trades Workers.

Source: NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', report commissioned by AWPA, unpublished, Table 1.

As of February 2013, the Resources Sector employed a significant proportion of Horticultural Trades Workers (30.8 per cent), Mechanical Engineering Trades Workers (16.3 per cent) and Building and Engineering Technicians (15.2 per cent).[136] Data on the share of employment at the individual trade occupation level is presented in Appendix H.

The number of trade apprentices in each of the component Resources Sector industries is presented in Table 45. In 2005, the Resources Sector as a whole employed only 4,000 trade apprentices, representing 2.4 per cent of the total. By the end of 2012 the figure had risen to 13,700 or 6.8 per cent of all trade apprentices. This increase was largely driven by Other Construction Services, which increased its employment of trade apprentices from 2,000 in 2005 to 6,300 in 2012. The other industries with significant increases were Other Mining Support Services (up from 600 in 2005 to 2,600 in December 2012) and Heavy and Civil Engineering Construction (up from 800 in 2005 to 2,600 in December 2012).[137]

136 Ibid., p. 9.

137 Ibid., p. 11.

Table 45 Trade apprentices by selected Resources Sector industries, in training at 30 June 2005–12 and at 31 December 2012 ('000)

Industry	2005	2006	2007	2008	2009	2010	2011	June 2012	Dec. 2012
Coal Mining	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.4
Oil and Gas Extraction	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
Metal Ore Mining	0.3	0.3	0.4	0.5	0.5	0.7	0.9	1.0	0.9
Exploration	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.4	0.4
Other Mining Support Services	0.6	0.8	1.0	1.1	1.1	1.4	2.1	2.7	2.6
Heavy and Civil Engineering Construction	0.8	0.9	1.0	1.0	1.1	1.2	1.8	2.6	2.6
Land Development and Site Preparation Services	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3
Other Construction Services	2.0	2.2	2.5	3.0	3.7	4.8	6.0	6.3	6.3
Total resource industries	**4.0**	**4.6**	**5.4**	**6.3**	**7.2**	**8.9**	**11.7**	**14.0**	**13.7**
Total other industries	**165.4**	**178.3**	**189.9**	**203.0**	**196.0**	**201.5**	**202.9**	**203.1**	**189.5**
Total	**169.5**	**182.9**	**195.3**	**209.3**	**203.3**	**210.4**	**214.6**	**217.0**	**203.2**

Source: NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', report commissioned by AWPA, unpublished, Table 3a.

The share of trade apprentices employed by the Resources Sector relative to the all industries trade employment share was also examined. A value of 100 or higher indicates the Resources Sector employs its 'fair share' or more of apprentices, while a value of less than 100 indicates it employs less than its 'fair share' of apprentices.

Table 46 shows the ratio of the relative share of trade apprentices to the share of all industries trade employment. The ratio has nearly doubled since the start of the mining boom, increasing from 63 in 2005 to 104 in 2013. This implies that overall the Resources Sector has come to employ its 'fair share' of trade apprentices. However, the figures vary greatly by subsector, with Other Mining Support Services (211 per cent in 2013), Heavy and Civil Engineering Construction (155 per cent) and Other Construction Services (143 per cent) employing their 'fair share' and more, in contrast to industries such as Coal Mining (27 per cent), Metal Ore Mining (33 per cent) and Oil and Gas Extraction (48 per cent).[138]

138 Ibid., Table 5, p. 12.

Table 46 Relative share of apprentices employed in the Resources Sector, by selected industries, 2005 to 2013 ('fair share' = 100)

Industry	2005	2006	2007	2008	2009	2010	2011	2012	2013
Coal Mining	22	12	27	21	27	22	24	21	27
Oil and Gas Extraction	13	15	12	14	10	12	23	39	48
Metal Ore Mining	24	18	27	38	28	39	30	34	33
Exploration	26	23	18	12	55	45	103	56	60
Other Mining Support Services	475	244	177	362	380	227	230	246	211
Heavy and Civil Engineering Construction	62	65	59	53	70	83	101	172	155
Land Development and Site Preparation Services	68	46	58	39	36	37	87	64	57
Other Construction Services	83	55	72	86	149	136	134	177	143
Total resource industries	**63**	**50**	**60**	**64**	**81**	**86**	**93**	**107**	**104**
Total other industries	**101**	**103**	**102**	**102**	**101**	**101**	**100**	**100**	**100**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Note: The figures for 2005 to 2012 are derived from June apprentice data and May employment data, whereas the 2013 figures are derived from December 2012 apprentice data and February 2013 employment data.

Source: NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', report commissioned by AWPA, unpublished, Table 5.

At an individual occupation level in 2013, the Resources Sector employed more than its 'fair share' of trade apprentices who were Bricklayers, Carpenters and Joiners (335 per cent), Miscellaneous Technicians and Trades Workers (260 per cent), Building and Engineering Technicians (234 per cent) and Horticultural Trades Workers (100 per cent) (Table 47). Across the time period, the ratio of apprentice fabrication engineers to employed persons nearly doubled, indicating that the Resources Sector was more or less carrying its 'fair share' in 2013.[139]

139 Ibid., p. 13.

Table 47 Relative share of apprentices employed by the Resources Sector, by selected three-digit ANZSCO trade occupations, 2005 to 2013 ('fair share' = 100)

Occupation	2005	2006	2007	2008	2009	2010	2011	2012	2013
Technicians and Trades Workers	**63**	**50**	**60**	**64**	**81**	**86**	**93**	**107**	**104**
Building and Engineering Technicians	135	90	32	152	163	146	323	253	234
Fabrication Engineering Trades Workers	55	40	40	63	68	73	83	84	96
Mechanical Engineering Trades Workers	52	39	58	54	50	51	39	54	62
Bricklayers, and Carpenters and Joiners	160	127	180	149	204	288	584	357	335
Plumbers	9	11	23	11	23	34	26	20	25
Electricians	28	19	23	17	24	30	31	36	33
Electronics and Telecommunications Trades Workers	36	24	27	56	34	31	30	51	21
Horticultural Trades Workers	112	87	105	112	151	133	105	115	100
Miscellaneous Technicians and Trades Workers	162	60	44	124	59	98	479	376	260

Note: The figures for 2005 to 2012 are derived from June apprentice data and May employment data, whereas the 2013 figures are derived from December 2012 apprentice data and February 2013 employment data.

Source: NCVER, 2013, 'The relationship between the resources and other sectors, 2005–2013', report commissioned by AWPA, unpublished, Table 6.

4.6 Recent trends in skills supply from migration

Skilled migration is an important source of supply for the Resources Sector and is influenced by domestic economic conditions, with increased migration during periods of increased labour demand. The data included in this section is the most recent data made available to AWPA by the Department of Immigration and Border Protection.

Though employers can access skilled migration through several different streams, there are two principal streams: permanent migration (through the General Skilled Migration program and the Employer Sponsored Migration Scheme), and temporary migration (largely through the Temporary Work (Skilled) (subclass 457) visa program.

The General Skilled Migration program is intended to manage permanent migration of workers to Australia with skills in demand, either independently (Independent (Migrant) Visa (subclass 175)) or through family or government sponsorship (Sponsored (Migrant) Visa (subclass 176)). There is also a provisional three-year visa (Regional Sponsored (Provisional) Visa (subclass 475)) for skilled workers who are unable to meet the criteria for a Skilled – Independent visa. These workers have the opportunity to apply for permanent residency after living for two years and working for at least 12 months in a Specified Regional Area of Australia.[140]

In the 12 months to 30 June 2013, 37,140 subclass 457 visa holders were granted permanent residence or provisional visas (Table 48). The majority (95.1 per cent) of subclass 457 visas holders who were granted permanent residence or provisional visas came through the skilled stream.

140 Department of Immigration and Border Protection, 2013, *Professionals and other skilled migrants*, immi.gov.au/skilled/general-skilled-migration, accessed 14 November 2013.

Table 48 Number of permanent and provisional visa grants where the previous visa held was a subclass 457 visa, 12 months to 30 June 2013

Visa type	Granted where last visa held was subclass 457	% of total applications granted
Skilled stream	**38,470**	**95.1**
Employer Nomination	21,320	52.7
Regional Sponsored Migration	7,810	19.3
Labour Agreement	1,060	2.6
Skilled Independent	6,350	15.7
Other Skilled Migration	1,940	4.8
Family stream	**1,980**	**4.9**
Partner	1,750	4.3
Other family	220	0.6
Total applications granted	**40,450**	**100**

Source: Department of Immigration and Border Protection, 2013, *Subclass 457 state/territory summary report 2012–13 to 30 June 2013*, Table 1.27.

A range of other migration arrangements including Enterprise Migration Agreements and Regional Migration Agreements are also in place to further supplement supply streams of critical skills in regional areas and resources areas. All subclass 457 visa sponsors have a legal obligation to demonstrate they have undertaken labour market testing, prior to nominating the position to be filled by a subclass 457 visa holder. The purpose is to ensure that sponsors look to the local domestic market first before recruiting overseas workers.

The Resources Sector Jobs Board was created in May 2012 to display job vacancies in the sector, enabling Australians to apply for jobs advertised on projects with an Enterprise Migration Agreement.[141] In October 2012, the Department of Employment partnered with SEEK to provide a co-branded Resources Sector Jobs Board which was launched in February 2013. In the nine months to November 2013, a monthly average of 5,561 advertisements was recorded on the website. A point in time snapshot (as at 14 November 2013) shows the highest number of vacancies were advertised in Western Australia (1,466), followed by Queensland (940) and New South Wales (267). The most widely advertised occupations were in mining (engineering and maintenance) with 744 vacancies, followed by mining (operations) with 620 vacancies and oil and gas (engineering and maintenance) with 260 vacancies.[142]

141 Department of Immigration and Border Protection, 2013, *Fact sheet 48a—Enterprise Migration Agreements*, immi.gov.au/media/fact-sheets/48a-enterprise.htm, accessed 14 November 2013.

142 Data on the number of applications and the number of vacancies filled is not available from the Department of Employment.

Overall subclass 457 visa trends

Since its commencement in 1996, the Temporary Work (Skilled) (subclass 457) visa program has played an important role in the Australian economy. It is a demand-driven program, enabling Australian employers to address immediate workforce needs by sponsoring skilled workers to fill vacancies where appropriately skilled domestic workers cannot be sourced. The program aims to support and complement existing domestic education, training and skills development by allowing businesses to sponsor overseas workers over the short term to address confirmed labour needs, while investing in training and skills development of domestic workers to meet longer term needs. Employers can only nominate potential workers to work in an approved occupation on the Consolidated Skilled Occupation List. The program is not intended to address longer term workforce needs.[143]

The subclass 457 visa program is the most significant component of temporary skilled migration and it provides a quick response to fluctuations in demand for labour. Subclass 457 visa holders can work in Australia for up to four years.

In the 12 months to 30 June 2013, a total of 68,480 primary[144] subclass 457 visas were granted (steady compared to 68,310 in 2011–12).[145] The Department of Immigration and Border Protection does not publish data detailing primary subclass 457 visa holders by sponsoring individual company, but an approximate picture of where visa holders 'end up', regionally, can be constructed by looking at the separate data.

Not surprisingly, most of the subclass 457 visa applications sponsored by the Mining industry were granted for occupational roles in Western Australia (2,760) and Queensland (1,200) (Table 49). This pattern is repeated for the Construction sector (3,320 in Western Australia and 1,760 in Queensland), indicating the majority of subclass 457 visas sponsored by Construction (except in New South Wales) are probably related to Resources Project Construction.

Table 49 Subclass 457 primary visa grants by selected sponsoring industry and nominated position location, 12 months to 30 June 2013

Industry	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	NS	Total
Construction	70	1,570	230	1,760	200	10	700	3,320	10	**7,870**
Electricity, Gas, Water and Waste Services	< 5	220	10	300	40	20	140	460	< 5	**1,200**
Mining	0	230	80	1,200	160	20	170	2,760	10	**8,440**

NS = not specified.

Source: Department of Immigration and Border Protection, 2013, *Subclass 457 state/territory summary report 2012–13 to 30 June 2013*, Table 1.11.

143 Department of Immigration and Border Protection, 2013, *Temporary Work (Skilled) (subclass 457) visa*, immi.gov.au/allforms/booklets/books9.pdf, accessed 19 November 2013.

144 Primary refers to the main individual applicant. Secondary visas are usually generated by dependents of the primary visa applicant.

145 Department of Immigration and Border Protection, 2013, *Subclass 457 state/territory summary report 2012–13 to 30 June 2013,* immi.gov.au/media/statistics/pdf/457-stats-state-territory-june13.pdf, accessed 18 November 2013.

Table 50 shows the location of subclass 457 visa grants by major occupation groups. The bulk of grants in the resources states of Queensland and Western Australia were for Professionals (4,560 in Queensland and 5,500 in Western Australia) and Technicians and Trades Workers (3,170 in Queensland and 6,000 in Western Australia).

Table 50 Subclass 457 primary visa grants by nominated occupation major group and nominated position location, 12 months to June 2013

Nominated occupation major group	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	NS	Total
Managers	130	4,750	140	2,050	300	50	2,200	2,110	20	**11,740**
Professionals	610	13,460	340	4,560	990	240	7,720	5,500	20	**33,440**
Technicians and Trades Workers	160	4,130	380	3,170	550	80	3,730	6,000	20	**18,230**
Community and Personal Service Workers	20	390	20	120	20	< 5	310	180	< 5	**1,060**
Clerical and Administrative Workers	20	1,190	20	370	50	< 5	350	590	< 5	**2,590**
Sales Workers	< 5	100	< 5	50	< 5	< 5	30	80	0	**260**
Machinery Operators and Drivers	0	20	10	200	10	0	40	140	0	**420**
Labourers	0	10	0	30	10	0	0	50	0	**100**
Not recorded	0	110	0	390	90	< 5	< 5	10	20	**630**
Total	**940**	**24,160**	**910**	**10,950**	**2,030**	**370**	**14,660**	**14,660**	**80**	**68,480**

NS = not specified.

Source: Department of Immigration and Border Protection, 2013, *Subclass 457 state/territory summary report 2012–13 to 30 June 2013*, Table 1.13.

Professions relevant to the Resources Sector and the subclass 457 visa

Compared to 2011–12, the number of subclass 457 visas granted in 2012–13 decreased significantly (overall by 35.5 per cent) in all of the professional occupations relevant to the Resources Sector (Table 51). The most significant decline was observed for Geologists and Geophysicists (down 50 per cent to 520 visas), Civil Engineering Professionals (down 45.9 per cent to 1,050 visas) and Environmental Scientists (down 43.3 per cent to 170 visas). This trend is consistent with the Department of Employment's ongoing skills shortage research, which shows that although these occupations have been in shortage over the past few years, skills shortages have eased and employers are recruiting suitable candidates without difficulties.[146] This may explain the decrease in subclass 457 visas granted to these occupations.

146 Department of Employment, 2013, *National, state and territory skill shortage information*, employment.gov.au/national-state-and-territory-skill-shortage-information, accessed 14 November 2013.

Table 51 Subclass 457 visas granted to selected professional occupations relevant to the Resources Sector, 2005–06 to 2012–13

Occupation	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13
2322 Surveyors and Spatial Scientists	120	140	180	150	50	90	230	200
2331 Chemical and Materials Engineers	150	200	290	240	170	190	160	110
2332 Civil Engineering Professionals	690	880	1,380	1,220	730	1,340	1,940	1,050
2333 Electrical Engineers	320	400	460	380	210	320	450	320
2334 Electronics Engineers	210	310	240	180	120	110	190	120
2335 Industrial, Mechanical and Production Engineers	790	780	1,080	860	530	790	1,020	860
2336 Mining Engineers	290	360	450	360	230	370	610	410
2339 Other Engineering Professionals	630	700	880	790	430	720	1,030	710
2343 Environmental Scientists	200	200	250	260	230	220	300	170
2344 Geologists and Geophysicists	270	360	730	660	380	650	1,040	520
2349 Other Natural and Physical Science Professionals	170	180	230	220	180	210	210	160

Note: Figures rounded to the nearest 10.

Source: Department of Immigration and Border Protection, 2013, unpublished data.

Trades relevant to the Resources Sector and the subclass 457 visa

Table 52 shows that compared to 2011–12, the number of subclass 457 visas granted in 2012–13 decreased in 15 out of 19 trades occupations, representing an overall decrease of 12.3 per cent. Visas granted increased for Safety Inspectors (up 27.3 per cent to 140 visas), Electrical Distribution Trades Workers (up 22.7 per cent to 270), Motor Mechanics (up 14 per cent to 1,540), Automotive Electricians (up 11.1 per cent to 100) and Mechanical Engineering Draftspersons and Technicians (up 9.5 per cent to 1,380). The data suggests labour market conditions are tighter for these trades, resulting in employers using this avenue to meet their skills needs.

Table 52 Subclass 457 visas granted to nominated trade occupations relevant to the Resources Sector, 2005–06 to 2012–13

Occupation		2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13
3121	Architectural, Building and Surveying Technicians	130	200	370	340	220	410	750	650
3211	Civil Engineering Draftspersons and Technicians	120	180	300	360	130	240	380	100
3123	Electrical Engineering Draftspersons and Technicians	150	290	410	380	220	380	540	520
3124	Electronic Engineering Draftspersons and Technicians	110	320	200	260	160	170	230	200
3125	Mechanical Engineering Draftspersons and Technicians	340	450	610	760	550	750	1,260	1,380
3126	Safety Inspectors	10	10	30	20	20	60	110	140
3129	Other Building and Engineering Technicians	190	280	320	310	180	260	510	400
3211	Automotive Electricians	40	80	90	70	20	20	90	100
3212	Motor Mechanics	560	680	1,050	850	250	520	1,350	1,540
3221	Metal Casting, Forging and Finishing Trades Workers	10	30	50	30	10	30	70	50
3222	Sheetmetal Trades Workers	40	90	120	70	20	100	290	90
3223	Structural Steel and Welding Trades Workers	1,590	1,870	2,180	1,560	310	490	1,480	1,150
3232	Metal Fitters and Machinists	840	1,040	1,220	1,040	250	350	930	610
3233	Precision Metal Trades Workers	10	10	10	20	10	10	20	10
3411	Electricians	310	350	360	330	160	370	630	610
3421	Airconditioning and Refrigeration Mechanics	60	90	120	90	30	60	100	90
3422	Electrical Distribution Trades Workers	440	260	160	130	70	60	220	270
3423	Electronics Trades Workers	110	130	150	130	60	90	220	150
3424	Telecommunications Trades Workers	20	100	80	40	30	40	120	100

Note: Figures rounded to the nearest 10.

Source: Department of Immigration and Border Protection, 2013, unpublished data.

The number of subclass 457 visas granted each year can be used as an indicator of specific occupational shortages in various industry sectors. For example, in 2011–12, the Construction and Mining sectors together sponsored 22.9 per cent of all subclass 457 visas, compared to 18.3 per cent in 2012–13,[147] suggesting employers in this sector are finding it difficult to meet their skills demand from the domestic labour market and are increasingly looking at migration options to meet their short-term skills needs.

Despite a streamlined migration program in place to address skills shortages, the resources industry at large believes more can be done to improve the contribution of skilled migration to meeting its skills needs. According to the stakeholders that AWPA consulted, as the Resources Sector gears itself for the next major phase requiring specialist skills, in the short term at least, temporary skilled migration (generally under subclass 457 visas) will be the primary source of high-end critical engineering skills, as these skills are not currently being fostered in sufficient numbers locally. The data provided on both higher education and vocational education and training confirms this view.

Our consultations indicate that some large global companies rely on obtaining skilled workers from their overseas operations to work on their Australian sites, with the expectation that these personnel will share their expertise and contribute to the skilling of the local workforce. Other firms rotate relevant Australian employees to overseas operations for training.

4.7 Trends in projected skills supply in the Resources Sector, 2014–18

Deloitte Access Economics modelling of skills supply from 2013 to 2018 takes into account completions of qualifications through the domestic training system (both higher education and vocational education and training), as well as the contribution of qualifications through net international migration. Details on the modelling methodology are available in the Deloitte Access Economics report.

Table 53 presents projected skills supply across the Resources Sector. The data shows that supply across the sector is expected to rise substantially every year from 2013 to 2018. The greatest increases are in Resources Project Construction and Mining Operations.

Table 53 Projected additional supply by resources industry sector, 2013–18

Sector	2013	2014	2015	2016	2017	2018
Resources Project Construction	3,943	4,005	4,073	4,140	4,204	4,265
Mining Operations	8,657	8,799	8,951	9,111	9,263	9,413
Oil and Gas Operations	1,116	1,137	1,159	1,184	1,207	1,230
Total	**13,716**	**13,941**	**14,183**	**14,435**	**14,674**	**14,908**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, Appendix D.

147 Department of Immigration and Border Protection, 2013, *Subclass 457 state/territory summary report 2012–13 to 30 June 2013*, Table 1.10.

Resources Project Construction

Table 54 shows that growth in supply in Resources Project Construction is stable across the outlook period. For the selected occupations at the four-digit ANZSCO level, the overall supply of Professionals and Technical and Trades Workers increases by more than 1,000 workers each year—up to 554 extra Managers and Professionals in 2018, and 725 Technicians and Trades Workers.

Table 54 Projected total additional supply for selected Resources Sector occupations in Resources Project Construction, 2013–18

	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	55	56	57	58	59	60
1332 Engineering Managers	16	17	17	18	18	19
1335 Production Managers	3	3	4	4	4	4
2322 Cartographers and Surveyors	0	0	0	0	0	0
2332 Civil Engineering Professionals	330	336	343	350	356	361
2333 Electrical Engineers	13	14	14	14	14	14
2335 Industrial, Mechanical and Production Engineers	40	41	42	42	43	43
2336 Mining Engineers	12	13	13	13	13	13
2343 Environmental Scientists	22	22	23	23	23	23
2344 Geologists and Geophysicists	0	0	0	0	0	0
2513 Occupational and Environmental Health Professionals	14	14	15	15	15	15
Subtotal	**506**	**516**	**526**	**536**	**545**	**554**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	108	110	111	113	114	115
3126 Safety Inspectors	142	144	146	148	150	152
3212 Motor Mechanics	26	27	27	27	28	28
3223 Structural Steel and Welding Trades Workers	15	15	14	14	14	15
3232 Metal Fitters and Machinists	27	27	27	28	28	29
3411 Electricians	138	140	143	145	148	150
3992 Chemical, Gas, Petroleum and Power Generation Plant Operators	7	7	7	7	7	7
7122 Drillers, Miners and Shot Firers	17	17	17	18	18	18
7212 Earthmoving Plant Operators	190	191	194	197	200	203
7313 Train and Tram Drivers	0	0	0	0	0	0
7331 Truck Drivers	7	7	7	7	7	8
Subtotal	**676**	**684**	**687**	**705**	**707**	**725**
Total	**1,183**	**1,200**	**1,214**	**1,241**	**1,253**	**1,278**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, Appendix D.

Mining Operations

In the case of Mining Operations, the projected supply of workers (Table 55) is higher than for Resources Project Construction, increasing by 3,000 to 3,500 workers a year from 2013 to 2018.

At the four-digit ANZSCO level, additional supply of a number of selected occupations increases to 2018. Construction Managers, Engineering Managers, and Civil Engineering Draftspersons and Technicians are some of the occupations where the growth is small.

Table 55 Projected total additional supply for selected Resources Sector occupations in Mining Operations, 2013–18

	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	7	7	7	7	7	8
1332 Engineering Managers	11	11	11	11	12	12
1335 Production Managers	74	76	78	79	81	83
2322 Cartographers and Surveyors	0	0	0	0	0	0
2332 Civil Engineering Professionals	47	48	49	49	50	51
2333 Electrical Engineers	53	54	55	56	56	57
2335 Industrial, Mechanical and Production Engineers	87	89	90	91	93	94
2336 Mining Engineers	239	242	246	250	254	259
2343 Environmental Scientists	74	75	76	78	79	80
2344 Geologists and Geophysicists	580	583	592	604	615	627
2513 Occupational and Environmental Health Professionals	65	66	67	69	70	71
Subtotal	**1,234**	**1,250**	**1,270**	**1,295**	**1,318**	**1,340**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	9	9	9	9	9	9
3126 Safety Inspectors	433	444	455	466	477	487
3212 Motor Mechanics	65	66	67	68	68	69
3223 Structural Steel and Welding Trades Workers	17	16	16	16	17	17
3232 Metal Fitters and Machinists	57	56	56	57	58	59
3411 Electricians	308	313	319	326	331	337
3992 Chemical, Gas, Petroleum and Power Generation Plant Operators	23	24	25	25	26	26
7122 Drillers, Miners and Shot Firers	872	881	895	910	925	939
7212 Earthmoving Plant Operators	70	70	71	72	73	73
7313 Train and Tram Drivers	26	26	25	25	25	25
7331 Truck Drivers	41	40	40	41	41	42
Subtotal	**1,920**	**1,945**	**1,978**	**2,015**	**2,050**	**2,083**
Total	**3,155**	**3,195**	**3,248**	**3,310**	**3,367**	**3,423**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, Appendix D.

Oil and Gas Operations

Analysis of selected occupations at the four-digit ANZSCO level in Oil and Gas Operations indicates that any growth in supply per year is small, with only 596 extra workers in total in 2018 (279 extra Managers and Professionals and 317 Technicians and Trades Workers/Machinery Operators and Drivers) (Table 56). Cartographers and Surveyors, Civil Engineering Draftspersons and Technicians, Train and Tram Drivers, and Truck Drivers are among the occupations expected to have no growth in supply.

Table 56 Projected total additional supply for selected Resources Sector occupations in Oil and Gas Operations, 2013–18

	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	2	2	3	3	3	3
1332 Engineering Managers	7	7	7	8	8	8
1335 Production Managers	7	7	7	8	8	8
2322 Cartographers and Surveyors	0	0	0	0	0	0
2332 Civil Engineering Professionals	16	17	17	17	18	18
2333 Electrical Engineers	18	19	19	19	20	20
2335 Industrial, Mechanical and Production Engineers	39	40	41	41	42	42
2336 Mining Engineers	75	76	77	79	80	81
2343 Environmental Scientists	15	15	16	16	16	17
2344 Geologists and Geophysicists	62	63	64	66	67	69
2513 Occupational and Environmental Health Professionals	11	12	12	12	13	13
Subtotal	**254**	**259**	**263**	**268**	**274**	**279**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	0	0	0	0	0	0
3126 Safety Inspectors	35	36	36	37	38	38
3212 Motor Mechanics	3	3	3	3	3	3
3223 Structural Steel and Welding Trades Workers	2	2	1	1	1	1
3232 Metal Fitters and Machinists	24	24	24	25	25	26
3411 Electricians	19	19	20	20	20	20
3992 Chemical, Gas, Petroleum and Power Generation Plant Operators	181	187	192	198	203	208
7122 Drillers, Miners and Shot Firers	17	17	18	18	18	19
7212 Earthmoving Plant Operators	1	1	1	1	1	1
7313 Train and Tram Drivers	0	0	0	0	0	0
7331 Truck Drivers	0	0	0	0	0	0
Subtotal	**281**	**288**	**296**	**303**	**310**	**317**
Total	**536**	**547**	**559**	**571**	**584**	**596**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, Appendix D.

4.8 Conclusion

Information about the supply of skills for Resources Sector occupations points to an overall increase in commencements in key disciplines relevant to the sector. However, it is important to note student numbers remain low. This signals a need to encourage prospective students to study in these disciplines and for employers to attract and retain graduates with relevant skills. Our consultations and other evidence demonstrate many graduates with relevant qualifications are not employed in occupations directly relevant to their field of study. The challenge is to stem the flow of qualified graduates seeking employment in non-resources sectors. This is especially so in the years ahead as the sector faces an increase in demand for specific professional skills.

The apprentices and trainees data indicates that while there have been fluctuations in the number of commencements in fields related to the sector, commencements and completions have increased overall. However, given the shift in the Resources Sector from a construction to an operations phase in major projects and growth in liquefied natural gas projects, there is a need to refocus on skills formation and retention strategies in occupations specific to operations and the liquefied natural gas sector. Investing in apprentices or trainees is an effective way for the Resources Sector to address immediate and forthcoming skills needs in the trades.

Migration of skilled workers remains an important source of labour. The move from construction to operations may change the way subclass 457 visas and other migration streams are used by employers and governments, with more highly skilled workers required for longer term roles. The expectation is that these highly skilled workers will both add to the existing pool of workers and contribute to the firm's internal training capacity.

The supply projections based on Deloitte Access Economics modelling suggest an increase in the overall supply of skills to the Resources Sector. However, skills supply projections for Oil and Gas Operations do not appear to meet demand, as this sector is projected to experience very strong growth during the outlook period which could result in skills shortages.

5 Existing and projected skills shortages

5.1 Introduction

In this chapter we examine existing and projected skills shortages in the Resources Sector. During our consultations, industry stakeholders noted the current easing of skills shortages across most occupations due to softening in the Construction and Manufacturing sectors. However, they expressed concern about shortages in critical specialist occupations such as skilled and experienced Mining Engineers, Electricians and Underground Miners.

While stakeholders indicate the Mining industry does not lack for prospective recruits, finding workers with the right skills and experience for complex mining and engineering jobs is proving to be difficult, especially for roles that require decades of relevant experience or are relatively new, such as experienced Drill Managers for offshore natural gas projects.

There are various factors influencing the skills crunch in the Resources Sector, such as the competing demand for skills from other sectors of the economy and the increasing international competition for mining skills. While migration may provide a short-term solution in terms of meeting the supply of some of the skills in shortage, employers in many resource-rich countries are also experiencing recruitment difficulties, suggesting there may be substantial international competition for skilled labour in coming years.

Our consultations and results from Deloitte Access Economics modelling indicate that even though skills shortages have eased in most occupations of relevance to the Resources Sector, the sector still anticipates shortages over the next five years. This is despite the likely transition to a less labour-intensive operations phase in many major projects in the years ahead. In total, Deloitte Access Economics projects 25 occupations will be in *sustained* supply–demand shortage across the period 2014–18.[148] While supply–demand deficits are expected in 2014 for many occupations relevant to Resources Project Construction, the longer term shortages relate to key occupations in Mining Operations and Oil and Gas Operations. In some cases, these workers will be recruited from other industries, but several resources-specific occupations will need to increase in supply to meet demand during this period. These occupations include Drillers, Miners and Shot Firers; Mining Engineers; and Chemical, Gas, Petroleum and Power Generation Plant Operators.

As part of its ongoing labour market research, the Department of Employment investigates and identifies occupations in shortage. The core of the research is the 'Survey of employers who have recently advertised', which collects information from employers on their recruitment experiences. The research program focuses on occupations which are skilled—those which generally require at least three years of post-school education and training.

Research into a range of skilled occupations for which employment is primarily in the Resources Sector (including Geologists and Mining Engineers) was completed between March and April 2013. Analysis of the skills shortage research included in this report was provided by the Department of Employment. It is based on research undertaken in 2012–13 and generally relates to the labour markets for these occupations across all industry sectors.

148 Occupations in *sustained* supply–demand shortage include those occupations where demand is expected to exceed supply for three or more years across the five-year timeframe, and therefore do not include the construction occupations expected to be in shortage in 2014 only.

5.2 National demand for skills

In line with the overall softening in the Australian labour market, skills shortages were less evident in 2012–13 than in the recent past. The proportion of occupations in national shortage is at its lowest level since 2007–08. While shortages are still evident for a small number of occupations, they are generally restricted to occupations requiring specialist qualifications and experienced workers.[149]

The Australian Chamber of Commerce and Industry's Survey of Investor Confidence suggests skills shortages are no longer a key concern for business, ranking outside the top 10 constraints on investment almost continuously since July 2011.[150]

Employers in almost all states and territories experienced less difficulty recruiting skilled workers in 2012–13 than they did in 2011–12. Results varied in the resource-rich states:

- Employers in Queensland filled 71 per cent of their surveyed vacancies. Competition from job seekers for available vacancies was particularly strong, with an average of 2.8 suitable applicants per vacancy (compared with the national average of 2.3). Employers in Queensland attracted slightly fewer suitable applicants per vacancy but filled a higher proportion of those vacancies than they did in 2011–12.
- Employers in Western Australia filled 63 per cent of their surveyed vacancies, which is below the national average (70 per cent). In Western Australia, employers attracted larger fields of suitable applicants compared with 2011–12 but filled a slightly lower proportion of vacancies.
- Employers in the Northern Territory continued to have the most difficulty filling their positions, with 60 per cent of vacancies filled in 2012–13, although this was a slight increase compared with the previous year.

A number of employers in the eastern states noted that they had received interest in their vacancies from significant numbers of workers who had returned after working in the Resources Sector.

5.3 Skills shortages in selected Resources Sector occupations

According to the Department of Employment, shortages of skilled workers were a feature of the Resources Sector over the four years to 2011–12, and were particularly evident in 2007–08 and 2011–12. In 2012–13, however, there was a marked easing in the labour market for skilled Resources Sector workers. Skills shortages are now restricted to a small number of key occupations and locations and are mostly in highly specialised positions.

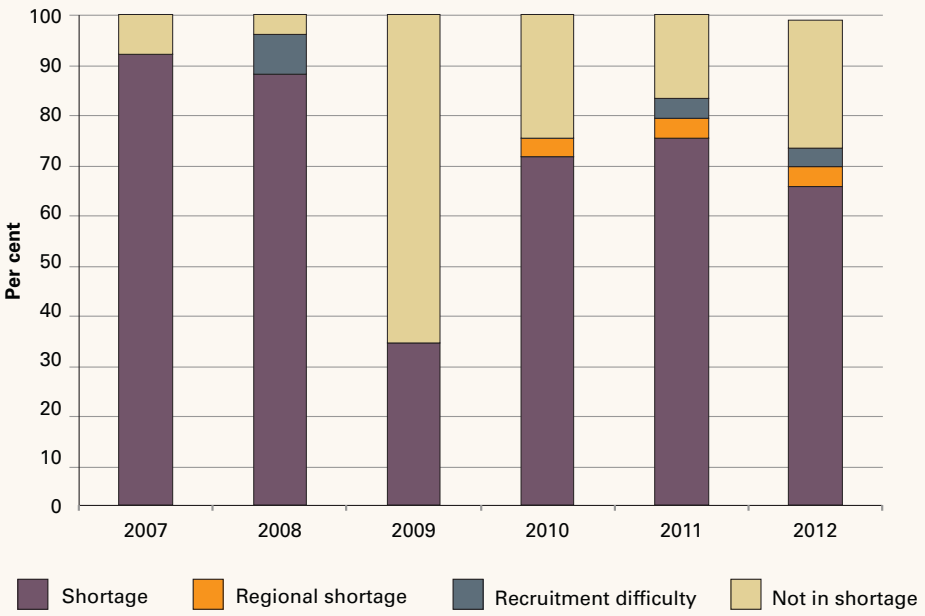
The proportion of resources-related occupations in shortage is now at its lowest level since the series began in 2007–08 (Figure 26). Skills shortages are now particularly notable for the following, although some trades are also in shortage:

- Mining Production Managers (ANZSCO 133513)
- Mining Engineers (ANZSCO 233611)
- Petroleum Engineers (ANZSCO 233612)
- Mine Deputies (ANZSCO 312913)
- Geophysicists (ANZSCO 234412).

149 Department of Employment, 2013, *Skill shortages Australia 2012–13,* docs.employment.gov.au/system/files/doc/other/skillshortagesaustralia2012_13.pdf, accessed 18 November 2013.

150 Australian Chamber of Commerce and Industry, 2013, *ACCI survey of investor confidence,* acci.asn.au/Research-and-Publications/Research/Economic-Surveys/Investor-Confidence/ACCI-Survey-Of-Investor-Confidence-(15), accessed 5 November 2013.

Figure 26 Proportion of consistently surveyed resources-related occupations in shortage, 2007–08 to 2012–13



Note: These proportions have been calculated based on the 24 resources-related occupations that have been consistently surveyed by the Department of Employment over the time period and cover manager, professional, technician and trade occupations (see Appendix I).

Source: Department of Employment, 2013, Skill shortage research program data, June.

Appendix I presents the top 20 occupations in Mining and their skills shortage rating as at June 2013.

The following sections examine selected occupations that are relevant to the Resources Sector. Some of these occupations are also in high demand and employers often experience difficulties in sourcing candidates with relevant qualifications and experience.

Managers, professionals and technicians

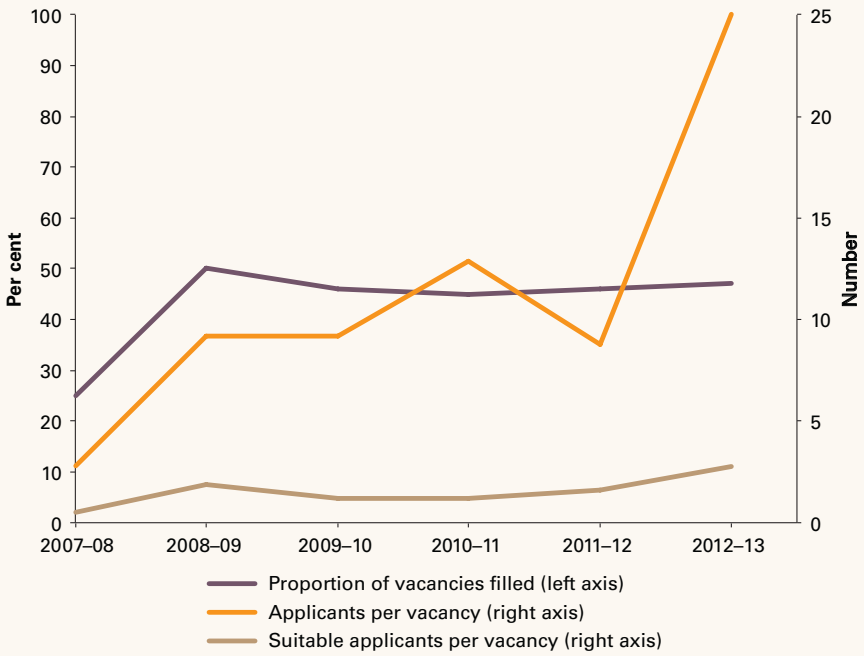
Employers recruiting for managers, professionals and technicians in occupations which are primarily engaged in resources-related activities had large fields of applicants from which to choose in 2012–13.[151] However, it is also evident that strong competition for available positions coexists with shortages of experienced workers.

151 Namely, Production Manager (Mining), Mining Engineer, Petroleum Engineer, Geologist, Metallurgist, Metallurgical or Materials Technician and Mine Deputy.

There were significant increases in both the average number of applicants and suitable applicants per vacancy, up from 8.8 and 1.6 respectively in 2011–12, to 24.8 and 2.8 in 2012–13. Despite the increase in suitable applicants, employers filled slightly less than half (46 per cent) of their surveyed vacancies for resources-related managers, professionals and technicians.

The low proportion of vacancies filled can be attributed to the ongoing difficulty in recruiting for senior and specialised roles, particularly in Western Australia (where the majority of vacancies were concentrated). Although most employers received a strong response to their advertisements, many applicants lacked the required skills and experience and were considered to be unsuitable (in 2012–13, there were 9.2 qualified but unsuitable applicants per vacancy). Figures 27 to 29 show the proportion of vacancies filled and the number of suitable applicants per vacancy for selected resources-related occupations.

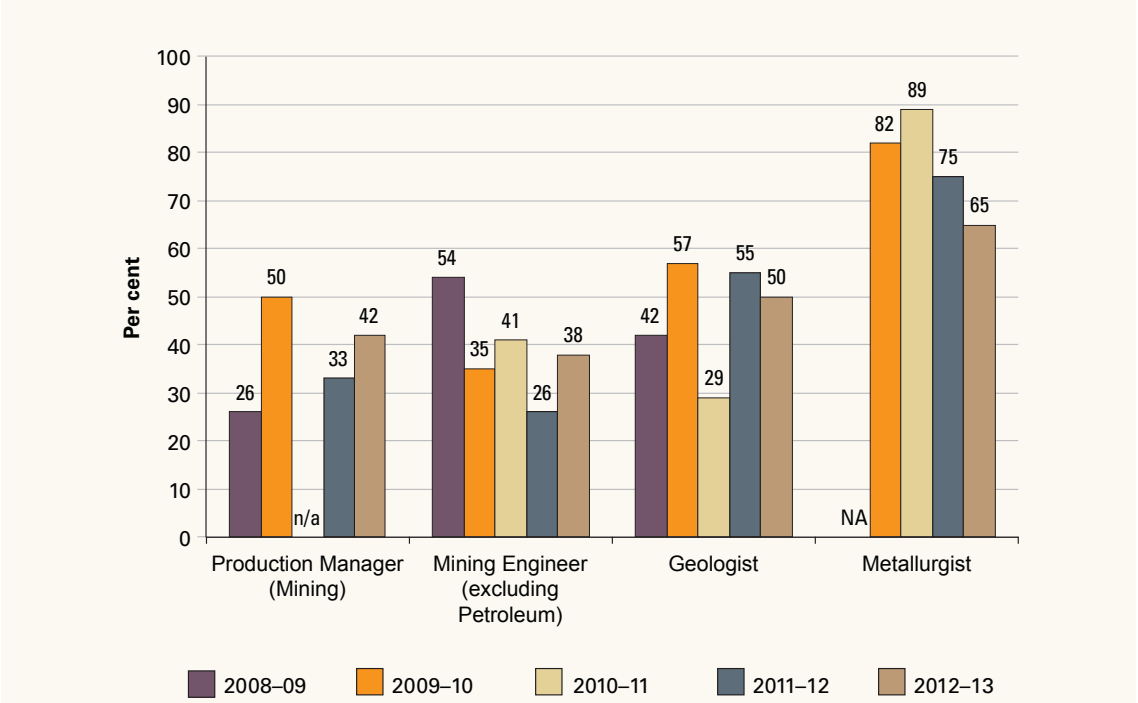
Figure 27 Proportion of vacancies filled, average number of applicants and suitable applicants per vacancy, selected resources-related occupations,* 2007–08 to 2012–13



* Comprises Production Manager (Mining), Mining Engineer, Petroleum Engineer, Geologist, Metallurgist, Metallurgical or Materials Technician and Mine Deputy.

Source: Department of Employment, 2013, Survey of employers who have recently advertised, June.

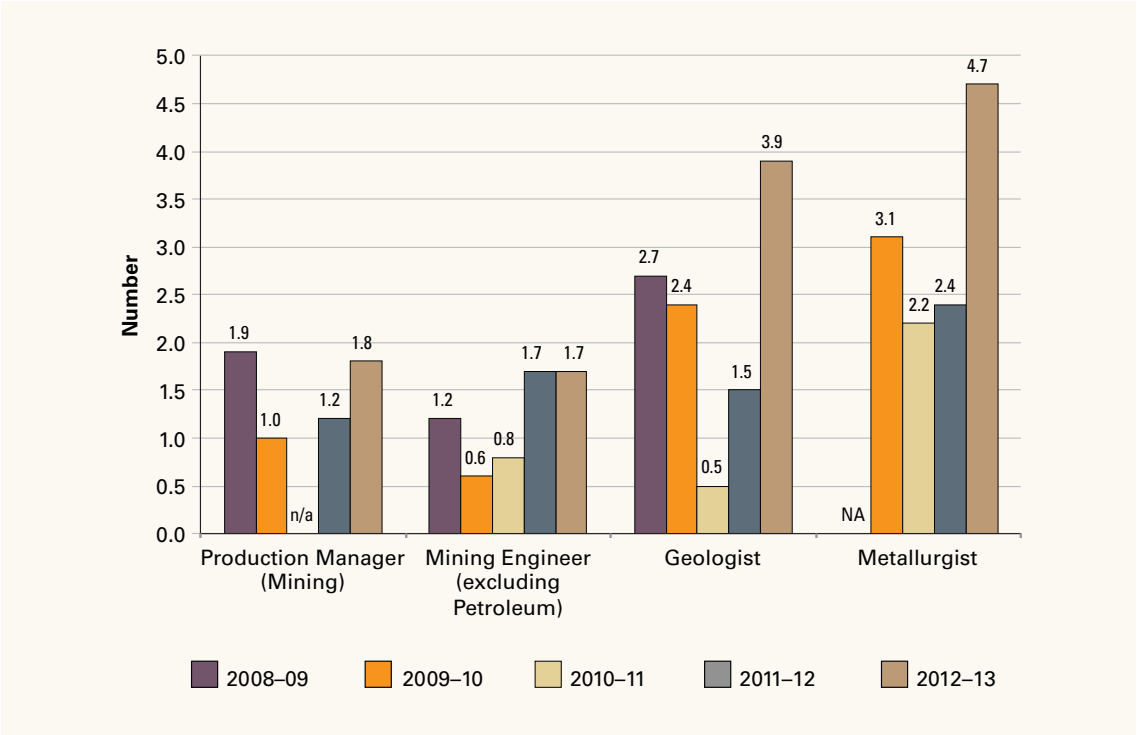
Figure 28 Proportion of vacancies filled, selected resources-related occupations, 2008–09 to 2012–13



NA = not assessed, n/a = not available.

Source: Department of Employment, 2013, Survey of employers who have recently advertised, June.

Figure 29 Number of suitable applicants per vacancy, selected resources-related occupations, 2008–09 to 2012–13



NA = not assessed, n/a = not available.

Source: Department of Employment, 2013, Survey of employers who have recently advertised, June.

Production Managers (Mining)

Shortages of Mining Production Managers have been persistent over the last five years and recruitment of these workers remains difficult. Advertised vacancies in 2012–13 were for positions across a range of mining activities, including gold, iron ore, coal, and oil and gas. These roles are often highly specialised, with most surveyed vacancies requiring applicants to have more than 10 years of industry experience and knowledge of specific mining techniques.

In 2012–13, 42 per cent of surveyed vacancies were filled. While there were large fields of applicants (an average of 15.6 per vacancy), just 1.8 applicants per vacancy were considered by employers to be suitable, as few had the required mining and senior management experience.

Almost 20 per cent of surveyed employers and recruitment agencies reported they often have to approach potential applicants to fill these positions. Jobs requiring applicants to live near the workplace attracted significantly lower numbers of applicants than those with fly-in, fly-out arrangements, as applicants were often not prepared to relocate.

Engineers and Engineering Draftspersons and Technicians

The Mining industry employs around one in 10 engineering professionals directly and these skills are vital to the Resources Sector. There was a pronounced easing in shortages of engineering professionals in 2012–13. The softer labour market for engineers is likely to be due, in part, to a slowdown in the Resources Sector and in engineering construction.

Employers recruiting professional engineers generally attract large numbers of qualified applicants. Most, however, are considered to be unsuitable as they do not meet employers' very specific skill and experience requirements.

Shortages of engineering technicians have been patchy over the last five years, but in 2012–13 were not evident at the national level. Recruitment eased across almost all states and territories, although employers in Queensland filled a relatively low proportion of vacancies (53 per cent) despite attracting large fields of candidates.

Employers seeking Civil Engineering Draftspersons and Technicians nationally filled around 77 per cent of surveyed vacancies and attracted, on average, 3.8 suitable applicants per vacancy. This compares with 55 per cent of vacancies filled and 1.6 suitable applicants per vacancy in 2011–12.

Employers seeking Electrical Engineering Draftspersons and Technicians filled around 78 per cent of surveyed vacancies (up from 60 per cent in 2011–12). Despite large fields of qualified applicants per vacancy (29.8, on average), employers considered 3.2 to be suitable.

Mining and Petroleum Engineers

The Mining industry directly employs more than half of all Mining and Petroleum Engineers, although due to the specialisation of these occupations it is likely those employed in other industries work indirectly in the Resources Sector. Accordingly, Mining faces little competition for workers with these skills domestically.

These engineering specialisations are now the only two to be in national shortage. The majority of employers surveyed in 2012–13 experienced difficulty filling specialised and senior mining engineering roles. Large numbers of qualified applicants were considered to be unsuitable because employers generally required specific industry experience and generally were unwilling, or unable, to compromise.

The labour market for Mining Engineers remains particularly tight, with 38 per cent of surveyed vacancies filled in 2012–13 (up from 26 per cent in 2011–12). On average, though, there were 19.6 applicants per vacancy, but just 1.7 were considered suitable.

Only a small number of vacancies were identified for Petroleum Engineers in 2012–13. Employers who did advertise attracted large fields of applicants; however, the majority lacked relevant experience or qualifications. Notably, a small number of unfilled vacancies for Petroleum Engineers attracted suitable applicants, but applicants and employers were unable to agree on the terms and conditions of employment.

Other Engineers

The number of Other Engineers employed directly by the Mining industry is relatively small. Nonetheless, the skills of mechanical, electrical, chemical and civil engineering professionals are important to the sector.

After a number of years of persistent shortages, in 2012–13 employers recruiting for these positions filled their vacancies without significant difficulty. Some surveyed vacancies had been withdrawn after advertising despite attracting a strong response from applicants, because the employers had decided not to proceed with recruitment due to uncertainty surrounding future activity levels.

Geologists and Geophysicists

The labour market for Geologists eased in 2012–13, with nearly all employers recruiting without difficulty. Surveyed vacancies for Geologists attracted large numbers of suitably qualified and experienced workers (an average of 16.3 qualified applicants per vacancy), with a high 3.9 suitable

applicants per vacancy on average (compared with 1.5 in 2011–12). A number of employers suggested the recent fall in commodity prices has led to a freeze on some exploration projects and may account for the large numbers of applicants.

Conversely, the labour market for Geophysicists remains tight, with employers continuing to experience difficulty recruiting. In 2012–13, employers recruiting Geophysicists filled 33 per cent of their surveyed vacancies and attracted 1.5 suitable applicants per vacancy. Despite the low numbers, this was a marked increase in both the proportion of vacancies filled and the number of suitable applicants compared with 2011–12 (20 per cent and 0.2 respectively). A number of surveyed employers and recruitment agencies reported they often have to approach potential applicants to fill these roles.

In June 2013 the peak body representing geoscientists, the Australian Institute of Geoscientists, released its survey of 1,100 geoscientists. The survey found the rates of unemployment and underemployment for geoscientists nationally are at 9.4 per cent and 12.6 per cent respectively, rising from 7.9 per cent and 11.3 per cent since March 2013.[152]

AWPA's consultations suggest the labour market for geoscientists involved in resources and energy exploration—the early stages of a resources project—is easing, while the market for geoscientists geared towards supporting extraction operations remains tight.

Accountants

Mining employs a very small proportion of Accountants (around 2 per cent) and competes for these workers with all other industries. Nonetheless, in 2012 there were around 3,400 Accountants employed in the sector. Employers across all accounting specialisations recruited without difficulty in 2012–13, attracting relatively large fields of suitable candidates.

Surveyors

After being in national shortage continuously since 2006–07, there was a marked easing in the labour market for Surveyors in 2012–13. While shortages are evident in some locations, they are no longer considered to be widespread nationally. In 2012–13, there was a large rise in the average number of suitable applicants per vacancy (from 1.1 in 2011–12 to 3.2), suggesting there is an adequate supply of these workers, and 63 per cent of vacancies were filled (up from 33 per cent in 2011–12).

Occupational and Environmental Health Professionals

The Mining industry employs around 16 per cent of Occupational and Environmental Health Professionals. In 2012–13, research into the labour market for Occupational Health And Safety Advisers and Environmental Health Officers across all sectors suggested employers recruited with ease.

Employers seeking Occupational Health and Safety Advisers filled 91 per cent of surveyed vacancies, with an average of 2.5 suitable applicants per vacancy. Employers seeking Environmental Health Officers filled almost all their surveyed advertised vacancies (97 per cent) and attracted 4.1 suitable applicants per vacancy on average.

Metallurgists and Metallurgical or Materials Technicians

Employers of Metallurgists continued to experience little difficulty recruiting in 2012–13, filling 65 per cent of vacancies and attracting 4.7 suitable applicants per vacancy on average. This is a notable divergence from the general recruitment experience of employers across the Resources Sector.

By contrast, while few vacancies were identified for Metallurgical or Materials Technicians, employer comments suggest shortages of experienced and specialist workers are emerging.

152 Australian Institute of Geoscientists, 2013, *Geoscientist employment slide continues—worst in four years,* aig.org.au/index.php?option=com_content&view=article&id=312&Itemid=339, accessed 26 August 2013.

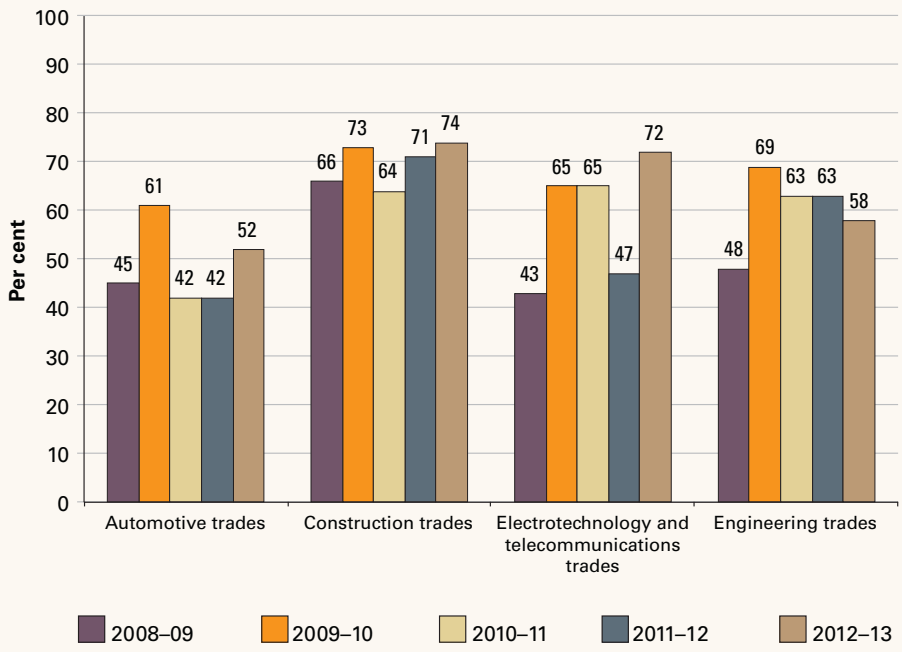
Mine Deputies

Shortages of Mine Deputies have been persistent in recent years. Few vacancies were identified in 2012–13, but surveyed employers suggested it is difficult to recruit these workers. Employers commented it was difficult to attract applicants with the appropriate mining and supervisory experience, deputy/shift supervisor tickets and knowledge of mine health and safety regulations. This view was reinforced during AWPA's consultations.

Trades

The proportion of trades workers employed directly by the Mining industry is low; nonetheless, a number of trade occupations are important to the sector. Demand for trade skills from the Resources Sector is easing in line with the peak in resources-related construction and the sector's transition into a less labour-intensive operations phase.[153] Figures 30 and 31 present the proportion of vacancies filled in selected trade occupations and the number of suitable applicants for those vacancies from 2008–09 to 2012–13.

Figure 30 Proportion of vacancies filled, selected trade occupational groups, 2008–09 to 2012–13

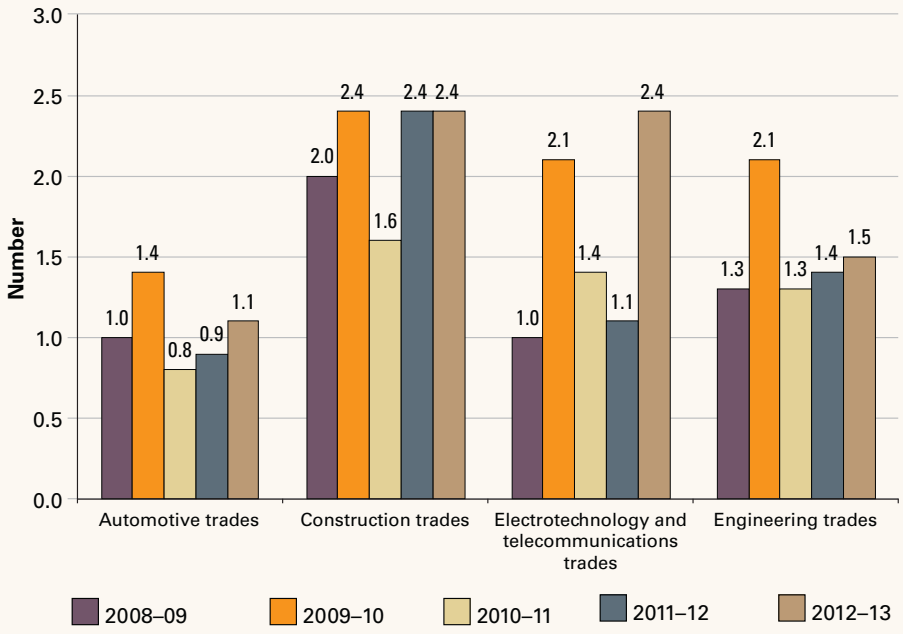


Note: The occupations that comprise each cluster may not be consistent from year to year.

Source: Department of Employment, 2013, Survey of employers who have recently advertised, June.

153 Department of the Treasury, 2013, *Economic statement August 2013*; DAE, 2013, *Business outlook, March 2013,* deloitte.com/view/en_au/au/a859b70a6d03e310VgnVCM2000003356f70aRCRD.htm, accessed 6 November 2013.

Figure 31 Number of suitable applicants per vacancy, selected trade occupational groups, 2008–09 to 2012–13



Note: The occupations that comprise each cluster may not be consistent from year to year.

Source: Department of Employment, 2013, Survey of employers who have recently advertised, June, unpublished.

Automotive trades

Relatively few automotive trades workers are employed in Mining, but these skills are key to the sector (particularly Automotive Electricians and Motor Mechanics). Employers in resource-rich states suggest demand for these trades from the Resources Sector has contributed to more general shortages, especially in regional areas.

National shortages are evident across all automotive trades, although employers filled a slightly higher proportion of vacancies in 2012–13 (52 per cent) than they did in 2011–12 (42 per cent).

The labour market for these occupations eased in the resources states of Queensland and Western Australia, although conditions remain tight.

Queensland employers filled 54 per cent of their surveyed vacancies, up from 32 per cent in 2011–12. In Western Australia employers filled 57 per cent of vacancies, compared with 40 per cent in 2011–12. By contrast, a relatively low proportion of were filled in the Northern Territory in 2012–13 (13 per cent, down from 45 per cent in 2011–12).

Engineering trades

Recruitment experiences vary markedly across the engineering trades. Shortages of Fitters have re-emerged in some regional areas and are particularly evident in Western Australia, reflecting the strong demand from the Resources Sector.

In line with the multi-speed nature of the Australian economy, employers in non–resources states generally filled their engineering trades vacancies with relative ease. Labour market conditions were considerably tighter in Western Australia and the Northern Territory. Employers in the Northern Territory filled 52 per cent of vacancies and attracted 1.5 suitable applicants per vacancy, while employers in Western Australia filled 41 per cent of vacancies and attracted an average of 0.8 suitable applicants.

Resources Sector employers are very particular about qualifications, licences, trade skills and experience, and are generally unwilling to accept applicants who do not fully meet their requirements.

Construction trades

The construction trades labour market continued to ease in 2012–13, due to lower construction activity levels in a number of sectors. Conditions are likely to remain subdued for these workers, at least in the short term.

Accordingly, skills shortages have abated and competition from trades workers for available vacancies is strong.

Employers in most states and territories fill vacancies with ease, including in Western Australia and Queensland. The exception is the Northern Territory, where employers filled slightly more than half of their surveyed vacancies in 2012–13. Of particular note are the results of the Housing Industry Association Trades Report, which indicated a surplus in construction trades capacity in all surveyed regions except Western Australia.[154]

As resource-related construction peaks, demand for a number of trades will ease. Deloitte Access Economics suggests further that engineering construction (which includes resources-related construction) has started to decline from recent peaks as the high Australian dollar, higher input costs and weaker commodity prices have resulted in a number of proposed mining projects being placed on hold.[155]

Electrotechnology and telecommunications trades

Electrotechnology and telecommunications trades make up a relatively large occupational group covering a diverse range of occupations. The labour market for these trades eased significantly in 2012–13, and shortages have abated across a number of occupations. Shortages are evident, though, for airconditioning and refrigeration mechanics and electronic equipment trades workers.

The largest of these trades employed in the Mining industry is Electricians (with 8,800 workers or around 6 per cent of all Electricians). In line with the soft building activity, the labour market for electricians eased in 2012–13. The Australian Petroleum Production and Exploration Association has forecast a shortage of Electricians in 2014 and 2015, suggesting demand will exceed labour availability.[156] Industry sources suggest demand remains strong in the Mining sector for dual-trade workers who have electrical and instrumentation skills.

154 Housing Industry Association, 2013, *HIA Trades Report June quarter 2013,* economics.hia.com.au/publications/austral_trades_report.aspx, accessed 13 November 2013. Note the data do not include Tasmania, the Australian Capital Territory or the Northern Territory.

155 DAE, 2013, *Business outlook March 2013*, pp. 17–19.

156 Australian Petroleum Production and Exploration Association, 2012, *State of the industry 2012*, appea.com.au/wp-content/uploads/2013/04/121130_State-of-the-Industry-2012_web.pdf, accessed 18 November 2013.

Other occupations

Drillers

The labour market for Drillers eased over the six months to March 2013, with employers and recruitment agents commenting there are a large number of Drillers seeking work. Around 77 per cent of vacancies were filled in 2012–13, up from 61 per cent in 2011–12.

There was greater competition among applicants for advertised positions, with an average of 14.4 applicants per vacancy (compared with 4.2 in 2011–12). Of these, however, an average of 2.0 per vacancy was considered to be suitable (compared with 1.6 in 2011–12). Although no significant recruitment difficulties are evident, surveyed employers suggested it can be difficult to recruit for Offshore Drillers and Horizontal Directional Drillers.

Specialised Occupation List

As part of its workforce development strategy, AWPA develops and publishes a Specialised Occupation List each year. The list identifies occupational areas where the risk of shortages (or indeed oversupply) needs to be examined in detail and addressed. A wide range of data and information is examined each year to generate a new Specialised Occupation List. Occupations that satisfy a criterion of high information, as well as two of the following three criteria: long lead-time, high use and high risk, are identified and placed on the list.

Appendix J provides a selection of Mining and resources-related Construction occupations that are on the Specialised Occupation List. Many of these occupations were examined in detail by Deloitte Access Economics in its modelling for this report.

5.4 Trends in projected skills supply–demand balance in the Resources Sector, 2014–18

Deloitte Access Economics has developed a resources industry proxy for the supply of skills that maps occupations skills supply across the economy to industries based on occupational composition within each industry, using data from the 2011 Census. It is important to note that these supply projections are indicative of possible skills supply in the economy—there is no guarantee that individuals with these skills will work in the sector for which they are trained. Additional information relating to supply projections is available in the Deloitte Access Economics report.

The estimated supply–demand comparisons by scenario at the broad occupational level are presented in tables below. According to Deloitte Access Economics modelling there are significant differences in the supply–demand comparison for the three individual sectors during the outlook period (2014 to 2018). The projections suggest an undersupply of skilled workers in the Mining Operations and Oil and Gas Operations sectors. In the low growth scenario, as seen in Chapter 3, the fall in demand in the Resources Project Construction sector is offset by the additional demand in the Mining Operations and Oil and Gas Operations sectors over the outlook period. However, it is evident that this increased demand will be largely unmet due to the shortage of workers in the Mining Operations and Oil and Gas Operations sectors.

Each of the scenarios projects strong employment levels in the Resources Project Construction sector in 2014. The low growth scenario, considered the most likely outcome for the sector, projects adequate skills supply to meet demand in 2014 across each of the key occupations, with the exception of potential small deficits for Concreters, Construction Managers, Secretaries and Bookkeepers. However, the base case and high growth scenarios project significant skills imbalances for a range of trade and technical occupations including Electricians, Plumbers, Carpenters and Joiners, Painting Trades Workers, Earthmoving Plant Operators and Concreters, and some Managers and Professionals including Construction Managers and Engineers.

Between 2015 and 2018, the emphasis shifts to projected shortages in key occupations related to Mining Operations and Oil and Gas Operations. In Mining Operations, shortages for Technicians and Trades Workers are apparent across the forecast period, particularly in relation to Metal Fitters and Machinists, Other Building and Engineering Technicians and Earthmoving Plant Operators.

For Oil and Gas Operations**,** shortages are forecast across key professional, managerial and trades and technical occupations from 2015 to 2018. These shortages are particularly concerning given the significant investment profile of liquefied natural gas projects and the high level of demand for oil and gas from Australia's trading partners. Already, there is evidence that skills shortages are affecting the competitiveness of Australian liquefied natural gas prospects by contributing to delays and increased project costs.

Declining employment in the construction phase of projects will be offset by growing skills demand for the operations phase. However, most workers in the trade occupations associated with Resources Project Construction have little or no opportunity to transfer into either Mining Operations or Oil and Gas Operations. Fifteen occupations that are significant in construction, including 11 trades and technical occupations, are not heavily represented in the operations phase. On the positive side, there are 15 significant occupations in construction that could transition into operations. This issue is explored further in Chapter 7.

In the supply–demand balance tables in this section, a number greater than zero indicates a surplus of workers for that occupation, while a negative number indicates a shortfall for that occupation. These numbers accumulate each year—for instance, in the low growth scenario for Resources Project Construction there will be a surplus of 7,316 Managers by 2018 (Table 57).

Resources Project Construction

There are significant differences across the growth scenarios for Resources Project Construction, as shown in Table 57. In the low growth scenario, considered to be the most likely outcome, the oversupply of workers increases from 2,440 in 2014 to 21,622 in 2016. The number then declines significantly to an oversupply of 10,745 in 2018.

In the base case scenario, the projections indicate a total undersupply of 19,324 workers in 2014 across all the occupational groups, suggesting job needs in the Resources Sector alone will impact markedly on national skills supply in these occupations at least up to 2014. However, the supply of workers then shows a significant increase from an oversupply of 7,178 workers in 2015 to 15,351 in 2018.

In the high growth scenario, projections indicate an undersupply of 34,530 workers in 2014–15 across all the occupational groups. The supply of workers then increases from 2016 onwards to reach an oversupply of 19,498 in 2018.

There could be several reasons for the undersupply in 2014 under the base case and high growth scenarios. Construction activity associated with major projects is expected to peak around this time, and therefore demand exceeds normal supply to this industry significantly in 2014, and supply thereafter is higher than demand.[157] This is due to a decline in resources project construction, as major projects near completion or are completed, and fewer new projects come on board. As demand for construction work in the Resources Sector decreases, there is greater capacity within the economy to meet the lower demand with existing skills supply. While there is a general oversupply of workers from 2015 onwards, Professional and Technical and Trades Worker occupations show a significant surplus of workers in Resources Projects Construction, as many of the current major resource-related construction projects move into the operations phase.

As mentioned above, some of these workers may be able to transition from construction to operations roles. However, this will be a significant task—under the low growth scenario approximately 20,000 workers engaged in jobs significant to resources and employing more than 500 people will need to be re-absorbed into the broader workforce.

157 DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 57 Projected supply–demand balance in Resources Project Construction by scenario and broad occupations, 2014–18

	2014	2015	2016	2017	2018
Base case					
Managers	–2,988	702	3,091	1,967	2,127
Professionals	–3,629	1,178	4,217	2,720	2,824
Technicians and Trades Workers	–5,787	2,446	7,393	4,677	4,670
Community and Personal Service Workers	–54	9	52	33	38
Clerical and Administrative Workers	–2,035	914	2,766	1,882	2,007
Sales Workers	–99	23	100	64	71
Machinery Operators and Drivers	–2,239	818	2,679	1,691	1,669
Labourers	–2,493	1,087	3,312	2,090	1,944
Total	**–19,324**	**7,178**	**23,610**	**15,125**	**15,351**
High growth					
Managers	–5,075	–373	3,218	2,231	2,726
Professionals	–6,399	–188	4,476	3,145	3,622
Technicians and Trades Workers	–10,416	276	7,935	5,436	5,970
Community and Personal Service Workers	–91	–10	53	37	49
Clerical and Administrative Workers	–3,673	87	2,869	2,099	2,495
Sales Workers	–168	–12	103	72	92
Machinery Operators and Drivers	–4,035	–14	2,940	2,006	2,119
Labourers	–4,588	147	3,739	2,524	2,426
Total	**–34,444**	**–86**	**25,333**	**17,550**	**19,498**
Low growth					
Managers	38	1,131	2,919	1,779	1,449
Professionals	343	1,669	3,896	2,395	1,929
Technicians and Trades Workers	901	3,165	6,747	4,072	3,218
Community and Personal Service Workers	–1	18	50	31	25
Clerical and Administrative Workers	362	1,239	2,631	1,724	1,459
Sales Workers	3	38	97	59	49
Machinery Operators and Drivers	338	1,112	2,410	1,475	1,186
Labourers	457	1,388	2,874	1,779	1,429
Total	**2,440**	**9,758**	**21,622**	**13,315**	**10,745**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

The supply of skilled workers in the top 10 employing occupations at the detailed occupational (four-digit ANZSCO) level is presented in Table 58. The data indicates there will be no skills shortages in any of the identified occupations (apart from Concreters in 2014). There is a surplus in all the identified occupations across the outlook period.

Table 58 Projected supply–demand balance in the top 10 employing occupations, Resources Project Construction, low growth, 2014–18

Occupation	2014	2015	2016	2017	2018
3411 Electricians	135	626	1,347	878	636
3341 Plumbers	98	484	1,051	682	491
3312 Carpenters and Joiners	88	452	988	639	459
3322 Painting Trades Workers	16	234	555	345	237
7212 Earthmoving Plant Operators	152	569	1,218	812	608
8212 Concreters	–12	333	848	511	343
3332 Plasterers	11	167	396	246	169
3311 Bricklayers and Stonemasons	11	132	311	194	134
8211 Building and Plumbing Labourers	245	455	766	565	465
3334 Wall and Floor Tilers	6	95	225	140	96
Total	**749**	**3,548**	**7,706**	**5,012**	**3,637**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 59 presents the projected supply–demand balance under the low growth scenario for selected Resources Sector occupations. Shortfalls can only be seen for Construction Managers, Production Managers, and Cartographers and Surveyors in 2014. On the whole there is expected to be an increasing surplus of workers across all relevant occupations, rising from 782 in 2014 to peak at 6,590 in 2016 and then decreasing to 3,273 in 2018. Projections under the base case and high growth scenarios are provided in Appendix K.

Table 59 Projected supply–demand balance for selected Resources Sector occupations, Resources Project Construction, low growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–26	319	879	531	419
1332	Engineering Managers	3	42	104	65	53
1335	Production Managers	–8	49	142	84	66
2322	Cartographers and Surveyors	–1	48	130	76	57
2332	Civil Engineering Professionals	179	448	901	592	504
2333	Electrical Engineers	5	101	260	155	119
2335	Industrial, Mechanical and Production Engineers	20	110	260	160	127
2336	Mining Engineers	7	17	35	23	19
2343	Environmental Scientists	12	22	38	27	24
2344	Geologists and Geophysicists	0	2	6	3	2
2513	Occupational and Environmental Health Professionals	6	69	174	104	81
Subtotal		**232**	**1,227**	**2,929**	**1,820**	**1,471**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	79	84	95	82	86
3126	Safety Inspectors	104	106	114	102	108
3212	Motor Mechanics	20	27	40	29	28
3223	Structural Steel and Welding Trades Workers	13	56	124	73	57
3232	Metal Fitters and Machinists	22	56	112	70	58
3411	Electricians	135	626	1,403	826	636
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	5	6	7	6	6
7122	Drillers, Miners and Shot Firers	13	32	63	40	34
7212	Earthmoving Plant Operators	152	569	1,268	765	608
7313	Train and Tram Drivers	0	0	1	0	0
7331	Truck Drivers	7	167	434	245	181
Subtotal		**550**	**1,729**	**3,661**	**2,238**	**1,802**
Total		**782**	**2,956**	**6,590**	**4,058**	**3,273**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Mining Operations

The Deloitte Access Economics modelling report states 'commodity prices will play an important role in shaping future growth for the Australian economy, and specifically demand for labour within mining operations'.[158] Modelling suggests that by 2018 employment in Mining Operations will reach 254,260 (an additional 17,570 workers compared to 2013) under the base case scenario, which is a 7.4 per cent increase on the estimated 2013 employment level.

Supply–demand balance projections indicate shortages throughout the outlook period for skilled workers in Mining Operations. This is because demand growth is strong for the sector, as investment translates into additional production capacity. It is evident from Table 60 that demand will far exceed supply in all occupational groups in the sector. It is also evident that skills shortages will be critical

158 Ibid., p. ii.

in Mining Operations in the period ahead. Under the base case, the occupational groups with the greatest shortages are Technicians and Trades Workers, Managers (throughout the outlook period), Professionals (from 2015 to 2016) and Machinery Operators and Drivers (from 2015 to 2017) as major resources-related construction projects move into the operations phase.

Under the high growth scenario, the greatest shortages are in Technicians and Trades Workers, Managers (throughout the outlook period), Professionals (from 2015 to 2017) and Machinery Operators and Drivers (from 2015 to 2018) as major resource construction projects move into the operations phase. In the low growth scenario, shortages occur throughout the outlook period in Technicians and Trades Workers, Managers, Community and Personal Service Workers and Sales Workers.

Table 60 Projected supply–demand balance in Mining Operations by scenario and broad occupations, 2014–18

	2014	2015	2016	2017	2018
Base case					
Managers	–425	–464	–510	–511	–476
Professionals	425	–170	–236	235	539
Technicians and Trades Workers	–1,548	–1,926	–1,909	–1,692	–1,600
Community and Personal Service Workers	–10	–19	–23	–26	–17
Clerical and Administrative Workers	367	418	425	401	433
Sales Workers	–24	–27	–30	–32	–32
Machinery Operators and Drivers	515	–703	–1,152	–401	121
Labourers	611	603	629	675	699
Total	**–89**	**–2,288**	**–2,806**	**–1,351**	**–333**
High growth					
Managers	–432	–617	–659	–645	–600
Professionals	413	–547	–643	–117	241
Technicians and Trades Workers	–1,488	–2,277	–2,215	–1,921	–1,760
Community and Personal Service Workers	–9	–26	–31	–33	–26
Clerical and Administrative Workers	382	341	356	343	382
Sales Workers	–22	–28	–30	–32	–32
Machinery Operators and Drivers	570	–1,014	–1,526	–702	–104
Labourers	638	606	636	689	718
Total	**52**	**–3,562**	**–4,112**	**–2,418**	**–1,181**
Low growth					
Managers	–418	–306	–388	–408	–374
Professionals	391	253	124	510	777
Technicians and Trades Workers	–1,358	–1,294	–1,429	–1,305	–1,251
Community and Personal Service Workers	–11	–11	–16	–20	–12
Clerical and Administrative Workers	388	535	514	478	510
Sales Workers	–23	–23	–26	–29	–29
Machinery Operators and Drivers	452	–299	–749	–96	360
Labourers	639	664	681	719	738
Total	**60**	**–481**	**–1,289**	**–151**	**719**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

The outlook for employers in Mining Operations indicates shortfalls throughout the projected period. Overall, shortages in the top 10 employing occupations peak in 2016, and then decrease in 2017 and 2018 (Table 61).

Table 61 Projected supply–demand balance in the top 10 employing occupations, Mining Operations, base case, 2014–18

Occupation		2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	346	–458	–751	–262	84
3232	Metal Fitters and Machinists	–933	–1,105	–1,109	–1,025	–987
3129	Other Building and Engineering Technicians	–468	–569	–571	–512	–486
7331	Truck Drivers	–43	–214	–279	–175	–105
1335	Production Managers	–244	–270	–291	–285	–267
3411	Electricians	–131	–217	–222	–175	–148
2344	Geologists and Geophysicists	165	87	83	154	197
3223	Structural Steel and Welding Trades Workers	–222	–238	–232	–224	–225
2336	Mining Engineers	9	–87	–101	–31	16
7212	Earthmoving Plant Operators	22	–56	–86	–39	–7
Total		**–1,498**	**–3,129**	**–3,559**	**–2,574**	**–1,928**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 62 presents the projected supply–demand balance under the base case scenario for selected Resources Sector professional and technical occupations in Mining Operations. Skills shortages are projected in many of these occupations to 2018. Acute shortages are projected for Production Managers, with shortages persisting to 2018 (Table 61). On the other hand, professional occupations such as Geologists and Geophysicists will be in surplus across the entire period, while Environmental Scientists are projected to be in shortage in 2015–16 only.

Severe skills supply shortages are evident in several trade occupations such as Metal Fitters and Machinists and Drillers, Miners and Shot Firers. Other occupations in persistent shortage are Structural Steel and Welding Trades Workers, Electricians, Truck Drivers and Chemical, Gas, Petroleum and Power Generation Plant Operators. Projections for the high growth and low growth scenarios are provided in Appendix K.

Table 62 Projected supply–demand balance for selected Resources Sector occupations, Mining Operations, base case, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–18	–19	–20	–20	–20
1332	Engineering Managers	–21	–24	–27	–25	–23
2322	Cartographers and Surveyors	–32	–59	–63	–44	–32
2332	Civil Engineering Professionals	1	–17	–19	–6	2
2333	Electrical Engineers	4	–22	–26	–9	3
2335	Industrial, Mechanical and Production Engineers	4	–33	–38	–12	5
2343	Environmental Scientists	11	–12	–15	3	14
2513	Occupational and Environmental Health Professionals	–14	–48	–53	–26	–9
Subtotal		**–65**	**–234**	**–261**	**–139**	**–60**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–1	–1	–1	–1	–1
3126	Safety Inspectors	296	298	303	311	317
3212	Motor Mechanics	–26	–31	–28	–25	–25
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–2	–1	0	0	–1
7313	Train and Tram Drivers	14	5	1	7	11
Subtotal		**281**	**270**	**275**	**292**	**301**
Total		**216**	**36**	**14**	**153**	**241**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Oil and Gas Operations

Employment in the Oil and Gas Operations sector has experienced the strongest growth since 2010 as many of the liquefied natural gas projects under construction have moved into their production phase. This trend is expected to continue as many of the major new liquefied natural gas projects and existing project upgrades and expansions currently under construction move into their production phase. The sector is expected to have an average employment growth of approximately 9.5 per cent annually to 2018, with a base case estimate of 61,212 workers employed in 2018 (an additional 22,269).[159]

However, it is unlikely the significant growth in demand will be met in the short term as skills shortages are predicted in all of the occupational groups under all of the scenarios (Table 63). The Professionals and Technical and Trades Workers occupations are expected to face severe skills shortages.

This situation is not significantly altered at the detailed four-digit ANZSCO occupational level, with shortages predicted in all the top 10 employing occupations up to 2018 (Table 64).

159 Ibid.

Table 63 Projected supply–demand balance in Oil and Gas Operations by scenario and broad occupations, 2014–18

	2014	2015	2016	2017	2018
Base case					
Managers	–628	–703	–688	–502	–450
Professionals	–1,549	–1,861	–1,781	–1,071	–807
Technicians and Trades Workers	–875	–958	–915	–665	–591
Community and Personal Service Workers	–18	–22	–22	–17	–13
Clerical and Administrative Workers	–565	–628	–602	–409	–344
Sales Workers	–31	–37	–39	–31	–29
Machinery Operators And Drivers	–164	–229	–253	–182	–152
Labourers	–136	–155	–157	–132	–127
Total	**–3,966**	**–4,593**	**–4,457**	**–3,009**	**–2,513**
High growth					
Managers	–605	–754	–796	–632	–587
Professionals	–1,490	–2,029	–2,122	–1,461	–1,193
Technicians and Trades Workers	–831	–993	–1,003	–768	–689
Community and Personal Service Workers	–16	–23	–26	–21	–18
Clerical and Administrative Workers	–537	–673	–702	–528	–468
Sales Workers	–29	–39	–43	–37	–35
Machinery Operators And Drivers	–150	–236	–278	–212	–181
Labourers	–125	–152	–159	–136	–132
Total	**–3,783**	**–4,899**	**–5,129**	**–3,795**	**–3,303**
Low growth					
Managers	–651	–941	–927	–655	–564
Professionals	–1,631	–1,314	–1,248	–663	–424
Technicians and Trades Workers	–854	–685	–662	–462	–395
Community and Personal Service Workers	–19	–16	–16	–11	–8
Clerical and Administrative Workers	–589	–443	–422	–265	–202
Sales Workers	–32	–29	–30	–24	–22
Machinery Operators And Drivers	–172	–175	–194	–133	–107
Labourers	–134	–126	–126	–105	–101
Total	**–4,082**	**–3,729**	**–3,625**	**–2,318**	**–1,823**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 64 Projected supply–demand balance in the top 10 employing occupations, Oil and Gas Operations, base case, 2014–18

Occupation		2014	2015	2016	2017	2018
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–191	–221	–204	–122	–96
2336	Mining Engineers	–284	–344	–325	–193	–145
2211	Accountants	–193	–233	–223	–134	–100
7122	Drillers, Miners and Shot Firers	–96	–133	–144	–102	–85
2344	Geologists and Geophysicists	–191	–232	–218	–127	–93
3232	Metal Fitters and Machinists	–168	–186	–178	–134	–120
5111	Contract, Program and Project Administrators	–75	–86	–81	–51	–41
3341	Plumbers	–38	–30	–33	–34	–35
5511	Accounting Clerks	–65	–71	–68	–46	–39
2335	Industrial, Mechanical and Production Engineers	–105	–128	–122	–70	–51
Total		**–1,407**	**–1,663**	**–1,597**	**–1,013**	**–804**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

The projections under the base case scenario for the skills supply–demand balance for selected Resources Sector occupations in Oil and Gas Operations are shown in Table 65. Shortages are expected for all the identified occupations (with the exception of Safety Inspectors) through the outlook period. The shortages are expected to peak around 2015–16, when many new large liquefied natural gas projects and expansions are expected to begin production.

Oil and Gas Operations has a small workforce and supply shortfalls can have significant impacts on ongoing project viability. The shortfalls in all the selected managerial/professional and technical/trades occupations are indicative of the difficulty in obtaining suitable candidates for these occupations and the overall lack of supply. Projections under the high growth and low growth scenarios are provided in Appendix K.

Table 65 Projected supply–demand balance for selected Resources Sector occupations, Oil and Gas Operations, base case, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–19	–20	–20	–15	–14
1332	Engineering Managers	–61	–69	–67	–49	–44
1335	Production Managers	–127	–146	–142	–104	–93
2322	Cartographers and Surveyors	–18	–21	–20	–13	–11
2332	Civil Engineering Professionals	–48	–58	–55	–33	–24
2333	Electrical Engineers	–22	–27	–26	–14	–9
2343	Environmental Scientists	–31	–38	–36	–20	–14
2513	Occupational and Environmental Health Professionals	–45	–54	–52	–31	–24
Subtotal		**–371**	**–433**	**–418**	**–279**	**–233**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–5	–5	–5	–4	–4
3126	Safety Inspectors	12	12	13	15	16
3212	Motor Mechanics	–25	–27	–26	–20	–18
3223	Structural Steel and Welding Trades Workers	–39	–42	–41	–32	–29
3411	Electricians	–62	–68	–65	–48	–43
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–191	–221	–204	–122	–96
7122	Drillers, Miners and Shot Firers	–96	–133	–144	–102	–85
7212	Earthmoving Plant Operators	–4	–5	–6	–4	–4
7313	Train and Tram Drivers	0	0	0	0	0
7331	Truck Drivers	–12	–17	–20	–16	–14
Subtotal		**–422**	**–506**	**–498**	**–333**	**–277**
Total		**–793**	**–939**	**–916**	**–612**	**–510**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

As can be seen from the data, in Mining Operations and Oil and Gas Operations the additional demand for skilled workers is not expected to be met. This is of concern as many of the professions and trades are also sought in other areas of the economy. While industry has collaborated successfully with the higher education sector—for example, the Minerals Tertiary Education Council initiative (discussed in the previous chapter) has helped address skills shortages as graduates from the council's programs comprise the bulk of domestically trained professionals for the Australian Resources Sector—it appears this may not be sufficient to meet future needs.

AWPA considers temporary migration to be an option that can augment local supply of skills in the short term and enable domestic workers to take up opportunities as they graduate or complete relevant training. Some companies adopt a two-pronged approach to solving this problem by sourcing skilled workers from their overseas operations to both add to the current pool of workers and contribute to the firm's internal training capacity to grow the pool. However, this is an expensive exercise as overseas workers may not be able to engage in training to the fullest extent because they need to undertake the job for which they were recruited.

There are several informative websites on the Resources Sector featuring career information tools, jobs boards and education resources that provide comprehensive career information and opportunities to individuals seeking employment in the sector. AWPA believes industry needs to make use of the current general easing of shortages as evidenced in the data examined in this chapter and develop and implement strategies to alleviate emerging skills shortages. Strategies that may assist industry in meeting this challenge are examined in further detail in Chapters 6, 7 and 8.

5.5 Competing demand for skills

Employers' recruitment and retention experiences

The Department of Employment regularly conducts surveys of employers' recruitment experiences in regions across Australia. Employers from all sectors of the local economy are asked questions about their experiences recruiting and retaining workers in their business. Over the past two years, surveys have been conducted in four regions that are heavily reliant on the Resources Sector—the Kimberley in Western Australia, and Capricornia, Gladstone and Mt Isa in Queensland. Findings from these surveys have highlighted some common features to these four regions which differentiate their labour market conditions from those reported by employers in other regions across Australia.[160]

Employers in regions with high levels of employment in the Resources Sector were two to three times more likely to report staff retention was a significant problem for their business than employers in other surveyed regions.

Staff retention problems were also reflected in higher measures of recruitment activity. The recruitment rate, which identifies the annual number of vacancies reported in surveyed businesses per 100 staff, was much higher in resource-intensive areas than in other regions surveyed (see Figure 32). For instance, the data show that among Mount Isa employers there were 38 vacancies per 100 staff, and 25 per cent of employers said that staff retention problems had had a negative impact on their business in the 12 months to the survey date.

Figure 32 Recruitment rate (vacancies per 100 staff) and staff retention problems in the 12 months prior to survey date, resources areas versus all regions (%)

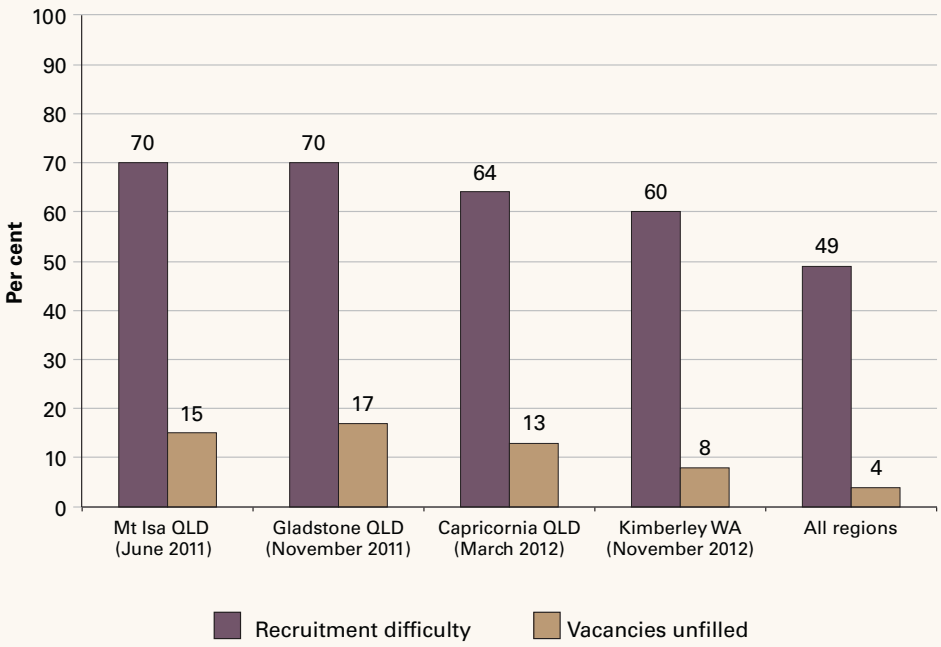
Source: Department of Employment, 2011–13, Surveys of employers' recruitment experiences.

160 In the 12 months to March 2013, 26 regions were surveyed. The majority of regions surveyed were Priority Employment Areas, so the data for this period may be more representative of disadvantaged labour markets than of the Australian labour market in general.

A far higher proportion of vacancies remained unfilled in resources areas than was the case for all regions surveyed. Employers were also more likely to report that it was 'difficult' to fill vacancies in regions with large Resources Sectors (see Figure 33).

Employers in resources areas were also far more likely to say that recruitment was 'difficult' because of the location of the job. This reflects the additional challenge of remoteness in many resource-intensive regions, which contributed to the average number of job applicants per vacancy in these regions (4.2) being less than half that for all surveyed regions (8.8).

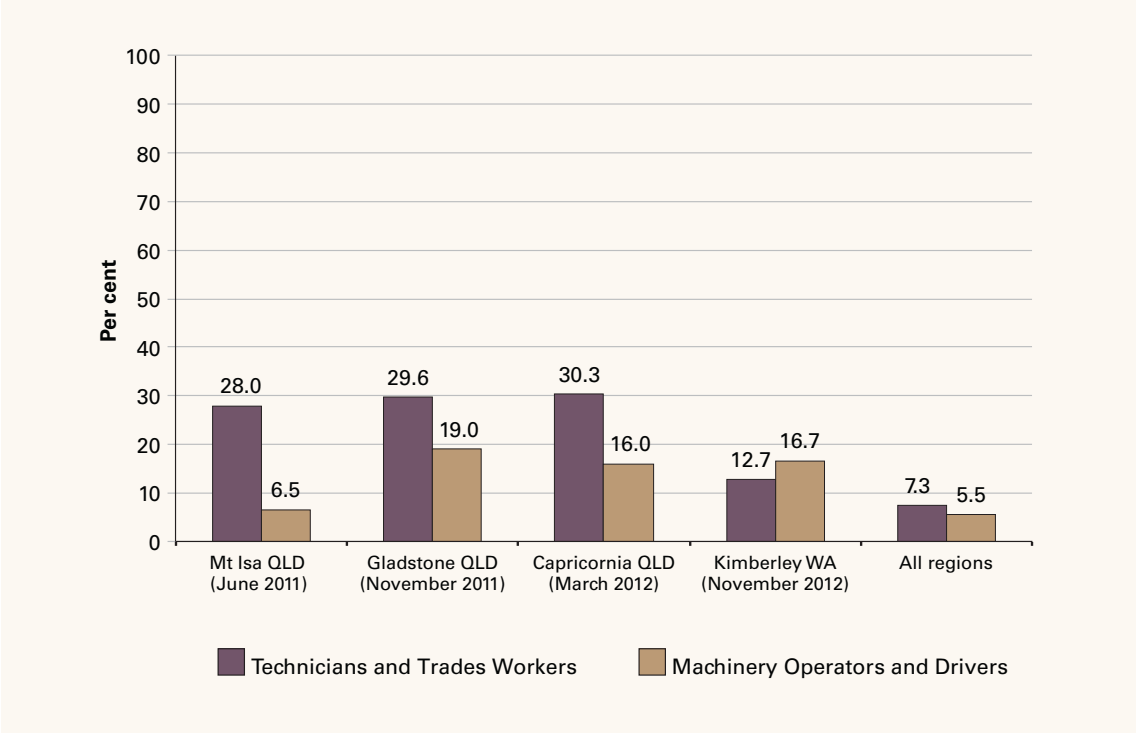
Figure 33 Recruitment difficulty (% of recruiting employers) and vacancies unfilled (% of recent vacancies), resources areas versus all regions



Source: Department of Employment, 2011–13, Surveys of employers' recruitment experiences.

In general, employers in resources areas had particular difficulty filling vacancies for Technicians and Trades Workers and Machinery Operators and Drivers. More than one-quarter of recent vacancies for Technicians and Trades Workers remained unfilled in three of the regions (Mount Isa, Gladstone and Capricornia), well above the all-region average of 7.3 per cent (Figure 34). The proportion of vacancies remaining unfilled for Machinery Operators and Drivers in Gladstone, Capricornia and the Kimberley were also more than three times the all-region average.

Figure 34 Percentage of unfilled vacancies for Technicians and Trades Workers and Machinery Operators and Drivers, resources areas versus all regions



Source: Department of Employment, 2011–13, Surveys of employers' recruitment experiences.

Domestic industries competing for skills relevant to the Resources Sector

AWPA's industry consultations indicate there is competition for resources-related skills both from within and outside the Resources Sector. The 'poaching' of staff with specialist skills impacts heavily on organisations—it is not just about replacing, retaining and attracting individuals with the required skills, but also replacing discrete capabilities comprising a degree of corporate and professional knowledge. The added difficulties of retaining staff in remote areas and the high wages offered by Resources Sector employers also make it difficult for other industry sectors to compete for skills.

State and territory governments have increased their investment in infrastructure planning and construction, which has resulted in greater competition for skills that are similar to those required in the Resources Sector.[161] The Resources Sector faces competition for skills from infrastructure projects in defence, communications, and rail and road (given these projects employ a number of occupations vital to the Resources Sector).

A 2013 Department of Defence report stated there are currently 48 major Defence capital facilities projects across Australia, with a total estimated expenditure of $1.5 billion.[162] In New South Wales, the Hunter Expressway and the Northern Sydney Freight Corridor Program will support thousands of jobs throughout their construction lifetimes. The Hunter Expressway alone will support 800 direct

161 Bleby M, 2013, 'One quarter of engineers to cut jobs as politicians dither: Consult Australia', *Business Review Weekly*, 15 March, brw.com.au/p/one_quarter_consult_engineers_australia_MbLSXtzi5qFK64g2j0iXLI, accessed 26 August 2013.

162 Department of Defence, 2012, *Defence Portfolio Additional Estimates Statements 2012–13*, section 2, defence.gov.au/budget/12-13/paes/2012-2013_Defence_PAES_02_Department.pdf, accessed 18 November 2013.

and 2,400 indirect jobs by the time it is completed at the end of 2013.[163] In Victoria, the Regional Rail Link is one of Melbourne's largest infrastructure projects in progress, and is estimated to directly or indirectly employ 5,600 people.[164] A raft of additional roads and infrastructure projects, committing over $20 billion to road projects alone (including $11.5 billion over the four-year forward estimates period) was also announced by the Australian Government in October 2013.

Across the nation, these projects source many of the same skills required by the Resources Sector, such as Civil Engineering Professionals, Building and Construction Managers, Mobile Plant Operators, Railway Track Plant Operators, Civil Engineering Draftspersons and Technicians, and Road and Bridge Construction Workers. Skills shortages in several of these occupations will create challenges in sourcing the required engineering and construction skills required for these projects.

A recent study for the Western Australian State Training Board examined the competition for skilled labour in the state and the 'crowding out' effects of skilled labour in non-resource industries. The study identified 25 critical occupations for which skills shortages are likely in the coming years (see Appendix L).[165] The report also noted that the extent of crowding out caused by the Mining and heavy construction sectors varies by industry and occupation.[166]

The most heavily impacted non–Resources Sector industry is Manufacturing, followed by the Professional, Scientific and Technical Services industry. The most severely impacted occupations tend to be mostly production and construction related (Appendix M). The report concludes that training and education programs, while important, cannot alone mitigate the impact of resources and construction projects on non–Resources Sector industries. It recommends an integrated approach combining training and education, more flexible workplace relations, skilled migration programs and other targeted strategies.[167]

So far, evidence indicates the Resources Sector is in competition for skills with other industry sectors due to a range of infrastructure and defence industry construction projects in progress. It does appear, however, that the labour market has eased significantly due in part to weak building and manufacturing activity, which has alleviated skills shortages to some extent, and the ongoing transition of the Resources Sector from an intense construction phase to an operations phase that requires workers with different skills. While the domestic situation may have eased somewhat in relation to the availability of labour in some occupations, internationally, skills shortages persist in occupations critical to the Resources Sector, which also affects Australian companies.

International competition for Resources Sector skills

AWPA's 2012 report on Resources Sector skills needs noted overseas workers are a significant source of skilled labour for the Australian Resources Sector. Research undertaken by Manpower draws attention to the fact that as the global economy continues to improve, skills shortages will become more pronounced, as organisations that reduced their workforce during the recession begin to compete for workers in a continued challenging environment.[168] Different countries and regions have different focuses on training—Europe, for example, prefers to buy skills rather than build them, and the Asia–Pacific focuses more on sales skills and professional development.[169]

163 New South Wales Government, 2013, *The Hunter Expressway employment opportunities*, Transport, Roads and Maritime Services, rta.nsw.gov.au/roadprojects/projects/hunter_expressway/employment/index.html, accessed 22 February 2013.

164 Victorian Government, 2013, *Regional Rail Link project benefits*, regionalraillink.vic.gov.au/about/benefits, accessed 4 March 2013.

165 ACIL Tasman, 2013, *Crowding out: competition for skilled labour in WA*, report prepared for the WA State Training Board, acilallen.com.au/cms_files/ACILTasman_CrowdingOut_2013.pdf, accessed 18 November 2013, pp. 49–53.

166 Ibid., pp. 121–122.

167 Ibid., p. 121.

168 Manpower Group, 2012, *Leveraging talent through training—Australia and New Zealand*, research report, manpower.com.au/documents/White-Papers/2012_LeveragingTalentThroughTrainingResearchPaper_2012_Global.pdf, accessed 18 November 2013.

169 Ibid., p. 3.

The skills shortages seen in Australia have spread during the past year, with projects in Indonesia, Mongolia, Brazil, Chile, Peru and Mozambique all facing this challenge.[170] In Chile, over US$100 billion is expected to be invested in mining developments to 2020 that would require around 70,000 new workers each year by 2014 alone.[171] In 2012, Peru was expecting investment in mining projects in the next five years to reach around US$53 billion across 47 projects, mainly across copper, gold and iron ore.[172] In Peru, the National Mining, Oil and Energy Society estimated that the mining sector would need an additional 40,000 employees this decade—30,000 new positions and 10,000 to replace retirees.[173] This has raised concerns that a shortage of workers could cause delays to mining projects and investment plans in the next two years.[174]

In Canada, the Mining Industry Human Resources Council's analysis in 2011 shows hiring requirements by 2016 within the Trades and Undesignated Occupations will be the highest for Heavy-Equipment Operators (except crane), followed by Truck Drivers and Underground Production and Development Miners.[175] In the case of Professional and Physical Science occupations, by 2016 the hiring requirements are significant for Geologists, Geochemists and Geophysicists, followed by Mining Engineers and Industrial and Manufacturing Engineers. These occupations are also in demand in the Australian Resources Sector. Not surprisingly, in 2013 Hays Canada noted organisations are finding it challenging to find candidates with key skills relevant to mining.[176]

While there is no existing data on movement of Australian resources workers (especially for senior staff) to work overseas on international projects, that transnational migration occurs is not in doubt. Our stakeholder consultations indicated that Australian companies scoping, constructing or operating projects in countries with less developed workforces routinely use Australian staff to oversee local workforces, at least temporarily. As noted earlier in this report, some companies utilise overseas training facilities to train Australian graduates. This approach enables companies to train and skill Australian workers overseas. The expectation is that these skilled workers will contribute to the firm's internal training capacity and train other Australian workers on their return to Australia.

5.6 Conclusion

This chapter presented data on existing occupations in shortage and trends in filling vacancies in those occupations. The available information suggests that while there has been an easing of skills shortages compared to 2011–12, ongoing skills shortages still exist in many occupations critical to the Resources Sector. According to Department of Employment skills shortage research, Production Managers (Mining), Mining Engineers, Petroleum Engineers, Geophysicists, Motor Mechanics and Fitters are some of the occupations in shortage nationally. These occupations are also in demand in other sectors of the economy.

The Resources Sector is in competition for skills from other industry sectors due to a range of infrastructure and defence projects in progress. Internationally too, skills shortages persist in occupations critical to the Resources Sector and increasingly Australian employers have to compete with other countries for a small pool of available workers.

170 Ernst & Young, 2013, *Business risks facing mining and metals 2012–2013*.

171 Deloitte Canada, 2013, *Tracking the trends*, deloitte.com/assets/Dcom-Canada/Local%20Assets/Documents/EandR/Mining/ca_en_energy_Tracking_the_trends_2013_112812.pdf, accessed 18 November 2013, p. 30.

172 Batten K, 2012, 'Peru dangles its investment credentials'.

173 Canadian Mining Journal, 2012, 'The 101 on Peruvian mining', 1 February, canadianminingjournal.com/news/the-101-on-peruvian-mining/1000940230, accessed 26 August 2013.

174 Ernst & Young, 2013, *Business risks facing mining and metals 2012–2013*, p. 14.

175 Mining Industry Human Resources Council, 2011, *Canadian mining industry employment and hiring forecasts*, mihr.ca/en/publications/resources/Employment_HiringForecasts2011_FINALAug4_ENG.pdf, accessed 18 November 2013, pp. 10–11.

176 Burns K, 2013, 'Skills shortages in mining a major barrier to Canadian competitiveness', *Mining.com,* 26 August, mining.com/web/skills-shortages-in-mining-a-major-barrier-to-canadian-competitiveness, accessed 14 November 2013.

The supply projections based on Deloitte Access Economics modelling suggest there are significant differences in the supply–demand profiles for the three individual sectors during the outlook period (2014 to 2018). The low growth scenario, considered to be the most likely outcome for Resources Project Construction, shows an oversupply of workers. An oversupply of workers is also predicted under both the high growth and base case scenarios for Resources Project Construction.

However, modelling estimates suggest critical skills shortages in the Mining and Oil and Gas sectors in the period ahead. The projections suggest an undersupply of skilled workers in the Mining Operations and Oil and Gas Operations sectors. In the low growth scenario, the fall in demand in Resources Project Construction is offset by the additional demand in the Mining Operations and Oil and Gas Operations sectors over the outlook period. However, most workers in the trade occupations associated with Resources Project Construction have little or no opportunity to transfer into either Mining Operations or Oil and Gas Operations.

Skills shortages have long been recognised by the Resources Sector as potentially creating economic problems for the industry as they impact on its ability to compete in global markets. In AWPA's view, the challenges facing the Resources Sector lie not only in attracting and retaining skilled workers (given the potential competition for critical skills from other industries domestically and resources projects internationally), but also in developing long-term skills formation solutions to increase the pool of domestic workers. Skills formation needs to be underpinned by cooperation and a partnership approach between key players in industry, the tertiary education sector, government and unions. The following chapters identify a range of strategies to maximise the attraction, effective formation, utilisation and retention of skills in the Resources Sector.

Part Two:

Workforce planning and development

6 Improving the skills pipeline to resources employment

6.1 Introduction

This part of the report builds on the evidence and analysis provided in Part One on key issues for the sector in relation to skills demand and supply, and details a set of targeted recommendations to address these issues.

This chapter examines key issues related to the skills pipeline to Resources Sector employment. There is strong agreement across the industry that it needs to attract more people into the relevant resources-related professions and trades, and to consider ways to make these occupations and the courses that lead to them more attractive to prospective students. The 'employee value proposition' for working in these occupations needs to be clearly articulated and more widely understood.

This chapter features some of the good work already underway to promote resources careers, introduce school-aged students to resources career pathways and prepare tertiary students for careers in the industry. It also proposes a number of strategies to improve the promotion of careers and support innovative approaches to improving the supply of high-quality skills to the industry.

6.2 The pipeline to resources employment: the schooling system

AWPA's consultations suggest resources employers are concerned about the general decline in participation in the delivery of science, technology, engineering and mathematics subjects at primary and secondary schools, and the impact on the pipeline of students to relevant tertiary courses and resources employment. There are also concerns about negative perceptions of resources careers.

There are a range of examples of resources companies and industry organisations working together to boost professional development for teachers and career practitioners and inform students about pathways to dynamic careers. However, there is more to be done to engage a broader range of students in resources careers, and in the subject choices required to facilitate those careers.

Participation in science, technology, engineering and mathematics subjects

The number of young people studying science, technology, engineering and mathematics subjects at school has a direct impact on the nature of their studies post-school and therefore their potential career paths. This includes pathways to a range of professional, technical and trades occupations in the Resources Sector.

Participation in science, technology, engineering and mathematics subjects has declined considerably in recent years. The Office of the Chief Scientist reports that between 1992 and 2009, the proportion of Year 12 students taking physics, chemistry and biology fell by 31 per cent, 23 per cent and 32 per cent respectively.[177] In mathematics, the bulk of student participation has shifted from advanced to elementary subjects, and participation in the mathematics subjects required for university courses, such as engineering, is particularly low.[178]

Research suggests the participation of girls in science, technology, engineering and mathematics subjects is particularly low. The Australian Industry Group reports 21.8 per cent of girls in New South Wales opted not to study any mathematics at the high school certificate level in 2011, up

177 Office of the Chief Scientist, 2012, *Mathematics, engineering and science in the national interest*, chiefscientist.gov.au/wp-content/uploads/Office-of-the-Chief-Scientist-MES-Report-8-May-2012.pdf, accessed 18 November 2013, pp. 19–20.

178 Ibid.

from 9.5 per cent in 2001, and that the gender disparity in science, technology, engineering and mathematics participation is now greater than it was in the 1980s.[179]

The impacts of low science, technology, engineering and mathematics participation flow through to industry and the economy, and to the Resources Sector in particular. A recent Australian Industry Group survey of employers found that 37.5 per cent of mining employers experienced difficulty recruiting individuals with science, technology, engineering and mathematics skills, the highest proportion of the four sectors surveyed (construction, services and manufacturing employers were also surveyed).[180] Mining employers rated science, technology, engineering and mathematics skills deficits as the biggest barrier to recruiting staff. Many of the resources companies AWPA consulted with indicated concern with the delivery of science, engineering, technology, and mathematics subjects at primary and secondary schools.

One positive development for the resources industry is the incorporation of earth science into the Australian curriculum. The science (Foundation to Year 10) curriculum includes earth and space sciences as one of four key subject areas for primary and secondary school science education, alongside biological sciences, chemical sciences and physical sciences. The Australasian Institute of Mining and Metallurgy considers that this focus on earth sciences will assist with the attraction and retention of students to the geosciences.[181]

A range of work is underway to boost science, technology, engineering and mathematics participation and to increase the proportion of students entering science, technology, engineering and mathematics-related subject areas at tertiary education institutions. In the 2012–13 Federal Budget, a $54 million science and mathematics package was announced, with a portion of these funds going towards establishing an Australian Science and Mathematics Education and Industry Adviser located within the Office of the Chief Scientist. The adviser is working with the education, industry, research and government sectors to promote the importance of science and mathematics to Australians.[182] In March 2013 new standards for teacher training were announced and the Enhancing the Training of Mathematics and Science Teachers Program was introduced.[183] These initiatives are based on the recommendations of the Office of the Chief Scientist to utilise the combined expertise of university mathematics, science and education faculties to assist in training teachers in mathematics and science, currently in short supply.[184]

In 2012 Universities Australia suggested science, technology, engineering and mathematics participation may be increased through efforts to make mathematics and science more relevant to daily life, 'coupled with a more hands-on or learning-by-doing methodology' for instructors.[185] Teachers and career advisers should also make students aware of the consequences of not choosing to study mathematics and sciences subjects in upper secondary school, and the potential impact on future aspirations to work in a science- or engineering-related occupation or industry.

179 Ai Group, 2013, *Lifting our Science, Technology, Engineering and Maths (STEM) skills*, aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf, accessed 18 November 2013, p. 3.

180 Ibid., p. 5.

181 AusIMM, 2009, *Mining Institute applauds inclusion of earth sciences in new national curriculum*, media release, ausimm.com.au/content/docs/mi_applauds_earth_sciences.pdf, accessed 18 November 2013.

182 Office of the Chief Scientist, 2012, *$54 million commitment to mathematics, engineering and science*, media release, chiefscientist.gov.au/2012/05/54-million-committment-to-mathematics-engineering-and-science, accessed 25 March 2013.

183 Garrett P and Bowen C, 2013, *Higher standards for teacher training courses*, media release, 11 March, ministers.deewr.gov.au/garrett/higher-standards-teacher-training-courses, accessed 25 March 2013.

184 Office of the Chief Scientist, 2012, *Health of Australian science*, chiefscientist.gov.au/wp-content/uploads/OCS_Health_of_Australian_Science_LOWRES1.pdf, accessed 18 November 2013, pp. 161–189; Office of the Chief Scientist, 2012, *Mathematics, engineering and science in the national interest*, pp. 20–23.

185 Universities Australia, 2012, *STEM and non-STEM first year students*, universitiesaustralia.edu.au/resources/680/1319, accessed 6 November 2013, p. 2.

For many students, 'the relationship between mathematics, tertiary study and career remains largely unimportant and poorly understood',[186] and science is seen as 'irrelevant to students' lives'.[187] The Australian Mathematical Sciences Institute recently stated that despite high demand for mathematical and statistical skills across all sectors of the economy, 'many students are unaware that closing the door on mathematics at school will limit their future career options'.[188]

Some resources companies are engaging with schools and students to demonstrate the links between science, technology, engineering and mathematics study and resources careers. The Queensland Minerals and Energy Academy, which is largely funded by industry sponsors, delivers a range of services to 34 schools across the state. Services include a comprehensive professional development program for teachers across the science, technology, engineering and mathematics subject areas.

Chevron is working with the Western Australian School Curriculum and Standards Authority to deliver customised units on the liquefied natural gas industry. Chevron provides guidance and professional development for teachers delivering the course, which covers a range of topics including the science behind liquefied natural gas, career pathways, and safety and environmental issues. The program was successfully piloted in five schools, and is now being rolled out to other schools.[189]

In some cases, these types of partnerships between schools and resources companies have proven controversial. Teacher unions and some commentators have criticised sponsorship of schools on the grounds it could narrow students' career ambitions to the Resources Sector.

Some commentators were also critical of the decision to include earth sciences in the national curriculum for science. While the decision reflected demand for greater emphasis on environmental sciences and geological sciences, some teachers claim the curriculum is more oriented to the geological sciences, and that this reflects a disproportionate influence on the consultation process by resources companies.

To deflect some of this criticism, and support a more broad-based approach to the promotion of science, technology, engineering and mathematics-related careers, AWPA suggests resource companies and industry associations collaborate with other industries to support science, technology, engineering and mathematics initiatives.[190]

As indicated earlier in this chapter, a considerable amount of work is already underway in the Resources Sector to develop partnerships with schools to support engagement in science, technology, engineering and mathematics subject areas, including the programs run by the Queensland Minerals and Energy Academy. The Resources Sector should engage with other industry bodies to showcase these approaches as successful examples, and consider strategies to broaden the availability and sustainability of these programs.

A good avenue for this collaboration is the proposed industry working group on science, technology, engineering and mathematics skills initiatives. This group will develop a national strategy and framework for schools–industry science, technology, engineering and mathematics skills initiatives, including consideration of successful approaches already underway, and potential options for attracting expanded funding support for these partnerships.[191] The Office of the Chief Scientist is leading work to establish this working group. AWPA recommends resources companies and peak bodies engage in this process.

186 Chinnappan M, Dinham S, Herrington A and Scott D, 2007, *Year 12 students and higher mathematics: emerging issues*, Australian Association for Research in Education, aare.edu.au/07pap/chi07180.pdf, accessed 18 November 2013, p. 5.

187 Australian Science Teachers Association, 2006, *Submission to Skills Audit: science, engineering and technology skills*, asta.edu.au/media/policy/skillaudit, accessed 25 January 2012.

188 Australian Mathematical Sciences Institute, 2012, *Solutions to the mathematics skills shortage*, media release, 1 February, lists.asc.asn.au/pipermail/asc-media/2012-February/004771.html, accessed 6 November 2013.

189 Diss K, 2013, 'Chevron targets units for students', *ABC News*, 13 March, abc.net.au/news/2013-03-12/chevron-targets-unit-for-students/4568600, accessed 27 August 2013.

190 Topsfield J, 2012, 'Science subject comes under fire', *Sydney Morning Herald*, 18 July, smh.com.au/national/education/science-subject-comes-under-fire-20120718-22alp.html, accessed 27 August 2013.

191 Ai Group, 2013, *Lifting our Science, Technology, Engineering and Maths (STEM) skills*, p. 5.

Recommendation 1

That resources companies and peak organisations engage with the proposed industry working group for schools–industry science, technology, engineering and mathematics skills initiatives; and contribute to the development of a national strategy and framework for these initiatives.

Responsible parties—Industry and industry associations.

Perceptions of resources careers

The resources industry is an attractive career option for young people. In particular, the relatively high wages draw large numbers of applicants for positions. However, many young people are not engaging with the industry due to negative perceptions of a physically demanding, geographically remote, male-dominated work environment. A recent PricewaterhouseCoopers survey found many young people in particular hold a negative perception of the industry, and this perception discourages them from considering work in the industry. Fourteen per cent of respondents to the survey indicated the image of the Oil and Gas sector discouraged them from considering work in the industry (the highest rate for all sectors), and 6 per cent indicated similar views on the Mining industry.[192]

PricewaterhouseCoopers also reports 'strong attitudes from both the community and resources sector leaders suggesting that the industry appeals only to a narrow range of people, professions and trades'.[193] In particular, the perception of the industry as male-dominated discourages female students from considering a career in resources, and evidence suggests many girls and women are not well informed about the range of roles available in the industry.[194]

However, there is strong evidence these perceptions can be changed. Career promotion highlighting the 'prospect of doing interesting, exciting work and enjoying good career opportunities' is shown to encourage female students to engage with resources careers and enrol in tertiary courses related to the industry.[195] Research indicates perceptions of different industries and related career pathways are shaped by early experiences.[196] Therefore, it is vital the resources industry works with schools to ensure students' early exposure to the industry is positive.

A good example of a positive approach is the Toolkit for Girls program run by the Queensland Minerals and Energy Academy. This project with the Pioneer Senior High School in the Mackay region is aimed at female students in Years 10 to 12. It comprises a one-day forum which introduces students to the range of career options in the industry and relevant pathways, features guest speakers from professional and technical pathways, and finishes with a practical workshop and site visit. Following the workshop, students have the opportunity to complete a Certificate I in Resource and Infrastructure Operation, a mine-readiness course focused on employability skills and preparing students for work.[197]

192 PricewaterhouseCoopers, 2012, *Millennials at work: reshaping the workplace*, pwc.com/en_M1/m1/services/consulting/documents/millennials-at-work.pdf, accessed 18 November 2013, p. 15.

193 PricewaterhouseCoopers, 2012, *Mind the gap: solving the skills shortages in resources*, pwc.com.au/industry/energy-utilities-mining/assets/Mind-the-gap-Jun12.pdf, accessed 18 November 2013, p. 25.

194 Ozkan UR and Beckton C, 2012, *The pathway forward: creating gender inclusive leadership in mining and resources*, Centre for Women in Politics and Public Leadership, Carleton University, carleton.ca/cwppl/ccms/wp-content/ccms-files/Women-in-Mining-2.5.pdf, accessed 18 November 2013, p. 6.

195 Australasian Mining Review, 2013, 'Mind the gap: special feature', Australasian Mining Review Bi Annual, Issue 7, ebook.aprs.com.au/i/105244, accessed 19 November 2013, p. 26.

196 Ozkan UR and Beckton C, 2012, *The pathway forward: creating gender inclusive leadership in mining and resources*, p. 28.

197 Queensland Minerals and Energy Academy, *Toolkit for Girls*, qmea.org.au/wp-content/uploads/2011/08/Toolkit-for-Girls.pdf, accessed 18 November 2013.

It is important that efforts to promote the Resources Sector acknowledge the reality of work in the industry, including the competitiveness of the job market, the high attrition rate and, in particular, the challenges associated with working in remote locations and long-distance commuting. The Australian Mines and Metals Association website miningoilandgasjobs.com.au includes a set of resources to guide job seekers to set realistic expectations about the prospects of securing employment in the Mining and Oil and Gas sectors. The website advises prospective job seekers that employment in the industry is difficult to obtain without relevant qualifications and direct experience and notes the jobs are challenging and early-career attrition rates are very high.[198]

Much has been written on the difficulties of long-distance commuting and, indeed, this reportage has contributed to a growing awareness of these challenges and the provision of a number of support services including the *FIFO Families* website and services.[199] It is important resources companies are clear about these challenges when they engage with schools to promote careers in the industry.

Enhancing the promotion of resources careers in schools

A number of universities have established programs to introduce secondary school students to the possibilities of resources careers. For example, Curtin University's School of Mines offers an intensive five-day camp to Year 12 students considering enrolling in mining-related courses. The camp includes visits to Curtin's campuses and operational mine sites in the Kalgoorlie and Goldfields region, and a series of hands-on workshops with lecturers, students and industry representatives. Approximately 75 per cent of students who join the camp go on to study mining engineering.[200]

Industry has a key role to play here. The provision of career information underpinned by up-to-date labour market information and a real-life perspective will interest and engage students, invite them to question their assumptions and encourage them to consider a career in the industry. Of course, students are influenced by a range of factors, and industry should also work to raise awareness among parents, teachers and career counsellors about career prospects in the industry.

Over the past few years, considerable progress has been made in promoting resources careers, and a range of initiatives are underway to promote pathways into the industry. Initiatives range from broad-scale marketing campaigns, such as the Australian Mining 'This is Our Story' campaign, to targeted websites that provide information on the industry for students, teachers and career counsellors.

Career promotion was a key focus for the National Resources Sector Employment Taskforce, and governments and industry have supported a range of career promotion initiatives since the release of the taskforce's report in 2011. Some of these are featured in the following case study.

198 Australian Mines and Metals Association, 2012, *Reality check: entry-level mining jobs*, miningoilgasjobs.com.au/our-blog/december-2012/reality-check-entry-level-mining-jobs.aspx, accessed 9 September 2013.

199 This website was established for parents and partners of fly-in, fly-out workers to share their experiences. The website hosts a forum and promotes a range of support services including community meet-ups and seminars.

200 Senate Education, Employment and Workplace Relations References Committee, 2012, *The shortage of engineering and related employment skills*, p. 35.

Websites promoting resources careers

Several useful and informative websites featuring career information tools, jobs boards and education resources have been developed that integrate material from across the Resources Sector to provide comprehensive career information. These include:

- *People for the Future* (peopleforthefuture.com.au), which is a joint venture between the Chamber of Minerals and Energy of Western Australia, the Queensland Resources Council and the Minerals Council of Australia. The site provides a wealth of information on in-demand occupations and potential pathways to them, and a user-friendly career explorer resource that enables visitors to filter jobs according to their preferences and work styles
- *Mining Oil and Gas Jobs* (miningoilandgasjobs.com) by the Australian Mines and Metals Association, which includes a highly customisable jobs board, a career and industry guide, and information on specific projects looking for workers
- *The Resource Channel* (theresourcechannel.com.au), which includes a comprehensive jobs site that also offers a range of career information
- *Oresome Resources* (oresomeresources.com) by the Queensland Resources Council, which provides a range of interactive resources, tools and games for schools, teachers and students.

Other websites which are not specifically focused on information about the Resources Sector but which are also useful include:

- *myfuture.edu.au,* which is Australia's national online career information and exploration service. It provides opportunities for people to explore career options, identify their interests, and understand the education and training requirements to be able to get a job in their chosen field. It has information about a wide range of sectors, occupations and courses, including the Resources Sector
- *jobguide.thegoodguides.com.au,* which is a national career information resource that helps young people to explore their career options and make subject choices at school. It provides an in-depth look at a range of occupations, and their education and training pathways.

The National Resources Sector Employment Taskforce report also called for specific support to provide direct employment pathways for students to entry-level Resources Sector occupations, including opening up rules for trade training centres to include mining certificate courses. As a result, trade training centres across three jurisdictions (Western Australia, South Australia and Queensland) are offering resources-specific qualifications backed up by funding partnerships with industry.[201] These partnerships will ensure students receive industry-relevant training, and provide a valuable labour supply for critical areas of skills demand.

Each of the initiatives outlined in this section will contribute to improving perceptions of resources careers and provide reliable, industry-supported advice to people interested in resources careers. In addition, AWPA highlights the value of resources companies developing partnerships with regional schools to promote career opportunities in the sector. The transition from the construction phase to the operations phase of many resources projects may lead to an increased proportion of locally sourced workers. These positions provide considerable opportunities for regional communities as many of the jobs last for the duration of the mine cycle.

One issue highlighted in our industry consultations was a lack of satisfaction with the advice provided by career development practitioners in schools. To address this, we recommend increased engagement between resources companies, industry bodies and career practitioners. This

201 Department of Industry, 2013, *National Resources Sector Workforce Strategy: actioned recommendations—March 2013*, innovation.gov.au/Skills/SkillsTrainingAndWorkforceDevelopment/Documents/NRSWSActionedRecsMarch2013.pdf, accessed 18 November 2013.

engagement could be modelled on the National Career Development Strategy, released in May 2013. The strategy supports the following long-term vision:

> All Australians have the skills, knowledge and capabilities to manage their careers throughout life to support their individual wellbeing and participation in the workforce and contribute to Australia's productivity.[202]

The strategy identifies the roles and responsibilities for stakeholders in relation to career development. It also encourages stakeholders to work collaboratively to develop programs and resources that support career development, and provides a framework for this to occur. Funding of $6.1 million was announced for a series of Making Career Connections projects to support the release of the strategy. The funded projects include a range of measures to support programs providing work placements, workshops, mentoring and other support for young people, and programs assisting parents, teachers and career advisers to deliver quality advice to students.

AWPA suggests the Minerals Council of Australia, the Australian Petroleum Production and Exploration Association and other industry organisations work with education providers to enhance the provision of career development information to students.

Recommendation 2

That industry work with tertiary education providers to fund, develop and implement a strategy to deliver training and support to career development practitioners. This will ensure they have skills and knowledge to provide current and relevant advice to students on the resources labour market and raise awareness of the value of professional and trade qualifications.

Responsible parties—Industry, industry associations and tertiary education providers.

6.3 The pipeline to resources employment: the higher education sector

This section considers issues related to the pipeline of skills from tertiary education to resources employment.

Some of the professionals employed by resources companies are engineers and geologists. However, many of the engineers and geologists sought by Resources Sector employers are highly specialised and a small number of tertiary education providers deliver the relevant courses.

The majority of employers view relevant experience as the most important criterion when it comes to recruiting new employees. This view, though understandable for reasons of productivity and safety, limits the opportunities available to recent graduates, and can lead them to seek employment in occupations other than the discipline in which they are qualified.

AWPA recognises there are certain constraints on employing inexperienced staff. Many occupations involve highly technical, challenging and remote work—for example, managers of operations on remote and offshore drilling sites for oil and gas. Shortages in these occupations occur regularly due to the inexperience of existing candidates and inadequate existing capacity to develop their skills.

Many employers commit to the employment of new workers through graduate programs and apprentice intakes, and provide relevant training and skills to equip staff with the necessary job-specific skills. These efforts need to continue if the sector is to meet skills demands in coming years, given the number of oil and gas projects expected to come on board in the next few years.

AWPA supports measures to increase the proportion of domestic graduates employed by resources companies, and build the capacity of tertiary education providers to prepare graduates for employment in the industry. As noted in AWPA's 2012 Resources Sector report, this forward planning can occur through ensuring that a proportion of the workforce comprises new graduates

202 Department of Education, 2013, *National Career Development Strategy*, education.gov.au/system/files/doc/other/national_career_development_strategy.pdf, accessed 18 November 2013.

and/or apprentices. The sector's investment and operational environment has changed significantly since we developed the 2012 report. Nonetheless, we highlight the value of entry-level staff for meeting the sector's skills needs in the medium to long term.

Successful approaches

In recent years industry and the tertiary education sector have undertaken a range of measures to boost the supply of work-ready domestic graduates. While the Minerals Tertiary Education Council provides a ready supply of graduates with the specialist skills required to work in the sector, a number of challenges remain that constrain the provision of domestic graduates to the sector. The Minerals Council of Australia cites uncertainty in funding levels for important minerals-related courses with low student numbers, coupled with 'shortages of skilled academic staff' in some areas and 'the rising average age of academics in minerals-related disciplines', as key factors constraining domestic skills supply.[203]

Also, there is no equivalent to the Minerals Tertiary Education Council for the delivery of qualifications specific to the Oil and Gas sector. Several universities have established specialist oil and gas faculties in collaboration with industry, including the University of Western Australia's School of Oil and Gas Engineering (sponsored by Woodside), the University of Adelaide's Australian School of Petroleum (sponsored by Santos), the University of New South Wales' School of Petroleum Engineering and the North Australian Centre for Oil and Gas at Charles Sturt University. The Australian Petroleum Production and Exploration Association also supports participation in oil- and gas-related courses by providing scholarships for domestic students undertaking an engineering degree in Australia relevant to the Oil and Gas sector. However, a similar approach to the Minerals Tertiary Education Council's is worth consideration as demand for specialist skills for the Oil and Gas sector increases in coming years. A coordinated approach would complement the considerable contribution of the Oil and Gas sector to the tertiary education sector.

Automation

Automation in the Resources Sector also provides some unique challenges, as well as opportunities, for tertiary education providers. As discussed in Chapter 2, the Resources Industry Training Council's 2012 report *Rise of the machines?* identifies the potential impact of automation in its various guises on the Resources Sector.

The report acknowledges the difficulties faced by higher education providers seeking to prepare graduates for automated work environments. Companies on the cutting edge of automated processes maintain a high level of commercial confidentiality around these processes, which makes 'it difficult for universities to assess future skill needs and determine the capability that needs to build into faculties for the delivery of future programs'.[204]

Nonetheless, a number of universities have integrated automation into their course offerings. The report finds that students enrolled in mechatronics, electrical and electronic engineering and, to a lesser extent, mechanical engineering degrees are more likely to be exposed to the knowledge required to work with automated systems than students enrolled in mining engineering and petroleum engineering degrees.[205] For students in the latter category, double degrees or postgraduate qualifications may be required to provide this expertise; however, no suitable courses of this type are currently provided in Australia.

The report concedes the formation of a dual or double undergraduate degree in mechatronics engineering in resources is unlikely until 'a specific new resources industry technical profession in automation emerges'.[206] However, a suitable postgraduate qualification aimed at mechanical, electrical, mining or oil and gas engineering graduates may form an appropriate medium-term solution. AWPA recommends that the Minerals Tertiary Education Council member universities and specialist oil and gas university faculties consider the viability of such a qualification.

203 MCA, 2012, *Workforce skills, education and training: priorities and principles of the Australian minerals industry*, minerals.org.au/file_upload/files/publications/MCA%20Policy%20Brief%204-2012%20-%20Workforce%20skills%20education%20%20training.pdf, accessed 18 November 2013, p. 7.

204 Australian Venture Consultants, 2012, *Rise of the machines?*, p. 18.

205 Ibid, p. 104.

206 Ibid., p. 18.

Recommendation 3

That the Minerals Tertiary Education Council member universities and specialist oil and gas university faculties work with industry to scope the development of a postgraduate qualification in automation for mechanical, electrical, mining and oil and gas engineering graduates.

Responsible parties—The Minerals Tertiary Education Council, oil and gas university faculties and industry.

6.4 The pipeline to resources employment: the vocational education and training sector

As noted in earlier chapters, while the vocational education and training sector is a vital source of skills supply for the Resources Sector, it draws a small proportion from the pool of total supply. However, the cyclical nature of labour demand for resources projects, combined with industry expectations for the level of experience and competence of tradespeople engaged in the industry, can create recruitment challenges for resources companies.

Apprenticeships and traineeships

As outlined in Chapter 4, there are encouraging trends in the proportion of apprentices and trainees engaged by resources companies.

These trends reflect positively on recent efforts by a variety of stakeholders to increase the adoption of apprentices by resources companies. The National Resources Sector Workforce Strategy supports a range of targeted initiatives to support the engagement of apprentices by resources companies. The flagship initiative emerging from the strategy is the National Apprenticeships Program, which supports experienced workers with extensive trade skills but few or no relevant formal qualifications to complete an apprenticeship with a suitable employer in the resources and energy sector.

The program was developed by East Coast Apprenticeships in 2011 and is an industry-led program involving collaboration between the minerals, resources and energy sectors, governments, training providers and participating group training organisations, with Australian Government co-funding. It was established to serve as an advanced entry adult apprenticeship program for the minerals and petroleum resource sector and aims to assist up to 1,000 experienced workers to have their existing skills recognised through the attainment of a full trade qualification within 18 months, well short of the traditional four-year apprenticeship.

To July 2013, the program had received 8,852 applications, 5,306 of which passed the initial desktop recruitment process to be ready for skills assessments. Anglo American Metallurgical Coal, Bechtel, Macmahon, Leighton Contractors and John Holland have committed to engaging adult apprentices. A total of 170 apprentices have been engaged, 11 of whom have already graduated with full trades qualifications.

The Department of Industry notes that employers have been slower than anticipated in recruiting adult apprentices. The National Apprenticeships Program is demonstrating that it takes a long time to change traditional perceptions about the value of apprenticeships. The project proponents are addressing these issues by conducting a cost–benefit analysis of apprentices under the program compared to traditional four-year apprentices. The analysis has found that for every adult apprentice reaching trade qualifications within the program's 18-month training cycle, there is a cost saving to industry as high as $320,000 per participant.[207]

The National Resources Sector Workforce Strategy identified a range of other initiatives to support apprentices in the sector, including targeted support for apprentices to participate in the coal seam

207 Department of Industry, 2013, *National Resources Sector Workforce Strategy: implementation plan*, innovation.gov.au/skills/SkillsTrainingAndWorkforceDevelopment/Documents/NRSWSImplementationPlan.pdf, accessed 10 September 2013.

gas/liquefied natural gas sector in the Gladstone region and support through Job Services Australia for experienced, unemployed construction workers without formal qualifications to commence an adult apprenticeship pathway.

AWPA's consultations also highlighted different approaches to the training of apprentices and trainees. One of these approaches is examined in the following case study.

Downer EDI's apprenticeship program

Downer EDI is a large Australian engineering and infrastructure services firm, with global operations in mining, energy, road and rail infrastructure, telecommunications and water. It has a total workforce of more than 20,000 in Australia, New Zealand and the Asia–Pacific region. This workforce includes a mining construction and operations workforce of around 5,000 employees and 1,500 contractors working across more than 50 sites in Australia, New Zealand, Papua New Guinea, South America and Southern Africa.

Downer's current focus is its apprenticeship program, which is run by an apprenticeship coordinator, under the guidance and direction of a specially appointed Apprenticeship Steering Committee comprising members drawn from management, supervisors and human resources. The committee meets once a month to manage and discuss apprenticeship take-ups and monitor progress and rotations. It is the responsibility of the apprenticeship coordinator to meet any objectives that arise at these meetings.

The apprenticeship coordinator is a dedicated, hands-on role involving providing support services to apprentices and their supervisors. Site visits are regularly undertaken to check on the progress of apprentices with their supervisors and the results of learning modules are examined to identify gaps in the knowledge of each apprentice. If necessary, additional tutoring is arranged with the apprenticeship coordinator or the apprentice's trade trainers. Extra support is provided to first-year apprentices to assist them in coping with the transition to work in the form of counselling and a formal, personalised mentoring scheme, alongside supervisors who are also trained in mentoring skills.

Downer recruits both school leavers and mature-aged candidates as apprentices in the automotive and engineering trades. This includes Electricians, Metal Fabricators and Heavy Automotive Vehicle Mechanics. In 2011–12, 48 apprentices were recruited nationally, taking the total number to 86. Apprentices are recruited through the Downer website, the CareerOne portal and personal recommendations. Many prospective candidates complete a six-month, part-time pre-apprenticeship vocational training course if they have completed schooling.

An industry pilot for high school students is currently underway in the Wyndham area of Victoria, in partnership with the Victorian Government's Local Learning and Employment Networks and local schools. The program includes visits to schools by current apprentices to enable them to share their experiences at Downer and begin a dialogue with future apprentices along with structured workplace learning initiatives.[208]

Challenges to high-quality vocational education and training provision

Despite the encouraging trends, the vocational education and training sector still faces a range of challenges in relation to the supply of trades workers to the Resources Sector.

The tendency for resources companies to deliver much of their training in-house presents a significant challenge to the vocational education and training sector. During our consultations, industry stakeholders suggested that registered training organisations often struggle to predict what training needs to be delivered over a five-year period. The lag time between discovery and production activity on large energy projects can exacerbate this problem. Some resources

208 The information for this case study was provided by Downer EDI during AWPA consultations.

companies are currently over-hiring staff for key specialist roles to enable onsite training down the line. Generally, public sector trainers have limited up-to-date technology for training, suggesting an increased emphasis on onsite training. Stakeholders also indicated that skilled trainers are in short supply, generally because skilled workers and frontline staff are engaged in productive activity with an employer.

The Minerals Council of Australia advocates an employer-driven focus to training provision, asserting 'the training market should be geared towards meeting employer demands to ensure more job-centred quality outcomes'.[209] SkillsDMC shares this view and supports training delivery that is 'consistent, of high quality and relevance and able to be tailored to the needs of industry with assessment outcomes being validated by industry'.[210]

AWPA notes a strong trend towards partnership arrangements in recent years. There are many examples of training centres with advanced facilities delivering structured training in close partnership with industry. For example, the Australian Centre for Energy and Process Training, based at the Challenger Institute of Technology in Western Australia, is the leading provider of process operations and technician training for the Oil and Gas sector, and offers Australian Quality Training Framework qualifications for the Australian oil and gas, mineral and chemical processing industries. The facility trains up to 900 students a year using process plant and process control equipment that replicates an industry facility, and includes equipment donated by Apache Energy, Honeywell and Woodside.[211] The facility is being expanded to include engineering (both mechanical and electrical) that will encompass mechanical and electrical/instrumentation cross training, and in addition to its vocational training initiatives, the facility also provides valuable practical experience for graduate engineers at its process plant and operations centre.

The Australian Petroleum Production and Exploration Association recognises the Australian Centre for Energy and Process Training as 'one of the few training facilities with the plant, equipment and expertise needed to meet industry standards', and supports the centre's move towards an expanded, national role.[212] To this end the centre signed a memorandum of understanding with Charles Darwin University's Northern Centre for Oil and Gas to expand its operations to the Northern Territory and allow for remote training for students in other states and territories, and is undertaking work to develop partnerships with education providers in Queensland.[213]

Partnerships are also underway in regional locations. For example, the recently announced Electrical/Instrumentation Centre of Specialisation at Pilbara Institute's Karratha campus, a joint project with Woodside, will enhance training capacity in the Pilbara region and provide a strong source of skills supply for the region's major resources projects in coming years. The centre will support training for electrical apprentices, higher level courses for qualified electricians who require specialist skills development and electrical trade career pathways for school leavers.[214]

Many industry stakeholders support the provision of targeted skill sets for Resources Sector employees rather than full qualifications. Skill sets are structured training courses mapped to one or more units of competency listed in a training package qualification. Already, engagement in skill sets is extensive in the industry. Research conducted by the National Centre for Vocational Education Research found that around 50 per cent of mining employees are undertaking training in skill sets, including close to 75 per cent of employees in iron ore.[215]

209 MCA, 2012, *Workforce skills, education and training: priorities and principles of the Australian minerals industry*, pp. 8–9.

210 SkillsDMC, 2013, *Environmental scan 2013: resources and infrastructure industry*, isc.org.au/pdf/SkillsDMCEnvironmentalScan2013.pdf, accessed 18 November 2013, p. 37.

211 Australian Centre for Energy and Process Training, 2012, *Women in engineering*, challenger.wa.edu.au/showcase/publications/Documents/acept-magazine/issue01-ACEPT-magazine.pdf, accessed 18 November 2013, p. 2.

212 Australian Petroleum Production and Exploration Association, 2012, *State of the industry 2012*, p. 17.

213 Ibid.

214 Western Australian Government, 2013, *New training opportunities for Pilbara workers*, 4 October, media release, mediastatements.wa.gov.au/pages/StatementDetails.aspx?listName=StatementsBarnett&StatId=7807, accessed 18 November 2013.

215 NCVER, 2013, *Training and education activity in the minerals sector*, p. 12.

Support for skill sets should be balanced with the career aspirations and security of workers, given the high proportion of tradespeople engaged in temporary work in the construction phase of projects. Assistance for these workers to translate skill sets and work experience to full qualifications will be important as investment in the construction phase of projects declines in coming years. Skill sets are discussed in more detail in Chapter 7.

Paraprofessionals and technicians

An emerging issue for both the vocational education and training sector and the higher education sector is the increasing demand for mid-level qualifications for technicians. Qualifications at the Australian Qualification Framework levels 5 and 6, including associate degrees, diplomas and advanced diplomas, may alleviate recruitment difficulties associated with professional engineers by encouraging mining companies to consider paraprofessional roles in mining engineering and related technologies. For example, the Minerals Council of Australia in conjunction with the Australian Government is developing the Minerals Industry National Associate Degree Program to grow these paraprofessionals who would operate 'under the supervision and mentorship of a four-year trained professional'.[216] Vocational education and training providers also deliver a range of diplomas and advanced diplomas to supply paraprofessionals and technicians to the Mining sector.

Some organisations, including the Australian Institute of Geoscientists, argue the provision of degrees for paraprofessionals may lead to excess supply in the labour market as demand slows.[217] In particular, the Australian Institute of Geoscientists contends paraprofessionals could fill entry-level positions that could otherwise be occupied by graduates.

6.5 High-quality skills provision for the liquefied natural gas sector

The skills challenge

The burgeoning liquefied natural gas sector will form a priority for the supply of skills from tertiary education in coming years. The increasing number of oil and gas projects, most of which will be under construction for a significant period of time, makes it challenging to develop a skilled workforce and the local industry supply capability to operate these projects. Oil and gas projects are also competing for labour with many other mining and infrastructure projects in Australia that are also planned for construction over the next five years.[218]

AWPA consultations found that some stakeholders have identified skills gaps at highly technical and senior levels. There is a high level of demand for technical personnel in oil and gas plant process operations and maintenance, and for supervisors with appropriate levels of technical and safety experience and front-line management skills, but these skills are difficult to source, especially in the domestic labour market. One estimate suggests that between 180 and 500 process operators are currently available in Australia, and this number will have to increase to between 1,500 and 3,000 over the next 10 years.[219] A range of approaches will be required to access these skills.

216 MCA, 2012, *Workforce skills, education and training: priorities and principles of the Australian minerals industry*, p. 8.

217 ABC, 2013, 'Fast-tracked mining degrees could swamp job market', *ABC News,* 19 February, abc.net.au/news/2013-02-19/fast-tracked-mining-degrees-could-swamp-job-market/4526312, accessed 10 September 2013.

218 Australian Petroleum Production and Exploration Association, 2012, *State of the industry 2012*, p. 8.

219 Koh Q, 2012, 'Investments in Australian LNG projects cool amid cost blowouts', *Rigzone*, 26 November, rigzone.com/news/oil_gas/a/122325/Investments_in_Australian_LNG_Projects_Cool_amid_Cost_Blowouts, accessed 10 September 2013; Australian Petroleum Production and Exploration Association, 2012, *State of the industry 2012*, p. 17.

Accessing transferable skills from other sectors

One option to meet the growing demand for skills for the liquefied natural gas sector is to utilise transferable skills from other sectors that have an adequate supply or oversupply of these skills. Several recent reports have supported these strategies. For example, the Ernst & Young report *Business risks facing mining and metals 2012–2013* supports the development of strategies to attract non-resources workers with 'similar and/or complementary skills, such as oil and gas, and manufacturing'.[220]

Given the strict safety regimes of the resources industry, workers from outside the Resources Sector need reskilling and/or upskilling before they can join the workforce. SkillsDMC recommends rather than creating a time lag by having workers undertake training from the basics, targeted training addressing knowledge and skills gaps and recognising prior learning and experience could be developed by industry in partnership with registered training organisations.[221]

Maritime Employees Training Limited (METL) has developed a training program to upskill and reskill workers from allied professions in the maritime sector who wish to enter the Oil and Gas sector. Workers with transferable skills in dredging and other related occupations can enter into the traineeship. The qualifications they gain are of long-term value due to their transferability to other allied sectors.

Attracting workers with transferable skills to the liquefied natural gas projects sector

METL is a not-for-profit company jointly established by maritime employers and the Maritime Union of Australia to run training and facilities directly related to the provision of training to maritime employees. It aims to build employee capability and deliver better business outcomes through training across the Maritime industry.

METL is funded by industry, including maritime employers, beneficiaries of maritime skills, international shipowners and maritime employees, and uses these funds to provide comprehensive training courses. For instance, it provides traineeships in Certificate III Transport and Distribution (Maritime Operations—Integrated Rating), known as Integrated Ratings, which include 12–15 weeks of off-the-job training and 36 weeks of sea-service with host employers. With a 12-week on, 4-week off roster, the training usually takes approximately 15 months to complete, and provides the trainee with a Certificate III and an Integrated Rating Certificate of Proficiency Australian issued by the Australian Maritime Safety Authority. This is an internationally recognised occupational licence, enabling employment on 'blue-water' (such as commercial shipping) and offshore oil and gas vessels.

As METL works directly with host employers, the delay in acquiring the required sea-service training is avoided and the trainee is provided with a direct pathway to acquiring the necessary skills in a quick and efficient timeframe. METL employs trainees on behalf of a host company, and facilitates all aspects of the traineeship including recruitment, placement at a registered training organisation and sea-service and assists with the funding of course fees and accommodation. For employers, working with METL provides the benefit of a dedicated pipeline of workers with the required experience that meets industry standards.

A number of former trainees who have attained their certification are now undertaking their Deck Watchkeeper understudy. This is the first step in a career pathway from Integrated Rating to Deck Officer and potentially Master of ocean-going vessels. Even though METL is no longer the employer, facilitating this process and funding the distance education program provides career options for individuals and is designed to help address the critical shortage of officers in Australia and internationally.

220 Ernst & Young, 2013, *Business risks facing mining and metals 2012–2013*, p. 7.

221 SkillsDMC, 2013, *Environmental scan 2013: resources and infrastructure industry*, p. 21.

METL is currently undertaking a pilot program to upskill workers from the dredging sector, funded by contributions from dredging employees and companies. Due to the nature of work and classification of vessels in this sector, limited or no qualifying sea-service can be gained towards an Integrated Rating Certificate of Proficiency. At the time of publishing, the first trainees undertaking the pilot project are set to finish their off-the-job training and begin their first swing at sea through METL's network of host employers.[222]

UK programs to increase supply of skills to the liquefied natural gas sector

The case study provided above gives an example of a specific program designed to increase the pool of maritime workers available to the Oil and Gas sector. AWPA supports a broader commitment to this kind of collaborative approach across more vital areas of skills demand for the Oil and Gas sector.

There is merit in looking at how other countries have dealt with these challenges. For example, the United Kingdom has implemented a number of innovative skills programs to meet labour demand in its burgeoning Oil and Gas sector. These programs are run by the UK Offshore Petroleum Industry Training Organisation and are featured in the following case study.

UK Offshore Petroleum Industry Training Organisation programs to bolster oil and gas skills pipeline

The Offshore Petroleum Industry Training Organisation (OPITO) is a joint partnership between employers and trade unions. It seeks to develop and sustain a safe, skilled and effective workforce for the UK Oil and Gas sector, and works in collaboration with industry employers, learning and training providers, education and academia and partnership organisations.

The production of oil and gas from the UK continental shelf supports almost half a million jobs in the UK. A skilled and competent workforce is vital to the health of the sector, in terms of ensuring safe operations, sustaining domestic oil and gas production and supporting the export of the knowledge and expertise that has grown up with it. OPITO is delivering two innovative skilling programs to increase the supply of skilled workers to the industry—the Upstream Technician Training Scheme for apprentices and the Transition Training Program.

Upstream Technician Training Scheme

Established in 1999, the Upstream Technician Training Scheme is a partnership between Oil and Gas UK, the Offshore Contractors Association and the training organisations that support them (OPITO, the Oil and Gas Academy and the Engineering and Construction Industry Training Board). The apprenticeship scheme has brought nearly 1,400 young people into the sector over the past decade.

The scheme targets four key disciplines (Process Operations, Electrical Maintenance, Mechanical Maintenance, and Instrument and Control Maintenance) and involves two intensive years at an industry-appointed training college followed by two years of on-the-job training with a sponsoring company. OPITO requires participating companies to demonstrate a commitment to the program by providing on-the-job training placements and appointing a coordinator to act as the scheme's focal point within the organisation.

222 The information for this case study was provided by METL during AWPA consultations.

The scheme has one of the best retention rates in the UK, with 91 per cent of apprentices completing the course and securing employment (compared to the national average of 55 per cent). OPITO received more than 3,500 applications for the 2013 program, indicating the strong interest from young people wanting to pursue a career in the Oil and Gas sector.

Transition Training Programme

OPITO has created a program targeted at transitioning skilled, qualified workers from other industries into the Oil and Gas sector. The program is targeted at skilled workers who have relevant practical experience in other industries and are potentially facing redundancy or reduced career opportunities. By developing their existing skills to suit the Oil and Gas sector, the program has the potential to provide a trained, quality assured, competent workforce in a relatively short period of time.

OPITO launched the first Transition Training Programme of 2013 for mechanical technician roles. It intends to roll out a further three programs in 2013–14, covering instrumentation, process and electrical disciplines. The program includes a mix of integrated classroom and workshop-based learning. Industry plays a vital role by ensuring employment opportunities are guaranteed to those individuals who successfully complete the programs.

Early indications of program outcomes are very positive. Following the completion of a 12-week OPITO Transition Training Programme geared towards the drilling sector, all candidates taking part in the course have now received offers of employment from major drilling companies.[223]

Each of these programs could be trialled in the Australian Oil and Gas sector to increase the pool of workers with relevant skills.

AWPA recommends that the Australian Government develop and pilot a national program for apprentices and trainees tailored to the Oil and Gas sector, along the lines of the UK Upstream Technician Training Scheme. We concede that some aspects of the program may not be transferable to the Australian context and acknowledge that some similar programs are already underway in Australia, including the Energy Apprenticeship Group joint venture between the Chamber of Commerce and Industry of Western Australia and the Australian Centre for Energy and Process Training which is supporting 160 apprentices and trainees at a range of major oil and gas organisations.[224] However, the high level of interest in places in the UK program and the positive employment outcomes experienced by participants make aspects of this model well worth consideration in the Australian context.

We also support the piloting in Australia of a program like the UK Transition Training Programme. Clearly, the highly specialised nature of many roles in the Oil and Gas sector makes the development of such a training program challenging. The UK Government identifies ex-military personnel as a key target market for transition training in its March 2013 Oil and Gas Industrial Strategy.[225] Oil and gas news service Rigzone notes that ex-military personnel have provided a strong source of skills to the Oil and Gas sector for many years, but notes a 'comprehensive and nationwide approach' is necessary to increase this form of skills supply.[226]

223 OPITO, 2013, uk.opito.com/learning-training/modern-apprenticeship-scheme and uk.opito.com/learning-training/transition-training-programme, accessed 14 November 2013.

224 Chamber of Commerce and Industry WA, 2013, *Energy Apprenticeships Group*, cciwa.com/Apprenticeships_WA/Energy_Apprenticeships_Group, accessed 13 September 2013.

225 Her Majesty's Government, 2013, *Industrial strategy: government and industry in partnership*, gov.uk/government/uploads/system/uploads/attachment_data/file/175480/bis-13-748-uk-oil-and-gas-industrial-strategy.pdf, accessed 18 November 2013, p. 23.

226 Mainwaring J, 2013, 'Getting serious about ex-military recruitment', *Rigzone*, 8 May, rigzone.com/news/oil_gas/a/126344/Getting_Serious_about_ExMilitary_Recruitment, accessed 10 September 2013.

The UK Government will facilitate these transitions by mapping the skills required across oil and gas occupations and technical military roles and looking for matching capabilities. Already, mechanics and electricians from the Royal Air Force, Navy and Armed Forces, submariners with specialised skills in subsea work and logistics experts have been identified as potential areas of matching skills.[227] Following this skills matching process, suitable candidates undertake short, intensive training courses to acquire specialist skills relevant to the Oil and Gas sector. Currently, courses are available for mechanical, instrument, process and electrical technicians and these can be tailored according to specific industry and project requirements.[228]

A similar targeted approach could also prove effective in the Australian context, given the high exit rates for experienced, skilled Australian Defence Force personnel. In late 2012, the separation rate was 10.2 per cent, up 1.6 per cent on the previous year.[229] The Australian Oil and Gas sector can take advantage of this trend by adopting a similar approach to its counterpart in the UK, including mapping crossover skill sets, linking candidates with intensive training and providing employment in the sector.

Recommendation 4

That the Australian Government, industry and the tertiary education sector pilot a program based on the United Kingdom's successful Transition Training Programme with the aim of improving the supply of long-term technical operational skills to the Oil and Gas sector.

Responsible parties—Australian Government, industry associations and tertiary education providers.

Recommendation 5

That the Australian Government, in collaboration with industry stakeholders, develop and pilot a national program for apprentices and trainees, modelled on the UK Oil and Gas Upstream Technician Training Scheme and the Western Australian Energy Apprenticeship Group joint venture, to provide clear pathways to the liquefied natural gas sector and ensure supply of long-term technical skills.

Responsible parties—Australian Government, industry and industry associations.

Developing an oil and gas workforce development strategy

The approaches outlined above present some options for addressing skills demand for trade and technical occupations vital to oil and gas operations. However, more can be done in relation to the high-end skills needs of the industry.

The rapidly growing Oil and Gas sector will require workers with specialist skills such as geophysicists, geotechnical engineers and others. A range of examples exist of training centres and university faculties that are supplying high-quality skills to the sector, including the Australian Centre for Energy and Process Training, Charles Darwin University, the GE Skills Development Centre, and university faculties at the University of Western Australia, the University of Adelaide, the University of Queensland, the University of New South Wales and Charles Sturt University.

227 Ibid.

228 OPITO, 2013, *Transition Training Programme.*

229 Parnell S, 2012, 'Defence force opt-outs increase', *The Australian*, 26 December, theaustralian.com.au/national-affairs/defence/defence-force-opt-outs-increase/story-e6frg8yo-1226543366416, accessed 12 September 2013.

However, more work is required to position higher education providers to deliver high-level skills for the Oil and Gas sector and to improve the domestic supply of these skills. As AWPA Board member Keith Spence stated in June 2012:

> There are number of initiatives and training programs currently in place through established partnerships with industry and education facilities … However, there are limitations on the number of workers that can be trained at any one time, as there are only a few established training facilities. To meet industry needs in the next four years, the training efforts will need to grow right across Australia to train local Australians in local jobs.[230]

Building domestic supply will require a new, collaborative approach from industry. The transition from very few to many liquefied natural gas projects requires employers to work together to grow the pool of workers with the required skills, instead of training at the company level. Keith Spence notes that 'with all the additional liquefied natural gas projects coming online and the need for other similarly qualified workers across the Resources Sector as a whole, a more strategic, collective industry training effort is required to meet the demand for workers'.[231]

AWPA supports the development of a comprehensive oil and gas workforce development strategy for the Oil and Gas sector to promote collaboration across industry and between industry and the tertiary education sector, and to coordinate and promote activities to train, reskill and upskill workers for oil and gas operations, including though the pilot programs recommended in this chapter.

Recommendation 6

That industry stakeholders and the tertiary education sector collaborate to develop an industry-driven workforce development strategy to support the development of a domestic workforce to meet future demand for long-running oil and gas operations occupations.

Responsible parties—Industry, industry associations and the tertiary education sector.

6.6 Conclusion

This chapter profiled a range of initiatives and programs that demonstrate effective partnerships between schools, tertiary education providers and resources companies, which augur well for future domestic skills supply to the industry.

However, there are some concerning trends, particularly the potential shortages of sufficiently skilled, qualified domestic graduates to meet skills demand in the burgeoning liquefied natural gas sector. This chapter has proposed a range of measures to boost domestic supply, including the trialling of innovative programs that are currently being delivered in the UK. The industry can also improve the way it works with schools to promote pathways to resources employment and overcome negative stereotypes about the industry.

The next chapter examines the role of industry in ongoing skills and capability development for the existing workforce.

230 Spence K, quoted in Australian Gas Technology, 2012, *Cooperation not competition is key to solving skills shortage*, australiangastechnology.com.au/index.php/news-header/71-cooperation-not-competition-is-key-to-solving-skills-shortage, accessed 12 September.

231 Ibid.

7 Role of government and industry in enabling strategic approaches

7.1 Introduction

In this chapter we identify a range of strategies implemented by governments, industry bodies and individual companies to maximise the development, effective utilisation and retention of existing skills in the Resources Sector through workforce planning and development practices.

We have defined workforce development as those policies and practices which support people to participate effectively in the workforce and to develop and apply skills effectively in a workplace context.[232] Workforce development is concerned with the development of knowledge and skills in tertiary education; the matching of tertiary provision to the needs of industry, individuals and society; and the effective use and further development of knowledge and skills in the workplace. A workforce development approach can support productivity in the workplace, in industry, in regions and nationally.[233]

The Resources Sector is a significant investor in training and workforce development. Many companies have implemented innovative approaches to attracting, developing and retaining specialist staff. However, employers in the sector face a challenging environment marked by the transition from construction to operations phases of projects, the demand for specialist industry experience for many roles, the challenges triggered by automation and its impact on work, and balancing long-distance commuting staff with local staff at regional and remote locations.

The development of 'a highly skilled and adaptable workforce where skills are used effectively to meet the increasingly complex needs of industry and individuals are able to fulfil their potential' is the shared responsibility of industry, government and individuals.[234] Workforce development involves networks of employers, industry associations, local councils, training providers and government bodies working together to address local skills and workforce needs. At the enterprise level, workforce development uses business strategy to drive organisational improvement and skills development: work is organised to maximise employee capabilities and training is based on business needs.[235]

Much has been done to address workforce development challenges and institute effective workforce development cultures in Australian resources companies. The National Resources Sector Workforce Strategy has acted as a focal point for government and industry actions to enhance workforce planning, support skills development and improve participation in the Australian Resources Sector. At the enterprise level, many organisations have put strategies in place to invest in graduate programs, attract workers from allied sectors, facilitate the upskilling and employment of regionally based workers and support succession planning.

This chapter examines the context for workforce development in the Resources Sector and highlights government and enterprise-level strategies to address the issues and promote effective, sustainable workforce development in the Resources Sector.

232 Skills Australia, 2010, *Australian workforce futures: a national workforce development strategy*, awpa.gov.au/our-work/national-workforce-development-strategy/Pages/Australian-Workforce-Futures.aspx, p. 7.

233 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, accessed 18 November 2013, p. 51.

234 Ibid., p. 9.

235 Ibid., p. 53.

7.2 The context for workforce development in the Resources Sector

As noted elsewhere in this report, the Australian Resources Sector is going through a period of change as commodity prices and investment moderate. The majority of industry activity is expected to transition to Mining Operations and Oil and Gas Operations over the next five years.

The changing investment environment and the transition from construction to operations generate a series of challenges and opportunities for workforce development in the Resources Sector. These trends may reduce pressure on resources companies in the medium term as the competition for skilled labour becomes less intense and skills shortages become less acute. Indeed, as discussed in Chapter 5, the proportion of occupations in shortage is at its lowest level since 2007–08.

However, over the next five years many companies will continue to face a number of the pressures experienced during the height of the boom, including difficulty accessing workers with the requisite experience to work in vital, highly specialised roles; managing the attraction and retention of appropriate staff including through skilled migration where required; and addressing the challenge of balancing long-distance commuting workforces with local staff in regional areas. While the quantity and breadth of shortages across key occupations may reduce during the outlook period (2014–18), the nature of these shortages will shift emphasis from shortages in trade and technical and engineering occupations related to resources construction in 2014, to a range of highly specialised professional, managerial and trade and technical skills vital for Mining Operations and Oil and Gas Operations in the period from 2015 to 2018. Many of these occupations have long lead times for training and the development of requisite experience.

Skills development and training activity

As noted in Chapter 4, it is difficult to find information about the types of training provided by companies in the Resources Sector. There is considerable evidence to suggest resources companies invest heavily in training and workforce development. The traditional perception held by some commentators is that they focus on technology and equipment to the detriment of attention on people and skills. As Tara Diamond, the Australian Mines and Metals Association's Director of Group Services, conceded in a May 2013 speech, 'In the past, resource organisations have put a lot of strategic planning and rigour into capital investment decisions, but the same rigour isn't always carried through with analysing and forecasting labour costs and requirements.'[236]

A 2013 National Centre for Vocational and Education Research study commissioned by the Minerals Council of Australia found the minerals sector spent more than $1.1 billion on training during the financial year ending 30 June 2012, equivalent to almost 5.5 per cent of total payroll.[237] The report, which is based on a survey of mining companies that achieved a response rate of 40 per cent, found apprentices and trainees make up around 5 per cent of the total mining workforce. Sixty-five per cent of the surveyed companies reported employing apprentices and trainees, which means that close to one-third of companies do not employ any apprentices and trainees. All of the contractors surveyed employed trainees and apprentices.[238] As noted in Chapter 4, separate research by the National Centre for Vocational Education Research indicates the Resources Sector has considerably improved the proportion of its workforce engaged as apprentices and trainees in recent years.

Research shows that most of the training for mining operators is industry-led, and provided either by the companies themselves or through specialised training providers.[239] Government subsidies represented only 2 per cent of the training expenditure committed by the companies surveyed. The report also provides interesting findings about the nature of training supported by resources companies. Around half of all nationally recognised training supported by the companies surveyed is delivered in the form of skill sets, which are single units or combinations of units which link to a licensing or regulatory requirement, or defined industry need, rather than full qualifications.[240]

236 Diamond T, 2013, 'The people puzzle: addressing the resource industry's skills challenges', presentation to the Mining Skills Australia Summit 2013, amma.org.au/assets/Policy/Speeches/2013/20130530_TaraDiamond_Mining_Skills_Australia_Summit.pdf, accessed 19 November 2013, p. 6.

237 NCVER, 2013, *Training and education activity in the minerals sector*, p. 11.

238 Ibid., p. 12.

239 Ibid., p. 21.

240 Ibid., p. 12.

AWPA acknowledges the ongoing debate about the value and role of skill sets for the resources industry. The position of skill sets relative to full qualifications contrasts the long-term individual and broader economic benefits of undertaking qualifications, with the short-term benefits of skill sets for individuals' job prospects and for presenting 'just in time' responses to immediate skills demands. Several stakeholders indicated to us that full qualifications do not always meet the needs of companies. For example, the Construction Materials Processors Association reports most current qualification-based training involves training in skills that are irrelevant to the job for which the trainee or apprentice is being trained, and it is therefore in favour of job-relevant skill sets. Other stakeholders, such as the Resources and Engineering Skills Alliance in South Australia, have also reported companies' preference for skill sets.[241]

The Resources Industry Training Council examines this issue in detail in a recent report. The report highlights the importance of skill set training 'for its potential to realise efficiencies in skills development and to maximise productivity'.[242] It notes that many employers are utilising skill sets to train new and existing employees, ranging from upskilling to enable qualified workers to meet new regulatory or technological requirements, to 'just in time' training to enable operators to secure the licence required to perform the role, and complementary training to enable workers to perform additional job roles including management and supervisory roles.[243]

AWPA is of the view that public funding should generally be directed to full qualifications and skill sets that are listed in training packages, and for individuals already qualified at the Certificate III level. Where skill sets are endorsed in training packages, they have portability and recognition among employers and across jurisdictions, an important consideration from AWPA's perspective. However, the Resources Industry Training Council notes policy settings limiting public subsidies for skill sets to Certificate III–qualified individuals exclude 'substantial cohorts of resource operations workers for whom skills sets training is attractive and the most efficient and effective application of available training resources'.[244] It also notes difficulty in forming an authoritative evidence base on the use of skill sets in the industry due to the exclusion of skill sets from national reporting, and identifies shortcomings with the management of skill sets within established training package review processes.[245]

The National Centre for Vocational Education Research also notes resources companies offer a range of other non-accredited training to develop staff, including mentoring and leadership programs, residential programs, professional memberships, health and wellness training, cultural awareness training, graduate development programs, school-based traineeships, study assistance and Indigenous programs.[246] Around 80 per cent of employees reported participating in some form of structured training and the same proportion of companies offered forms of structured training programs. A significant proportion of companies (65 per cent of companies and 90 per cent of contracting firms) employ training staff. In addition, companies also employ consultants to provide training.[247]

The role of onsite training is important due to the limitations in the capacity of tertiary education sector trainers to predict emerging trends in mining over a five-year period, as discussed in Chapter 6 of this report. In addition, successful training in industry's view allows an employee to operate safely and competently in the workplace at the desired level, and it may not be possible for registered training organisations to meet these requirements due to a variety of reasons, including the complexity of simulating mine conditions offsite.

Offsite training is often used for new mining workers or 'cleanskins' who can be trained in controlled and safe environments away from the actual mine site. Offsite training programs may replicate

241 Resources and Engineering Skills Alliance, 2012, *Workforce study for the Resources Sector in the Eyre Peninsula*, report prepared for the South Australian Skills and Training Commission, voced.edu.au/content/ngv51831, accessed 19 November 2013, p. 24.

242 Resources Industry Training Council, 2013, *Skill sets for the resources sector: an exploratory study*, ritcwa.com.au/LinkClick.aspx?fileticket=_bfgWGrFspQ%3d&tabid=135, accessed 6 November 2013, p. 5.

243 Ibid., p. 7.

244 Ibid., p. 5.

245 Ibid., p. 38.

246 NCVER, 2013, *Training and education activity in the minerals sector*, pp. 48–49.

247 Ibid., pp. 12–13.

the working conditions of actual sites and can be designed to be scalable to meet clients' needs.[248] Examples of offsite courses include training for operating dump trucks, light vehicle courses, safety- and occupational health and wellbeing–related courses and mine induction–related qualifications. The offsite courses tend to be short and intensive training programs. Some of these programs include qualifications that are nationally recognised and are designed in consultation with industry.[249] Examples of companies utilising offsite training for skills development are provided later in this chapter.

Over the next five years, the investment of resources companies in training and workforce development will be paramount, especially in relation to operations roles. As discussed in Chapter 5, employment in resources construction is likely to contract significantly after 2014. In the meantime, while construction activity remains strong, short-term approaches to skills development, such as skill set training, and the utilisation of skilled migration will be required to meet demand for these skills. Indeed, temporary skilled migration in particular addresses the volatility of the construction outlook and mitigates the issue of integrating surplus workers back into the broader industry after 2014.

By contrast, medium-term training and workforce development strategies will be required to meet demand for vital operations skills in the period from 2015 to 2018. Most of the major projects currently in construction will be operational for decades, providing attractive, secure employment options for workers in the regions where operations are occurring.

7.3 Key challenges

As outlined above, resources companies employ a range of methods to access skilled workers to meet their construction and operational requirements. Nonetheless, resources companies continue to report a challenging recruitment environment. The challenges include the demand for considerable industry experience for many roles, the need to balance long-distance commuting staff with local staff at regional and remote locations, transferring staff from construction to operations roles, and the impact of automation on work processes.

Demand for industry experience

While the evidence suggests skills shortages have eased in many occupations relevant to the Resources Sector, the challenge for many organisations is getting people with the right skills in the right place at the right time—and at market rates. The impact of prolonged skills shortages on major projects is substantial, and is a significant contributing factor to delays and cost blowouts in those projects. According to David Knox, Chief Executive Officer of Santos, 'one of our biggest hurdles, and contributors to cost inflation, is Australia's lack of skilled labour, a shortage of experienced subcontractors, and a dearth of specialist suppliers'.[250] These impacts are not surprising when the economic value of Resources Sector workers is taken into account. As noted in Chapter 3, the Australian Bureau of Statistics' national accounts data suggests gross value added per person employed in oil and gas extraction in 2012 amounted to $873,000. For mining operations, gross value added per person in 2012 amounted to $462,000.[251]

AWPA's stakeholder consultations revealed that many companies do not have problems sourcing workers in the skilled trades and semi-skilled occupations, either as feed-in for internal training programs or as already experienced hires. Where companies do experience problems is in sourcing well-trained and experienced workers with advanced skills for their operational workforces. Industry experience is often a non-negotiable demand by companies given the strict safety regimes of the Resources Sector.

248 Iminco, 2011, *Offsite training centres for mining*, iminco.net/offsite-training-centres-for-mining, accessed 11 September 2013; Runge Pincock Minarco, 2013, *Smartminer: an introduction to mining*, rpmglobal.com/professional-development/smartminer-an-introduction-to-mining, accessed 11 September 2013.

249 Industry Pathways, 2013, *Mining induction: incorporating Standard 11*, industrypathways.com.au/pdf/course-overviews/mining-induction-s11-course-overview-industry-pathways.pdf, accessed 19 November 2013.

250 Knox D, 2012, 'Fuelling nations: the role of gas', presentation at the Australian Institute of Energy Conference 2012, santos.com/library/121119_David_Knox_AIE2012_presentation.pdf, accessed 19 November 2013, p. 25.

251 DAE, 2013, *Modelling employment demand and supply in the Resources Sector*, p. 28.

According to Department of Employment skills shortages research, the demand for job-ready and experienced workers creates a paucity of entry-level positions for new graduates and entrants into the mining workforce. While companies endeavour to source these positions locally through a range of avenues including jobs boards like miningoilandgasjobs.com.au, competition for a very small pool of specialist workers is fierce. Some of this demand is met by supply from skilled migration. However, while the skilled migration program provides an important supply of skills to the Resources Sector and will continue to do so, it is important for companies to continue to identify opportunities to train and engage domestic workers, and commit to working with industry bodies and tertiary education institutions to implement strategies to enable domestic graduates to compete for high-value jobs and rewarding long-term careers in the sector.

AWPA's report *Future focus: 2013 National Workforce Development Strategy* recommends the increased provision of professional cadetships to support the job readiness of domestic graduates. A professional cadetship is an arrangement under which an employer agrees to contribute to, or subsidise the cost of, an employee's education. AWPA notes that several resources companies provide professional cadetships, many of which are advertised on websites such as *The Resource Channel*.

To increase the provision of cadetships, AWPA proposes that governments, industry bodies and tertiary education providers work together to develop a model for a professional cadetships program. The program could include government incentives for professional cadetships in both higher education occupations (focusing on specialised occupations) and specified higher level vocational education and training qualifications. Government incentives could also help offset the costs of training if workers move on before the enterprise has recouped its investment.[252]

The strong growth of the liquefied natural gas sector creates recruitment pressures for oil and gas companies in particular. In its 2012 report for the Australian Petroleum Production and Exploration Agency, Deloitte Access Economics notes 'the rapid expansion trajectory and largely concurrent project scheduling' will create 'significant demands on industry to source and place workers to ensure the pace of development can be sustained'.[253] In most cases, these occupations are very highly skilled and require extensive experience on a liquefied natural gas platform. The Deloitte Access Economics modelling commissioned by AWPA for this report indicates demand for labour in the Oil and Gas Operations sector has experienced robust growth since 2010, and this growth is expected to continue as many of the major liquefied natural gas projects under construction move into their production phase.

A consistent theme reported by stakeholders during AWPA's consultations was the growth of the Oil and Gas sector and the resulting demand for skills outstripping the capacity of the training system to supply the necessary skills, leading to the extensive use of skilled migration to fill key positions. AWPA has been informed during consultations that there are no shortages of interested trainees for critical maritime-related occupations in the Oil and Gas sector, but there is a shortage of positions available to train them. AWPA notes training for anticipated skills demands is a good investment, as many of these occupations, such as petroleum engineering, 'will continue to serve our country well after the peak construction period of these projects is long past'.[254]

As indicated in Chapter 6, the Australian tertiary education system provides some capacity to prepare individuals for critical occupations related to oil and gas supply and extraction. However, this capacity is constrained by the fact that there are few training facilities and those in place are generally in metropolitan locations, while the facilities are offshore or remote.

This physical separation creates difficulties, since onsite experience is a vital component of training for specialised liquefied natural gas roles. In particular, liquefied natural gas plant and process operators, highlighted in Chapter 3 as the second largest employing occupation in Oil and Gas Operations, need access to plants to gain relevant experience and obtain the necessary

252 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 108–10.

253 DAE, 2012, *Advancing Australia: harnessing our comparative energy advantage*, deloitte.com/assets/Dcom-Australia/Local%20Assets/Documents/Services/Corporate%20Finance/Access%20Economics/Deloitte_Access_Economics_Advancing_Australia_June_2012.pdf, accessed 19 November 2013, p. 48.

254 PricewaterhouseCoopers, 2011, *What's the impact of Australasian LNG projects on the shaping of the LNG market in Australia?*, pwc.com.au/industry/energy-utilities-mining/assets/Challenges-Opportunities-LNG-projects-May10.pdf, accessed 19 November 2013.

qualification. However, currently there are only three operating liquefied natural gas plants in Australia—the Pluto and North West Shelf projects off Western Australia and the Bayu-Undan field in the Timor Sea northwest of Darwin—and construction on the majority of new plants is scheduled to finish in 2014–15. These plants have the capacity to train a small number of people, but not the volume required to provide sufficient plant operators for the significant number of major liquefied natural gas projects that will come online in the second half of the decade.

A mixed approach will be required here, and major project proponents will need to consider innovative ways to provide trainees with the plant access required to train process operators domestically, and continue to draw on skilled migration to access experienced staff where required.

Transferring staff from construction to operations project phases

In the Resources Project Construction sector, under the low growth scenario (considered the most realistic) employment is expected to dip slightly from 2013 levels in 2014 (a projected decline of 3 per cent), and then decline rapidly to fewer than 8,000 workers in 2018 if existing projected construction schedules are met. Many of the trades workers in construction are not in demand in the operations phases, including Bricklayers and Stonemasons, Carpenters and Joiners, Floor Finishers, Painters, Glaziers, Plasterers, Tilers, Plumbers, Airconditioning and Refrigeration Mechanics, Concreters, and Insulation and Home Improvement Installers. This presents the significant issue of absorbing some 20,000 trades workers into other industries between 2015 and 2018.

However, as discussed in Chapter 5, there is potential for workers in some occupations to transfer from the construction to the operations phase of major projects. Many of these are generalist occupations such as Chief Executives and Managing Directors, Construction Managers, Office Managers, Secretaries and General Clerks. Workers in many of those occupations could also be sourced from other parts of the economy, although exposure to the major project environment potentially gives workers seeking to transfer from construction to operations a competitive advantage.

In addition to these generalist occupations, there are a number of specialist roles that could transfer from construction to operations, including Structural Steel and Welding Trades Workers, Metal Fitters and Machinists, Electricians, Earthmoving Plant Operators, Truck Drivers, Structural Steel Construction Workers, Civil Engineering Professionals and Architectural, Building and Surveying Technicians. In most cases, workers transferring to operations roles will require reskilling and retraining. Major project proponents should consider options to transfer workers in these occupations from the construction to operations project phases. Indeed, AWPA's consultations with stakeholders suggest that work is already underway to plan transition pathways to enable workers in relevant occupations to transfer from construction to operations roles. Recommendation 4 (see Chapter 6) is relevant to these retraining efforts.

Balancing long-distance commuting staff with regional staff

A key challenge for the resources industry is meeting demand for specialist skills in regional and remote locations. Sixty-one per cent of employment in the Mining industry takes place in regional and remote areas, compared to 37 per cent for all industries,[255] and the majority of oil and gas projects are located in regional and remote locations. Workforce planning for resources companies involves a complex balance between staff commuting long distances to work on project sites, and staff residing in nearby population centres.

As explained earlier in this report, fly-in, fly-out workers provide a largely effective solution for many resources companies to acute labour demand in regional and remote locations, particularly for the labour-intensive construction phase of resources projects. In many cases, workers from regional communities are unlikely to satisfy the required labour demand and engaging locals risks leaving

255 AWPA, 2013, *Mining—industry snapshot*, awpa.gov.au/our-work/national-workforce-development-strategy/2013-workforce-development-strategy/Documents/2013%20Industry%20Snapshots/B-Mining.pdf, accessed 19 November 2013.

workers under- or unemployed once facilities are completed, especially in communities with few alternative industries.[256]

Longer term positions on mining operations sites and oil and gas extraction projects potentially present greater opportunities for regional workforces. In the past, operational workforces have largely been drawn from the regional communities close to project sites.[257] However, in many cases, fly-in, fly-out camps are 'now being utilised to provide a permanent operational workforce adjacent to established regional towns' as sites become more remote and 'the number of skilled, professional and middle management workers becomes more difficult to source'. [258]

In these ways, engaging local workers in the operations phase of projects poses challenges for resources companies, as many of the positions require skills and experience that may not be available in small regional or remote labour market pools.[259] Often the best outcome for companies, communities and individuals is an approach that builds the capacity of the local workforce to meet the required skills and supports workers to build transferable skills relevant to work in several industries.[260]

There are several good examples of this approach. The Gladstone LNG project's proponents support the Santos GLNG and Skills Tech Australia Training Centre, which opened in 2011 and provides 'gap' training for people from other industries to fast-track them for employment on the Santos GLNG project.[261] Shell is also retraining its former Clyde oil refinery staff alongside new recruits for its Prelude FLNG project, through the new FLNG Training Consortium initiative with Curtin University and the Challenger Institute's Australian Centre for Energy and Process Operators, to train about 200 new engineering maintenance and operations staff over four years.[262] A $21 million centre specialising in training for workers on coal seam gas to liquefied natural gas projects proposed for Gladstone, to be located at the Central Queensland Institute of TAFE, will utilise simulators and provide more than 140 additional training places in the resources and energy sector.[263]

AWPA's consultations for this report indicated most resources companies have a general awareness of the skills needs of other resources-related companies operating in the same region. Despite similar skills needs, enduring skills shortages (particularly for highly skilled occupations) and high labour costs, attraction and retention of skilled workers has become a source of competitive advantage, leading to a competitive rather than collaborative approach to skills challenges.

AWPA believes a collaborative, regional approach to skills development and available worker pools will increase the availability of skilled workers in mining regions and reduce the longer term negative effects of skills shortages. This approach provides added value in relation to cross-sectoral skills development and supports pathways into the Resources Sector from other sectors undergoing structural changes such as Manufacturing and Construction.

256 DAE, 2012, *Advancing Australia: harnessing our comparative energy advantage*, p. 50.

257 Skills Australia, 2011, *Submission to House of Representatives inquiry into the use of 'fly-in, fly-out' (FIFO) workforce practices in regional Australia*, awpa.gov.au/our-work/sector-specific-skill-needs/documents/FIFOsubmission.pdf, accessed 19 November 2013, p. 6.

258 Ibid., p. 1.

259 DAE, 2012, *Advancing Australia: harnessing our comparative energy advantage*, pp. 49–50.

260 Ibid.

261 Australian Petroleum Production and Exploration Association, 2012, *State of the industry 2012*, p. 17.

262 Ibid.; World Maritime News, 2013, *Shell, Challenger to develop training programs for Prelude FLNG workers*, 30 September, worldmaritimenews.com/archives/94381/shell-challenger-to-develop-training-programs-for-prelude-flng-workers, accessed 17 October 2013.

263 Central Queensland Institute of TAFE, 2013, *New energy training centre at CQ TAFE Gladstone*, media release, 30 July, cq.tafe.qld.gov.au/about-us/news-events/news/2013080100.html, accessed 17 October 2013.

Impact of automation

The advent of automation will create new skills requirements and drive organisational change in the Resources Sector. According to the Resources Industry Training Council's *Rise of the machines?* report, automation will provide a range of benefits to the industry, including improvements to labour and capital productivity, increased efficiency flowing from whole-of-operation optimisation and enhanced scheduling and planning for maintenance.[264] However, the skills required to make the most of these technologies are currently in short supply:

> the skills, work patterns, leadership models and culture that are necessary to support an integrated operations approach to optimizing the benefits from automation are typically not present in a resources company, particularly in the mining sector.[265]

The report notes automation and remote control technologies could create significant organisational change in the Mining sector, and result in its workforce resembling the Oil and Gas sector's workforce, 'with a smaller portion of unskilled and semi-skilled labour and a larger portion of technicians and technical professionals working in a process oriented culture'.[266]

Across the Resources Sector, automation will create new roles and work patterns and require workforce retraining and new management and leadership models. The importance of worker participation in any transition phase is critical. Workplace culture:

> plays an important role in implementing new processes and technologies—the workforce must be willing and able to support change in the transition phase. Too often, the importance of having a workforce that is not only skilled in operations, but also supportive of the implementation process is disregarded.[267]

Training for automation is currently undertaken mainly by large companies to gain competitive advantage. As noted in Chapter 5, the commercial-in-confidence issues around such models make it difficult for wider dissemination of training models and for training institutions to develop programs to address the demand for new skills.

Automation provides companies with the opportunity to commit to in-house innovation. Research by the National Centre for Vocational Education Research found mining companies invest significantly in equipment for the purpose of innovation, but rely heavily on external expertise, including new employees and contractors, to source skills for innovation when compared to similar industry sectors.[268] One of the hallmarks of innovation is workers demonstrating both knowledge and skills (theoretical and practical information), including prior knowledge, which is where 'learning is done prior to tasks being undertaken'.[269] Companies need to commit to upskilling and retraining existing employees to support innovative practices such as automation. Mining and oil and gas companies will also need to work closely with tertiary education providers to ensure training programs take automated technologies into account, and training facilities are available to enable students to gain practical experience with these technologies.

In view of the relatively small size of the workforce, AWPA encourages mining and oil and gas companies to collaborate with education training providers to form a Centre of Excellence, focusing on the skills required for the mining and oil and gas jobs of the future, resulting from automated technologies. The establishment of a Centre of Excellence would provide a formal mechanism for collaboration between industry and government to drive and promote innovation and capitalise on the growth of the Resources Sector. The centre could provide education, training and professional

264 DAE, 2012, *Advancing Australia: harnessing our comparative energy advantage*, pp. 49–50.

265 Australian Venture Consultants, 2012, *Rise of the machines?*, p. 32.

266 Ibid., p. 85.

267 PricewaterhouseCoopers, 2013, *Mine: a confidence crisis—review of global trends in the mining industry 2013*, pwc.com.au/industry/energy-utilities-mining/assets/Mine-May13.pdf, accessed 19 November 2013, p. 17.

268 Dalitz R, Toner P and Turpin T, 2011, *VET and the diffusion and implementation of innovation in the mining, solar energy and computer games sectors*, NCVER, research report, ncver.edu.au/publications/2392.html, accessed 6 November 2013, p. 15.

269 PricewaterhouseCoopers, 2013, *Mine: a confidence crisis—review of global trends in the mining industry 2013*, p. 12.

development to the sector, as well as research on new and emerging industry practices, processes and technology.

AWPA supports renewed focus on training but notes the sensitivities in developing widespread training packages specific to sector needs due to the commercial-in-confidence information attached to company practices. There is an opportunity to develop targeted training arrangements that are based on the latest technology in the field. Linking research and development of that technology with training providers through a Centre of Excellence is one way of ensuring the relevant training is provided.

7.4 Australian approaches to Resources Sector workforce development

The federal, state and territory governments have developed a range of responses to support workforce development in the Resources Sector and address the challenges outlined in this chapter, including many initiatives pursued in partnership with industry. These include targeted responses for the Resources Sector such as the National Resources Sector Workforce Strategy and programs such as the National Workforce Development Fund.

The National Resources Sector Workforce Strategy

The National Resources Sector Workforce Strategy promotes and enables a partnership approach to workforce development between governments, industry and education providers. The 31 recommendations of the strategy address key issues in the sector including promoting workforce planning, developing regional workforce plans and enhancing participation in the Resources Sector workforce. Responsibility for implementing the recommendations is shared between governments, industry and the tertiary education sector. The March 2013 implementation update on the strategy notes 'implementation activities that address most of the Strategy's recommendations have become part of standard, leading business practice for industry, the tertiary education sector, and governments'.[270]

The National Resources Sector Workforce Strategy is an example of a centralised and coordinated approach to workforce development. It is a sector-wide plan to address the skills and labour needs of the Resources Sector. The strategy assists the Resources Sector to meet its demand for skilled labour, maintain national momentum on addressing skills shortages, and further build Australia's productive capacity.

The strategy includes a set of recommendations aimed at enhancing the resources skills pipeline and improving participation in resources employment. Perhaps the key recommendation for workforce development is recommendation 1.2, under which the Australian Government and Western Australian government departments are engaged in developing regional workforce plans to manage the impacts of major resources projects.

Several regional workforce development plans have been prepared through this partnership, including the Goldfields/Esperance and Wheatbelt regional workforce development plans (2013–2016). Resources and Engineering Skills Australia has undertaken a study focused on the Eyre Peninsula, and SkillsDMC is working with industry to improve the capacity and capability of the workforce at regional, community and enterprise levels. Several other initiatives are also underway, such as plans for the regions of South West, Great Southern, Pilbara and Kimberley in Western Australia. Governments have worked closely with relevant Regional Development Australia committees to facilitate the development of a revised approach to regional planning for implementation in 2013–14.[271]

Other recommendations in the National Resources Sector Workforce Strategy also support workforce development planning. Recommendation 5.2 supports sustainable job outcomes for local people in the Pilbara and Bowen Basin regions. The Minerals Council of Australia has

270 Department of Industry, 2013, *National Resources Sector Workforce Strategy: implementation plan*.

271 Ibid.

led a range of actions under this recommendation including the Minerals Council of Australia – Australian Government Memorandum of Understanding on Indigenous Employment and Enterprise Development. The aims under the memorandum are to increase Indigenous participation and support regional coordinators in a range of Indigenous population centres, develop workforce development plans for the Bowen and Galilee basins, support functional literacy projects in the workplace, and establish an Indigenous natural resources management hub to support Indigenous enterprises.

This recommendation also supports the innovative Regional Agriculture and Mining Industry Training Project Pilot. This project, which uses an innovative model for facilitating the transfer of skills between industries, is featured in the following case study.

Cross-sectoral collaboration to attract skilled workers in regional areas

The SkillsDMC/Minerals Council of Australia/National Farmers' Federation/Agrifoods Australia/Commonwealth Government Skills Memorandum of Understanding, signed in 2007, formalises a partnership to develop collaborative cross-sector skills and employment initiatives. Through the Regional Agriculture and Mining Industry Training Project Pilot, a successful model was developed for providing tailored cross-industry skilling for mining, agriculture and related industries. The project was piloted in two regional locations—Morawa in Western Australia and Emerald in Queensland.

Participant outcomes were outstanding: 86 per cent (25 of 29) of the original participants graduated with certificates and 93 per cent (27 of 29) gained employment or returned to advance their studies.

SkillsDMC will roll out the Regional Agriculture and Mining Industry Training Program and is working in concert with the Minerals Council of Australia, the National Farmers' Federation, Agrifoods Australia and state bodies to target some key mining and agricultural regions.[272]

Funding to support skills development: the National Workforce Development Fund

The National Workforce Development Fund is an Australian Government program that helps businesses identify and address their current and future workforce development needs. The program is administered by the Department of Industry with strategic oversight provided by AWPA. It uses an innovative, industry-driven model that enables businesses to co-invest with government to train, reskill and upskill workers. The program aims to help businesses lift their productivity, provide Australian workers with opportunities to increase their skills through formal training and assist areas of the economy where skilled workers are most in demand.

Under the program, industry contributes to the cost of training, while Industry Skills Councils play a key role in assisting businesses to identify their training needs, select a registered training organisation to address those needs, and monitor implementation of successful projects. Industry Skills Councils work with industry to identify projects that will deliver skills in areas of demand, covering all sectors including Mining, Construction, Aged Care, Manufacturing and Hospitality. They also support a range of qualifications ranging from diploma to certificate courses.

SkillsDMC helps businesses in the Resources Sector access the fund by providing advice on workforce planning, supporting application development, and providing further assistance through the application process. To 30 June 2013, around 15 per cent of all National Workforce Development Fund learners were supported through projects facilitated by SkillsDMC.

The following case study highlights a range of initiatives funded under the National Workforce Development Fund that are addressing skills issues, such as bespoke training programs to develop specialised skills, mining induction training for 'cleanskins' wanting to enter the Resources Sector, and staff retention strategies especially for new recruits from other industry sectors.

272 The information for this case study was provided by SkillsDMC during AWPA consultations.

The National Workforce Development Fund and industry working together to support skills development

Rio Tinto invests in training new quarry managers

Rio Tinto's iron ore business identified a need to ensure its quarry management positions were filled by a skill-rich and full-time employee workforce.

Working iron ore mines are required to have a certified quarry manager onsite at all times under the Mines Safety and Inspection Act and Regulations. With low numbers of full-time staff skilled with the required qualification, Rio Tinto relied on pre-skilled contract workers to fill temporary gaps in both lead and alternate quarry manager positions, recognising it was not a long-term solution.

Rio Tinto also found that no existing registered training organisation's training program covered the combined skills requirements needed to certify qualified quarry managers. In order to overcome this training gap, it recruited an offsite training company to design a training course comprising the required skill sets for a quarry manager.

Rio Tinto received funding from the National Workforce Development Fund to train 26 employees across 12 mine sites. The number of qualified quarry managers has now doubled, lessening Rio Tinto's reliance on contracted workers.

Rio Tinto's Iron Ore group received a second tranche of funding in 2012, transforming its tailored training course into an ongoing skills development program.

Mastermyne upskills its underground coal mining workforce at Myne Start

Mastermyne is a leading underground coal mining services provider, holding long-term contracts with some of the biggest coal companies in Australia. Shortages in skilled labour mean the company faces the potential risk of delayed completion of projects.

Mastermyne responded to the need for a training program providing clear and consistent pathways into the mining industry for 'cleanskins' who have never worked in the industry before. Myne Start, a wholly owned subsidiary of Mastermyne, was developed, consisting of an underground training complex designed to act like a fully working coal mine and simulate underground conditions.

A four-week intensive program was designed for the Myne Start facility, aligned with the nationally recognised Resources and Infrastructure Industry Training Package. Mastermyne applied for funding through the National Workforce Development Fund to enable the program to cover all relevant competencies, so cleanskins have a clear and comprehensive understanding of the safety and behavioural standards on a mine site. The funding ensures employees are getting one-on-one training, personalised for the specific New South Wales or Queensland mine.

Drill Torque builds capacity

Drill Torque is a leading Australian contract drilling company operating in mining and exploration projects throughout Queensland, Western Australia, New South Wales, the Northern Territory and South Australia.

Drill Torque was faced with low staff retention among new recruits, particularly those sourced from other industries, due to a lack of understanding and preparedness for what was required of them as drill workers. There were also occupational health and safety concerns due to the high rate of injury experienced by new recruits.

Drill Torque received funding from the National Workforce Development Fund to develop a tailored training course to ensure all aspects of rig safety were understood. A 13-week course was designed to provide the information and experience needed by staff before being deployed on a rig. It includes intense classroom training, simulated in-field training and occupational health and safety training. Since implementing the course, Drill Torque has seen staff retention improve significantly. Of the 16 students who undertook the first round of training, 15 are now qualified Drillers Assistants, some of whom are now employed on Drill Torque sites in the Bowen Basin.

7.5 International approaches to Resources Sector workforce development

The United Kingdom and Canada have developed a range of government policy responses to deal with skills and workforce development concerns in their resources and energy sectors.

Canada

Canada's minerals sector employs 340,000 workers and contributed $35.6 billion to Canada's gross domestic product in 2011.[273] Human resources–related issues have been identified as a significant barrier to future growth of the sector. It is projected one out of two Resources Sector workers, particularly in the high-skill areas, will need to be replaced in the next decade due to the ageing of the current workforce.[274]

Among the strategies proposed by the Mining Association of Canada to address this issue are:

- improving participation from under-represented groups
- providing re-entry pathways for retired workers including retraining and mentoring
- improving industry-provided training
- facilitating domestic worker mobility and skills recognition.[275]

The Canadian Government–funded Mining Industry Human Resources Council has worked to address these issues. The council collaborates with mining sector stakeholders to identify emerging human resources challenges and to develop and implement targeted solutions. It has developed resources to assist employers in managing times of transition, including mine closures and downsizing, and in seeking skills from non-resources sectors.[276]

For example, the council's 'Mining Workforce Transition Kit' has been endorsed by key industry stakeholders including companies, unions, government and education providers. The council also produced the 'Beyond the Sector—Identify a new pool of managers' resource, which assists human resources managers to 'identify transferable skill sets in other sectors'. The resource includes a 'list of non-technical transferable managerial competencies along with an occupational matrix to illustrate, at a glance, where similar managerial occupations can be found in other sectors' and case studies of successfully transitioned employees.[277]

273 Mining Association of Canada, 2012, *Facts and figures*, mining.ca/www/media_lib/MAC_Documents/Publications/2013/Facts%20and%20Figures/FactsandFigures2012Eng.pdf, accessed 19 November 2013, p. 6.

274 Ibid., p. 8.

275 Ibid., p. 63.

276 Mining Industry Human Resources Council, 2013, *Publications and resources*, mihr.ca/en/publications/index.asp, accessed 11 September 2013.

277 Ibid.

Canada is also developing its capacity in liquefied natural gas with significant projects in the pipeline awaiting approval.[278] According to the Canadian Association of Petroleum Producers, Canada's Oil and Gas sector is expected to double in size by 2030. This is expected to present significant skills challenges in a range of trades, technical and professional occupations as already discussed in Chapter 5. The challenge will be exacerbated by an ageing workforce.[279]

The Petroleum Human Resources Council of Canada provides tools and services to promote skills development for Canada's Oil and Gas sector. The council includes 11 oil and gas national and regional industry organisations, including a union, and represents the key sectors of the petroleum industry such as exploration, development, production, oil and gas services and upgrading heavy oil and bitumen.

Among the council's products and services are:

- tools and resources to address 'essential skills as they relate to workplace safety, attraction and workforce development'
- the Petroleum Competency Program, which enables assessment and certification of workers in certain petroleum occupations based on industry-agreed competencies
- the Labour Market Transition Program, which 'addresses skills shortages through transitioning underemployed and displaced workers from supply pools that have a high level of transferability to petroleum in-demand occupations'.[280] In 2009, the program transitioned displaced pulp and paper workers to several in-demand oil sands occupations. This provided re-employment for 90 workers in the oil sands sector.

United Kingdom

The United Kingdom's resources industry faces critical skills shortages as well as an ageing workforce, especially in coal mining. It has also faced challenges in attracting new and young workers into the industry, which is a legacy of the mining strikes of the 1980s.[281] Staff retention is an issue, particularly for smaller companies which compete with the capacity of larger companies to retain staff during downtimes and thus offer them longevity.[282]

The Oil and Gas sector in the UK is the largest contributor to the national gross value added among the industrial sectors of the economy.[283] The industry supported 450,000 jobs in 2011–12, most of which were in high-skilled occupations.[284] The growth of the industry in recent years has created skills shortages, particularly in mid-career roles. The lack of transition training to capture transferable skills is understood to be the biggest short-term human resources issue for the industry.

Promoting 'purposeful collaboration across industry and between industry and government' is a key priority of the UK Government. The government's oil and gas policy identifies a shortage of 'high calibre graduates' in a globally competitive labour market as a significant issue to be addressed.

278 PricewaterhouseCoopers, 2013, *Is Canada becoming an energy superpower?*, pwc.com/ca/en/energy-utilities/canadian-survey.jhtml, accessed 11 September 2013.

279 Cook DL, 2013, 'Building a workforce for the future', *Context,* Canadian Association of Petroleum Producers, capp.ca/context/Pages/ContextFeature2.aspx, accessed 11 September 2013.

280 Petroleum Human Resources Council of Canada, 2013, *Workforce development resources*, petrohrsc.ca/hr-strategies-resources/workforce-development-resources.aspx, accessed 11 September 2013.

281 Lingenfelder G, 2012, 'Mind the (skills) gap', *Energy Global*, 21 August, energyglobal.com/news/coal/articles/Skills%20shortages%20in%20UK%20mining%20industry.aspx, accessed 10 September 2013.

282 Ibid.

283 Her Majesty's Government, 2013, *Industrial strategy: business and industry in partnership*, p. 7.

284 Ibid., p. 9.

Some of the strategies identified by the policy are:

- cross-industry initiatives to attract personnel from outside the Resources Sector
- linking in with existing advocacy initiatives in science, technology, engineering and mathematics
- promoting awareness and understanding of the industry
- promoting greater diversity in the sector.[285]

Oil and Gas UK has collaborated with industry stakeholders, including the Offshore Petroleum Industry Training Organisation, on initiatives to address the shortages, including the transition training program discussed in Chapter 6. The Offshore Petroleum Industry Training Organisation has also recently responded to the 'fragmented approach to skills issues' by launching a £1.2 million annual investment to create a 'first ever national oil and gas agenda'.[286] A key priority is to obtain accurate labour market intelligence to determine evidence about the current and expected skills gaps across all industry sectors.

These international examples illustrate successful collaborations between industry and governments to train future workforces and to ensure the training matches the skills needs of the industry. The approaches undertaken in Canada and the UK are noteworthy, and AWPA suggests further consideration of these in Australia's workforce-wide efforts, particularly in relation to skills from allied professions and industries for the emerging Oil and Gas sector.

7.6 Workforce development at the enterprise level

The government programs outlined above (both domestic and international) make an important contribution to workforce development in the Resources Sector. However, AWPA notes that governments exert 'limited direct influence' on workforce development, and 'workforce development occurs most naturally within the enterprise'.[287]

We also note that employers are thinking differently about workforce development compared to previous years. With the softening of the labour market in the manufacturing and construction sectors, the slowing down of resources construction activity and the scaling back of some mining operations, companies are finding it easier to recruit skilled workers across many occupations. However, while skills shortages have generally eased, pockets of ongoing skills shortages persist in key specialist roles, and competition for a very small pool of workers is fierce.

In response to this competition, many Resources Sector companies have adopted new and flexible workplace models to attract and retain specialist staff. Strategies include investing in graduate programs, attracting workers from allied sectors, facilitating the upskilling and employment of regionally based workers and supporting succession planning.

Effective skills mapping

AWPA believes effective workforce development planning should form a priority for all organisations. PricewaterhouseCoopers argues in a recent report that 'workforce planning should be done with the same level of rigour and discipline applied to financial and operational planning'. The ability of companies to 'find, recruit, develop and keep the required skills' and anticipate events that could make the planning process difficult, including changes in project schedules, for example, are paramount to productivity and the success of project ventures.[288]

285 Ibid.

286 OPITO, 2013, *Radical approach to plug oil and gas skills gaps unveiled*, uk.opito.com/about-us/news/radical-approach-to-plug-oil-gas-skills-gaps-unveiled, accessed 11 September 2013.

287 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 11.

288 PricewaterhouseCoopers, 2012, *Mind the gap: solving the skills shortages in resources*, p. 19.

Models for mapping competency and skills provide a useful planning framework for this purpose. A growing number of companies now undertake competency/skills mapping exercises to match existing supply and future demand for technical and professional skills over the longer term. These models identify specific skills, knowledge, abilities and behaviours required to operate effectively in a specific trade, profession or job role. Competency/skills mapping exercises are valuable tools for workforce policy and planning and for industry investment in education and training. Such mapping is also a prerequisite to improving the quality of workforce data available to companies to support effective decision making.

SkillsDMC has developed the 'Skills Maximiser' tool to assist organisations to undertake a skills mapping process. The tool is designed to define skills needs and to help organisations identify any gaps in the skills of their current workforce.

A number of companies have applied competency/skills mapping techniques to plan for current, emerging and future skills demands. For example, one major infrastructure company has instituted a comprehensive skills mapping model.

The company's business stream directly employs 5,000 people across the eastern states of Australia. The heavy engineering nature of the contracts undertaken by the company means a project based, contract-driven recruitment process, with short lead times.

To avoid relying on a quickly sourced, untested workforce, the company has moved to an individual assessment model of workforce planning, in which the skills and experience of each employee are quantified, assessed against specific project criteria and recorded for future reference. This allows for the identification of suitable individuals for future projects through internal mechanisms, rather than relying entirely on external recruitment for each project. Additionally, this provides a continuity of work that acts as a retention strategy for valuable employees, and recruiting efficiency as employees can be smoothly transferred to new projects as existing ones near completion.

The role of an effective employee value proposition

Building on successful workforce planning models, resources companies must provide an effective employee value proposition to attract specialist staff when competition for skills is tight. The Australian Women in Resources Alliance defines an 'employee value proposition' as an organisation's explanation of 'what an employee would experience and gain from working at one organisation compared with another' that explains the 'tangible and intangible elements such as the work environment, content, and rewards and benefits for workplace performance'.[289] An effective employee value proposition will increase the chances of a company attracting, developing and retaining the best talent, including experienced mature-aged workers.[290]

PricewaterhouseCoopers conducted a 2012 survey of 30 senior mining executives in Australia to assess attitudes of companies to workforce planning and development. One of the critical findings of the study was that the increase in wages in the mining industry 'has not necessarily achieved higher levels of retention and productivity'. The study recommended a focus on the 'less tangible aspects of an organisation's employee value proposition which includes workplace engagement and career development'.[291]

289 Australian Women in Resources Alliance, 2013, *The way forward guide to building your employment brand and selling your employee value proposition (EVP)*, amma.org.au/assets/images/stories/AWRA/Way_Forward_Guides/WFG03_BrandEVP131028.pdf, accessed 19 November 2013, p. 1.

290 Ridley S, 2011, 'Attract and retain top performers', presentation to the Workforce Development for the Resources Sector Conference 2011, Perth.

291 PricewaterhouseCoopers, 2012, *Mind the gap: solving the skills shortages in resources*, p. 31.

Other research also supports the view that higher compensation does not always produce better performance outcomes and, in some cases, can actually result in poorer outcomes. Employee engagement is created by a range of factors of which remuneration is only one. This means expensive compensation packages offered by companies may in fact become losing propositions.[292] Factors that bolster employee engagement include quality of management, learning and development opportunities and organisational culture. For older employees, factors that encourage retention include respect, recognition, meaningful work and flexibility.[293]

In recent years, many resources companies have adopted a range of worker-friendly practices, including flexible work schedules enabling positive work–life balance, career breaks, working from home, parenting leave and in-house and online education alternatives. Mining companies tailor their attraction and retention strategies so 'they are aligned to employees' geographic location, nationality and life stage' by using 'predictive modeling techniques'. This is particularly important in the Mining sector as low retention rates are often attributed to a lack of career development pathways.[294]

Building an effective employee value proposition presents an organisational challenge for many resources companies. While many companies offer rewarding conditions and wages, perceptions about limited career development options and limited job-role flexibility continue to be prevalent. Workforce cultures enabling employees to adopt flexible work schedules where possible, to undertake training and skills development and facilitate the use of new skills in the workplace can play a significant role in creating differentiation between competing companies in a tight labour market.

Investing in graduate programs

An effective employee value proposition is also essential for companies providing graduate programs. While graduate programs are widely offered, the recent scaling back of operations and cost cuts have resulted in a reduced graduate intake by some companies.[295] In this context, it is increasingly important for companies to make the most of their graduate intakes. The Resources Industry Training Council notes:

> Graduates are attracted to companies that provide quality graduate programs. These graduate programs build on the knowledge gained at university and usually involve rotation through a number of job roles and mine sites to provide recent graduates with a greater understanding of the company/industry and enable the development of practical skills.[296]

A range of mining and oil and gas companies have put in place innovative graduate programs based on job rotations to expose graduates to a variety of work roles at the start of their careers. Some of these programs are featured in the following case study.

292 Ariely D, Gneezy U, Loewenstein G and Mazar N, 2005, *Large stakes and big mistakes*, Federal Bank of Boston Working Paper No. 05-11, bos.frb.org/economic/wp/wp2005/wp0511.pdf, accessed 19 November 2013, p. 21.

293 Ridley S, 2011, 'Attract and retain top performers'.

294 Ibid., p. 15.

295 This information was provided during AWPA's consultations for this report.

296 Resources Industry Training Council, 2010, *Western Australian gas and oil industry: workforce development plan*, ritcwa.com.au/LinkClick.aspx?fileticket=oH5bC1PV7aA%3D&tabid=133, p. 15.

Graduate programs to enhance entry-level opportunities

Atlas Iron

Atlas Iron offers a graduate program running over two years in the fields of geology, mine engineering and surveying. The first year entails structured rotations, providing graduates the opportunity to learn from experienced experts and apply the valuable practical skills essential for their specialised discipline. The second year consists of a single work placement in the graduate's area of specialisation coupled with personal development training sessions. These additional sessions are aimed to support graduates by providing them with many of the professional skills required to succeed in their chosen careers.[297]

Santos

Santos's graduate program is an integral part of its capability development strategy. It targets graduates in geosciences disciplines including geology and geophysics. It also targets graduates in engineering disciplines such as petroleum, chemical, mechanical/mechatronic, environmental, electrical and civil.

The goal of the program is to attract and retain the best graduates and provide them with a career path through planned strategies including job rotations. The key features of the program are:

- targeting premier Australian tertiary institutions to attract graduates with high technical and effective communication skills
- a structured interview and selection process with consistent candidate evaluation processes
- a buddy and mentor program to assist with career advice and counselling
- a structured job rotations program and individual development plans for each graduate
- regular feedback on performance with linkages between performance and remuneration
- a peer support volunteer Graduate Group to develop a social atmosphere by organising social functions and networking events and contributing to ongoing improvements within the graduate program.

Santos's wide-ranging business interests provide opportunities for graduate employees to experience both onshore and offshore operations and the latest software applications. Santos also offers vacation employment programs for students in their penultimate year of undergraduate study which provides hands-on experience through challenging project work including at site locations and offices.[298]

7.7 Conclusion

This chapter outlined challenges in relation to workforce development for the Australian Resources Sector and featured a range of government-level, industry-level and enterprise-level responses to these challenges. The next chapter examines the participation of women, Indigenous Australians and mature-aged workers in the Resources Sector workforce and highlights a range of programs undertaken by industry to enhance workforce participation.

297 This information was provided by Atlas Iron during AWPA consultations.

298 This information was provided by Santos during AWPA consultations.

8 Approaches to encouraging workforce participation of women, Indigenous Australians and mature-aged workers in the Resources Sector

8.1 Introduction

Previous chapters of this report have noted the significant increase in employment demand for skilled workers in the Resources Sector over 2014–18 and the concerns that supply may not be adequate to meet this growth in demand. Some strategies to improve the supply pipeline of workers were discussed in Chapters 6 and 7. In addition to these strategies, there is also a need to develop approaches to encourage the workforce participation of more groups in the community. In this chapter we consider existing strategies to attract under-represented groups, such as women, Indigenous Australians and mature-aged workers, into the Resources Sector workforce to enhance its diversity.

Successful businesses garner the benefits of a diverse workforce to produce positive outcomes at both individual and organisational levels. Managing workforce diversity is widely recognised as a credible way of improving organisational competitiveness and productivity. For companies, it is an integral and systemic approach to realising the full potential of their human capital and to addressing specific issues such as skills shortages.

Managing workforce diversity accepts 'the need to value the contribution people from diverse backgrounds can make to productivity and international competitiveness'.[299] It is not oriented specifically towards redressing endemic discrimination but instead 'centres on benefits to the organisation from having a membership that mirrors the external labour force'.[300] Thus, while diversity management continues to acknowledge the factors underpinning under-representation of specific groups in the labour market, it also endeavours to apply the framework of merit and business outcomes to diversity strategies.

For Resources Sector companies, improving workforce participation of under-represented groups is critical to their business needs, which include addressing skills shortages, particularly in remote regions where resources sites are usually located. Women's participation in the resources labour market remains an unrealised potential, although this has improved in recent years. With increasing global and domestic competition for skills in the Resources Sector, realising this potential is important to increasing the pool of domestic skills supply.

The capacity of the resources industry to engage increasing numbers of women and Indigenous Australians is limited by the small numbers of these groups that actually come through the skills pipeline. As noted in earlier chapters, there are wide gaps between the numbers of male and female students who opt for science, technology, engineering and mathematics-related disciplines. Indigenous Australians are also represented in low numbers in the tertiary education system.

The Resources Sector employs one of the highest proportions of Indigenous workers in relation to its total workforce—3.1 per cent, compared with 1.4 per cent for all industries. However, the figure for women is not as positive. The Resources Sector workforce is male-dominated, with a male participation rate of 85.4 per cent compared with 54.3 per cent for all industries. While women only account for a small proportion of employment in resources, the share has increased over the past 10 years, up from 11.1 per cent in May 2003 to 14.6 per cent in May 2013.

299 Equal Opportunity for Women in the Workplace Agency cited in AusIMM, 2003, *Increasing the diversity of the mining industry—strategies for employers*, ausimm.com.au/content/docs/divers180803.pdf, accessed 18 November 2013.

300 Gullett CR, 2011, 'Reverse discrimination and remedial affirmative action in employment: dealing with the paradox of nondiscrimination', *Public Personnel Management* 29(1), pp. 107–118, cited in AusIMM, 2003, *Increasing the diversity of the mining industry—strategies for employers*.

Mature-aged workers are under-represented in the Resources Sector and this presents potential loss of experience and corporate knowledge for enterprises. Strategies are being developed to address upskilling and reskilling of mature-aged workers, but more needs to be done to transform workplace culture in favour of flexible work patterns in order to retain older workers.

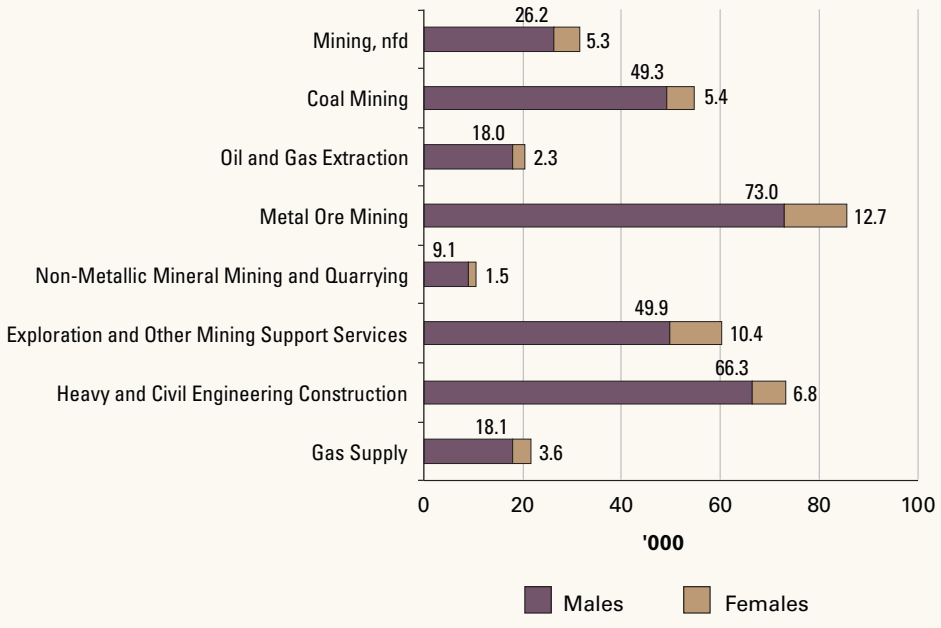
Future trends in the participation of these groups will be influenced by changes in the workplace patterns in the resources industry such as automation. As noted in earlier chapters, automation will bring both benefits and barriers to participation. For women, outcomes of automation such as remote working will reduce the need to relocate to mining sites and allow working from home. Automated processes will also replace some of the physically demanding and dangerous onsite work, which will make employment in the Resources Sector more appealing to women. However, for Indigenous Australians, the movement of jobs away from actual operating sites due to increased automation may reduce their employment opportunities in the Resources Sector.

In this chapter we examine data related to participation trends, barriers faced by under-represented groups and strategies currently used by companies to enhance the workforce participation of women, Indigenous workers and mature-aged workers.

8.2 Women in the Resources Sector workforce

As noted before, when compared with other industries, the Resources Sector has one of the lowest participation rates for women. The share of employment for women in the sector has historically been low. Figure 35 shows the number of men and women in full-time employment in the resources industry in August 2013. Men accounted for more than 80 per cent of employment in each of these industry areas. Metal Ore Resources had the highest number of women workers at 12,700 (15 per cent of its workforce).

Figure 35 Full-time employment level ('000), resources subsector by gender, August 2013

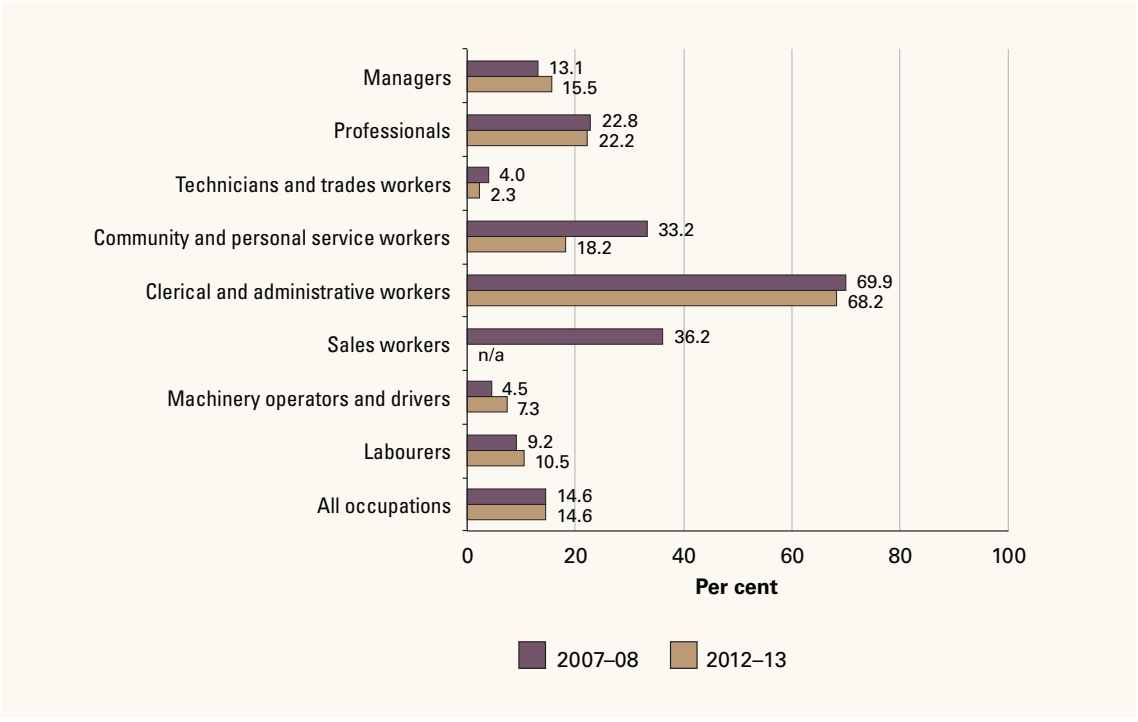


nfd = not further defined.

Source: ABS, *Labour force, detailed, quarterly, August 2013*, cat. no. 6291.0.55.003.

Figures 36 and 37 show the numbers of women by occupational level in the Resources Sector and in all industries in 2007–08 and 2012–13. In the Resources Sector, women are under-represented in the occupational groups of Managers and Professionals; in 2012–13 they constituted only 15.5 per cent and 22.2 per cent of the total workforce respectively, compared with 34.7 per cent and 52.5 per cent respectively for all industries. However, the proportion of women in some occupations in the Resources Sector showed marginal increases between 2007–08 and 2012–13. The share of women in the occupational grouping of Managers increased by 2.3 per cent and by 2.8 per cent in the occupation of Labourers.

Figure 36 Female participation in the Resources Sector at occupational level, 2007–08 and 2012–13



Source: ABS, *Labour force, Australia, detailed, quarterly*, cat. no. 6291.0.55.003.

Figure 37 Female participation in all industries at occupational level, 2007–08 and 2012–13

Source: ABS, *Labour force, Australia, detailed, quarterly*, cat. no. 6291.0.55.003.

Over the years, the Resources Sector has been proactive in addressing the issue of women's participation and there has been a suite of research and projects targeting strategies to attract and retain women and to improve workplace culture. In June 2013, the Minerals Council of Australia released a comprehensive study, *Workforce gender diversity review white paper*, which examined the recent literature on women in resources including industry responses to remove identified barriers to women's participation. The council's recommendations included strategies to address gaps in existing approaches,[301] noting that while industry has been proactive in developing programs to boost the participation of women, some issues persist including the work patterns of the sector such as fly-in, fly-out arrangements, physical demands at operating sites and underground mines, and limited part-time options.

Barriers to women's participation in the Resources Sector

International research confirms that barriers to increasing women's participation are found globally across the Resources Sector. A 2012 study by Canada's Carleton University Centre for Women in Politics and Public Leadership found that women across the global Resources Sector face barriers in relation to career advancement opportunities, work–life balance in the context of mobility demands of the industry and 'the male-dominated culture' which 'continues to exist through implicit, hidden, and subtler forms of biases in the workplace'.[302]

AWPA's 2012 report also discussed factors affecting women's participation in the Resources Sector. These include perceptions of the sector as being a 'masculine work environment accompanied by sexual harassment and bullying' and gendered perceptions of capabilities ('women are more family-oriented than career-oriented'). The report identified other factors such as lack of career

301 MCA, 2012, *Workforce gender diversity review white paper: 'It's not just a program'*, wgea.gov.au/sites/default/files/Minerals-Council-of-Australia-(2013)-The-MCA-Workforce-Gender-Diversity-Review.pdf, accessed 19 November 2013, pp. 48–57.

302 Ozkan UR and Beckton C, 2012, *The pathway forward: creating gender inclusive leadership in mining and resources*, p. 6.

development pathways for women due to limited mentoring opportunities and appropriate role models, and lack of access to senior roles in companies. Workplace flexibility was also a key issue for women where, despite the existence of family-friendly policies, long hours were considered the norm. Women planning maternity leave faced strong challenges when it interfered with production schedules.[303] These factors continue to persist and have been highlighted in subsequent studies such as the Minerals Council of Australia's white paper.[304]

In general, factors that affect women's participation in the Resources Sector workforce fall into two categories—their low representation in the skills pipeline and the workplace culture in the sector.

Low representation of women in the skills pipeline

The under-representation of women in senior roles can be traced back to the skills pipeline at schools and universities and the fact that there are low numbers of women studying science, technology, engineering and mathematics-related disciplines relevant to Resources Sector occupations. This is discussed in detail in Chapter 6, where it is noted that gender disparity in science, technology, engineering and mathematics participation is greater now than it was in the 1980s.

The skills pipeline issues make it challenging to make large-scale improvements in women's participation at the overall industry workforce level. As noted in Chapter 6, strategies to improve women's participation in science, technology, engineering and mathematics will go some way towards addressing these challenges.

Workplace culture

As noted in AWPA's 2012 Resources Sector report, workplace culture remains a barrier to women's participation. Despite the existence of family-friendly policies and gender diversity management strategies in many companies, women's take-up of these policies is affected by management expectations and gendered perceptions of capabilities and roles.

In a 2010 study of women's experiences in the Western Australian resources industry 45 women working in the industry were interviewed to assess their workplace experiences. The study found there was low take-up of family-friendly company policies where they did exist ('while policies are great, the practical application can be difficult'). The study found that implicit values around work–life balance deterred women from using such policies and persistence of 'the boys club' at senior management levels exacerbated the challenges.[305]

The predominantly masculine workplace culture in the Resources Sector is the key challenge to women's participation and, as the Minerals Council of Australia's white paper indicates, resources companies are aware of the need to continue to transform their workplaces in order to attract and retain women.

The white paper made a number of recommendations targeted at improving workplace culture, including:

- providing mentoring for young female professionals
- allowing flexible work patterns to accommodate work–life balance issues
- maintaining and enhancing measures to address discrimination and sexual harassment in workplaces

303 AWPA, 2012, *Resources Sector skill needs*, p. 66.

304 MCA, 2012, *Workforce gender diversity review white paper: 'It's not just a program'*.

305 Barrera S, Gardner J and Horstman B, 2010, 'Women's experiences in the Western Australian resources industry: a snapshot in 2010', paper presented to the Our Work Our Lives 2010 National Conference, Darwin, ntwwc.com.au/uploads/File/OWOL%20conference%20papers/Barrera,%20Gardner,%20Horstman.pdf, accessed 19 November 2013, p. 6.

- addressing psychological barriers such as 'professional role confidence'—in some cases women find it challenging to fulfil 'roles, competencies, and identity features of a profession', which reduces their confidence levels and may lead to them leaving the profession
- supporting re-entry pathways for women to resume careers
- enhancing skills at management levels in managing diversity.[306]

The largely full-time nature of resources jobs points to the persistence of practices where flexibility in work schedules is low. Since women access part-time options to balance their work and caring duties, low take-up of part-time jobs indicates that more can be done to implement flexible policies in Resources Sector workplaces. AWPA acknowledges that often this may be difficult to achieve due to the demands of production schedules.

Women's participation in the Oil and Gas sector

Increasing women's participation takes on added urgency in light of the skills demands of the growing Oil and Gas sector in Australia. The sector's workforce is small and women comprise a very small proportion.

Anecdotal evidence suggests the presence of women workers on oil rigs is a novelty in Australia. In the article 'On the rigs', mechanical engineer Yassmin Abdel-Magied highlighted the challenges of being the only female worker on a 25-person oil rig in Central Western Queensland:

> What has been most surprising about the experience, however, is not the physical aspect or the male-dominated environment—studying engineering will accustom any woman to this, only five women graduated in my year in a class of 200—but the constant reminder of gender.[307]

The article discussed the 'unapologetically male' workplace culture where women were expected to fit in, where remoteness and isolation exacerbated the challenges of not having a critical mass of a community of women workers, and where amenities were often not adapted for women. However, Abdel-Magied acknowledged that while numbers of women on oil rigs are very low, there are increasing numbers of women in other professional occupations in the Oil and Gas sector such as geologists and engineers in wireline and drilling services.[308]

When compared to the Australian experience, data from the Canadian Resources Sector highlights women as having a high representation in the Oil and Gas sector. In 2011 women formed 27.2 per cent of the workforce in the Canadian Oil and Gas sector, compared with 12.3 per cent of the coal resources workforce and 15.2 per cent of the Support for Resources Activities workforce.[309] Norway is another country with relatively high levels of participation by women in the Oil and Gas sector. Depending on the type of company, women can constitute as much as 30 per cent of the total workforce in the Norwegian oil companies.[310]

Norway and Canada have well-established Oil and Gas sectors, and the approaches they have used could provide models for improving women's participation in the Oil and Gas sector in Australia. Some Australian companies have already developed innovative approaches to gender diversity management such as the Women@Clough program run by Clough Limited, an engineering and construction company servicing the Resources Sector. The success of the program is attributed to 'positioning the strategy as a business issue, rather than a gender issue' and to including senior male staff in its operations. The focus on the long-term skills pipeline of women into the company

306 MCA, 2012, *Workforce gender diversity review white paper: 'It's not just a program'*, pp. 39–47.

307 Abdel-Magied Y, 2013, 'On the rigs', *Griffith Review Edition 40: Women in Power*, Griffith University, Victoria, griffithreview.com/edition-40-women-power/on-the-rigs, accessed 19 November 2013.

308 Ibid.

309 Catalyst, 2013, *Women in gas, mining & oil in Australia, Canada & the US*, catalyst.org/knowledge/women-gas-mining-oil-australia-canada-us, accessed 27 September 2013.

310 Marinelli M and McGrath K, 2012, 'Female participation in the Australian oil and gas industry—a global comparison', abstract of presentation at the 2012 APPEA National Oil and Gas Conference.

prevented a 'stop-gap' approach, and the board's endorsement of the program also reinforced the importance of the initiative within the company.[311]

Enterprise-level responses to improve participation of women

The 2012 Carleton University study included international best practice examples of enterprise-level initiatives to increase female participation in the Resources Sector workforce, many of which are located in Australia. One of the innovative approaches highlighted was the development of women's unions in South Africa 'which are responsible for relaying women's demands (such as offering career development advice, providing hostels in resources sites, as well as underground toilets for women) to management'.[312] Other initiatives included Anglo American Metallurgical Coal's Speak Up program and Rio Tinto Coal Australia's Speak OUT program, which has 'a 24 hour, independent, confidential and anonymous service' to deal with workplace harassment issues.[313]

Australian resources companies often go beyond their compliance requirements in providing attractive employee value propositions that include benefits such as paid parental leave, mentoring networks and career development opportunities. Recognising the lack of career development pathways as a barrier to women's participation, the Minerals Council of Australia has targeted enhanced opportunities for women to participate in senior management roles by successfully nominating three women through its member companies for the Australian Institute of Company Directors scholarships.[314] These scholarships are offered to high-performing women to undertake the Company Directors Course or Mastering the Boardroom program and are aimed at increasing women's representation on company boards.[315] The following case studies of company policies and programs illustrate the commitment by industry to increase the presence of women at senior management levels and to integrate gender diversity management with merit recognition frameworks.

311 Ibid.

312 Ozkan UR and Beckton C, 2012, *The pathway forward: creating gender inclusive leadership in mining and resources*, p. 38.

313 Ibid., p. 39.

314 MCA, 2012, *Workforce gender diversity review white paper: 'It's not just a program'*, p. 10.

315 Australian Institute of Company Directors, 2011, *Scholarship programs*, companydirectors.com.au/Director-Resource-Centre/Governance-and-Director-Issues/Board-Diversity/Scholarship-Program, accessed 10 October 2012.

Emerging Leaders Program—OZ Minerals

OZ Minerals has aimed to address the low representation of women in senior management levels through a high-performance leadership program that includes mentoring.

The Emerging Leaders Program targets high-performing women employees who could achieve a leadership position two levels above their current level within the next two to five years.

OZ Minerals employs strict criteria for nomination to the program, and all Emerging Leaders must have the trifecta of high performance, aspiration to achieve a leadership role and consistent demonstration of behaviours recognised as Leadership Potential Differentiators.

Emerging Leaders participants undertake an intensive five-day residential program to accelerate their management and leadership development. The program involves a 360 degree assessment identifying leadership strengths and areas for development, and best-practice approaches to implementing strategy and improving performance. Skills are developed in managing conflict, leading performance and negotiating internally for more productive outcomes. Emerging Leaders participants are strategically paired with a senior executive or non-executive director for the mentoring component of the program.

This program is designed to prepare the next generation of future leaders for the company and is closely connected with succession planning. All Emerging Leaders participants (current and previous) are tracked against specific succession plans, and to date 55 per cent have achieved promotions. This is a significant achievement given that the program commenced in 2010.[316]

Human Resources Strategy—St Barbara[317]

St Barbara (ASX: SBM) is one of Australia's largest ASX-listed gold producers and explorers, employing over 620 staff and contractors in Australia. St Barbara has operations at Leonora in Western Australia, Simberi Island in Papua New Guinea and Gold Ridge on Guadalcanal Island in the Solomon Islands.

St Barbara has implemented a systematic and sustainable approach to reduce the pay equity gap. Six years ago the human resources practices at St Barbara were transactional. They consisted mostly of recruitment and there was no linkage to the business strategy. A remuneration strategy did not exist and the pay equity gap was a staggering 43 per cent.

From a standing-start in 2007, St Barbara now has in place a human resources strategy that is hard-wired to the company's business strategy and approved by the board. The success of each of the six strategic human resources priorities is underpinned by diversity.

316 This information was provided by Oz Minerals during AWPA's consultations.

317 This information was provided by St Barbara during AWPA consultations.

Talent Management Framework

To help bring these priorities to life and to make them sustainable, St Barbara has developed a Talent Management Framework. The framework comprises a range of initiatives and removes the undue reliance on individual people. Consistent with the strategic human resources priorities, with respect to gender diversity the company now has in place a competitive and effective remuneration system; competitive parental leave provisions; a gender diversity policy that is in line with Australian Stock Exchange recommendations; and gender diversity targets for reducing the pay equity gap, increasing the percentage of women across the company including on the board, and boosting the number of women returning from parental leave.

All of these initiatives have been approved by St Barbara's board. The initiatives are actively led by the executive leadership team and reviewed regularly by the board.

As a result of these initiatives, the pay equity gap at St Barbara has reduced from a staggering 43 per cent in 2007 to 15.9 per cent in 2013 (compared with 22.6 per cent for the mining industry[318]), the percentage of women in St Barbara's Australian workforce is now 25.4 per cent (compared with the mining industry at 15.4 per cent[319]), and 29.2 per cent of women in St Barbara are in leadership roles (compared with the mining industry at 13.7 per cent[320]).

318 Workplace Gender Equality Agency, 2013, *Gender pay gap statistics August 2013*, wgea.gov.au/sites/default/files/2013-08-28-Gender-Pay-Gap%20FINAL.pdf, accessed 19 November 2013.

319 Workplace Gender Equality Agency, 2013, *Women in the workforce: by industry*, wgea.gov.au/sites/default/files/2013-07-25%20-%20Women%20in%20the%20workforce%20by%20industry_FINAL_0.pdf, accessed 19 November 2013.

320 Workplace Gender Equality Agency, 2012, *Industry snapshots: mining*, wgea.gov.au/sites/default/files/All_Industries_2012.pdf, accessed 19 November 2013.

8.3 Indigenous Australians in the Resources Sector workforce

The share of Indigenous employment in the Resources Sector has improved strongly over the past five years, suggesting that employer initiatives are making a positive impact.[321] The increase has coincided with increases in total Indigenous employment.

Indigenous employment in the resources industry more than doubled between the 2006 and 2011 censuses (Table 66), with 3.6 per cent of resources employees identifying themselves as being Aboriginal or Torres Strait Islander or both. In the Construction sector, employment of Indigenous Australians increased by more than 3,000 workers between the 2006 and 2011 censuses. Compared to the all-industry figure of 1.4 per cent of the workforce, these figures indicate that the Resources Sector has achieved strong outcomes in Indigenous workforce participation.

Table 66 Indigenous employment in the resources and Construction industries, 2006 and 2011 censuses

Industry	2006 Census	2006 Census (%)	All industry 2006 Census (%)	2011 Census	2011 Census (%)	All industry 2011 Census (%)
Resources	2,488	2.3	1.3	5,433	3.1	1.4
Construction	8,386	1.1	1.3	11,751	1.4	1.4

Source: ABS, 2006 and 2011, *Census of population and housing*.

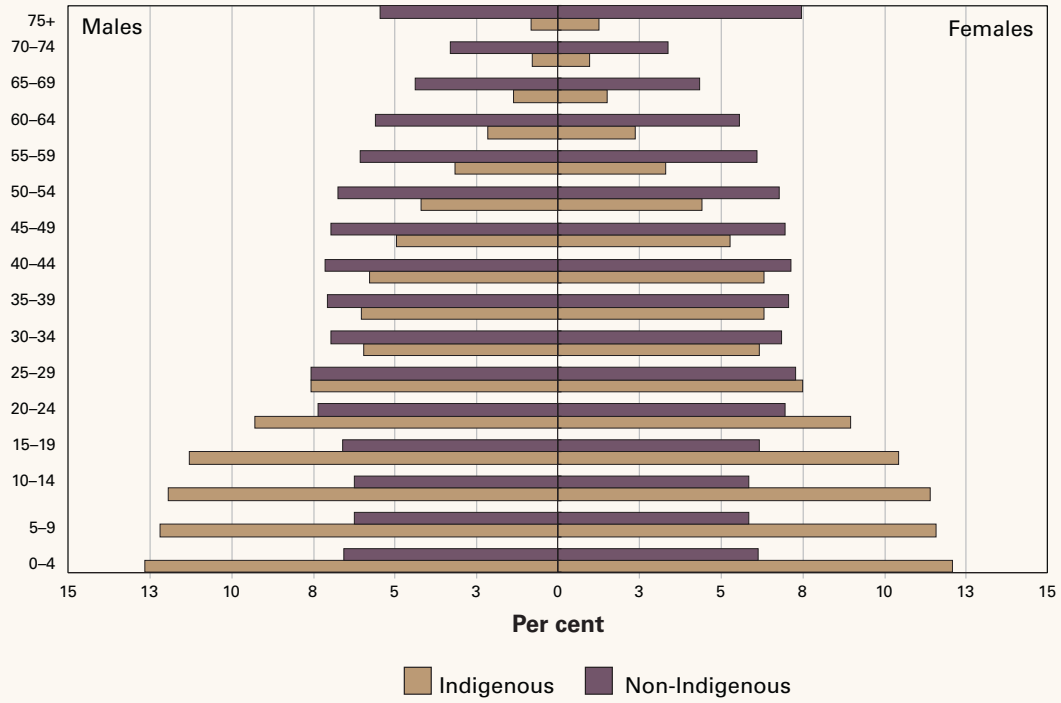
Demographic trends in the Indigenous population indicate the proportion of people of working age (between 15 and 54 years of age) is increasing and is projected to comprise 50 per cent of the Indigenous population by 2016.[322] Figure 38 shows that in 2011, 35.8 per cent of Indigenous Australians were under 35 years of age, compared with 18.3 per cent of non-Indigenous Australians.[323] This is important as it will balance the effects of an ageing demographic trend in the non-Indigenous Australian population and will potentially provide a source of young workers for the Resources Sector.

321 Gray M, Hunter B and Lohoar S, 2012, *Increasing Indigenous employment rates*, Closing the Gap Clearinghouse, Australian Institute of Health and Welfare, aihw.gov.au/uploadedFiles/ClosingTheGap/Content/Publications/2012/ctg-ip03.pdf, accessed 19 November 2013, p. 16.

322 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, Centre for Social Responsibility in Mining, University of Queensland, csrm.uq.edu.au/docs/CSRM%20Report_FINAL%20TO%20PRINT_singles.pdf, accessed 19 November 2013, p. 11.

323 ABS, 2012, Aboriginal and Torres Strait Islander population estimates 2011—preliminary, Australian Demographic Statistics, *Census of population and housing*, March, cat. no. 3101.0.

Figure 38 Age distribution of Indigenous and non-Indigenous populations by gender, 30 June 2011



Note: The 75+ age group includes all ages 85 years and over and is not directly comparable with the other age groups.

Source: ABS, 2011, *Estimates of Aboriginal and Torres Strait Islander Australians, June estimates*, cat. no. 3238.0.55.001.

In addition, according to Australian Bureau of Statistics data, a significant proportion of Indigenous people live outside urban centres.[324] Remote Indigenous communities thus provide local skills for resources operations that are mostly located in these regions. This can bring cost benefits to companies in a range of areas such as relocation costs associated with fly-in, fly-out workers. It also provides companies with access to local suppliers and businesses for 'non-core' business contracting.[325]

In recognition of the importance of the continued and enhanced engagement of Indigenous Australians in the workforce, the Prime Minister, the Hon Tony Abbott MP, recently announced a review of Indigenous training and employment programs.[326] The review, chaired by Fortescue Metal Group chairman Andrew Forrest, will consider issues and develop 'practical recommendations to ensure Indigenous training and employment services are targeted and administered to connect unemployed Indigenous people with real and sustainable jobs'. It aims to develop 'innovative approaches' such as 'practical life training and mentoring'.[327]

324 ABS, 2011, *Estimates of Aboriginal and Torres Strait Islander Australians, June estimates*, cat. no. 3238.0.55.001.

325 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, p. 11.

326 Maher S, 2013, 'Review aims to find real jobs', *The Australian*, 8 October, theaustralian.com.au/national-affairs/policy/review-aims-to-find-real-jobs/story-fn9hm1pm-1226734354035, accessed 9 October 2013.

327 Department of the Prime Minister and Cabinet, 2013, *Indigenous jobs and training review*, indigenousjobsandtrainingreview.dpmc.gov.au/about, accessed 30 October 2013.

Best practice approaches to Indigenous engagement in the resources workforce

Best practice approaches to Indigenous engagement used by resources companies share some features including partnerships which involve local community leaders and networks, and organisational commitment including appropriate personnel in training and liaison positions who are respected by Indigenous communities. Other key characteristics relate to recruitment, retention and training support.

Recruitment

Recruitment strategies targeted at Indigenous workers incorporate cultural preferences including face-to-face engagement, flexible management strategies and cultural awareness training for all workers. Recruitment pathways often use culturally appropriate psychometric testing and a proactive approach which includes outreach work such as visits to local communities and disseminating information through land councils, word of mouth and on local Indigenous radio stations. In addition, in some companies, unsuccessful applicants are provided feedback and sometimes personal development plans.[328]

Downer EDI Mining was the joint winner of the Indigenous Employment Award at the inaugural Australian Human Resources Institute Diversity Prize in 2012 for its suite of culturally appropriate human resources strategies.[329] This included onsite assessment workshops instead of conventional recruitment processes. Potential candidates were assessed for practical work in a training simulator and provided with 'experiential learning activities', presentations and a tour of the mine. The training was led by members of Downer EDI Mining's Indigenous affairs team, local site supervisors and human resources staff.[330] Table 67 compares standard practices used by companies against good practice models for Indigenous recruitment.

328 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, p. 31.

329 Downer EDI Mining, 2012, *Downer Mining wins AHRI diversity award*, downergroup.com/Media/Community-News/2012/Downer-Mining-wins-AHRI-Diversity-Award.aspx, accessed 1 October 2013.

330 Downer EDI Mining, 2013, *Indigenous affairs*, downergroup.com/Documents/Collateral/Downer-Mining_Indigenous-Recruitment-Capability-Statement.pdf, accessed 19 November 2013, p. 2.

Table 67 Comparison between good practices in mainstream and Indigenous recruitment processes

Step	Mainstream	Indigenous
Advertise/ promote	Advertise in newspapers, jobs boards and company websites	Go to the community, hand out advertisements, talk/ explain to individuals and families about the positions vacant, answer questions. Talk to previous applicants and/or people on the company regional database who have the requisite skills. Post advertisements on community noticeboards
Applications/ resumes	Submitted in hard copy or electronically	Prepared in hard copy or electronically. Assistance provided to applicants in completing forms and writing resumes during community visits. Collect applications/ résumés during community visits
Short-list	Assessing applications and résumés; telephone interviews; reference checks	Assessing applications and résumés. Reference checks, local knowledge
Selection	Final shortlisting of applicants	Selection centre workshops of 1–4 days
	Interview by human resources officer	In very small regions where all Indigenous applicants are known, interviews are conducted by experienced non-Indigenous and Indigenous company personnel
	Psychometric test, if required	Culturally appropriate psychometric test
	Medical, if required	Medical that includes appropriate feedback
	Alcohol and drug test, if required	Alcohol and drug testing that includes appropriate feedback and follow-up
	Security clearance, if required	Security clearance that includes appropriate screening
	Best candidate chosen	Affirmative action policy and practice that allows Indigenous people who meet a range of acceptable levels for the role to be selected
Offer of employment	Successful applicants informed in writing	Successful applicants informed in writing
	Unsuccessful applicants informed in writing	Unsuccessful applicants briefed and supported appropriately as required

Source: Adapted from Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, Centre for Social Responsibility in Mining, University of Queensland, p. 25.

Entry-level pathways

Work-readiness programs are important pathways into employment for potential Indigenous workers. These programs assist with developing work habits such as attendance, punctuality, following instructions, and skills to balance family, social, community and work obligations. Programs include Australian Qualification Framework traineeships and pre-vocational or pre-employment programs, and 'the evidence so far suggests that these are very effective programs for enabling Indigenous people to make the transition from community life to the mainstream workforce'.[331] For example, BHP Billiton Iron Ore's Indigenous Mining Skills Program was piloted in 2006 in partnership with Macmahon Holdings, a mining and construction contractor.

331 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, p. 32.

The program was designed to provide a pathway to employment opportunities in the Mining industry. The program graduated 10 students in 2006 and the number increased to 80 students in 2010.[332]

Retention strategies

All-Indigenous work groups aim to provide a support network for Indigenous workers and to boost individual self-confidence. Evidence from existing programs also indicates they are 'a very effective way of keeping young Indigenous men from remote communities involved in training schemes'.[333]

Other targeted retention strategies include mentoring, especially in the first 12 months of employment. Important aspects to be considered when developing an effective mentoring strategy for Indigenous workers are:

- supportive workplace requirements—the mentoring strategy has to be integrated into workplace planning and strategic policies
- training for mentors—integration of cultural awareness training even if mentors are of Indigenous background themselves, in recognition of the heterogeneity of Indigenous cultures
- specific mentoring processes that need to be addressed by mentors—the process needs to be two-way and to include the family and community of the worker.[334]

Rio Tinto has developed a holistic Indigenous Employment in Australia strategy which covers partnership approaches with Indigenous communities, financial assistance for Indigenous students, job readiness training and career development.

At Rio Tinto's Argyle Diamond Mine, its apprentice and trainee work readiness program has been in place for about eight years. Some of the features of this scheme are highlighted in the following case study.

332 Howard L, 2010, 'Indigenous pre-employment and workplace training in Macmahon Pilbara Operations', presentation to the NCVER No Frills Conference 2010, vital.new.voced.edu.au/vital/access/services/Download/ngv:44130/SOURCE2, accessed 7 November 2013, p. 4.

333 Ibid., p. 35.

334 Brereton D and Taufatofua R, 2010, *Good practice in the mentoring of Indigenous employees*, Centre for Social Responsibility in Mining, University of Queensland, p. 1.

Rio Tinto Argyle Diamonds—support processes for Indigenous workers

Argyle's work ready program is a formal process targeted at trainees and apprentices. The formal program is preceded by extensive work with families and communities to understand local barriers and strengths. The work readiness team supports the applicants through a four-day workshop on site at Argyle to assess the current capabilities of potential trainees and apprentices. Successful applicants are then placed in a longer four- to six-week formal work readiness program in preparation for the commencement of their formal apprenticeship or traineeship.

The success of this program is based on the individual approach taken with each participant, including the holistic linkage to families and a support process that is tailored to individual needs. The work ready team is small, consisting of an Indigenous superintendent and two support roles filled by local Indigenous staff.

Supplementing this team is a partnership with the Kimberley Training Institute, which is in place to provide workplace literacy and numeracy skills under the Australian Workplace English Language and Literacy (WELL) program. This program enables gaps identified during the assessment workshop to be addressed and sets the participants up for success when they undertake training and role placements.

Argyle has recently restructured the WELL program so that support is available for all interested Indigenous employees (and many contractors) rather than just for apprentices and trainees.

The scheme has delivered some positive outcomes, namely retention rates for apprentices exceeding previous expectations and all apprentices and trainees securing employment at the end of their training. These participants have served as 'good workers and social role models' both in the business and in the wider community.

Other Rio Tinto companies in Australia, such as Rio Tinto Alcan and Rio Tinto Energy, have Indigenous mentoring programs in place for their employees. In the case of Rio Tinto Alcan, the program is undertaken by experienced Indigenous employees who provide advice, guidance and support during the critical first year of employment.

In the Northern Territory, Rio Tinto's Energy Resources of Australia operates a mentoring program that includes a buddy system and peer mentoring in the workplace.

At Rio Tinto Iron Ore, a comprehensive Indigenous mentoring program is delivered by more than 15 dedicated staff assisting Indigenous employees and their leaders to work together to achieve business objectives and leadership goals by providing cultural, personal and technical guidance.

Overall, Rio Tinto is one of the largest private sector employers of Indigenous people in Australia. In mid-2013, the company employed directly over 1,700 Indigenous workers and a further 700 contractors across Rio Tinto's Australian businesses.

In addition to established mentoring support, workplace practices such as flexible rosters, and a balance between work and family/community commitments also support retention of Indigenous workers. Over time, industry has invested in research to better understand the challenges associated with retention. For example, Rio Tinto Iron Ore has partnered with the Centre for Social Responsibility in Mining to contribute to a project on Indigenous retention at Rio Tinto Iron Ore. It is expected that this project will offer useful insights into community workforce sustainability across the industry.

Career development pathways and monitoring and evaluation

Career development pathways are required to address the longer term benefits of upskilling. These benefits, which include enhanced job prospects following the completion of short-term resources jobs, are not self-evident and there is a need to educate workers about these issues.

Monitoring and evaluation of Indigenous-related diversity strategies includes exit interviews with workers who leave the company, tools to gauge organisational maturity around relevant policies and practices, and evidence-based assessment of outcomes and results.

Enterprise-level approaches to Indigenous engagement in the Resources Sector

The resources industry is well placed to be a key player in improving the labour market participation of Indigenous Australians. Since the development of international and domestic instruments that acknowledge the land rights of Indigenous peoples and the obligation of the resources industry to distribute the economic benefits from resources to traditional owners, resources companies have been proactive in improving the quality of life in Indigenous communities.[335] Companies such as MMG, Arrow Energy, Fortescue Metal Group, Rio Tinto and Chevron provide employment, training opportunities and other capacity-building initiatives in local communities. Large corporations are able to invest in training and to link training with pathways into employment. They provide upskilling and professional development opportunities through leadership, management and governance skills. As noted in a 2007 report on Indigenous employment published by the Centre for Social Responsibility in Resources:

> If Indigenous people are to live in prosperous and sustainable communities, it is essential for them to develop leadership and management skills, which are essential competencies of viable communities.[336]

Resources companies have a range of programs to enhance the quality of their engagement with Indigenous workers and to improve retention and upskilling opportunities. For example, MMG prioritises sourcing local employment and at some sites has an Indigenous workforce participation of about 20 per cent. Each mine site has a community team, which handles Indigenous staff recruitment and management, recognising that there are unique issues and sensitivities associated with Indigenous employees.[337]

Indigenous participation at MMG's Century mine

MMG's Century mine in northwest Queensland was one of the first Australian mines to provide education, employment and training opportunities to Indigenous Australians and local people. Century's approach to Indigenous employment includes an offsite Work Ready, Job Ready program at Myuma, an Indigenous training organisation to assist participants to get ready for entry into traineeships and apprenticeships. Participation in the program is jointly funded by the Queensland Government, Myuma and Century.

Other aspects of MMG's Indigenous employment focus include onsite literacy and numeracy assistance, ongoing support by experienced mentors and offsite placements to enable trainees and apprentices to gain broader trade experience.[338]

Other companies such as Arrow Energy offer training for Indigenous suppliers to build their capacity in tendering for supplier contracts[339] and have employment strategies targeting Indigenous workers.[340] Fortescue Metals Group's Vocational Training and Employment Centre program includes literacy programs and provides an employment guarantee for those who successfully complete.[341]

335 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, p. 9.

336 Ibid., p. 10.

337 This information was provided during AWPA's consultations for this report.

338 Tiplady T and Barclay MA, 2007, *Indigenous employment in the Australian minerals industry*, p. 10; Case study information provided by MMG during AWPA consultations.

339 Arrow Energy, 2013, *Indigenous companies training in Brisbane*, media release, 16 August, arrowenergy.com.au/__data/assets/pdf_file/0007/7675/Aug-16-Whanu-Binal-business-extension-day.pdf, accessed 19 November 2013.

340 Arrow Energy, 2013, *Indigenous relations*, arrowenergy.com.au/sustainability/indigenous-relations, accessed 1 November 2013.

341 Fortescue Metals Group, 2013, *People and careers*, fmgl.com.au/people_and_careers/VTEC, accessed 1 November 2013.

Rio Tinto and Chevron both offer Indigenous cadetship programs with the assistance of the national Indigenous Cadetship Support project. Rio Tinto's program is open to Indigenous students studying full-time in a variety of engineering and science courses. As part of the program, cadets are offered financial support for university fees and books, 12 weeks paid holiday employment, career development and mentoring.[342] Chevron's program provides Indigenous university students with financial assistance during their studies and paid work experience during summer breaks. The program is limited to Indigenous students who are studying towards their first undergraduate degree in the fields of commerce, engineering, information technology, law, finance, accounting, health and safety, human resources and environmental sciences.[343]

Barriers to Indigenous participation in professional and high-skilled jobs

While the participation of Indigenous Australians in the resources workforce is strong, it is mostly in semi-skilled and low-skilled positions. The gap between Indigenous and non-Indigenous students in participation in school education flows through to post-school education. For example, based on the Australian Bureau of Statistics' 2006 Census figures, by the ages of 20 to 24, only 36 per cent of Indigenous Australians had completed Year 12 compared with 74.5 per cent of non-Indigenous Australians.[344]

Indigenous students are 'significantly and substantially less likely to undertake post-school education'. Only 68.6 per cent of Indigenous youth surveyed in the 2006 Longitudinal Study of Australian Youth expected to study for a degree, which is lower than the figure for non-Indigenous youth (79.6 per cent).[345] While remoteness is an influencing factor, research points to the fact that these differences cannot simply be attributed to socio-economic and geographic reasons alone. Disparities in educational outcomes between Indigenous and non-Indigenous students appear early, which points to the fact that early interventions are most effective in improving the situation.[346]

In its submission to the Review of Higher Education Access and Outcomes for Aboriginal and Torres Strait Islander People, the Minerals Council of Australia suggested a 'whole-of-education' approach is required to provide 'multi-level support' for Indigenous students who face particular challenges related to relocation and removal from their community contexts.[347] The submission highlighted several initiatives undertaken by industry to address the need to increase the representation of Indigenous Australians in professional roles. For example, the Minerals Council of Australia is a principal sponsor of The Aspiration Initiative, which aims to understand reasons for under-representation of Indigenous Australians in universities, provides information about tertiary education opportunities to Indigenous school students and 'supports and inspires students to excel in their university studies' through accessing scholarships and other similar opportunities.[348]

342 Rio Tinto, 2013, *Australian Indigenous Cadetships*, riotinto.com.au/ENG/careers/1325_australian_indigenous_cadetships.asp, accessed 28 October 2013.

343 Chevron, 2013, *Aboriginal employment opportunities*, careers.chevron.com/global_operations/country_operations/australia/australia_aeo.aspx, accessed 28 October 2013.

344 Biddle N and Cameron T, 2010, *Potential factors influencing Indigenous education participation and achievement*, NCVER research report, ncver.edu.au/publications/2560.html, accessed 6 November 2013, p. 8.

345 Ibid., p. 27.

346 Ibid., p. 7.

347 MCA, 2011, *Review of higher education access and outcomes for Aboriginal and Torres Strait Islander people,* submission to the Australian Government's Review of Higher Education Access and Outcomes for Aboriginal and Torres Strait Islander People, mineralscouncil.com.au/file_upload/files/submissions/MCA_Higher_Education_Access_and_Outcomes_for_Aboriginal_and_Torres_Strait_Islander_People_FINAL.pdf, accessed 8 November 2013, p. 2.

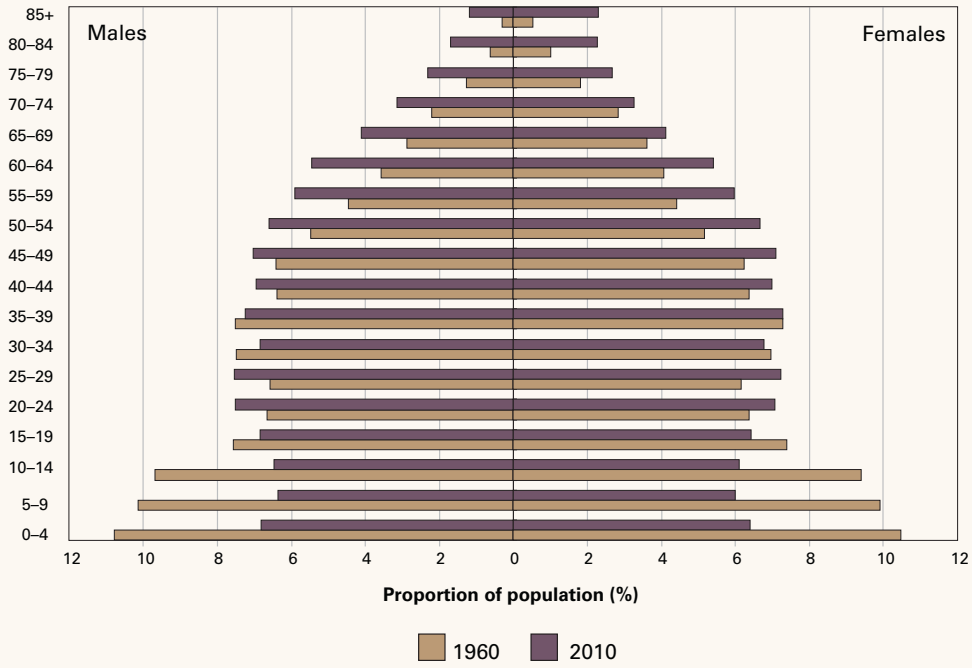
348 The Aurora Project, 2013, *About TAI*, auroraproject.com.au/about_TAI, accessed 1 October 2013.

8.4 Mature-aged workers in the Resources Sector workforce

AWPA's report *Future focus: 2013 National Workforce Development Strategy* identified the ageing of Australia's population as a certainty across each of its projected scenarios to 2025. The report noted that while industry peak bodies and associations have developed 'a good understanding of the implications' of workforce ageing, there is a paucity of information about the level of understanding at enterprise levels.[349]

In the last 50 years, the proportion of the population in older age groups has increased and the proportion in younger age groups has declined (Figure 39).[350] By 2030, Australians aged 65 years and above are expected to constitute 20 per cent of the total population.

Figure 39 Age distribution of population by gender, 1960 and 2010



Note: The 85+ age group includes all ages 85 years and over and is not directly comparable with the other age groups.

Source: ABS, 2008, *Australian historical population statistics*, cat. no. 3105.0.65.001; ABS, 2013, *Australian demographic statistics*, March, cat. no. 3101.0.

The Organisation for Economic Co-operation and Development's 2007 report on global workforce ageing found that 'unless there is a substantial increase in labour force participation, especially among older people, Australia's labour force will remain broadly stagnant over the next 50 years'. While the report acknowledged Australia's proactive engagement with the issue of workforce ageing, it noted mature-aged participation in the Australian workforce was lower than that of countries such as Japan, New Zealand, Sweden and the United States.[351] One of the three recommendations in the report in relation to mature-aged participation in Australia was to 'strengthen older workers' employability' through enhanced training opportunities and more targeted job search assistance.[352]

349 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 75.

350 ABS, 2012, 'Population size and growth', *ABS Year Book Australia*, cat. no. 1301.0.

351 OECD, 2006, *Live longer work longer—executive summary: Australia*, oecd.org/els/emp/38107362.pdf, accessed 19 November 2013, p. 1.

352 Ibid., p. 2.

The Resources Sector is projected to face skills shortages from 2014 onwards. Compared to other industry sectors, mature-aged workers are under-represented in the Resources Sector. As at May 2013, workers aged over 45 years constituted 33.2 per cent of the total Resources Sector workforce, compared to 38.9 per cent for all industries.[353] The proportion of mature-aged workers in the Resources Sector has decreased considerably over the past 10 years.[354] If the sector is to meet its future skills needs and retain vital skills and experience, it will need to develop and engage in strategies to attract and retain older workers.

Government and industry approaches to engaging mature-aged workers

The Australian Government, in collaboration with industry, has recognised both the challenges and benefits of enhancing the participation of mature-aged workers in the Resources Sector workforce.

The National Apprenticeship Program, discussed in Chapter 6, is one example of action in this area. In 2012, the Director of the National Apprenticeship Program, Alan Sparks, said training under the program captures workers at the peak of their productivity and, as they are mature-aged workers, they 'require less supervision and have a higher awareness of risk mitigation'.[355] Increased maturity of the workforce and the potential for older workers to take on mentoring and supervisory roles are other identified benefits of training mature-aged apprentices.

In 2010, Xstrata's Mount Isa Mines Skills Centre was featured as a case study in a report highlighting opportunities for mature-aged workers. The centre runs training for 'specialist technical areas and refresher training for existing qualified tradespersons'. The training is provided as a pathway for mature-aged workers to promotional opportunities within the company.[356]

The organisation Mature Age Apprenticeships offers mining-related opportunities which include training in 'how to repair, analyse and use different types of machinery'. It also offers training in 'how to maintain the heavy vehicles that are used in mining', noting that 'these vehicles, mainly back hoes, are essential to the industry'.[357]

Barriers to engaging older workers

There are a range of barriers to the engagement of older workers in the Resources Sector, some of which are based on existing stereotypes of ageing; others relate to the challenges of transforming workplaces to accommodate their skills and experience. Some of the barriers are:

- the physically demanding nature of some of frontline mining jobs, which could lead to increased injuries and stresses for older workers. The industry is cognisant of this fact and is working on management strategies for finding better matches between jobs and workers' physical capabilities, particularly in sectors such as coal mining
- stereotypes around ageing including the ability of older workers to adapt to technology
- inflexible workplace culture. The provision of part-time jobs, alternative job opportunities, options to be contracted, and 'flexible hours entitlements' and working from home arrangements will enhance workplace flexibility and contribute to retention of older workers.[358]

353 Department of Employment, 2013, *Industry outlook—mining*, p. 5.

354 Department of Employment, 2012, *Mining—employment outlook*, jobsearch.gov.au/documents/20120705miningoutlook.pdf, accessed 19 November 2013, p. 7.

355 Latimer C, 2012, 'Mining apprenticeships: tapping an old vein', *MiningIQ*, miningiq.com/human-resources-talent-recruitment-and-fifo/articles/tapping-an-old-vein, accessed 4 October 2013.

356 Mitchell J and Dobbs G, 2010, *Case studies of employers with mature age and existing worker apprentices*, Australian Chamber of Commerce and Industry, acci.asn.au/getattachment/1a4ddf26-92c7-4fca-9ea5-0607aaca9fdb/It-s-Not-Age-Case-Studies.aspx, accessed 8 November 2013, p. 17.

357 Mature Age Apprenticeships, 2012, *Mining apprenticeships*, matureageapprenticeships.org/mining-apprenticeships, accessed 4 October 2013.

358 Australian Mines and Metals Association, 2012, *Tackling the skills shortage: mature age workers*, miningoilgasjobs.com.au/our-blog/february-2012/tackling-the-skill-shortage--mature-age-workers.aspx, accessed 4 October 2013.

Some of these barriers will be potentially transformed by the rapid adoption of automation trends by the Resources Sector industry as discussed earlier in this report. In fact, it has been suggested that automation itself will drive the need to improve participation from a range of groups in the Resources Sector workforce, including from mature-aged workers, as it will create demands for new skills and experience and also drive changes in workplace culture.[359]

Benefits of improving mature-aged participation

Mature-aged workers are a key source of domestic experience and skills, which is significant in a tight labour market such as in the Resources Sector with skills shortages in important occupations. There are several benefits to business in employing mature-aged workers, including retention of corporate knowledge and experience, and succession management opportunities.

Retention of experience and corporate knowledge

As the Resources Sector workforce ages, industry potentially faces the loss of experience and corporate knowledge due to the attrition of older workers from the workforce. The Queensland University of Technology study of the mature-aged workforce in the coal mining industry noted:

> Older workers bring greater experience to their work, and are often irreplaceable because of their high skills … However, this demographic change presents major challenges in the organisation of work and the workplace to accommodate age related changes in work ability.[360]

The study found that a mismatch between the abilities of older workers and their work can lead to workers leaving the industry. The focus of the study was on injury management and other physical barriers to the continued engagement of older workers in the coal mining sector.

Experienced workers can be utilised in areas other than physically demanding jobs where there is a need for their skills. For example, Australian Institute of Management Victoria's Chief Executive Officer Susan Heron said that older workers were a 'skills blind spot' for Australian companies and stated:

> companies are placing great reliance on training and other mostly internal means to try to close their skills gap, but the one potential resource they are overlooking is their older and experienced staff.[361]

AWPA's consultations for this report found the lack of experienced trainers in the industry to be a key barrier to the provision of effective training in Resources Sector companies. Some recruitment and training companies in the sector have already recognised the value of the expertise of older workers.

AWPA suggests one of the strategies to successfully retain mature-aged workers is to engage them as trainers for new entrants into the Resources Sector. This contributes to the development of the next generation of Resources Sector workers.

359 McNab K and Franks D, 2012, 'Robots, red dust and the future of mining towns', *The Conversation*, theconversation.com/robots-red-dust-and-the-future-of-mining-towns-5814, accessed 4 October 2013.

360 Parker T and Worringham C, 2010, *Managing the ageing workforce: issues and opportunities for the Queensland coal mining industry*, School of Human Movement Studies, Queensland University of Technology, eprints.qut.edu.au/1030/1/Managing_The_Ageing_Workforce.pdf, accessed 19 November 2013.

361 Duffy A, 2012, 'Companies overlook older workers: report', *Mining Australia*, 7 May, miningaustralia.com.au/news/companies-overlook-older-workers-report, accessed 4 October 2013.

Succession management and return on investment in training and development

Globally, the Resources Sector faces an ageing workforce with emerging talent gaps and shortages as the senior and middle management workers leave the sector. A 2011 Deloitte report states:

> while older workers are wrapping up their careers, and younger workers are attracted to the industry thanks to its growth prospects, there is a noticeable lack of experienced middle managers.[362]

According to Deloitte Australia mining leader Tim Richards, 'it is really that middle core of good managers that are needed to keep these operations going and developing'.[363] While industry has been active in engaging with education providers to address these talent gaps, 'none of these activities serves to attract the coveted 30 to 50 year old generation'. The report suggests companies 'will need to get more aggressive about talent retention' through customised work which matches the changing abilities of older workers with their work and internal transfers instead of exits.[364]

Retention of older workers also brings companies a better return on their investment in training and development, as they stay in the workforce longer.

8.5 Conclusion

AWPA notes the Resources Sector is cognisant of the benefits of a diverse workforce and of the urgency of increasing workforce participation, particularly of women, Indigenous Australians and mature-aged workers, to meet current and future skills demands. As demonstrated by initiatives such as the Minerals Council of Australia's white paper, which allocated action items to relevant stakeholders to address identified gaps in workforce diversity strategies, the Resources Sector looks to build on the strengths of its current approaches while addressing challenges in relation to the transformation of workplace culture and patterns.

The case studies showcased in this chapter highlight current measures undertaken by several companies to attract, retain and increase the participation of women, Indigenous workers and mature-aged workers in the workforce. AWPA expects that targeted strategies implemented across the sector will yield improved results over the years ahead.

362 Deloitte Canada, 2011, *Tracking the trends 2011*, p. 9.

363 Richards T, quoted in Orchison K, 2011, 'Growing gap in the middle for miners', *The Australian*, 11 January, theaustralian.com.au/national-affairs/growing-gap-in-the-middle-for-miners/story-fn717l4s-1225995920673, accessed 4 October 2013.

364 Deloitte Canada, 2011, *Tracking the trends 2011*, p. 9.

9 Recommendations and responsibilities

Recommendation 1

That resources companies and peak organisations engage with the proposed industry working group for schools–industry science, technology, engineering and mathematics skills initiatives; and contribute to the development of a national strategy and framework for these initiatives.

Responsible parties—Industry and industry associations.

Recommendation 2

That industry work with tertiary education providers to fund, develop and implement a strategy to deliver training and support to career development practitioners. This will ensure they have skills and knowledge to provide current and relevant advice to students on the resources labour market and raise awareness of the value of professional and trade qualifications.

Responsible parties—Industry, industry associations and tertiary education providers.

Recommendation 3

That the Minerals Tertiary Education Council member universities and specialist oil and gas university faculties work with industry to scope the development of a postgraduate qualification in automation for mechanical, electrical, mining and oil and gas engineering graduates.

Responsible parties—The Minerals Tertiary Education Council, oil and gas university faculties and industry.

Recommendation 4

That the Australian Government, industry and the tertiary education sector pilot a program based on the United Kingdom's successful Transition Training Programme with the aim of improving the supply of long-term technical operational skills to the Oil and Gas sector.

Responsible parties—Australian Government, industry associations and tertiary education providers.

Recommendation 5

That the Australian Government, in collaboration with industry stakeholders, develop and pilot a national program for apprentices and trainees, modelled on the UK Oil and Gas Upstream Technician Training Scheme and the Western Australian Energy Apprenticeship Group joint venture, to provide clear pathways to the liquefied natural gas sector and ensure supply of long-term technical skills.

Responsible parties—Australian Government, industry and industry associations.

Recommendation 6

That industry stakeholders and the tertiary education sector collaborate to develop an industry-driven workforce development strategy to support the development of a domestic workforce to meet future demand for long-running oil and gas operations occupations.

Responsible parties—Industry, industry associations and the tertiary education sector.

Appendix A
Resources Reference Group membership

Role of the reference group

The Resources Reference Group considers and oversees the undertaking of research into the skills needs of the Resources Sector and assists the Australian Workforce and Productivity Agency in delivering accurate and timely advice to government.

The reference group:

- provides guidance on the scope and research methodology to be used in the report
- agrees to the objectives and structure of the commissioned research
- provides input and guidance on appropriate engagement of stakeholders
- ensures that commissioned research can be delivered, within budget and project timelines.

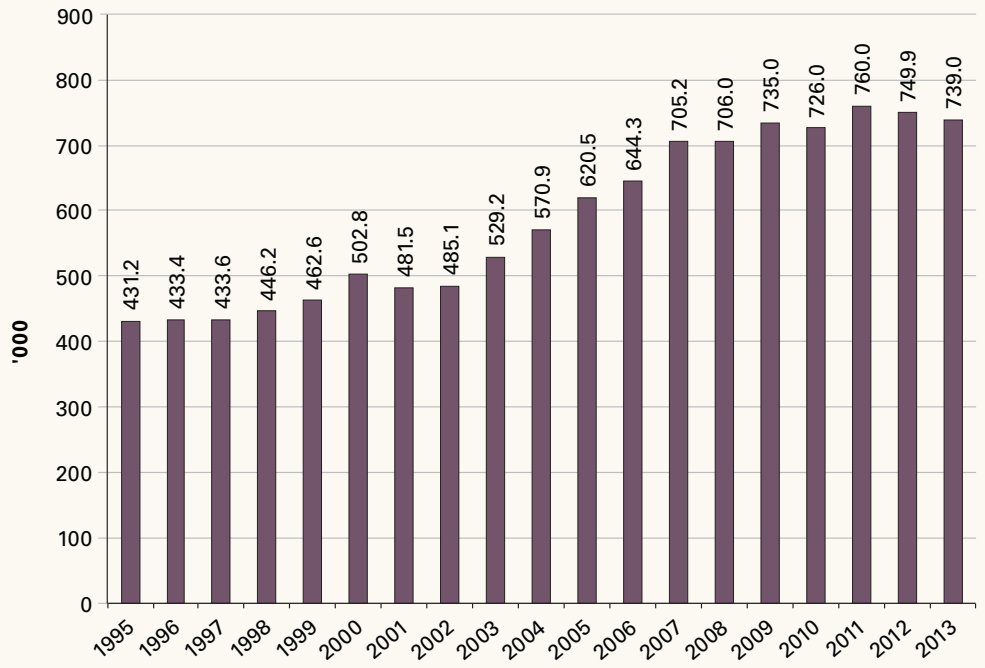
Membership of the reference group

- Keith Spence, reference group chair, Australian Workforce and Productivity Agency Board member
- Chris James, Assistant Director of Education and Training, Minerals Council of Australia
- Ray Barker, Chair, SkillsDMC
- Miranda Taylor, Director of Safety, Environment and Skills, Australian Petroleum Production and Exploration Association
- Lindsay Le Compte, Executive Director, Australian Constructors Association
- Tim Shipstone, Industrial Officer, Australian Council of Trade Unions
- Bob Kinnaird, National Policy Officer, Construction, Forestry, Mining and Energy Union
- Ivan Neville, Assistant Secretary, Labour Market Research and Analysis Branch, Department of Education
- Linda White, Branch Manager, Department of Industry

The AWPA Secretariat provides secretariat support to the reference group and other assistance as required.

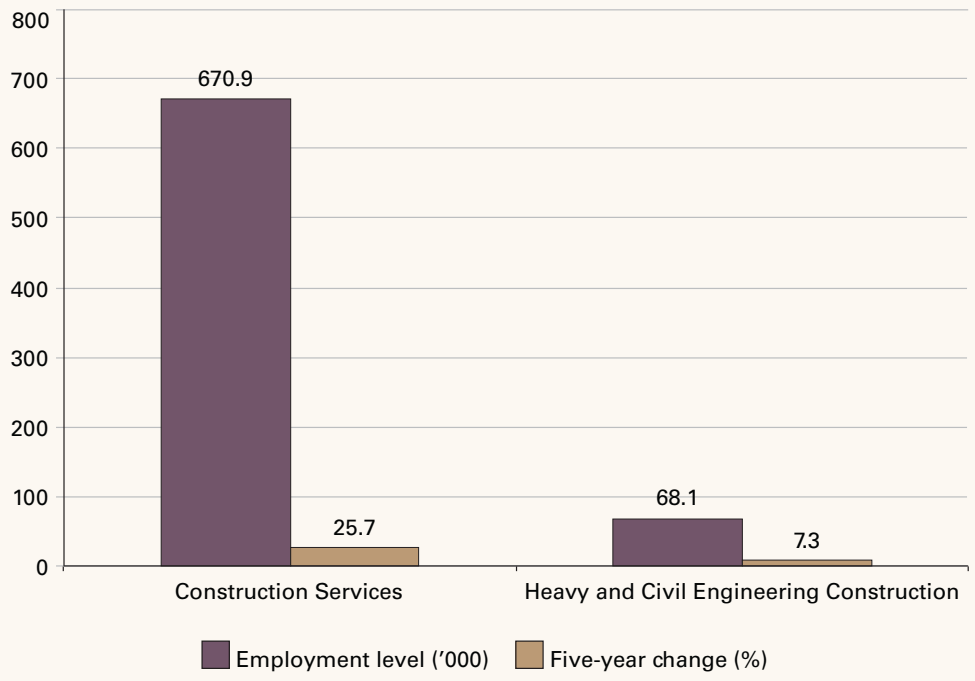
Appendix B
Resources Project Construction workforce characteristics

Figure 40 Number employed in Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services), May 1995 to May 2013 (four-quarter average)



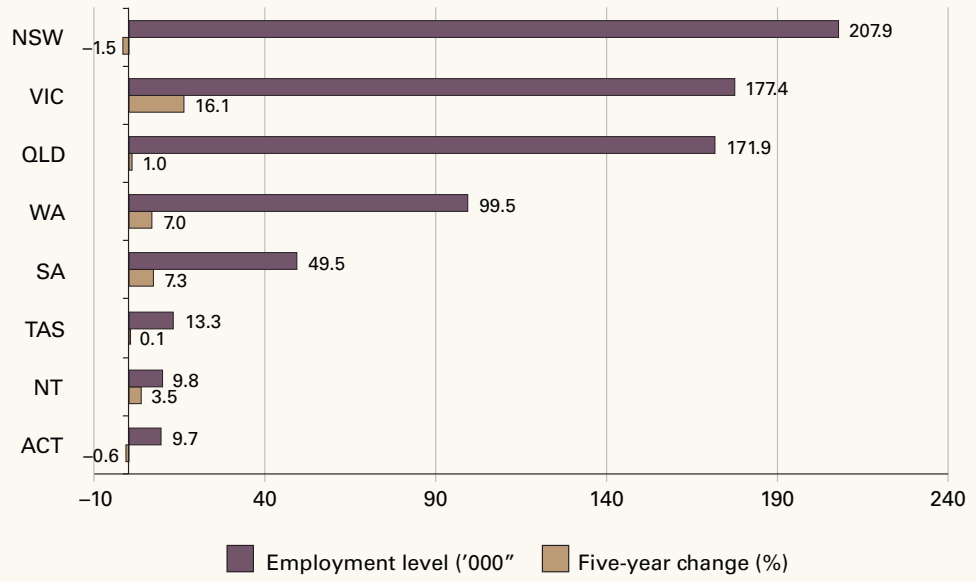
Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* May, cat. no. 6291.0.55.003, original data.

Figure 41 Employment level at May 2013 (four-quarter average) and percentage change over the past five years (2007–08 to 2012–13) in Resources Project Construction sectors (Heavy and Civil Engineering Construction and Construction Services)



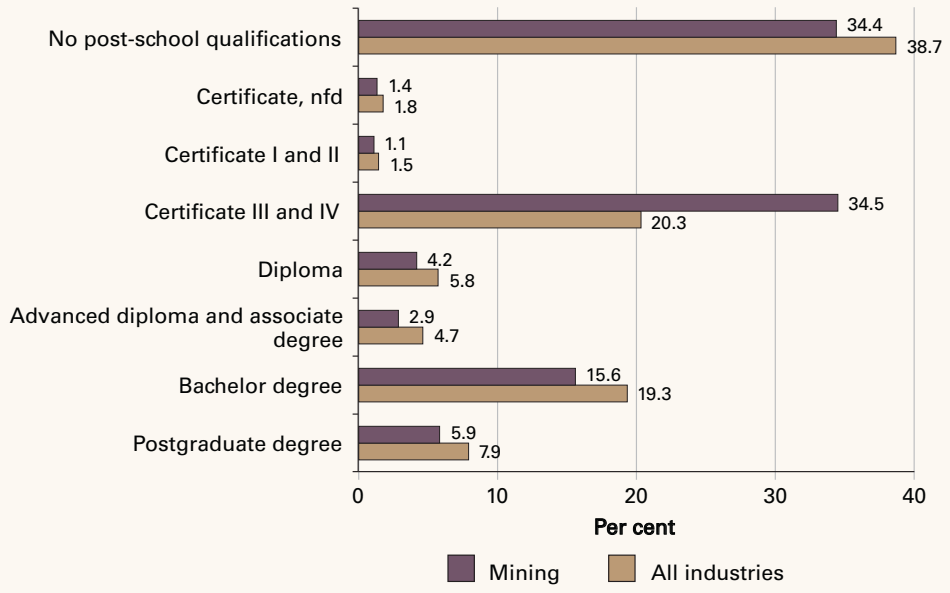
Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* May, cat. no. 6291.0.55.003, original data.

Figure 42 Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services) employment level at May 2013 (four-quarter average) and percentage change between 2007–08 and 2012–13 by state/territory



Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* May, cat. no. 6291.0.55.003, original data.

Figure 43 Highest educational attainment by percentage share of employment, Mining industry versus all industries, 2011 Census

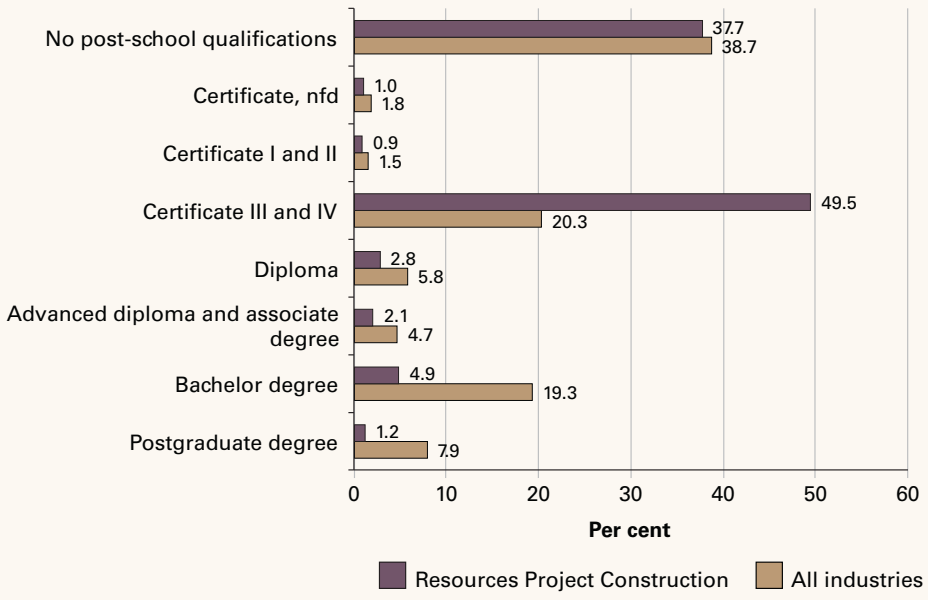


nfd = not further defined.

Source: ABS, 2011, *Census of population and housing.* Excludes inadequately described and not stated.

Appendices

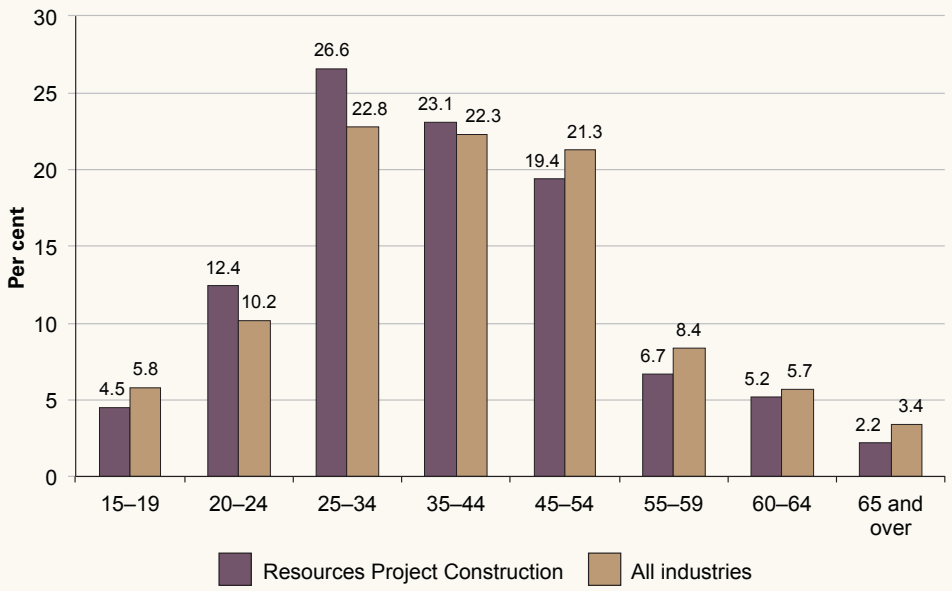
Figure 44 Highest educational attainment by percentage share of employment, Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services) industry versus all industries, 2011 Census



nfd = not further defined.

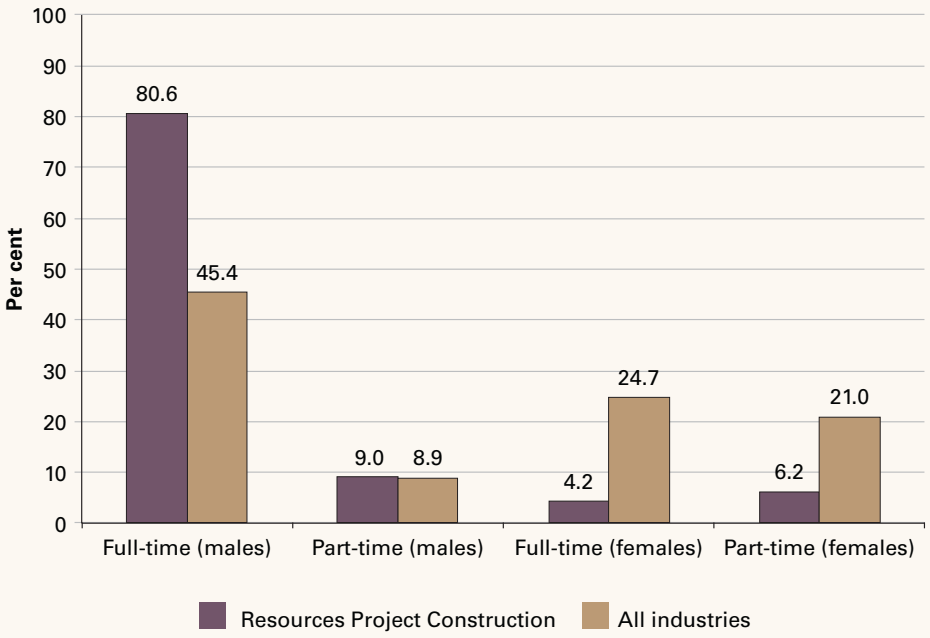
Source: ABS, 2011, *Census of population and housing*. Excludes inadequately described and not stated.

Figure 45 Employed persons by age, Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services) versus all industries, percentage share of employment, May 2013 (four-quarter average)



Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* May, cat. no. 6291.0.55.003, original data.

Figure 46 Full-time and part-time workers by gender, Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services) versus all industries, percentage share of employment, May 2013 (four-quarter average)



Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* May, cat. no. 6291.0.55.003, original data.

Figure 47 Percentage of Indigenous workers employed in Resources Project Construction (Heavy and Civil Engineering Construction and Construction Services) and all industries, 2011 Census

Source: ABS, 2011, *Census of population and housing*. Includes Aboriginals, Torres Strait Islanders and both Aboriginals and Torres Strait Islanders; excludes not stated and inadequately described.

Appendix C
Occupational profile of the Resources Sector

At the time of the 2011 Census, employment in the Mining industry covered more than 300 occupations. Of these, only 16 occupations had an employment level of more than 2,000 (see Table 68). These occupations make up more than 60 per cent of total employment in the Mining industry.

Table 68 Selected occupations in Mining with employment of 2,000 or more, 2011

Occupation		No. employed in the Mining industry	No. employed outside the Mining industry	% of the occupation employed in the Mining industry	% of total Mining industry employment
7122	Drillers, Miners and Shot Firers	39,280	8,690	82	22
3132	Metal Fitters and Machinists	14,570	72,390	17	8
3129	Other Building and Engineering Technicians	8,370	11,270	43	5
7331	Truck Drivers	7,310	138,890	5	4
3411	Electricians	5,510	105,210	5	3
2336	Mining Engineers	5,210	3,770	58	3
1335	Production Managers	5,140	42,560	11	3
2344	Geologists and Geophysicists	4,950	3,960	56	3
8129	Other Construction and Mining Labourers	3,790	4,490	46	2
3223	Structural Steel and Welding Trades Workers	3,140	62,850	5	2
7212	Earthmoving Plant Operators	2,920	35,410	8	2
5311	General Clerks	2,910	233,470	1	2
7129	Other Stationary Plant Operators	2,820	16,340	15	2
2211	Accountants	2,780	135,520	2	2
5111	Contract, Program and Project Administrators	2,510	102,140	2	1
2513	Occupational and Environmental Health Professionals	2,030	16,890	11	1
Total		**113,240**	**993,850**	**–**	**65**

Source: ABS, 2011, *Census of population and housing*.

Drillers, Miners and Shot Firers (ANZSCO 7122)

Data from the 2011 Census indicates that the vast majority of Drillers, Miners and Shot Firers work in the Mining industry (82 per cent), suggesting that competition from other industries is limited.

The level of Drillers, Miners and Shot Firers employed in the Mining industry increased strongly over the five years to August 2011, up by 15,200 (or 63.1 per cent). This is probably a reflection of the increased number of resources projects in construction and the subsequent demand for workers with relevant skills in this occupation.

Metal Fitters and Machinists (ANZSCO 3232)

At the time of the 2011 Census, approximately 17 per cent of all Metal Fitters and Machinists worked in the Mining industry, up from 11 per cent in 2006. Despite being the second largest employing industry for this occupation, Mining is still competing with a range of other industries for people with these skills.

The majority of Metal Fitters and Machinists are concentrated in Manufacturing (36 per cent), suggesting employers in that industry pose the largest competition for these workers. That said, the industry's employment share of Metal Fitters and Machinists has declined from 43 per cent in 2006, with a number of sectors within Manufacturing experiencing declining employment over recent years.

For example, Motor Vehicle and Motor Vehicle Part Manufacturing is a key employer of this occupation; however, employment of Metal Fitters and Machinists in that sector contracted by almost 29 per cent over the five years to August 2011.

Other Building and Engineering Technicians (ANZSCO 3129)

At the time of the 2011 Census, the Mining industry was the largest employer of Other Building and Engineering Technicians (43 per cent), an increase of 4 percentage points since the 2006 Census. The greatest competition for these workers comes from Manufacturing (with 20 per cent of employment), although notably the industry's employment share has fallen by 3 percentage points since 2006.

Professional, Scientific and Technical Services was the third largest employing industry of Other Building and Engineering Technicians (12 per cent), with the vast majority located in the Architectural, Engineering and Technical Services sector.

Importantly, employment data for Professional, Scientific and Technical Services includes a number of companies working directly for mining companies on a consulting or contract basis. However, it is difficult to quantify the extent of this.

Truck Drivers (ANZSCO 7331)

While the Mining industry employs a very small fraction of all Truck Drivers in Australia (around 5 per cent), employment of Truck Drivers in Mining increased strongly over the five years to August 2011 (by 84.9 per cent).

Mining faces strong competition for people with the relevant skills from the Transport, Postal and Warehousing industry, with the majority of Truck Drivers employed in that sector (58 per cent), and to a smaller degree Construction and Manufacturing (each around 7 per cent).

It is worth noting that within the Construction industry, the largest employing sector of Truck Drivers was Heavy and Civil Engineering Construction, which has some association with mining-related activity, including mine site construction.

Electricians (ANZSCO 3411)

The Mining industry employs a very small fraction (5 per cent) of Electricians and faces strong competition from the Construction industry (which employs more than half of all Electricians) and to a lesser extent the Manufacturing industry (11 per cent).

More recently, however, the Construction industry has experienced a considerable decline in activity levels, particularly in the residential and commercial areas. The major employing sectors for Electricians within the Construction industry were Building Installation Services and Residential Building Construction, both of which recorded large declines in their employment levels over the two years to February 2013. While this may suggest a freeing up of labour for the Mining industry, a number of employer comments suggest these skills are not easily transferrable.

Mining Engineers (ANZSCO 2336)

The level of employment for Mining Engineers within the Mining industry doubled over the five years to August 2011, up by 2,750 (or 111.7 per cent) to 5,210. The Mining industry employs the majority of Mining Engineers (58 per cent), followed by Professional, Scientific and Technical Services (25 per cent). It is probably the case that a significant proportion of Mining Engineers employed in Professional, Scientific and Technical Services work indirectly for mining companies through contract or consultancy arrangements.

Production Managers (ANZSCO 1335)

The Mining industry employs a small proportion of Production Managers in Australia and is likely to face strong competition from the Manufacturing industry (which employs almost two-thirds of Production Managers) for people with these skills.

Over the five years to August 2011, the share of Production Managers in the Mining industry increased by 3 percentage points (to 11 per cent), while the proportion in the Manufacturing industry fell by 3 percentage points (to 63 per cent or 31,800).

It should be noted, however, that the level of employment of Production Managers in Manufacturing also increased over the period (by 1,930 or 6.9 per cent). This suggests the change in the distribution of employment share is due largely to poor employment growth in Manufacturing, together with strong employment growth in Mining, rather than a migration of labour from the Manufacturing industry to the Mining industry.

Looking at employment growth at the six-digit occupation level across all industries, Production Managers (Manufacturing) employment rose by 8.1 per cent between the 2006 and 2011 censuses, considerably lower than the 54.9 per cent growth recorded by Production Managers (Mining) over the same period. Production Managers (Mining) is a specialist occupation and it is unlikely that skills would be readily transferable between industries such as Manufacturing and Mining.

Geologists and Geophysicists (ANZSCO 2344)

The Mining industry employs just over half of Australia's Geologists and Geophysicists. It is also likely that most Geologists and Geophysicists who are employed within the Professional, Scientific and Technical Services industry work indirectly for mining companies through contract or consultancy arrangements.

Other Construction and Mining Labourers (ANZSCO 8219)

The Mining industry is the largest employer of Other Construction and Mining Labourers (with 46 per cent of total employment). The level of Other Construction and Mining Labourers employed in Mining increased strongly over the five years to August 2011, up by 54.1 per cent.

However, more than half are employed outside Mining, suggesting there is still significant competition for workers from a number of other industries. As at the 2011 Census, the Construction industry (20 per cent of total employment) and Professional, Scientific and Technical Services industry (15 per cent) were the largest competitors for Other Construction and Mining Labourers.

Structural Steel and Welding Trades Workers (ANZSCO 3223)

While the Mining industry is the third largest employer of Structural Steel and Welding Trades Workers, it has a considerably smaller share of total employment (just 5 per cent), suggesting that the Mining industry faces strong competition for these workers. Indeed, the majority of Structural Steel and Welding Trades Workers are employed in Manufacturing (66 per cent) followed by Construction (12 per cent); however, these industries have experienced declining employment over recent years.

The share of Structural Steel and Welding Trades Workers in Mining increased by 2 percentage points over the five years to August 2011, while the concentration in Manufacturing declined over the period by 3 percentage points.

Earthmoving Plant Operators (ANZSCO 7212)

The Mining industry employs a very small proportion of Earthmoving Plant Operators (8 per cent), up from 7 per cent in August 2006. The Mining industry is likely to face strong competition from the Construction industry (which employs around two-thirds of all Earthmoving Plant Operators), as well as from the Public Administration and Safety industry (7 per cent).

Earthmoving Plant Operators in the Construction industry recorded strong employment growth over the five years to August 2011, up by 4,300 (or 20.3 per cent). It is also likely that some of the Earthmoving Plant Operators employed in the Construction industry are indirectly linked to mining-related activity. For example, Heavy and Civil Engineering Construction was the second largest employing sector of Earthmoving Plant Operators in August 2011 (21 per cent or over 8,000). More recently, however, the Construction industry has experienced a contraction in building activity, which may constrain employment demand in this industry.

General Clerks (ANZSCO 5311)

The number of General Clerks employed in the Mining industry grew by 1,300 (or 81.8 per cent) in the five years to August 2011, reflecting the growth in mining companies and their administrative requirements.

The Mining industry employs a very small proportion of General Clerks (1 per cent), and has strong competition for workers from a number of other industries including Public Administration and Safety (17 per cent of total employment), Education and Training (12 per cent) and Health Care and Social Assistance (11 per cent).

Other Stationary Plant Operators (ANZSCO 7129)

The concentration of Other Stationary Plant Operators in the Mining industry rose significantly over the five years, from 5 per cent in August 2006 to 15 per cent in August 2011.

Despite the increase in employment share, the Mining industry still faces significant competition for workers in this occupation. Manufacturing in particular remains the largest employing industry of Other Stationary Plant Operators (23 per cent), followed by Transport, Postal and Warehousing (19 per cent) and Electricity, Gas, Water and Waste Services (16 per cent).

Accountants (ANZSCO 2211)

The Mining industry employs a very small proportion of Australia's 138,300 Accountants (2 per cent), with the strongest competition for workers from the Professional, Scientific and Technical Services (48 per cent) and Financial and Insurance Services industries (10 per cent).

Contract, Program and Project Administrators (ANZSCO 5111)

Reflecting the increasing size of mining companies in Australia, the number of Contract, Program and Project Administrators in the Mining industry increased by 1,280 (or 104.1 per cent) over the five years to August 2011.

Mining employs just 2 per cent of all Contract, Program and Project Administrators. Not surprisingly, the main competition comes from employers in the Public Administration and Safety industry (28 per cent), followed by Health Care and Social Assistance (10 per cent) and Education and Training (also 10 per cent).

Occupational and Environmental Health Professionals (ANZSCO 2513)

Mining employs around 11 per cent of all Occupational and Environmental Health Professionals. The strongest demand for these workers is from the Public Administration and Safety industry (with 21 per cent of total employment), the largest employing industry for this occupation. The Construction (13 per cent), Manufacturing, and Health Care and Social Assistance (each 10 per cent of total employment) industries also present strong competition for Occupational and Environmental Health Professionals.

Other occupations of relevance to the Resources Sector

Even though some occupations may have a relatively small number of people employed in the Mining industry, these skills remain vital to the industry and it employs significant numbers either on a consultancy basis, or on projects that are directly connected to the Mining industry (such as the construction phase of mining developments). Data for some of these occupations is provided in Table 69.

Table 69 Other occupations relevant to the Resources Sector

Occupation	No. employed in the Mining industry	No. employed outside the Mining industry	% of the occupation employed in the Mining industry	% of total Mining industry employment
3212 Motor Mechanics	1,040	80,680	1.3	0.6
2332 Civil Engineering Professionals	790	31,280	2.5	0.4
3211 Automotive Electricians	570	6,120	8.7	0.3
3341 Plumbers	270	66,750	0.4	0.2
2331 Chemical and Materials Engineers	240	2,150	10.0	0.1
3312 Carpenters and Joiners	180	98,070	0.2	0.1
3421 Airconditioning and Refrigeration Mechanics	130	17,360	0.8	0.1
Total	**3,220**	**302,410**	**–**	**1.8**

Source: ABS, 2011, *Census of population and housing*.

Motor Mechanics (ANZSCO 3212)

Only 1 per cent of Motor Mechanics are employed in the Mining industry, with the majority employed in the Other Services industry (56 per cent), followed by the Retail Trade industry (16 per cent). That said, recent employer comments suggest the Resources Sector has a strong pull-factor for these workers due to higher remuneration opportunities.

Civil Engineering Professionals (ANZSCO 2332)

The Mining industry employs just over 2 per cent of all Civil Engineering Professionals and faces strong competition for workers with these skills from the Professional, Scientific and Technical Services (with 46 per cent of total employment), Construction (24 per cent) and Public Administration and Safety (13 per cent) industries. It should be noted that a small proportion of those employed in the Professional, Scientific and Technical Services and Construction industries may be associated with mining-related activities.

Automotive Electricians (ANZSCO 3211)

The proportion of Automotive Electricians employed in Mining increased by 5 percentage points over the five years, to stand at 9 per cent in August 2011. It is an occupation that has been in shortage for a number of years, and competition for suitable workers is strong, particularly from the Other Services and Manufacturing industries.

Plumbers (ANZSCO 3341)

The Mining industry employs an extremely small fraction (less than 1 per cent) of all Plumbers in Australia and faces strong competition for people with these skills from Construction, which is the main employing industry of these workers (86 per cent).

Chemical and Materials Engineers (ANZSCO 2331)

The proportion of Chemical and Materials Engineers employed in Mining increased over the five years, by 4 percentage points to 10 per cent in August 2011. This is still a small number—just 240 workers.

The Manufacturing industry, as the largest employer (with 37 per cent), remains the greatest competing industry for these workers, followed by the Professional, Scientific and Technical Services (28 per cent) and Electricity, Gas, Water and Waste Services (13 per cent) industries.

Carpenters and Joiners (ANZSCO 3312)

The Mining industry employs an extremely small fraction of all Carpenters and Joiners (less than 1 per cent) and faces strong competition for people with these skills from the Construction industry (82 per cent).

Airconditioning and Refrigeration Mechanics (ANZSCO 3421)

A very small proportion of Airconditioning and Refrigeration Mechanics are located in the Mining industry (around 1 per cent). Strong competition for people with these skills comes from the Other Services industry (41 per cent of total employment), followed by the Construction (37 per cent) and Manufacturing (8 per cent) industries.

Table 70 Share of total employment in selected occupation by industry (%)

Industry	7122 Drillers, Miners and Shot Firers	3232 Metal Fitters and Machinists	3129 Other Building and Engineering Technicians	7331 Truck Drivers	3411 Electricians	2336 Mining Engineers	1335 Production Managers	2344 Geologists and Geophysicists	8219 Other Construction and Mining Labourers	3223 Structural Steel and Welding Trades Workers	7212 Earthmoving Plant Operators	5311 General Clerks	7129 Other Stationary Plant Operators	2211 Accountants	5111 Contract, Program and Project Administrators	2513 Occupational and Environmental Health Professionals
Agriculture, Forestry and Fishing	0	1	0	1	0	0	1	0	0	1	2	1	1	0	0	0
Mining	82	17	43	5	5	58	11	56	46	5	8	1	15	2	2	11
Manufacturing	6	36	20	7	11	7	63	1	7	66	3	6	23	6	6	10
Electricity, Gas, Water and Waste Services	0	2	3	5	6	2	1	1	1	1	2	1	16	1	3	4
Construction	6	7	5	7	61	3	4	0	20	12	67	7	12	3	8	13
Wholesale Trade	1	7	3	5	1	2	5	1	1	1	1	5	3	4	2	2
Retail Trade	0	1	0	2	1	1	1	0	0	0	0	6	0	3	1	2
Accommodation and Food Services	0	0	1	0	0	0	1	0	0	0	0	2	0	1	1	1
Transport, Postal and Warehousing	1	4	3	58	2	1	1	0	1	2	3	4	19	2	3	6
Information Media and Telecommunications	0	0	0	0	0	0	2	0	0	0	0	1	0	2	3	0
Financial and Insurance Services	0	0	0	0	0	0	1	0	0	0	0	5	0	10	5	3
Rental, Hiring and Real Estate Services	0	2	0	1	0	0	1	0	1	0	2	3	0	2	1	0
Professional, Scientific and Technical Services	1	2	12	0	1	25	3	30	15	3	1	7	1	48	9	9
Administrative and Support Services	1	2	1	1	1	1	1	0	2	1	1	3	1	2	2	2
Public Administration and Safety	0	2	2	3	1	0	1	6	2	1	7	17	5	5	28	21
Education and Training	0	0	0	0	1	0	0	0.02	0	0	0	12	0	2	10	4
Health Care and Social Assistance	0	0	2	0	1	0	1	0	0	0	0	11	0	3	10	10
Arts and Recreation Services	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
Other Services	0	14	2	1	5	0	1	0	1	4	0	4	1	1	2	1

Note: 'Inadequately described' and 'Not stated' have been excluded from the table. Accordingly, adding up individual proportions will not equal the total.
Source: ABS, 2011, *Census of population and housing*.

Appendices

Appendix D
Features and lifecycle of resources project development

Exploration

The objective of the exploration phase is to identify and assess resource areas to determine whether more intensive exploration is required. The methods used in initial exploration include geophysical surveys, exploration, prospecting and geological mapping. Advanced exploration identifies whether the extent and quality of the potential resource is sufficient to proceed to the feasibility stage and if so the most appropriate extraction and processing methods.

Project development and feasibility

Resource deposits identified for further inspection during the advanced exploration phase are evaluated in this phase to quantify the feasibility of developing those deposits. The feasibility process includes an in-depth analysis of the technical, financial and regulatory aspects of the potential project, including the safety, environmental soundness and economic suitability of any proposed extraction methods.

A positive final investment decision results in final site planning, engineering and technical studies in anticipation of developing the mine.

Following a positive final investment decision, all aspects of extraction of the resource (mine, oil or gas well) are considered and planned in detail. This includes planning and awarding of tenders for construction and site services, environmental impact assessment, workforce development, regulatory compliance measures and detailed scheduling of construction and commissioning of building facilities.

Construction

The most significant activity during mine construction is the establishment of an open-cut or underground mine to access the ore body. Ore processing facilities and other site infrastructure are also built, including transport facilities (such as roads, rail lines, ports and airports); ore handling and processing facilities; mine waste disposal facilities; water management and wastewater treatment systems; power infrastructure, including power distribution system and any onsite generation facilities; and offices, warehouses and staff accommodation.

In oil and gas extraction terrestrial processes are similar, while offshore construction can be vastly different. Both often require the construction of extensive pipeline networks or, at the very least, pipeline to connect to existing infrastructure. Offshore oil and gas wells involve extensive (and often ongoing) drilling works. Floating platforms are built purely for extraction or, in the case of floating LNG platforms, a single combined floating facility for handling and processing the resource is built and towed to the site. Extensive onshore processing facilities for the production of terrestrial and offshore gas are common elements of most gas projects. For these onshore production facilities, many of the elements associated with ore extraction (power and workforce infrastructure and transport facilities) are also employed and built.

Operations

The operations phase represents the bulk of the resources lifecycle. It commonly extends over several years to decades, depending on the resource and market conditions. This phase includes both resource extraction and processing/refining the product, if required or planned for during the feasibility phase.

Decommissioning

Resources projects are decommissioned when the resource body is exhausted, or its extraction is no longer sufficiently profitable given market conditions. Generally, when commodity prices experience a fall that is anticipated to be temporary, resources can be placed into 'care and maintenance', where extraction is suspended but the site itself is maintained. Decommissioning work also requires a suitably skilled workforce.

Permanent closure occurs when the resource reserves are depleted and includes dismantling of the mine, capping of shafts or capping of the oil or gas well, dismantling of equipment, environmental and landscaping works to restore the land to a suitable pre-mine condition and encourage revegetation, management or storage of waste and tailings, and ongoing monitoring. The closure period of a resource project can take several years, and regulation often requires ongoing monitoring of the land for a defined period after the land has been reconditioned.

Coal seam gas in Australia

Australia has large conventional and unconventional[365] gas reserves that supply the domestic market and generate exports of gas in the form of liquefied natural gas. Australia's identified coal seam gas reserves have grown substantially in recent years. Coal seam gas currently accounts for 27 per cent of Australia's economic demonstrated reserves of gas at 33 trillion cubic feet, but its total identified resources are 203 trillion cubic feet, much more than the identified resources of conventional gas (167 cubic feet).[366] Coal seam gas has a reserve life of around 150 years at current rates of production, noting that production is projected to substantially increase with the establishment of the coal seam gas/liquefied natural gas industry.[367]

Australia's conventional gas production is predominantly sourced from three basins: the Carnarvon (northwest Western Australia), the Cooper/Eromanga (central Australia) and the Gippsland (Victoria). These basins accounted for 83 per cent of production in 2011–12.[368] Production of coal seam gas has increased significantly in recent years, with its share of total Australian gas production, on an energy content basis, increasing from 2 per cent in 2002–03 to 12 per cent in 2012–13. Most coal seam gas production is sourced from Queensland, which accounted for around 98 per cent of total coal seam gas production in 2011–12 (New South Wales produces the remainder). Production of coal seam gas is expected to continue to grow, with a number of projects under construction and planned in both states, including three coal seam gas export projects in the form of liquefied natural gas under construction in Queensland, due for completion in the middle of this decade.[369] The following coal seam gas to liquefied natural gas case study is presented to illustrate the different phases, timing and workforce requirements.

365 Conventional gas is produced using conventional oil and gas industry extraction techniques, and generally refers to methane held in a porous rock reservoir frequently found in combination with heavier hydrocarbons. Unconventional gas generally refers to gas trapped deep underground by impermeable rocks such as coal, sandstone and shale. The most common types of unconventional gas are coal seam gas, shale gas and tight gas. BREE, 2013, *Energy in Australia*, bree.gov.au/documents/publications/energy-in-aust/BREE-EnergyInAustralia-2013.pdf, accessed 19 November 2013, pp. xiii–xiv.

366 Department of Industry, 2012, *Energy white paper 2012*, innovation.gov.au/Energy/Documents/ewp/2012/Energy_%20White_Paper_2012.pdf, accessed 19 November 2013, p. 69, Table 5.1.

367 Geoscience Australia, 2013, *Coal seam gas*, australianminesatlas.gov.au/education/fact_sheets/coal_seam_gas.html, accessed 20 August 2013.

368 BREE, 2013, *Energy in Australia*, p. 71.

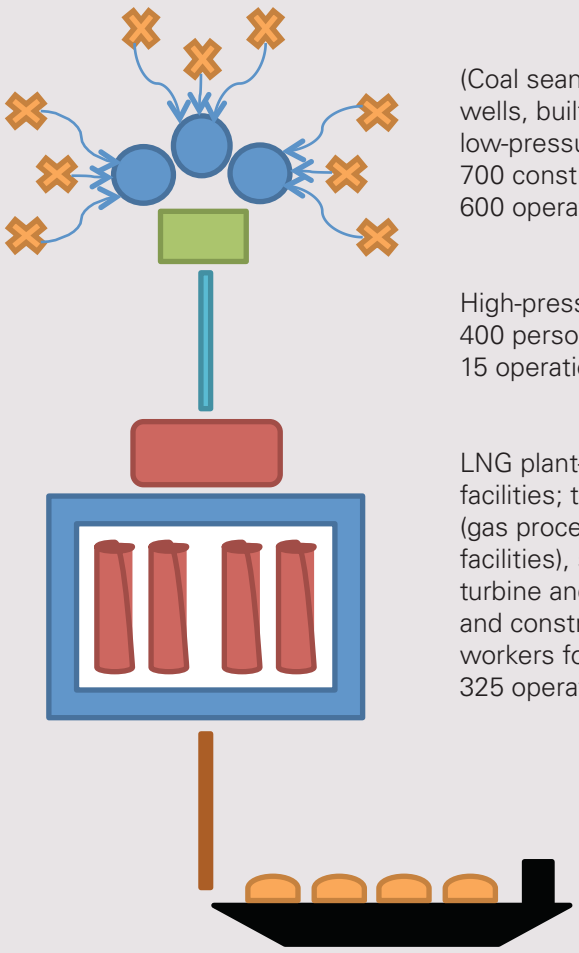
369 Ibid., p. 72.

A hypothetical coal seam gas to liquefied natural gas project

This project is a joint venture coal seam gas to liquefied natural gas project. The hypothetical project will deliver coal seam gas via a gas transmission pipeline from inland to a coastally located liquefaction plant where it will be liquefied prior to export in liquefied natural gas tankers to international markets.

The project consists of three parts: development of coal seam gas fields in Queensland, construction of a gas transmission pipeline from the gas fields to a liquefied natural gas facility on the coast, and a liquefied natural gas facility on the coast comprising up to four gas trains.[370] Figure 48 provides a schematic representation of the project.

Figure 48 Conceptualised coal seam gas to liquefied natural gas project



(Coal seam) gas fields—10,000 individual wells, built over 30 years, connected by low-pressure lines to field gas plants;
700 construction workers;
600 operational workforce.

High-pressure gas pipeline—
400 person construction workforce,
15 operational monitors.

LNG plant—inlet metering and gas pre-heating facilities; two LNG trains with capacity for four (gas processing, filtering and liquefaction facilities), storage and utilities (electricity, gas turbine and desalination) infrastructure, jetty and construction dock; 2,000–3,000 construction workers for trains 1 and 2; between 100 and 325 operational workers.

Sources: National Resouces Sector Employment Taskforce submissions and AWPA consultations.

370 The term 'gas train' or 'LNG train' refers to the facilities that purify and liquefy (through cryogenics) the gas into a condensed, transportable form. Generally an LNG plant has one or more trains.

Gas fields

The gas fields to be developed cover an area of approximately 370,000 hectares. The development of the gas fields will occur progressively, drilling up to a total of at least 10,000 wells over 30 years, with around 300 wells drilled per year.

Gas field development involves establishing separator and metering facilities at the well site, constructing 'in field' gas plants, laying an underground network of low-pressure gathering lines to link wells to the gas plants, and developing supporting infrastructure, including access roads, pipe and equipment storage areas, accommodation camps, and power and communications systems.

The fields will undergo a staged development over a period of at least 20 years, requiring a 'construction' workforce of approximately 750 people. The operational workforce will progressively increase to a peak of 600 people when all wells are operating.

Gas transmission pipeline

Pipeline construction will take approximately 18 months and will follow the typical construction sequence. Before construction commences, existing transport infrastructure will be upgraded to facilitate the transport of pipe to stockpile areas near the pipeline route. Temporary construction camps will be established and will be relocated at the end of each construction cycle. Communication infrastructure will be established to augment existing telecommunication networks.

A peak construction workforce of approximately 400 people will be required to construct the pipeline, and 15 people to monitor the pipeline and manage its operations.

Liquefied natural gas plant

The liquefied natural gas plant will be developed in stages, involving the construction and operation of the following major components: inlet metering and gas pre-heating facilities; two liquefied natural gas trains with additional capacity for four gas trains; storage and utilities (electricity, gas turbine and desalination) infrastructure; and jetty and construction dock.

A contracted peak construction workforce of 2,000 to 3,000 people will be required onsite during the concurrent construction of the first two liquefied natural gas trains. The operations workforce will start at around 100 workers for the first production train, increasing with each train added, until the maximum workforce of around 325 staff is reached when the fourth train comes online.

Meeting workforce needs

The expansion of the coal seam gas industry will provide a boost in construction and operational jobs. For example, Energy Skills Queensland notes the Queensland coal seam gas/liquefied natural gas industry has four major projects that have the potential to offer as many as 18,000 direct and indirect jobs.

The most significant skills needs relate to the construction of the liquefied natural gas plant and associated infrastructure (power station, desalination plant, jetty, berth and loading facilities). As construction is performed by a number of contractors and subcontractors, it is difficult to articulate an overarching workforce strategy or definitive assessment of total skills needs.

While this is a hypothetical project, experiences of similar real projects are indicative of general workforce needs at different stages. In one such project, during the early planning stages it was determined that the project would attempt to source at least 20 per cent of its construction labour force from the local area, and for the remainder use fly-in, fly-out or drive-in, drive-out workers who would reside in temporary accommodation nearby.

Labour demand is expected to be lower in the production phase than in the construction phase. Maintenance engineers, project managers, wellsite operators and operations technicians are some of the occupations in demand during this phase.[371]

371 The sources for this case study are submissions to the National Resources Sector Employment Taskforce and AWPA's consultations.

Appendix E
Projected employment levels by region and sector

Table 71 Projected employment level by region—Resources Project Construction, base case

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	853	923	807	692	618	540
Pilbara (WA)	3,058	3,272	2,877	2,499	2,254	1,981
Mid-West (WA)	1,832	2,017	1,803	1,589	1,462	1,319
Goldfields (WA)	1,103	1,206	1,069	932	846	752
Balance of Western Australia	21,729	27,647	18,938	10,344	5,002	–793
Western Australia	28,575	35,065	25,495	16,055	10,183	3,800
Darling Downs (QLD)	1,391	1,717	1,553	1,215	989	750
Fitzroy (QLD)	3,227	4,159	3,864	3,124	2,654	2,129
Mackay (QLD)	3,233	4,062	3,829	3,203	2,809	2,366
Balance of Queensland	19,014	34,395	29,987	18,254	10,896	2,665
Queensland	26,865	44,334	39,233	25,796	17,348	7,909
Hunter (NSW)	1,287	1,519	1,620	1,315	1,168	1,080
Balance of New South Wales	13,672	18,447	20,201	12,473	8,508	5,965
New South Wales	14,959	19,966	21,821	13,788	9,676	7,045
Outback – North East (SA)	395	429	444	410	387	368
Balance of South Australia	2,054	4,144	5,206	3,467	2,298	1,370
South Australia	2,449	4,573	5,651	3,877	2,685	1,738
Victoria	6,042	7,193	7,138	5,829	5,607	5,582
Tasmania	726	918	826	686	669	656
Northern Territory	5,853	6,421	7,194	4,526	2,815	1,789
ACT	274	274	274	274	274	274
Offshore oil and gas	74	81	78	71	67	63
Australia—total	**85,819**	**118,825**	**107,710**	**70,903**	**49,325**	**28,857**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 72 Projected employment level by region—Resources Project Construction, high growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	853	984	892	769	679	575
Pilbara (WA)	3,058	3,476	3,170	2,763	2,463	2,107
Mid-West (WA)	1,832	2,147	1,992	1,762	1,601	1,403
Goldfields (WA)	1,103	1,284	1,182	1,034	927	800
Balance of Western Australia	21,729	32,397	25,759	16,515	9,898	2,110
Western Australia	28,575	40,287	32,995	22,843	15,569	6,995
Darling Downs (QLD)	1,391	1,947	1,840	1,447	1,166	865
Fitzroy (QLD)	3,227	4,729	4,580	3,708	3,103	2,424
Mackay (QLD)	3,233	4,557	4,454	3,713	3,201	2,624
Balance of Queensland	19,014	43,576	41,542	27,662	18,097	7,369
Queensland	26,865	54,809	52,416	36,529	25,566	13,282
Hunter (NSW)	1,287	1,731	1,964	1,620	1,436	1,294
Balance of New South Wales	13,672	23,481	28,354	19,680	14,817	11,024
New South Wales	14,959	25,212	30,318	21,300	16,252	12,317
Outback – North East (SA)	395	453	483	442	413	386
Balance of South Australia	2,054	5,524	7,512	5,399	3,871	2,501
South Australia	2,449	5,976	7,995	5,841	4,283	2,887
Victoria	6,042	9,215	10,652	9,543	9,708	9,931
Tasmania	726	1,138	1,114	931	919	899
Northern Territory	5,853	6,959	8,035	5,375	3,405	1,851
ACT	274	361	435	446	455	455
Offshore oil and gas	74	86	86	77	72	66
Australia—total	**85,819**	**144,043**	**144,046**	**102,887**	**76,230**	**48,685**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 73 Projected employment level by region—Resources Project Construction, low growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	853	809	705	609	553	501
Pilbara (WA)	3,058	2,887	2,535	2,216	2,027	1,845
Mid-West (WA)	1,832	1,771	1,581	1,404	1,313	1,229
Goldfields (WA)	1,103	1,059	937	823	759	700
Balance of Western Australia	21,729	18,666	10,910	3,740	–275	–3,947
Western Australia	28,575	25,192	16,668	8,792	4,377	328
Darling Downs (QLD)	1,391	1,422	1,258	978	800	627
Fitzroy (QLD)	3,227	3,428	3,126	2,527	2,174	1,815
Mackay (QLD)	3,233	3,426	3,186	2,682	2,389	2,092
Balance of Queensland	19,014	22,573	18,058	8,637	3,195	–2,323
Queensland	26,865	30,849	25,628	14,825	8,559	2,211
Hunter (NSW)	1,287	1,230	1,250	998	880	847
Balance of New South Wales	13,672	11,602	11,476	4,980	1,689	469
New South Wales	14,959	12,832	12,726	5,978	2,569	1,315
Outback – North East (SA)	395	404	407	377	360	349
Balance of South Australia	2,054	2,664	3,028	1,503	607	177
South Australia	2,449	3,067	3,435	1,881	967	527
Victoria	6,042	5,253	4,377	2,103	1,055	957
Tasmania	726	722	614	446	393	403
Northern Territory	5,853	5,134	5,765	3,469	2,237	1,828
ACT	274	199	160	104	71	81
Offshore oil and gas	74	73	71	64	61	58
Australia—total	**85,819**	**83,321**	**69,444**	**37,661**	**20,288**	**7,708**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 74 Projected employment level by region—Mining Operations, base case

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	1,387	1,395	1,448	1,499	1,525	1,543
Pilbara (WA)	17,094	17,569	18,464	19,372	20,036	20,565
Mid-West (WA)	3,293	3,354	3,507	3,664	3,766	3,842
Goldfields (WA)	8,793	8,990	9,431	9,881	10,188	10,425
Balance of Western Australia	66,681	66,999	67,313	67,592	67,602	67,462
Western Australia	97,248	98,308	100,164	102,008	103,118	103,836
Darling Downs (QLD)	1,572	1,527	1,574	1,636	1,643	1,615
Fitzroy (QLD)	11,887	11,963	12,725	13,732	14,479	14,957
Mackay (QLD)	16,616	16,709	17,835	19,310	20,407	21,102
Balance of Queensland	35,196	35,282	35,584	35,782	35,721	35,505
Queensland	65,271	65,481	67,719	70,459	72,249	73,178
Hunter (NSW)	14,427	15,063	15,483	15,783	15,982	16,162
Balance of New South Wales	30,092	30,018	30,164	30,332	30,314	30,199
New South Wales	44,519	45,082	45,647	46,115	46,296	46,361
Outback – North East (SA)	3,161	3,225	3,202	3,242	3,340	3,433
Balance of South Australia	8,148	8,085	8,286	8,503	8,532	8,500
South Australia	11,309	11,310	11,488	11,744	11,872	11,933
Victoria	8,820	8,848	8,917	8,956	8,962	8,966
Tasmania	5,050	5,056	5,090	5,108	5,108	5,108
Northern Territory	4,270	4,249	4,296	4,516	4,647	4,672
ACT	150	150	150	150	150	150
Offshore oil and gas	53	53	53	54	55	54
Australia—total	**236,690**	**238,537**	**243,525**	**249,111**	**252,456**	**254,260**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 75 Projected employment level by region—Mining Operations, high growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	1,387	1,394	1,458	1,523	1,562	1,593
Pilbara (WA)	17,094	17,546	18,725	19,990	20,984	21,809
Mid-West (WA)	3,293	3,350	3,549	3,765	3,922	4,047
Goldfields (WA)	8,793	8,978	9,554	10,176	10,644	11,028
Balance of Western Australia	66,681	67,067	67,691	68,204	68,453	68,550
Western Australia	97,248	98,335	100,976	103,658	105,564	107,026
Darling Downs (QLD)	1,572	1,523	1,590	1,677	1,700	1,679
Fitzroy (QLD)	11,887	11,949	13,025	14,421	15,473	16,159
Mackay (QLD)	16,616	16,697	18,279	20,323	21,868	22,865
Balance of Queensland	35,196	35,348	35,821	36,094	36,084	35,898
Queensland	65,271	65,516	68,714	72,515	75,125	76,600
Hunter (NSW)	14,427	15,096	15,754	16,219	16,531	16,830
Balance of New South Wales	30,092	30,087	30,399	30,691	30,791	30,791
New South Wales	44,519	45,182	46,153	46,910	47,322	47,621
Outback – North East (SA)	3,161	3,237	3,240	3,320	3,472	3,615
Balance of South Australia	8,148	8,098	8,370	8,657	8,708	8,682
South Australia	11,309	11,335	11,610	11,977	12,180	12,297
Victoria	8,820	8,871	8,988	9,053	9,078	9,104
Tasmania	5,050	5,073	5,143	5,176	5,189	5,205
Northern Territory	4,270	4,243	4,340	4,625	4,806	4,868
ACT	150	150	150	150	150	150
Offshore oil and gas	53	53	54	55	56	56
Australia—total	**236,690**	**238,759**	**246,128**	**254,120**	**259,471**	**262,927**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 76 Projected employment level by region—Mining Operations, low growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	1,387	1,400	1,439	1,477	1,493	1,502
Pilbara (WA)	17,094	17,696	18,225	18,812	19,216	19,507
Mid-West (WA)	3,293	3,375	3,469	3,572	3,629	3,663
Goldfields (WA)	8,793	9,053	9,319	9,612	9,791	9,910
Balance of Western Australia	66,681	66,944	66,963	67,158	67,064	66,765
Western Australia	97,248	98,469	99,415	100,631	101,192	101,348
Darling Downs (QLD)	1,572	1,533	1,560	1,595	1,585	1,549
Fitzroy (QLD)	11,887	12,001	12,446	13,085	13,563	13,870
Mackay (QLD)	16,616	16,752	17,415	18,352	19,052	19,497
Balance of Queensland	35,196	35,211	35,348	35,506	35,428	35,198
Queensland	65,271	65,498	66,768	68,539	69,628	70,114
Hunter (NSW)	14,427	15,023	15,213	15,393	15,537	15,646
Balance of New South Wales	30,092	29,936	29,934	30,042	29,969	29,784
New South Wales	44,519	44,959	45,147	45,435	45,506	45,431
Outback – North East (SA)	3,161	3,213	3,170	3,177	3,231	3,284
Balance of South Australia	8,148	8,072	8,206	8,359	8,371	8,336
South Australia	11,309	11,285	11,375	11,535	11,602	11,620
Victoria	8,820	8,821	8,847	8,872	8,871	8,861
Tasmania	5,050	5,039	5,044	5,056	5,054	5,048
Northern Territory	4,270	4,279	4,288	4,440	4,524	4,522
ACT	150	150	150	150	150	150
Offshore oil and gas	53	53	53	54	54	53
Australia—total	**236,690**	**238,553**	**241,088**	**244,710**	**246,580**	**247,148**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 77 Projected employment level by region—Oil and Gas Operations, base case

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	44	85	131	157	169	179
Pilbara (WA)	1,256	2,515	3,937	4,740	5,118	5,395
Mid-West (WA)	137	262	408	495	541	580
Goldfields (WA)	14	21	29	33	35	37
Balance of Western Australia	14,507	14,512	14,652	14,943	15,234	15,531
Western Australia	15,958	17,395	19,157	20,368	21,098	21,722
Darling Downs (QLD)	1,304	3,163	5,097	6,387	7,196	7,933
Fitzroy (QLD)	317	810	1,334	1,694	1,929	2,148
Mackay (QLD)	213	580	971	1,241	1,420	1,587
Balance of Queensland	9,041	8,986	9,009	9,019	9,020	9,026
Queensland	10,874	13,538	16,411	18,341	19,565	20,695
Hunter (NSW)	62	77	81	95	152	209
Balance of New South Wales	2,078	2,064	2,066	2,072	2,073	2,074
New South Wales	2,140	2,141	2,147	2,167	2,225	2,283
Outback – North East (SA)	253	181	133	235	378	502
Balance of South Australia	2,472	2,478	2,426	2,422	2,425	2,429
South Australia	2,725	2,659	2,560	2,657	2,803	2,931
Victoria	6,231	6,305	6,419	6,541	6,543	6,537
Tasmania	290	291	287	285	283	281
Northern Territory	467	1,481	2,645	4,696	5,854	6,466
ACT	131	135	125	117	111	105
Offshore oil and gas	126	142	158	176	185	190
Australia—total	**38,943**	**44,087**	**49,908**	**55,349**	**58,666**	**61,212**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 78 Projected employment level by region—Oil and Gas Operations, high growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	44	84	132	161	177	190
Pilbara (WA)	1,256	2,501	3,970	4,855	5,341	5,748
Mid-West (WA)	137	261	412	507	565	618
Goldfields (WA)	14	21	29	34	36	39
Balance of Western Australia	14,507	14,503	14,746	15,185	15,632	16,102
Western Australia	15,958	17,371	19,289	20,742	21,751	22,697
Darling Downs (QLD)	1,304	3,146	5,274	6,836	7,935	8,943
Fitzroy (QLD)	317	806	1,381	1,815	2,132	2,427
Mackay (QLD)	213	576	1,006	1,332	1,571	1,796
Balance of Queensland	9,041	8,982	9,044	9,075	9,092	9,116
Queensland	10,874	13,510	16,704	19,057	20,730	22,281
Hunter (NSW)	62	77	82	101	178	257
Balance of New South Wales	2,078	2,059	2,073	2,092	2,100	2,111
New South Wales	2,140	2,136	2,155	2,193	2,278	2,367
Outback – North East (SA)	253	140	58	192	398	583
Balance of South Australia	2,472	2,472	2,425	2,429	2,441	2,457
South Australia	2,725	2,612	2,483	2,621	2,839	3,040
Victoria	6,231	6,290	6,416	6,560	6,580	6,597
Tasmania	290	290	288	287	286	285
Northern Territory	467	1,441	2,657	4,985	6,445	7,319
ACT	131	134	123	116	109	103
Offshore oil and gas	126	141	159	180	193	200
Australia—total	**38,943**	**43,924**	**50,275**	**56,740**	**61,210**	**64,891**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 79 Projected employment level by region—Oil and Gas Operations, low growth

Region	2013	2014	2015	2016	2017	2018
Kimberley (WA)	44	86	121	140	148	153
Pilbara (WA)	1,256	2,555	3,617	4,209	4,460	4,616
Mid-West (WA)	137	266	376	441	473	497
Goldfields (WA)	14	21	27	30	32	33
Balance of Western Australia	14,507	14,517	14,552	14,748	14,922	15,067
Western Australia	15,958	17,446	18,693	19,568	20,034	20,366
Darling Downs (QLD)	1,304	3,182	4,582	5,479	6,005	6,478
Fitzroy (QLD)	317	816	1,196	1,448	1,604	1,746
Mackay (QLD)	213	583	868	1,058	1,176	1,286
Balance of Queensland	9,041	8,975	8,962	8,972	8,970	8,959
Queensland	10,874	13,556	15,608	16,957	17,754	18,469
Hunter (NSW)	62	77	80	89	127	164
Balance of New South Wales	2,078	2,062	2,053	2,056	2,055	2,049
New South Wales	2,140	2,139	2,132	2,145	2,182	2,213
Outback – North East (SA)	253	224	204	266	341	403
Balance of South Australia	2,472	2,479	2,423	2,419	2,418	2,413
South Australia	2,725	2,703	2,627	2,685	2,759	2,816
Victoria	6,231	6,295	6,357	6,448	6,443	6,417
Tasmania	290	290	286	284	282	279
Northern Territory	467	1,592	2,451	3,918	4,684	5,035
ACT	131	136	126	119	113	107
Offshore oil and gas	126	142	154	167	173	174
Australia—total	**38,943**	**44,299**	**48,434**	**52,290**	**54,422**	**55,875**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Appendix F
Resources Sector employment projections, 2013–18

Resources Project Construction

Table 80 Projected employment levels of the top 10 employing occupations in Resources Project Construction, base case, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
3411 Electricians	11,175	15,493	13,895	9,018	6,203	3,585
3341 Plumbers	8,781	12,174	10,918	7,086	4,874	2,817
3312 Carpenters and Joiners	8,300	11,507	10,320	6,698	4,607	2,662
3322 Painting Trades Workers	4,979	6,903	6,191	4,018	2,764	1,597
7212 Earthmoving Plant Operators	3,979	5,402	4,882	3,242	2,262	1,319
8212 Concreters	3,766	5,256	4,783	3,154	2,197	1,288
3332 Plasterers	3,558	4,932	4,423	2,871	1,975	1,141
3311 Bricklayers and Stonemasons	2,771	3,842	3,446	2,236	1,538	889
8211 Building and Plumbing Labourers	2,265	3,160	2,876	1,896	1,321	774
3334 Wall and Floor Tilers	2,020	2,801	2,512	1,630	1,121	648
Total	**51,595**	**71,468**	**64,246**	**41,849**	**28,860**	**16,720**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 81 Projected employment levels of the top 10 employing occupations in Resources Project Construction, high growth, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
3411 Electricians	11,175	18,851	18,675	13,140	9,612	6,053
3341 Plumbers	8,781	14,812	14,674	10,325	7,553	4,756
3312 Carpenters and Joiners	8,300	14,001	13,871	9,759	7,139	4,496
3322 Painting Trades Workers	4,979	8,399	8,321	5,855	4,283	2,697
7212 Earthmoving Plant Operators	3,979	6,531	6,510	4,695	3,492	2,226
8212 Concreters	3,766	6,370	6,395	4,574	3,393	2,172
3332 Plasterers	3,558	6,001	5,945	4,183	3,060	1,927
3311 Bricklayers and Stonemasons	2,771	4,675	4,632	3,259	2,384	1,502
8211 Building and Plumbing Labourers	2,265	3,830	3,845	2,751	2,040	1,306
3334 Wall and Floor Tilers	2,020	3,408	3,376	2,375	1,738	1,094
Total	**51,594**	**86,878**	**86,244**	**60,916**	**44,694**	**28,229**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 82 Projected employment levels for other selected Resources Sector occupations in Resources Project Construction, base case, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
Managers/Professionals							
1331	Construction Managers	1,480	2,079	1,969	1,359	986	605
1332	Engineering Managers	164	231	219	151	110	67
1335	Production Managers	245	344	325	225	163	100
2322	Cartographers and Surveyors	101	141	133	92	67	41
2332	Civil Engineering Professionals	543	757	717	497	360	220
2333	Electrical Engineers	196	272	258	179	130	79
2335	Industrial, Mechanical and Production Engineers	183	255	241	167	121	74
2336	Mining Engineers	22	30	29	20	14	9
2343	Environmental Scientists	20	27	26	18	13	8
2344	Geologists and Geophysicists	4	6	6	4	3	2
2513	Occupational and Environmental Health Professionals	128	178	169	117	85	52
Subtotal		**3,086**	**4,320**	**4,092**	**2,829**	**2,052**	**1,257**
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	95	132	119	77	53	31
3126	Safety Inspectors	34	47	42	27	19	11
3212	Motor Mechanics	167	232	208	135	93	54
3223	Structural Steel and Welding Trades Workers	980	1,359	1,219	791	544	314
3232	Metal Fitters and Machinists	786	1,089	977	634	436	252
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	16	22	19	13	9	5
7122	Drillers, Miners and Shot Firers	175	237	215	142	99	58
7313	Train and Tram Drivers	2	3	2	2	1	1
7331	Truck Drivers	1,534	2,083	1,883	1,250	872	509
Subtotal		**3,789**	**5,204**	**4,684**	**3,071**	**2,126**	**1,235**
Total		**6,875**	**9,524**	**8,776**	**5,900**	**4,178**	**2,492**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 83 Projected employment levels for other selected Resources Sector occupations in Resources Project Construction, high growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
Managers/Professionals							
1331	Construction Managers	1,480	2,494	2,599	1,952	1,514	1,019
1332	Engineering Managers	164	277	289	217	168	113
1335	Production Managers	245	412	429	322	250	168
2322	Cartographers and Surveyors	101	169	176	132	103	69
2332	Civil Engineering Professionals	543	908	946	713	553	370
2333	Electrical Engineers	196	327	340	257	199	133
2335	Industrial, Mechanical and Production Engineers	183	306	318	240	186	125
2336	Mining Engineers	22	36	38	28	22	15
2343	Environmental Scientists	20	33	34	26	20	13
2344	Geologists and Geophysicists	4	7	7	6	4	3
2513	Occupational and Environmental Health Professionals	128	214	223	168	130	87
Subtotal		**3,086**	**5,183**	**5,399**	**4,061**	**3,149**	**2,115**
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	95	161	159	112	82	52
3126	Safety Inspectors	34	57	56	40	29	18
3212	Motor Mechanics	167	282	279	197	144	91
3223	Structural Steel and Welding Trades Workers	980	1,653	1,638	1,153	843	531
3232	Metal Fitters and Machinists	786	1,325	1,313	924	676	426
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	16	26	26	18	13	8
7122	Drillers, Miners and Shot Firers	175	287	286	206	153	98
7313	Train and Tram Drivers	2	3	3	2	2	1
7331	Truck Drivers	1,534	2,518	2,510	1,810	1,346	858
Subtotal		**3,789**	**6,312**	**6,270**	**4,462**	**3,288**	**2,083**
Total		**6,875**	**11,495**	**11,669**	**8,523**	**6,437**	**4,198**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Mining Operations

Table 84 Projected employment levels of the top 10 employing occupations in Mining Operations, high growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	49,125	48,824	50,900	53,614	55,055	55,545
3232	Metal Fitters and Machinists	23,664	23,832	24,261	24,610	24,849	25,023
3129	Other Building and Engineering Technicians	13,281	13,396	13,674	13,906	14,062	14,176
7331	Truck Drivers	11,864	11,774	12,160	12,682	12,941	13,009
1335	Production Managers	8,765	9,023	9,376	9,730	10,075	10,405
3411	Electricians	8,474	8,545	8,757	8,944	9,071	9,157
2344	Geologists and Geophysicists	7,249	7,436	7,741	8,044	8,289	8,509
2336	Mining Engineers	5,673	5,828	6,129	6,440	6,684	6,890
7212	Earthmoving Plant Operators	5,496	5,446	5,613	5,844	5,957	5,982
3223	Structural Steel and Welding Trades Workers	5,817	5,850	5,903	5,933	5,954	5,975
Total		**139,408**	**139,954**	**144,514**	**149,747**	**152,937**	**154,671**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 85 Projected employment levels of the top 10 employing occupations in Mining Operations, low growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	49,125	48,860	49,664	51,108	51,594	51,390
3232	Metal Fitters and Machinists	23,664	23,697	23,648	23,630	23,582	23,520
3129	Other Building and Engineering Technicians	13,281	13,321	13,306	13,311	13,290	13,255
7331	Truck Drivers	11,864	11,788	11,942	12,231	12,313	12,252
1335	Production Managers	8,765	9,023	9,200	9,400	9,610	9,809
3411	Electricians	8,474	8,493	8,497	8,519	8,517	8,500
2344	Geologists and Geophysicists	7,249	7,460	7,654	7,846	7,994	8,121
2336	Mining Engineers	5,673	5,843	6,017	6,201	6,337	6,446
3223	Structural Steel and Welding Trades Workers	5,817	5,820	5,790	5,759	5,733	5,712
7212	Earthmoving Plant Operators	5,496	5,452	5,519	5,648	5,685	5,657
Total		**139,408**	**139,757**	**141,237**	**143,653**	**144,655**	**144,662**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 86 Projected employment levels for other selected Resources Sector occupations in Mining Operations, high growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
Managers/Professionals							
1331	Construction Managers	696	715	739	762	786	809
1332	Engineering Managers	824	848	883	919	953	985
2322	Cartographers and Surveyors	1,412	1,453	1,536	1,621	1,688	1,743
2332	Civil Engineering Professionals	1,249	1,281	1,339	1,398	1,445	1,485
2333	Electrical Engineers	1,104	1,136	1,208	1,284	1,343	1,391
2335	Industrial, Mechanical and Production Engineers	1,985	2,041	2,153	2,270	2,361	2,436
2343	Environmental Scientists	1,242	1,279	1,353	1,429	1,488	1,537
2513	Occupational and Environmental Health Professionals	2,243	2,306	2,421	2,539	2,632	2,712
Subtotal		**10,755**	**11,059**	**11,632**	**12,222**	**12,696**	**13,098**
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	211	211	211	209	208	208
3126	Safety Inspectors	614	619	630	640	646	651
3212	Motor Mechanics	1,819	1,830	1,847	1,857	1,864	1,871
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	519	520	519	515	513	513
7313	Train and Tram Drivers	634	633	659	691	708	714
Subtotal		**3,797**	**3,813**	**3,866**	**3,912**	**3,939**	**3,957**
Total		**14,552**	**14,872**	**15,498**	**16,134**	**16,635**	**17,055**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 87 Projected employment levels for other selected Resources Sector occupations in Mining Operations, low growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
Managers/Professionals							
1331	Construction Managers	696	716	728	742	757	772
1332	Engineering Managers	824	848	865	885	905	925
2322	Cartographers and Surveyors	1,412	1,457	1,503	1,552	1,588	1,616
2332	Civil Engineering Professionals	1,249	1,285	1,320	1,356	1,384	1,407
2333	Electrical Engineers	1,104	1,138	1,177	1,220	1,251	1,274
2335	Industrial, Mechanical and Production Engineers	1,985	2,046	2,110	2,177	2,227	2,266
2343	Environmental Scientists	1,242	1,283	1,324	1,367	1,399	1,423
2513	Occupational and Environmental Health Professionals	2,243	2,313	2,380	2,450	2,502	2,544
Subtotal		**10,755**	**11,086**	**11,407**	**11,749**	**12,013**	**12,227**
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	211	210	208	206	205	204
3126	Safety Inspectors	614	615	614	614	613	611
3212	Motor Mechanics	1,819	1,820	1,811	1,802	1,794	1,787
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	519	518	513	507	504	501
7313	Train and Tram Drivers	634	634	644	662	666	663
Subtotal		**3,797**	**3,797**	**3,790**	**3,791**	**3,782**	**3,766**
Total		**14,552**	**14,883**	**15,197**	**15,540**	**15,795**	**15,993**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Oil and Gas Operations

Table 88 Projected employment levels of the top 10 employing occupations in Oil and Gas Operations, high growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
2336	Mining Engineers	1,940	2,273	2,720	3,183	3,514	3,795
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	2,060	2,381	2,760	3,114	3,335	3,503
2211	Accountants	1,702	1,927	2,232	2,555	2,787	2,985
2344	Geologists and Geophysicists	1,306	1,536	1,845	2,165	2,393	2,586
7122	Drillers, Miners and Shot Firers	1,328	1,523	1,813	2,123	2,320	2,459
3232	Metal Fitters and Machinists	1,219	1,400	1,612	1,811	1,935	2,029
1335	Production Managers	791	945	1,141	1,340	1,491	1,626
5111	Contract, Program and Project Administrators	976	1,106	1,261	1,412	1,511	1,590
2335	Industrial, Mechanical and Production Engineers	830	959	1,133	1,315	1,445	1,555
5511	Accounting Clerks	900	997	1,110	1,220	1,293	1,350
Total		**13,052**	**15,047**	**17,627**	**20,238**	**22,024**	**23,478**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 89 Projected employment levels of the top 10 employing occupations in Oil and Gas Operations, low growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
2336	Mining Engineers	1,940	2,299	2,604	2,893	3,065	3,192
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	2,060	2,379	2,605	2,798	2,882	2,926
2211	Accountants	1,702	1,951	2,161	2,364	2,485	2,575
2344	Geologists and Geophysicists	1,306	1,554	1,765	1,964	2,082	2,170
7122	Drillers, Miners and Shot Firers	1,328	1,537	1,722	1,906	1,995	2,038
3232	Metal Fitters and Machinists	1,219	1,399	1,525	1,633	1,679	1,703
1335	Production Managers	791	953	1,087	1,213	1,296	1,364
5111	Contract, Program and Project Administrators	976	1,116	1,213	1,297	1,339	1,363
2335	Industrial, Mechanical and Production Engineers	830	970	1,089	1,203	1,271	1,321
5511	Accounting Clerks	900	1,007	1,076	1,137	1,166	1,183
Total		**13,052**	**15,165**	**16,847**	**18,408**	**19,260**	**19,835**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 90 Projected employment levels for other selected Resources Sector occupations in Oil and Gas Operations, high growth, 2013–18

Occupation	2013	2014	2015	2016	2017	2018
Managers/Professionals						
1331 Construction Managers	192	213	239	267	289	309
1332 Engineering Managers	458	532	625	721	795	861
2322 Cartographers and Surveyors	145	162	186	211	230	245
2332 Civil Engineering Professionals	439	495	572	654	713	763
2333 Electrical Engineers	329	360	403	450	483	513
2343 Environmental Scientists	261	300	354	410	450	484
2513 Occupational and Environmental Health Professionals	395	446	516	590	643	688
Subtotal	**2,219**	**2,508**	**2,895**	**3,303**	**3,603**	**3,863**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122 Civil Engineering Draftspersons and Technicians	36	40	46	51	55	57
3126 Safety Inspectors	130	139	151	161	168	173
3212 Motor Mechanics	194	219	248	275	292	305
3223 Structural Steel and Welding Trades Workers	281	319	362	403	429	448
3411 Electricians	574	642	721	797	843	879
7212 Earthmoving Plant Operators	83	88	96	107	113	117
7313 Train and Tram Drivers	0	0	0	0	0	0
7331 Truck Drivers	426	427	442	465	478	485
Subtotal	**1,724**	**1,874**	**2,066**	**2,259**	**2,378**	**2,464**
Total	**3,943**	**4,382**	**4,961**	**5,562**	**5,981**	**6,327**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 91 Projected employment levels for other selected Resources Sector occupations in Oil and Gas Operations, low growth, 2013–18

Occupation		2013	2014	2015	2016	2017	2018
Managers/Professionals							
1331	Construction Managers	192	216	234	252	264	275
1332	Engineering Managers	458	537	601	662	703	737
2322	Cartographers and Surveyors	145	164	181	197	206	213
2332	Civil Engineering Professionals	439	502	555	606	637	659
2333	Electrical Engineers	329	365	395	424	442	456
2343	Environmental Scientists	261	304	341	376	396	412
2513	Occupational and Environmental Health Professionals	395	452	500	546	574	594
Subtotal		**2,219**	**2,540**	**2,807**	**3,063**	**3,222**	**3,346**
Technicians and Trades Workers/Machinery Operators and Drivers							
3122	Civil Engineering Draftspersons and Technicians	36	40	44	47	48	48
3126	Safety Inspectors	130	140	146	151	153	153
3212	Motor Mechanics	194	219	236	251	257	260
3223	Structural Steel and Welding Trades Workers	281	319	344	366	376	380
3411	Electricians	574	642	688	728	744	752
7212	Earthmoving Plant Operators	83	89	94	100	103	104
7313	Train and Tram Drivers	0	0	0	0	0	0
7331	Truck Drivers	426	433	441	454	459	457
Subtotal		**1,724**	**1,882**	**1,993**	**2,097**	**2,140**	**2,154**
Total		**3,943**	**4,422**	**4,800**	**5,160**	**5,362**	**5,500**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Appendix G
Student commencements and completions in selected Engineering and Related Technologies and Natural and Physical Sciences courses

Table 92 Student commencements in specific Engineering and Related Technologies higher education courses by level of course, domestic students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
030300 Process and Resources Engineering	< 5	38	25	42
030301 Chemical Engineering	280	447	86	185
030303 Mining Engineering	172	365	122	433
030701 Mechanical Engineering	758	1,117	125	138
030703 Industrial Engineering	49	85	250	88
030900 Civil Engineering	621	1,306	250	213
030901 Construction Engineering	76	79	7	10
030911 Geotechnical Engineering	0	9	< 5	< 5
031100 Geomatic Engineering	34	37	23	17
031301 Electrical Engineering	344	464	268	105
031701 Maritime Engineering	0	120	< 5	31
039901 Environmental Engineering	207	215	44	26

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Table 93 Student commencements in specific Engineering and Related Technologies higher education courses by level of course, overseas students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
030300 Process and Resources Engineering	0	0	< 5	67
030301 Chemical Engineering	108	121	44	282
030303 Mining Engineering	< 5	127	18	187
030701 Mechanical Engineering	435	590	130	249
030703 Industrial Engineering	6	11	23	18
030900 Civil Engineering	133	451	257	320
030901 Construction Engineering	15	11	< 5	12
030911 Geotechnical Engineering	0	< 5	< 5	< 5
031100 Geomatic Engineering	< 5	< 5	< 5	< 5
031301 Electrical Engineering	294	408	137	312
031701 Maritime Engineering	0	52	< 5	< 5
039901 Environmental Engineering	15	51	19	33

Source: Department of Education, 2001–12, *Selected higher education statistics.*

Table 94 Student completions in specific Engineering and Related Technologies higher education courses by level of course, domestic students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
030300 Process and Resources Engineering	21	< 5	15	24
030301 Chemical Engineering	364	327	51	107
030303 Mining Engineering	156	169	58	190
030701 Mechanical Engineering	720	742	90	112
030703 Industrial Engineering	38	21	52	62
030900 Civil Engineering	709	859	128	181
030901 Construction Engineering	36	14	5	< 5
030911 Geotechnical Engineering	0	6	0	< 5
031100 Geomatic Engineering	33	29	< 5	9
031301 Electrical Engineering	407	302	109	100
031701 Maritime Engineering	0	33	0	22
039901 Environmental Engineering	196	101	37	21

Source: Department of Education, 2001–12, *Selected higher education statistics.*

Table 95 Student completions in specific Engineering and Related Technologies higher education courses by level of course, overseas students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
030300 Process and Resources Engineering	0	0	< 5	61
030301 Chemical Engineering	75	230	23	119
030303 Mining Engineering	< 5	51	5	132
030701 Mechanical Engineering	267	549	74	161
030703 Industrial Engineering	16	5	7	17
030900 Civil Engineering	134	225	106	159
030901 Construction Engineering	28	< 5	< 5	5
030911 Geotechnical Engineering	0	< 5	0	0
031100 Geomatic Engineering	< 5	< 5	< 5	< 5
031301 Electrical Engineering	223	226	62	203
031701 Maritime Engineering	0	11	0	< 5
039901 Environmental Engineering	9	31	25	33

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Table 96 Student commencements in specific Natural and Physical Sciences higher education courses by level of course, domestic students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
010700 Earth Sciences	723	52	60	85
010703 Geology	80	411	84	76
010705 Geophysics	np	29	0	np
010707 Geochemistry	< 5	0	< 5	0
010711 Hydrology	0	0	18	47
010713 Oceanography	0	0	< 5	0

np = not published.

Source: Department of Education, 2001–12, *Selected higher education statistics*.

Table 97 Student commencements in specific Natural and Physical Sciences higher education courses by level of course, overseas students, 2001 and 2012

Course	Undergraduate		Postgraduate	
	2001	2012	2001	2012
010700 Earth Sciences	55	< 5	9	32
010703 Geology	0	55	27	41
010705 Geophysics	0	0	< 5	np
010707 Geochemistry	0	0	< 5	0
010711 Hydrology	0	0	< 5	< 5
010713 Oceanography	0	0	< 5	0

np = not published.

Source: Department of Education, 2001–12, *Selected higher education statistics.*

Table 98 Student completions in specific Natural and Physical Sciences higher education courses by level of course, domestic students, 2001 and 2012

np = not published.

Source: Department of Education, 2001–12, *Selected higher education statistics.*

Table 99 Student completions in specific Natural and Physical Sciences higher education courses by level of course, overseas students, 2001 and 2012

np = not published.

Source: Department of Education, 2001–12, *Selected higher education statistics.*

Appendix H
Trade employment in the Resources Sector

Table 100 Trade employment in the Resources Sector (% of respective occupation), May 2005 to 2012, and February 2013

Occupation	2005	2006	2007	2008	2009	2010	2011	2012	2013
311 Agricultural, Medical and Science Technicians	1.7	1.5	1.6	1.6	3.3	1.6	0.6	1.5	2.4
312 Building and Engineering Technicians	9.8	9.5	11.0	10.5	9.8	13.6	9.3	12.9	15.2
313 ICT and Telecommunications Technicians	1.9	1.1	–	–	1.9	0.6	1.2	0.6	–
321 Automotive Electricians and Mechanics	1.4	1.6	1.7	1.3	1.2	0.7	2.9	5.2	2.1
322 Fabrication Engineering Trades Workers	3.7	6.1	7.0	4.8	5.8	6.6	6.9	8.0	7.4
323 Mechanical Engineering Trades Workers	8.3	13.0	10.0	11.3	12.4	13.2	21.1	17.6	16.3
324 Panelbeaters, and Vehicle Body Builders, Trimmers and Painters	0.6	1.0	0.7	3.2	–	1.0	–	–	–
331 Bricklayers, and Carpenters and Joiners	1.9	2.7	2.1	2.7	2.8	2.5	1.5	2.7	3.0
332 Floor Finishers and Painting Trades Workers	–	0.4	0.9	–	–	–	–	0.6	0.4
333 Glaziers, Plasterers and Tilers	0.9	0.2	0.6	–	1.5	–	1.5	–	–
334 Plumbers	3.0	3.5	1.3	3.4	2.0	1.6	2.6	3.8	3.3
341 Electricians	3.0	4.4	4.8	7.4	5.8	5.3	5.2	6.1	6.6
342 Electronics and Telecommunications Trades Workers	2.2	3.5	3.6	1.8	2.3	3.4	3.4	2.1	5.7
351 Food Trades Workers	0.2	0.0	0.1	0.4	0.6	0.8	0.5	0.2	0.4
362 Horticultural Trades Workers	21.1	27.1	25.3	26.3	20.1	23.3	30.8	26.1	30.8
399 Miscellaneous Technicians and Trades Workers	1.7	3.4	4.1	1.8	2.6	4.7	1.8	2.0	3.4
3 Technicians and Trades Workers	3.8	5.1	4.6	4.7	4.4	4.9	5.8	6.0	6.5
Non-trade occupations	2.5	2.6	2.8	2.8	2.8	3.1	3.2	3.2	3.3
Total	**2.7**	**3.0**	**3.1**	**3.1**	**3.1**	**3.4**	**3.6**	**3.6**	**3.8**

Note: Dash (–) represents a true zero.

Source: ABS, 2013, *Labour force, Australia, detailed, quarterly,* February, unpublished.

Appendix I
Employment and skills shortages in resources occupations

Table 101 Employment and skills shortages, top 20 occupations in Mining, 2012–13

Rank	Top 20 occupations and, where applicable, their subdivisions that are part of the Department of Employment skill shortage research program	Number employed in Mining in 2012	Skills shortages—national and for the resources states			
			National rating	WA rating	QLD rating	NT rating
1	Drillers, Miners and Shot Firers	46,300				
	Drillers	7,000**	NS	*	*	*
2	Metal Fitters and Machinists	26,800				
	Fitters	23,300**	R	R	S	S
	Metal Machinists (First Class)	100**	S	S	S	NA
3	Truck Drivers	17,100	NA	NA	NA	NA
4	Other Building and Engineering Technicians	13,600				
	Metallurgical or Materials Technicians	1,600**	*	*	*	*
	Mine Deputies	7,800**	S	*	*	*
5	Electricians	8,800				
	Electricians (General)	8,800**	NS	NS	D	S
6	Earthmoving Plant Operators	7,600	NA	NA	NA	NA
7	Production Managers	7,100				
	Production Managers (Mining)	6,500**	S	*	*	*
8	Mining Engineers	6,500				
	Mining Engineers (excluding Petroleum)	4,100**	S	*	*	*
	Petroleum Engineers	2,300**	S	*	*	*
9	Structural Steel and Welding Trades Workers	6,500				
	Metal Fabricators	5,500**	NS	D	R	S
	Welders (First Class)	900**	NS	D	M	NS
10	Other Stationary Plant Operators	5,200	NA	NA	NA	NA
11	Occupational and Environmental Health Professionals	5,000				
	Environmental Health Officers	100**	NS	*	*	*
	Occupational Health and Safety Advisers	4,800**	NS	*	*	*
12	Geologists and Geophysicists	4,900				
	Geologists	4,400**	R	*	*	*
	Geophysicists	500**	S	*	*	*
13	Other Construction and Mining Labourers	4,700	NA	NA	NA	NA
14	Purchasing and Supply Logistics Clerks	3,900	NA	NA	NA	NA
15	Accountants	3,400	NS	*	*	*

Table 101 (continued)

Rank	Top 20 occupations and, where applicable, their subdivisions that are part of the Department of Employment skill shortage research program	Number employed in Mining in 2012	Skills shortages—national and for the resources states			
			National rating	WA rating	QLD rating	NT rating
16	Accounting Clerks	3,200	NA	NA	NA	NA
17	Contract, Program and Project Administrators	3,200	NA	NA	NA	NA
18	Human Resource Managers	3,200	NA	NA	NA	NA
19	Storepersons	3,000	NA	NA	NA	NA
20	Human Resource Professionals	2,800	NA	NA	NA	NA

S = shortage, M = metropolitan shortage, R = regional shortage, D = recruitment difficulty, NS = no shortage, * = state rating unavailable, NA = not assessed.

** Estimates of employment numbers in Mining were produced by applying that occupation's share of total employment from the 2011 Census to the 2012 labour force employment estimates for the broader occupational group.

Note: The top 20 occupations are based on ABS labour force employment numbers for broader occupational groups. Department of Employment skill shortage research ratings are presented under the broader occupational group where the occupation assessed is at a more detailed level.

Sources: ABS 2012, *Labour force, Australia, detailed, quarterly,* cat. no. 6291.0.55.003, average 2012; ABS, 2011, *Census of population and housing*; Department of Employment, 2013, Skill shortage research program data, June.

A number of other occupations are closely aligned with the Resources Sector, but their employment is recorded against other industries (such as Professional, Scientific and Technical Services). For instance, although construction trades are vital to the development of Resources Sector infrastructure, employment of these workers may not be directly in Mining and consequently they are not reflected in the industry's occupational profile. Table 102 provides a list of other occupations assessed as part of the Department of Employment's skill shortage research, which AWPA has indicated in its workforce estimates for Mining Operations and Construction[372] have significant employment in the Resources Sector.

372 Skills Australia, 2011, *Employment growth projections in Mining Operations, 2010–2016,* awpa.gov.au/our-work/sector-specific-skill-needs/Documents/Employment_Growth_Projections.pdf, accessed 19 November 2013; Skills Australia, 2011, *Major Projects Schedule and Construction workforce estimates*, awpa.gov.au/our-work/sector-specific-skill-needs/Documents/Major_Projects_Projections.pdf, accessed 19 November 2013.

Table 102 Employment and skills shortages, other occupations in the Resources Sector, 2012–13

Rank	Top 20 occupations and, where applicable, their subdivisions that are part of the Department of Employment skill shortage research program	Number employed in Mining in 2012	Skills shortages—national and for the resources states			
			National rating	WA rating	QLD rating	NT rating
21	Industrial, Mechanical and Production Engineers	2,700				
	Mechanical Engineers	1,700**	NS	D	NS	NA
24	Motor Mechanics	2,200	S	S	R	S
28	Civil Engineering Professionals	1,900	NS	D	NS	NS
29	Surveyors and Spatial Scienctists	1,900				
	Surveyors	1,500**	NS	NS	S	NA
37	Electrical Engineers	1,300	NS	D	NS	NS
38	Automotive Electricians	1,300	S	S	S	S
49	Plumbers	1,000	NS	NS	NS	S
50	Other Natural and Physical Science Professionals	1,000				
	Metallurgists	1,000**	NS	*	*	*
61	Carpenters and Joiners	700	NS	NS	NS	S
93	Airconditioning and Refrigeration Mechanics	300	S	NS	S	S
95	Electrical Engineering Draftspersons and Technicians	300	NS	NS	R	NA
98	Civil Engineering Draftspersons and Technicians	300	NS	*	NS	NS
101	Chemical and Materials Engineers	300				
	Chemical Engineers	200**	NS	*	*	*
123	Electronics Trades Workers	200				
	Electronic Equipment Trades Workers	50**	S	*	*	*

S = shortage, M = metropolitan shortage, R = regional shortage, D = recruitment difficulty, NS = no shortage, * = state rating unavailable, NA = not assessed.

** Estimates of employment numbers in Mining were produced by applying that occupation's share of total employment at the time of the 2011 Census to the 2012 labour force survey employment estimates for the broader occupational group.

Sources: ABS, *Labour force survey* (average 2012); ABS, 2011, *Census of population and housing*; Department of Employment, 2013, Skill shortage research program data, June.

Table 103 Historical skills shortages, selected occupations relevant to the Resources Sector

Occupation	Number of years in national shortage, 5 years to 2012	Number of years in national shortage, 10 years to 2012
Managers, Professionals and Technicians		
Accountants	1	5
Chemical Engineers	2	5
Civil Engineering Draftspersons and Technicians	4	6
Civil Engineering Professionals	5	10
Electrical Engineering Draftspersons and Technicians	3	4
Electrical Engineers	5	8
Geologists	4	7
Geophysicists	1*	1*
Mechanical Engineers	4	6
Metallurgists	0*	1*
Metallurgical or Materials Technicians	0*	0*
Mine Deputies	2	2
Mining Engineers (excluding Petroleum)	5	8
Petroleum Engineers	4	6
Production Managers (Mining)	4	5
Surveyors	5	7
Trades		
Airconditioning and Refrigeration Mechanics	5	10
Automotive Electricians	5	10
Carpenters and Joiners	1	6
Electricians (General)	2	7
Electronic Equipment Trades Workers	4	8
Electronic Instrument Trades Workers (General)	2*	4*
Fitters	2	7
Metal Fabricators	2	7
Metal Machinists (First Class)	4	9
Motor Mechanics	4	9
Plumbers	3	8
Welders (First Class)	1	6
Other occupations		
Drillers	1*	2*

* Occupation has not been assessed continually over the period.

Note: Does not include ratings based on research undertaken in 2013 as full-year results are not available at time of publication. This reflects shortages that were widespread enough to be considered national. Shortages may have existed in some states or territories that are not reflected in this count.

Source: Department of Employment, 2012, Skill shortage research program data, December.

Appendix J
Specialised Occupation List—Mining and Construction

There are 12 occupations in Construction and 11 in Mining that are on the Specialised Occupation List. Three occupations (Civil Engineering Professionals, Electricians and Structural Steel and Welding Trades Workers) are common to both Construction and Mining.

Table 104 Specialised Occupation List occupations relevant to the Mining and Construction industries

Occupation	Construction	Mining
Accountants		*
Airconditioning and Refrigeration Mechanics	*	
Bricklayers and Stonemasons	*	
Carpenters and Joiners	*	
Cartographers and Surveyors		*
Civil Engineering Professionals	*	*
Construction Managers	*	
Electricians	*	*
Floor Finishers	*	
Industrial, Mechanical and Production Engineers		*
Metal Fitters and Machinists		*
Mining Engineers		*
Motor Mechanics		*
Occupational and Environmental Health Professionals		*
Painting Trades Workers	*	
Plasterers	*	
Plumbers	*	
Production Managers		*
Structural Steel and Welding Trades Workers	*	*
Wall and Floor Tilers	*	

Note: * indicates the relevance of the occupation to the industry.

Source: AWPA, 2013, *Specialised Occupation List*.

Appendix K
Skills supply–demand balance

Resources Project Construction

Table 105 Projected supply–demand balance in the top 10 employing occupations, Resources Project Construction, base case, 2014–18

Occupation	2014	2015	2016	2017	2018
3411 Electricians	–1,319	470	1,545	954	952
3341 Plumbers	–1,044	361	1,206	741	739
3312 Carpenters and Joiners	–992	336	1,134	695	693
3322 Painting Trades Workers	–632	164	643	379	378
7212 Earthmoving Plant Operators	–1,238	411	1,414	880	868
8212 Concreters	–1,114	221	1,050	591	535
3332 Plasterers	–452	117	459	270	269
3311 Bricklayers and Stonemasons	–350	94	360	213	212
8211 Building and Plumbing Labourers	–417	387	887	613	580
3334 Wall and Floor Tilers	–257	67	261	154	153
Total	**–7,815**	**2,628**	**8,959**	**5,490**	**5,379**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 106 Projected supply–demand balance in the top 10 employing occupations, Resources Project Construction, high growth, 2014–18

Occupation	2014	2015	2016	2017	2018
3411 Electricians	–2,325	–2	1,662	1,119	1,234
3341 Plumbers	–1,835	–9	1,298	871	961
3312 Carpenters and Joiners	–1,739	–14	1,222	818	903
3322 Painting Trades Workers	–1,080	–46	695	452	504
7212 Earthmoving Plant Operators	–2,206	–38	1,554	1,050	1,111
8212 Concreters	–1,896	–130	1,209	753	715
3332 Plasterers	–772	–33	496	323	359
3311 Bricklayers and Stonemasons	–599	–23	389	254	282
8211 Building and Plumbing Labourers	–888	176	983	710	688
3334 Wall and Floor Tilers	–438	–19	282	184	204
Total	**–13,778**	**–138**	**9,790**	**6,534**	**6,961**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 107 Projected supply–demand balance for selected Resources Sector occupations, Resources Project Construction, base case, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–984	184	940	584	634
1332	Engineering Managers	–103	27	111	71	77
1335	Production Managers	–166	27	152	93	101
2322	Cartographers and Surveyors	–150	30	143	87	91
2332	Civil Engineering Professionals	–620	349	962	662	684
2333	Electrical Engineers	–283	65	285	176	184
2335	Industrial, Mechanical and Production Engineers	–249	77	282	181	188
2336	Mining Engineers	–25	13	38	26	27
2343	Environmental Scientists	–17	18	40	30	30
2344	Geologists and Geophysicists	–6	1	6	4	4
2513	Occupational and Environmental Health Professionals	–182	46	190	119	123
Subtotal		**–2,785**	**837**	**3,149**	**2,033**	**2,143**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	67	83	93	88	89
3126	Safety Inspectors	99	106	110	109	109
3212	Motor Mechanics	–2	25	41	32	32
3223	Structural Steel and Welding Trades Workers	–114	42	137	85	84
3232	Metal Fitters and Machinists	–80	45	121	80	80
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	3	6	7	6	6
7122	Drillers, Miners and Shot Firers	–48	25	69	46	45
7313	Train and Tram Drivers	–1	0	1	0	0
7331	Truck Drivers	–529	106	493	286	281
Subtotal		**–605**	**438**	**1,072**	**732**	**726**
Total		**–3,390**	**1,275**	**4,221**	**2,765**	**2,869**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 108 Projected supply–demand balance for selected Resources Sector occupations, Resources Project Construction, high growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–1,645	–157	980	667	823
1332	Engineering Managers	–176	–11	115	81	98
1335	Production Managers	–275	–29	159	107	133
2322	Cartographers and Surveyors	–253	–21	153	103	121
2332	Civil Engineering Professionals	–1,178	74	1,014	748	845
2333	Electrical Engineers	–484	–34	304	207	242
2335	Industrial, Mechanical and Production Engineers	–437	–16	300	210	242
2336	Mining Engineers	–47	2	40	29	33
2343	Environmental Scientists	–37	8	42	33	36
2344	Geologists and Geophysicists	–11	–1	6	4	5
2513	Occupational and Environmental Health Professionals	–314	–19	202	139	161
Subtotal		**–4,857**	**–204**	**3,315**	**2,328**	**2,739**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	58	79	94	89	91
3126	Safety Inspectors	96	104	110	109	110
3212	Motor Mechanics	–17	18	43	35	37
3223	Structural Steel and Welding Trades Workers	–202	1	147	99	109
3232	Metal Fitters and Machinists	–151	12	129	91	100
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	2	5	7	7	7
7122	Drillers, Miners and Shot Firers	–90	5	75	53	56
7313	Train and Tram Drivers	–1	0	1	0	0
7331	Truck Drivers	–902	–67	547	352	375
Subtotal		**–1,207**	**157**	**1,153**	**835**	**885**
Total		**–6,064**	**–47**	**4,468**	**3,163**	**3,624**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Mining Operations

Table 109 Projected supply–demand balance in the top 10 employing occupations, Mining Operations, high growth, 2014–18

Occupation		2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	379	-674	–1,010	–470	–72
3232	Metal Fitters and Machinists	–911	–1,248	–1,235	–1,119	–1,052
3129	Other Building and Engineering Technicians	–457	–660	–652	–575	–532
7331	Truck Drivers	–34	–252	–325	–212	–132
1335	Production Managers	–247	–337	–357	–343	–321
3411	Electricians	–125	–285	–284	–223	–183
2344	Geologists and Geophysicists	165	36	28	106	155
3223	Structural Steel and Welding Trades Workers	–215	–257	–248	–235	–231
2336	Mining Engineers	7	–146	–164	–85	–29
7212	Earthmoving Plant Operators	27	–72	–106	–55	–18
Total		**–1,411**	**–3,895**	**–4,353**	**–3,211**	**–2,415**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 110 Projected supply–demand balance in the top 10 employing occupations, Mining Operations, low growth, 2014–18

Occupation		2014	2015	2016	2017	2018
7122	Drillers, Miners and Shot Firers	309	–183	–477	–54	246
3232	Metal Fitters and Machinists	–859	–856	–917	–871	–850
3129	Other Building and Engineering Technicians	–428	–417	–455	–419	–401
7331	Truck Drivers	–53	–162	–227	–136	–74
1335	Production Managers	–242	–202	–238	–240	–223
3411	Electricians	–103	–110	–138	–108	–89
2344	Geologists and Geophysicists	158	146	132	192	231
3223	Structural Steel and Welding Trades Workers	–205	–192	–199	–197	–200
2336	Mining Engineers	5	–23	–45	11	51
7212	Earthmoving Plant Operators	18	–34	–63	–22	7
Total		**–1,400**	**–2,033**	**–2,627**	**–1,844**	**–1,302**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 111 Projected supply–demand balance for selected Resources Sector occupations, Mining Operations, high growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–18	–23	–24	–24	–23
1332	Engineering Managers	–21	–31	–33	–31	–29
2322	Cartographers and Surveyors	–33	–76	–81	–60	–45
2332	Civil Engineering Professionals	1	–27	–30	–16	–6
2333	Electrical Engineers	3	–37	–43	–23	–9
2335	Industrial, Mechanical and Production Engineers	3	–55	–62	–33	–12
2343	Environmental Scientists	10	–27	–31	–11	2
2513	Occupational and Environmental Health Professionals	–15	–70	–76	–46	–27
Subtotal		**–70**	**–346**	**–380**	**–244**	**–149**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–1	–1	0	–1	–1
3126	Safety Inspectors	296	294	300	308	315
3212	Motor Mechanics	–24	–37	–33	–29	–27
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–2	–1	1	1	0
7313	Train and Tram Drivers	15	2	–2	5	9
Subtotal		**284**	**257**	**266**	**284**	**296**
Total		**214**	**–89**	**–114**	**40**	**147**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 112 Projected supply–demand balance for selected Resources Sector occupations, Mining Operations, low growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–18	–14	–17	–17	–17
1332	Engineering Managers	–20	–17	–21	–21	–19
2322	Cartographers and Surveyors	–34	–41	–48	–32	–21
2332	Civil Engineering Professionals	0	–5	–9	2	9
2333	Electrical Engineers	4	–5	–12	2	12
2335	Industrial, Mechanical and Production Engineers	2	–8	–17	4	19
2343	Environmental Scientists	10	5	–1	13	23
2513	Occupational and Environmental Health Professionals	–16	–24	–32	–10	5
Subtotal		**–72**	**–109**	**–157**	**–59**	**11**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–1	0	0	0	–1
3126	Safety Inspectors	298	304	308	315	321
3212	Motor Mechanics	–21	–16	–18	–17	–17
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–1	1	2	1	0
7313	Train and Tram Drivers	13	8	4	10	14
Subtotal		**288**	**297**	**296**	**309**	**317**
Total		**216**	**188**	**139**	**250**	**328**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Oil and Gas Operations

Table 113 Projected supply–demand balance in the top 10 employing occupations, Oil and Gas Operations, high growth, 2014–18

Occupation		2014	2015	2016	2017	2018
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–182	–235	–233	–156	–129
2336	Mining Engineers	–278	–376	–387	–264	–215
2211	Accountants	–185	–254	–267	–183	–149
7122	Drillers, Miners and Shot Firers	–90	–139	–160	–121	–103
2344	Geologists and Geophysicists	–186	–254	–261	–176	–141
3232	Metal Fitters and Machinists	–162	–194	–194	–153	–139
5111	Contract, Program and Project Administrators	–71	–93	–97	–70	–60
3341	Plumbers	–30	–25	–31	–31	–32
5511	Accounting Clerks	–61	–76	–80	–60	–53
2335	Industrial, Mechanical and Production Engineers	–102	–141	–146	–98	–79
Total		**–1,347**	**–1,787**	**–1,856**	**–1,312**	**–1,100**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 114 Projected supply–demand balance in the top 10 employing occupations, Oil and Gas Operations, low growth, 2014–18

Occupation		2014	2015	2016	2017	2018
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–186	–137	–125	–59	–36
2336	Mining Engineers	–297	–243	–226	–119	–76
2211	Accountants	–204	–164	–156	–82	–52
7122	Drillers, Miners and Shot Firers	–100	–100	–108	–73	–58
2344	Geologists and Geophysicists	–199	–162	–150	–75	–45
3232	Metal Fitters and Machinists	–165	–138	–134	–98	–87
5111	Contract, Program and Project Administrators	–78	–57	–53	–29	–19
3341	Plumbers	–35	–25	–30	–30	–30
5511	Accounting Clerks	–68	–50	–48	–30	–22
2335	Industrial, Mechanical and Production Engineers	–111	–89	–83	–41	–24
Total		**–1,443**	**–1,165**	**–1,113**	**–636**	**–449**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector.*

Table 115 Projected supply–demand balance for selected Resources Sector occupations, Oil and Gas Operations, high growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–18	–21	–23	–19	–18
1332	Engineering Managers	–59	–74	–77	–61	–57
1335	Production Managers	–125	–158	–163	–129	–119
2322	Cartographers and Surveyors	–17	–22	–23	–17	–14
2332	Civil Engineering Professionals	–46	–63	–66	–45	–36
2333	Electrical Engineers	–20	–30	–33	–21	–16
2343	Environmental Scientists	–30	–42	–43	–28	–22
2513	Occupational and Environmental Health Professionals	–43	–59	–62	–42	–35
Subtotal		**–358**	**–469**	**–490**	**–362**	**–317**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–5	–6	–6	–4	–4
3126	Safety Inspectors	13	12	12	14	15
3212	Motor Mechanics	–24	–28	–28	–23	–21
3223	Structural Steel and Welding Trades Workers	–37	–44	–44	–35	–33
3411	Electricians	–59	–70	–71	–55	–50
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–182	–235	–233	–156	–129
7122	Drillers, Miners and Shot Firers	–90	–139	–160	–121	–103
7212	Earthmoving Plant Operators	–3	–5	–6	–5	–4
7313	Train and Tram Drivers	0	0	0	0	0
7331	Truck Drivers	–9	–16	–21	–17	–15
Subtotal		**–396**	**–531**	**–557**	**–402**	**–344**
Total		**–754**	**–1,000**	**–1,047**	**–764**	**–661**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Table 116 Projected supply–demand balance for selected Resources Sector occupations, Oil and Gas Operations, low growth, 2014–18

Occupation		2014	2015	2016	2017	2018
Managers/Professionals						
1331	Construction Managers	–19	–27	–28	–21	–18
1332	Engineering Managers	–63	–93	–91	–65	–56
1335	Production Managers	–131	–199	–193	–137	–119
2322	Cartographers and Surveyors	–19	–15	–15	–9	–7
2332	Civil Engineering Professionals	–50	–40	–38	–19	–12
2333	Electrical Engineers	–24	–17	–17	–6	–2
2343	Environmental Scientists	–32	–26	–24	–11	–6
2513	Occupational and Environmental Health Professionals	–47	–38	–36	–19	–12
Subtotal		**–385**	**–455**	**–442**	**–287**	**–232**
Technicians and Trades Workers/Machinery Operators and Drivers						
3122	Civil Engineering Draftspersons and Technicians	–5	–4	–4	–3	–3
3126	Safety Inspectors	12	15	15	18	19
3212	Motor Mechanics	–24	–20	–20	–15	–13
3223	Structural Steel and Welding Trades Workers	–38	–32	–31	–24	–22
3411	Electricians	–61	–49	–48	–34	–30
3992	Chemical, Gas, Petroleum and Power Generation Plant Operators	–186	–137	–125	–59	–36
7122	Drillers, Miners and Shot Firers	–100	–100	–108	–73	–58
7212	Earthmoving Plant Operators	–4	–4	–4	–3	–3
7313	Train and Tram Drivers	0	0	0	0	0
7331	Truck Drivers	–13	–14	–17	–14	–11
Subtotal		**–419**	**–345**	**–342**	**–207**	**–157**
Total		**–804**	**–800**	**–784**	**–494**	**–389**

Source: DAE, 2013, *Modelling employment demand and supply in the Resources Sector*.

Appendix L
Projections of skills shortages in Western Australia

ACIL Tasman modelled future skills shortages in Western Australia[373] and identified the following 25 critical occupations for which skills shortages are very likely to occur in the next several years.

Professionals

- Geologists and Geophysicists (2344)
- Mining Engineers (2336)

Technicians and Trades Workers

- Drillers, Miners and Shot Firers (7122)
- Other Building and Engineering Technicians (8219)
- Glaziers, Plasterers and Tilers nfd (3330)
- Floor Finishers and Painting Trades Workers nfd (3320)
- Plasterers (3332)
- Wall and Floor Tilers (3334)
- Roof Tilers (3333)
- Painting Trades Workers (3322)
- Concreters (8212)
- Plumbers (3341)
- Floor Finishers (3321)
- Structural Steel Construction Workers (8217)
- Bricklayers and Stonemasons (3311)
- Railway Track Workers (8216)
- Fencers (8213)
- Carpenters and Joiners (3312)
- Construction Trades Workers nfd (8210)
- Construction Managers (1331)

373 ACIL Tasman, 2013, *Crowding out: competition for skilled labour in WA*, report prepared for the WA State Training Board.

Machinery Operators and Drivers

- Stationary Plant Operators nfd (7120)
- Earthmoving Plant Operators (7212)
- Chemical, Gas, Petroleum and Power Generation Plant Operators (3992)

Labourers

- Other Construction and Mining Labourers (8219)
- Construction and Mining Labourers nfd (8210)

Appendix M
Most heavily impacted non-resource industries by critical occupation in Western Australia

Table 117 Most heavily impacted non-resource industries by critical occupation in Western Australia

Critical occupation	Industry most heavily impacted	Employment rank in 2011	Income rank in 2011
Drillers, Miners and Shot Firers	Manufacturing	2	4
Other Construction and Mining Labourers	Construction	2	7
Geologists and Geophysicists	Professional, Scientific and Technical Services	2	10
Other Building and Engineering Technicians	Manufacturing	2	13
Chemical, Gas, Petroleum and Power Generation Plant Operators	Manufacturing	1	8
Mining Engineers	Professional, Scientific and Technical Services	2	8
Stationary Plant Operators nfd	Manufacturing	2	4
Plasterers	Construction	1	3
Wall and Floor Tilers	Construction	1	3
Roof Tilers	Construction	1	2
Painting Trades Workers	Construction	1	11
Concreters	Construction	1	6
Plumbers	Construction	1	12
Construction and Mining Labourers nfd	Construction	1	3
Earthmoving Plant Operators	Construction	1	5
Floor Finishers	Construction	1	3
Structural Steel Construction Workers	Construction	1	7
Bricklayers and Stonemasons	Construction	1	3
Railway Track Workers	Construction	1	3
Fencers	Construction	1	4
Carpenters and Joiners	Construction	1	6
Construction Trades Workers nfd	Construction	1	2
Construction Managers	Construction	1	17

nfd = not further defined.

Source: ACIL Tasman, 2013, *Crowding out: competition for skilled labour in WA*, report prepared for the WA State Training Board.

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